Reversals in Reading
Among Native Students From
Onion Lake, Saskatchewan-Alberta

A Thesis
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for the Degree of Master of Education
in the College of Education
University of Saskatchewan

by

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Saskatoon, Saskatchewan
1991

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The purpose of this study was to investigate the differences in the incidence of reversals and sequencing errors in reading among Native students, male and female, aged 7, 8, 9, and 10 years old who spoke Cree and/or English. The students were in Grades 1-3 at the Roman Catholic School, Anglican Church of Canada School and Grade 4 at Chief Taylor School at Onion Lake Reserve, Onion Lake, Saskatchewan-Alberta.

The dependent variable of the study was the number of reversal and sequencing errors in reading. The former are defined as the inversion of single letters, such as "big" for "dig". The latter are the total or partial inversion of letters in words, such as "was" for "saw". The independent variables were gender, age, and linguality in Cree and/or English.

All the students in the target population of 159 were rated for facility in Cree and English language utilizing rating scales. The language rating data was transferred onto bivariate matrices for the 7/8 and 9/10 year age groups. The target population of 159 students decreased to a sample of 55 Native students.

Data were collected by the administration of a revised version of the Test of Directional Attack on Words. The test consisted of 60 monosyllable isolated words. The students orally read the words and
the exact pronunciations were transcribed onto the test response sheet.

The three hypotheses were analyzed by employing a three-way (2x2x2) analysis of variance. This three-way ANOVA measured the effects of gender, age, and linguality in Cree and/or English on the incidence of reversal and sequencing errors in reading. No significant difference in reversal and sequencing errors in reading was found between male and female Native students. A significant difference ($p < 0.05$) was found between 7/8 year old Native students and 9/10 year old Native students. The 7/8 year olds made more reversal and sequencing errors in reading than did the 9/10 year olds. No significant difference in reversal and sequencing errors in reading was found between English dominant and bilingual Cree-English Native students.

The study concluded that:

1. The gender of Native students did not relate to the incidence of reversal and sequencing errors in reading.

2. The age of Native students was related to the incidence of reversal and sequencing errors in reading. Native students aged 7/8 years made more errors than did Native students aged 9/10 years.

3. Linguality in Cree-English of Native students did not relate to the incidence of reversal and sequencing errors in reading.
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Chapter 1

INTRODUCTION

A major concern of Native and non-Native educators and researchers, in most cases, is the academic achievement of Native students. Some Native students are academically successful while the majority are unsuccessful in the educational system. The focus of concern, at most times is towards the academically unsuccessful Native student population. Most of the literature on education of Natives consistently reiterates the academic failures of Native students. Within the literature are statistics providing a negative global view of the educational success of Native students. This negative view is prevalent in local, regional task forces, national reports, and reviews of Native education.

Statistics for the urban areas of the province are similar. An estimated 83% of Native students completing Grade 8 did not complete Grade 12 as compared to 38% of non-Native students in the same schools and 31% for the province (Cipywnyk, Pawlovich, and Randhawa, 1983). A study of annual drop-out rates in twenty selected schools in Saskatoon and Regina in
1980-81, reported that 43.2% of Native students dropped out as compared to 15.0% of non-Native students who dropped out in Grades 7-12 (Saskatchewan Education, 1985).

In 1989, the Report to the Minister of Education indicated that the drop-out rates prior to the completion of high school is unacceptably high. This is illustrated by the retention rates for Native students in the Northern schools. For 1988, the retention rates for Kindergarten Readiness was 9.3%; Grades 1-3, 31.9%; Grades 4-6, 21.3%; Grades 7-9, 17.2%; Grades 10-12, 9.2% and for Voc., Spec. Ed., 11.1% (Northern Education Task Force, 1989).

On a national level, the statistics are comparable to those for Saskatchewan. The Report of the Special Committee on Indian Self Government in Canada (1983) reported that "only 20 per cent of Indian children stay in school to the end of the secondary level" compared to a national rate of 75 percent (p. 15). Five years later the the rates for Grade 12 completion remained equally dismal. "Only 20% of the First Nations students complete grade twelve as opposed to a national average of 70%" (Assembly of First Nations, 1988). Furthermore, both the 1981 and 1986 Censuses indicated that
the proportion of the population with less than grade nine education declined for all groups except Indians off-reserve, which remained constant. According to the 1986 Census, 37% of all status Indians have less than grade nine education, two times the Canadian rate of 17%. Some 45% of Indians on-reserve are functionally illiterate, almost two times the rates for Indians off-reserve and for people living near reserves, 24% and 26% respectively. (Indian and Northern Affairs Canada, 1989, p. 5)

Compounding these bleak statistics are reports that Native students do not perform academically on par with their non-Native counterparts. This is especially marked in reading related tasks. Cummins (1981) reported that Native students at the end of Grade 6 were about two years below national norms in English reading. Philion and Galloway (1969) found that Indian children were less successful than non-Indians in all areas of reading. Lankford and Riley (1986) stated that Native American children exhibited low literacy levels in comparison to national norms. Burnaby (1982) stated that "there is reason to believe that English-speaking Native children generally do not do as
well as non-Native children in the language arts and other subject areas” (p. 16).

This researcher posed questions about what underlay the statistics that are briefly presented above. Why are Native students reported as drop-out statistics, as academically low in ability and performance in reading? More importantly, what precisely are the problems that Native students experience in reading? The complexity of reading difficulties of Native students led the researcher to examine one particular “problem within the reading problem”, that is, reversals in reading.

Statement of the Problem

This study investigated the incidence of reversal and sequencing errors in reading and its relationship to gender, age, and linguality in Cree and/or English of Native students at Onion Lake Reserve, Onion Lake, Saskatchewan- Alberta.

Specific Issues
The following subproblems were investigated:

1. Is there a difference in the incidence of reversal and sequencing errors in reading between males and females?
2. Do 7/8 year old Native students exhibit a higher incidence of reversal and sequencing errors in reading than 9/10 year old Native students?

3. Do bilingual Cree-English speakers exhibit a higher incidence of reversal and sequencing errors in reading than English dominant speakers?

The Research Hypotheses

The following research hypotheses were investigated:

Hypothesis 1: There will be no significant difference in the incidence of reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words between male and female Native students.

Hypothesis 2: There will be significantly more reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words by Native students aged 7/8 years than by Native students aged 9/10 years.

Hypothesis 3: There will be significantly more reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words by bilingual Cree-English Native students than by English dominant Native students.
Hypotheses 1 was stated in non-directional form due to the uncertainty regarding which direction the results would occur. Hypothesis 2 was stated in directional form to be consistent with the literature on reversals in reading.

The rationale for stating Hypothesis 3 in directional form is twofold. First, in view of research findings of Toohey (1985) and of Sealey and Kirkness (1973) regarding lingual interference, it was hypothesized that bilingual Cree-English Native students would likely experience more lingual interference in an English language system. Secondly, Hypothesis 3 was based on an observation regarding a particular aspect of the Cree sound system, i.e., the lack of a distinction made in voicing for the consonants "p", "t", and "k". That is to say, in Cree, the voiceless "p" is substituted for its voiced counterpart "b"; likewise, "t" and "k" are substituted for their respective voiced counterparts "d" and "g". Thus, no distinction would be sounded in the words "pin" and "bin", for example, even though they are spelled with a different initial letter; "bin" would be sounded as "pin". It was hypothesized, therefore, that Cree speakers would experience more difficulty in decoding printed words which involve the letters "b", "d", and "g".
"p", "d", "t", "g" and "k" and thus be more likely to confuse (or appear to confuse) these printed letters.

Delimitations

This study was confined to Native students attending three schools, the Roman Catholic School, the Anglican Church of Canada School and the Chief Taylor School at Onion Lake Reserve, Onion Lake, Saskatchewan-Alberta in 1988. The students were aged 7, 8, 9 and 10 years, and spoke Cree and/or English. The data collection was confined to a diagnosis of reversal and sequencing errors identified in the oral reading of 60 monosyllable isolated words. The testing instrument was a revised version of the Test of Directional Attack on Words initially developed by F.J. Schonell and F.E. Schonell (1954).

Assumptions

The following assumptions were made in designing and completing this study:

1. Reversal and sequencing errors in reading could contribute to low academic performances of Native students within the components of Language Arts.
2. Reversal and sequencing errors in reading could be ascertained by utilizing the revised version of the Test of Directional Attack on Words.

3. Cree Language Instructors and teachers could accurately classify Native students into English dominant and bilingual Cree/English groups.

4. The statistical technique selected for the study was appropriate to analyze the data.

Limitations of the Study

The conclusions drawn from the findings in this study were limited by the following factors:

1. The students' mental and physical states during testing may have been affected by fatigue, nervousness, anxiety, illnesses or uncorrected refractive errors which may have resulted in oral reading errors.

2. Due to learning, reading and physical disabilities, the students' performances may have resulted in oral reading errors.

3. The English dominant and bilingual Cree/English classifications of students by classroom teachers and Cree Language Instructors may not have been accurate.
4. Due to lack of background information on each student, the sample may not have been representative of Native students in Onion Lake, Saskatchewan-Alberta.

5. Due to the small sample size, generalizations of findings to the total population of Native students of Onion Lake, Saskatchewan-Alberta must remain tentative.

6. The testing instrument utilized for the study may have contained weaknesses in its capacity to measure reversal and sequencing errors in reading, e.g., more words may have provided a better estimate of a person's true score (Borg & Gall, 1989). As well, the original test (Test of Directional Attack on Words) did not contain a reliability check nor was a reliability check done on the revised version used as the testing instrument in this study.

7. There may have been linguistic interference in the reading of the test words (Sealy & Kirkness, 1973). Furthermore, apparent "visual reversal" (visual directional confusion) errors in reading may have been due to auditory perceptual and psycholinguistic factors. For example, in the English language, "b" at the beginning of words is easier to read than "b" at the end of words (because it more frequently appears at the beginning of English words than at the end of
English words); thus, "b" is more likely to be misread when at the end of a word (McLeod, 1975).

The Definition of Terms

For the purpose of this study, certain terms were defined as follows:

Bilingual Cree-English: The term bilingual Cree-English refers to students who were rated as being Cree-English speakers.

English dominant: The term English dominant refers to students who were rated as being predominantly English speakers.

Native students: The term Native students refers to the Onion Lake Reserve students, both Status and Non-Status Indians.

Reading: The term reading as used in this particular study refers to saying words aloud that are seen from a word list.

Reversals in reading: The term reversals in reading refers to the inversion of single letters at the beginning or at the end of a word, such as reading "big" for "dig" and "lad" for "lap".

Sequencing errors in reading: The term sequencing errors in reading refers to the total or partial
inversion of letters in words, such as reading "was" for "saw", and "won" for "own".

**Test of Directional Attack on Words:** This is a diagnostic test developed by F.J. Schonell and F.E. Schonell (1954), and revised by J. McLeod, (1988) of which the primary purpose is to reveal reversals or part reversals in the oral reading of words.

**Significance of the Study**

The reversal phenomena as a behavior exhibited by some readers has been identified as far back as the late-eighteenth century. Since then and to the present, educators and researchers have been perplexed at encountering students with reversal tendencies in reading. Throughout the years innumerable statistical studies and theories on the nature and cause of this phenomena have been brought forward by researchers in the field of education. This study contributes to the accumulation of statistical studies undertaken regarding reversal tendencies in reading.

There appears to be few, if any, studies of the reversal phenomena with regard to the Native population in particular. This study contributes towards that body of knowledge by examining the incidence of reversal and sequencing errors in reading among one
particular group of Natives located in northern Saskatchewan.

While there are many studies which examine reversal tendencies of children who speak English, there are far fewer such studies which take into account bilingualism and its possible influence on reversals in reading. The findings from this research add to the knowledge regarding the interface of bilingualism and reversals in reading.

Finally, by drawing attention to the reading reversal phenomena among a sample of Native students, this study may help to make teachers of Native children more aware of potential remedial activities which may enhance those children's chances of achieving academic success through improved reading skills. Any movement towards improved academic success may, in turn, bring about a decrease in the drop-out rates and an increase in the high school completion rates of the Native population in general.
Chapter 2

REVIEW OF LITERATURE

This chapter reviews the literature on the reversal phenomena encompassing the early 1800s to 1990. Although not exhaustive, the literature provides a comprehensive view of one particular aspect of this phenomena, reversals in reading, as distinct from other aspects, such as reversals in writing and spelling. Major chapter divisions include a brief history of the concept of reversals in reading; classification of reversals; theories on causes of reversals in reading; and the relationship of selected variables on reversals in reading.

Brief History of the Concept of Reversals in Reading

The inability to read and the concept of reversal tendencies was initially investigated in 1825. Riese (1954) reported the case of Jacques Lordat (1773-1870), a scientist and an eminent member of the medical school in Montpellier. Lordat, unable to read and exhibiting various other disorders as well, did an auto-observation of alalia or aphasia, generally naming the disease
as verbal amnesia. Lordat claimed that nervous Ataxia was evident, and had temporarily manifested disorders in various areas, as well located itself in the brain. As a result, the functions of retaining verbal sounds and their use were arrested without involving other intellectual functions. He also observed a condition which he termed paramnesia and which he explained to be faulty usage of known and remembered sounds. For example, when he wanted to ask for a book, he pronounced the word "handkerchief". Lordat cited another manifestation of paramnesia to be the "inversion of the letters of syllables in the polysyllabic words" (Riese, 1954, p. 239). Lordat explained, "instead of raisin, I asked for sairin; for musulman I tended to say sumulman" (Riese, 1954, p. 239).

Riese's (1954) interpretation of the Lordat case concluded that he suffered from a transient mixed aphasia, which is a speech defect. Moreover, Lordat exhibited motor aphasia, the inability to express thought by the symbols of the spoken language; sensory aphasia, the lack of coordination of movements needed for speech and simultaneous defect of understanding; and alexia, the inability to read and write coupled with syntactical defect which is a loss of grammatical structure. Riese (1954) stated that Lordat called the
whole condition "verbal amnesia" but agreed that the faulty usage of words and letters justified Lordat's term "paramnesia".

A perusal of the literature found other terms applied to reading disability cases. Hinshelwood (1895) credited Kussmaul (1877) with the invention of the term "word-blindness" or "acquired word-blindness" which is the inability to read visual words, although not literally blind. Nearly two decades later, in 1896, Kerr, an English school physician, and Morgan, an English ophthalmologist, introduced the term "congenital word-blindness" (Furness, 1956). Morgan's observations of children with congenital word-blindness found that they could not read, although their vision was normal, they were not mentally defective, and they knew the letters of the alphabet (Orton, 1925). Morgan considered the reversal tendency as a specific disease i.e., congenital.

Years later, this concept was still evident and accepted. Teegarden (1933) reported that tendencies to reverse symbols or the sequence of symbols was an essential feature of word-blindness. Acquired word-blindness and congenital word-blindness were suggested to be similar, in terms of the symptoms and being caused by the destruction of a small part in the brain due to an injury, a tumor, or a hemorrhage. The
result was practically a complete loss of the power to read (Orton, 1928; Furness, 1956).

Interest in these conditions was initiated by these people of various professions. Others followed, such as Hinshelwood, a second ophthalmologist. In 1917, Hinshelwood published a monograph on a group with acquired word-blindness of the congenital type (Orton, 1943). Word-blindness was stated to be a loss of visual memory of printed and written characters with which the patient was previously familiar. He attributed the cause "to a failure of development of the cerebral cortex in the neighborhood of the angular gyrus" (Orton, 1943, p. 255).

The terms "word-blindness" or "acquired word-blindness" and "congenital word-blindness" that were used for reading disabilities or reversal tendencies were questioned by Orton in 1925. He stated that these terms were not properly descriptive of the disabilities and offered the term "strephosymbolia" (Orton, 1925). He suggested that strephosymbolia was less misleading than the older term "congenital word-blindness". Orton explained that strephosymbolia is a term derived from Greek words, "strepho" meaning "twist", indicating turning or reversal. "Symbolon" is used in its original meaning of "word". The term "strephosymbolia" therefore is a descriptive name for
the condition whereupon children show unusual difficulty in learning to read, and exhibited reversal tendencies.

The controversy for appropriate terminology for reversal tendencies ended in the usage of Orton's term 'strephosymbolia'. However, controversy still remained with regard to the definition of the term 'reversals'.

In 1934, Hildreth defined reversals as the lateral inversion of word elements and written symbols, or the reading and writing of words in right to left, rather than left to right sequence. Hill (1935) stated that there was confusion with the terminology used for reversals. She noted that the term "reversals" designated "all directions of mirror imaging or directional disorientation in single letters and all kinds of sequence errors" (p. 474). According to Hill, this term connotated only horizontal mirror imaging, and she recommended the term "disorientation" as a more accurate descriptive term. The term "disorientation" then was taken to mean that units are perceptually confused according to horizontal, vertical and diagonal directions, as might be viewed in a mirror.

Wechsler and Pignatelli (1937) defined the term "reversals" to mean "a turning over". In reading errors, it was used to mean "a turning over or reorientation of a letter or groups of letters (word)
about a particular axis" (p. 215). However, they both stated that this definition was too vague to be of scientific value and therefore suggested a definition now used in the classification of reading errors. As they saw it, reversals denote a supposed change in spatial orientation of letters or groups of letters, causing confusion with other letters or words because of acquired identities or similarities in appearance. As a result, letters or words are misread; this misreading is called a reversal.

In a 1952 study, Krise defined reversals as the letters, or words, or a group of words that are miscalled during oral reading. The "reorientation of the letter or reordering of the letters within the word, or the words within the group" (Krise, 1952, p. 411) produce errors labelled as reversals in reading.

Bannatyne (cited in Aliotti, 1980) presented a distinctive definition for reversals. He used the term mirror-image which refers to the shape of single letters. The "b" reflects as a "d" when viewed in a mirror. The letter "b" written upside down as "p" becomes an inversion. The letter "z" written on its side or at an angle becomes "n" and may be called a rotation.

In more recent years, simpler definitions have been used by researchers. Cohn and Stricker (1976)
termed a reversal as the process of looking at a "b" and saying a "d", thus inferring that children received a reversed visual image. In a later study, they defined a reversal error in letter recognition as the process of looking at a symbol and assigning the name of its inverted, rotated or mirrored image. This is demonstrated in letters such as "b" for "d", "p" for "q", "u" for "n", and "m" for "w".

Today, the term "dyslexia" is often used as a replacement for the reversal phenomena. Laird and Cangemi (1981) cite dyslexia to be a severe reading disability, while Forness (1981) defines it as a specific reading disability. The reversal of letters and words, then, are viewed to be incorporated in the broader notion of dyslexia. For example, Aliotti (1980) and Laird and Cangemi (1981) view reversals as "characteristic" of dyslexia; Moyer and Newcomer (1977) see reversals as "symptoms" of dyslexia; Harmen (1982) deems reversals to be an "aspect" of dyslexia. For those researchers who utilize the term "learning disability", the reversal phenomena still remains "a characteristic" (Cohn & Stricker, 1979; Wagner, 1984) or "a symptom" (Lewis, 1983; Mather & Healey, 1984; Forness, 1981) of that broader phenomena.

The literature on the reversal phenomena indicates a general recognition of reversal errors
consequential to reading problems of children. Orton (1937) emphasized that reversals formed a fundamental obstacle in learning to read. He suggested that reversals also block any school progress in reading and may cause emotional problems. Monroe (1932) claimed that reversal tendencies impeded progress in reading. Carmichael and Dearborn, as well as Teegarden (cited in Bond & Tinker, 1957) stated that reversals interfered with children's normal reading progress. Similarly, Cohn and Stricker (1979) stated that reversal errors can interfere with the ability to read. Wagner (1976) implied that the characteristic signs of dyslexia rather than bilingualism, is the root for reading problems. Reversal errors, then, are considered by most researchers to produce disturbances in the reading function.

Classification of Reversals

The term "reversals" per se may be considered as an umbrella term. Within reversals, there are various error types. Classifications are therefore essential to adequately describe the various error types under the umbrella term "reversals". Moreover, classifications are essential in understanding the inner nature of reversals.
In 1937, Orton stated that reversals were of two types.

1. Static reversals are confusions existing "between two letters with the same form but opposite orientation, as when b is confused with d, and p with q " (p. 150).

2. Kinetic reversals are described as "when there is an element of sinistrad progression through a series of letters as when was is read as saw, or tomorrow as tworrom" (p. 150).

With respect to reversals, Monroe (1932) provided three components of reversals:

1. Reversed orientation of letters:
   - b, d, p, q, u, n interchanged
   - dig read big
   - squirt read spirit
   - bone read done
   - contemptuous read contemptuous

2. Reversed sequence of letters:
   - was read saw
   - on read no
   - left read felt
   - card read crad

3. Reversed sequence of words:
   - Text: 'Mother,' he said.
Read: 'Mother,' said he.

Text: Once there was ....

Read: There once was .... (p. 35)

In her study of reversals in reading and writing, Hildreth (1934) stated that reversals were primarily of two types:

(1) The pronunciation of single words, or sound elements as they would be pronounced if written in inverse order or as though individual letters were inverted, as for example, 'on' for 'no', 'bread' for 'bear' or 'big' for 'dig.'

(2) Inversion of the order of words in a phrase or sentence, as for example 'Kitty see I' for 'I see a kitty' (p. 1).

Within the term "disorientation" Hill (1935) stated that disorientation may be described directionally, such as horizontal, vertical and diagonal. From these directional terms, three classifications were presented:

A b mistaken for a d would be classified as a horizontal disorientation; confusion between p and b is a vertical disorientation; and the p-d pair illustrates the diagonal disorientation. (p. 475)

Wechsler and Pignatelli (1937) presented a different classification of reversal errors based on
their rotational analysis. The four types of errors were differentiated by their directional terms.

1. The rotation about a vertical axis (right and left reversals), e.g., d = b: p = q: Z = S:

2. Rotation about a horizontal axis (up and down reversals), e.g., b = p: d = q: M = W: f = t:

3. Rotation about a depth axis (clock and counter-clock reversals), w = m (script): d = p: Z = N: M = E:

4. Rotation of letters about two axes (double reversals), e.g., h = y: b = q: (although these may also be gotten by 3) (p. 218)

Kennedy (1954) in her study to ascertain the relative frequency of reversal occurrence in normal children differentiated four error types of reversals. The first type was called a letter change since the disorientation involved one letter in the word. This included either a reversal, an inversion, or and inverted-reversal such as "big-dig", "big-pig", or "dig-pig". The second type was the reversed form in which the letters remained correctly oriented but the sequence of the letters were reversed as in "was-saw". The third type was the mirrored image, in which the orientational change occurred either by inversion, reversal or inverted-reversal. The mirror image may be obtained by the use of the mirror. For the inverted
mirrored image, the mirror is placed above or below a symbol. For the reversed mirror image, the mirror is placed either to the right, the left or parallel to the symbol. The inverted-reversed form can be seen by turning the page upside down. The fourth reversal type was termed transpositions. Eight types of transpositions were identified:

(1) initial letter to an internal position
(2) initial letter to terminal position
(3) terminal letter to initial position
(4) terminal letter to internal position
(5) internal letter to a different internal position
(6) internal letter to initial position
(7) internal letter to terminal position
(8) miscellaneous changes involving several of the others or more than one letter (p. 161)

Tinker and McCullough (1968) classified reversals into two types. A full reversal occurs by reading "saw" for "was" or "on" for "no". A partial reversal is reading "won" for "own", and sometimes a reversal of a single letter that produces an error as reading "big" for "dig".

Harris (1970) stated that there are different kinds of errors used to describe reversals:
for further research. Let it be known also that "no one factor is responsible for the reversal tendency" (Gilkey & Parr, 1944, p. 292) and "no one single cause can be used to account for all reversal errors" (Betts, 1946, p. 346).

Physiological Theory

Etiologic variables of the reversal phenomenon were advanced as early as the 1800s. The most notable in that century were attributed to neurological dysfunctions; as a consequence, theories were formulated to explain reversals inherent in reading disability cases. Prominent scientists, physicians and ophthalmologists briefly discussed these etiologic variables. They did not, however, gain prominent recognition and influence as did the famous neurologist, Samuel Torrey Orton.

In 1925, Orton directed a mobile experimental clinic set up by a group of staff members from the State Psychopathic Hospital in Green County, Iowa. Cases to be studied were referred by four agencies of the county. These included children who were unusually bright, children with behavior problems, and children considered defective, retarded or failing in their school work. A total of 142 subjects from Grades 1, 2, 3, 7, 8, and 9 with intelligence quotients ranging from
(1) confusion of single letters such as b, d, p, and q;
(2) complete reversals of words such as on and no, saw and was, and tap and pat;
(3) partial reversals of words such as ram for arm, ate for tea, and never for even; and
(4) reversals of the order of words in a sentence, as 'The dog saw a boy' for 'The boy saw a dog.' (p. 372)

Liberman, Shankweiller and Orlando (1971), in their study to determine the frequency of reversals in reading of poor readers, identified errors as reversals of letter sequence and letter orientation. The reversals of letter sequence was termed as a word or a part of a word that is read from right to left as in "lap" for "pal." Reversals of letter orientation are single letter confusions such as reading "b" for "d", "bad" for "dad" or "pad."

Schlieper (1980), in her study to determine reversals in a meaningful context, classified three types of error-letter reversals. The first type was termed letter reversals that were comprised of confusions between "b", "d", and "p"; "n" and "u"; and "m" and "w." The second was word reversals which consisted of a complete right-to-left reading of words such as "was" for "saw" and "on" for "no." The third
was sequence errors described as an incorrect ordering of the letters in a word other than a total reversal such as "smile" for "simel" or "left" for "felt."

Shake (1982), in reviewing the research on reversals in connected text, identified orientation and sequence reversals. She stated that orientation reversals occur in either top-bottom or vertical fashion such as "u", "n" and left-right or horizontal fashion as "b", "d." Sequence reversals occur when words are perceived in an incorrect order such as "left" for "felt", "clam" for "calm" and "may I go" for "I may go."

Theoretical Causes of Reversals in Reading

Herein is a presentation of literature regarding the various causative theories for reversals in reading. The purpose is merely to show the evolution of thought concerning the causal factors of reversals in reading. It is not the purpose to personally disprove nor criticize the causative theories, but to provide an understanding for educators of the enigmatic nature of reversal causes. However, in some areas, the researcher has presented evidence against the theories. It can be seen that many theories are not quantitatively researched, which therefore leaves an open field
71-122 were selected for study. Eighty-eight in this

group were referred to as deficient by the teachers.
Eighty-eight in this group were referred to as deficient by the teachers.

Fifteen out of the 88 students with intelligence

quotients ranging from 71-122 and who were having great
difficulty in learning to read were selected for

intensive study (Orton, 1925). These were retarded in

reading for their ages and showed certain similarities

in the errors made in reading. Another observation of

this group were that there was a relatively high

proportion of boys to girls (Orton, 1928). Orton

(1925) also observed that this group tended to read

from right to left, leading to confusions of words such

as "on" for "no" and "not" for "ton". There were also

tendencies to reversals leading to difficulties in

telling "p" from "q" or "b" from "d".

Orton (1928) carried out a short series of tests

for this group. The results were as follows:

(1) difficulty in differentiating p and q, and b

and d;

(2) a striking tendency to confuse palindromic

words like was and saw, not and ton, and to

reverse paired letters or even whole syllables or

words in reading so that they were read from right
to left instead of from left to right;
(3) a considerable degree of capacity to read from a mirror— one boy actually read faster and with less mistakes with a mirror than without; and (4) a greater facility in producing mirror writing, i.e., in writing to the left with complete antitropic reversal of all letters (p. 62).

Orton coined and applied the term "strephosymbolia" to describe this specific group. Furthermore, he presented a cerebral dominance theory etiologic to strephosymbolia. Orton (1928) explained that there are three levels of functions in the right and left hemispheres of the brain. The first level named visual perceptive, resides in the area striata or calcarine cortex of the occipital lobes which furnish the element of external awareness. The second level named visual recognitive resides in the second type of occipital cortex surrounding the calcarine or striate area. Its function is to serve as a storehouse for visual impressions of objects previously seen. Orton stated that at this point, the two hemispheres work in unison producing single conscious impressions. For example, "the messages relayed from the eyes to the two sides of the brain are fused so as to give only one impression" (p. 64). He further explained that neither of these functions are entirely lost from the destruction of
either hemisphere but a bilateral lesion will suppress the first and second level functions. At the third level named visual associative, "destruction in one hemisphere may result in complete loss of associative function, resulting in inability to read (acquired word blindness), while destruction of exactly the same area in the opposite hemisphere will not give rise to any symptoms whatever. That hemisphere in which destruction produces loss of associative function is called the dominant hemisphere, and may be either the left or right, according to side which habitually initiates the motor responses of the individual (p.64).

It is then, as Orton stated, that the visual records of one hemisphere only are used in symbolic association while in the other side, they are elided or inactive in the process. Orton furthermore explained that there is no structural contrast between the two hemispheres. The nondominant associative area and the dominant are well developed in size and complexity. The current neurologic belief implies that the inactive area must have been irradiated equally with the active producing an equal growth. The irradiation would "presumably leave behind it some record in the cells of the nondominant side which one may call an engram" (p. 64). The engram would be opposite in sign from that of the dominant and would form a mirrored or antitropic
pattern. Orton explained that only one of the reciprocally paired engrams operates in association with reading and its mirrored mate is elided or remains inoperative.

If, however, the physiologic habit of complete elision of these engrams of the nondominant hemisphere were not established, their persistence might readily serve to explain the failure to differentiate between p and q and between was and saw, and also to account for facility in mirror reading and mirror writing.... (p. 64-65)

The physiological theory of Orton was not accepted by most of the researchers of the day. Gates (1949) for one, stated that this theory was extremely speculative. Brain functions were not well known enough to give positive support. Gates further stated that authorities in neurology disagreed with Orton's hypothesis. "The idea of word recognition being due to impressions stored up as copies or images or as engrams literally etched in one hemisphere in one form and in the other in mirrored form is unacceptable to most psychologists" (p. 313).
Laterality Theories

Carmichael and Dearborn (cited in Bond & Tinker, 1957) stated that left-handedness influences eye movements in reading, thus causing reversals. They pointed out that left-handed children acquire a natural, easy movement of their left-hand from right to left in writing. The eyes tending to follow the controlled hand movements results in the establishment of right to left perceptual orientation. Thus, a beginner in school who is left-handed may form this perceptual habit in word perception.

Similarly, Dearborn (1928), in his case studies of mirror-writers and non-readers, suggested a thesis that initial faulty learning conditions the individuals, consequently inhibiting habits in the learning process. He explained that a left-handed boy is taught to follow the hand movements of his right-handed teacher in writing the word "cat". He starts as he does, from the center of his body moving his left hand outward producing "cat". Furthermore, he is told that he must not move his hand from the right toward the left but from the left toward the right. This initial learning to write for the left-handed non-reader may possibly operate as an initial handicap in reading. Dearborn explained that the outgoing movement of the left hand is from the center of the body toward the
left. Thus, the left-handed reader, possibly because he watches what his preferred hand does, establishes a habit and may show a preference for the same direction in his eye-movements, consequently reading "saw" for "was". Likewise, in tachistoscopic experiments, Dearborn stated that there is a tendency for the left-handed to catch the end letters of words first, as the right-handed commonly catches the initial letters first in reading. As a result, the reading of words are mirror images.

Dearborn's (1928) theory of laterality, with respect to left-handedness influencing reversals in reading, was in disagreement with various researchers. Gates and Bennett (1933), studying the relationship of variables to reversal tendencies in reversal and non-reversal groups, found that left-handedness alone could not account for reversal errors. In their comparative study, the selection of pupils comprised of 26 pupils showing the largest number of reversals and semi-reversal errors. The non-reversal group were pupils who made absolutely no reversals or semi-reversals. Both groups were matched in the reading grade and intelligence quotient. The tests administered consisted of 30 isolated words from the Gates Primary Reading Vocabulary. In addition, a new test of context reading containing reversible words and
near reversible words in paragraphs was administered. Lastly, three tests of handedness in writing, throwing, and reaching and a test to determine dominant eyedness were included in the study. In part, Gates and Bennett found that left-handed children showed no greater difficulty in reading and no greater tendency to make reversal errors than the right-handed children.

Hildreth (1934), in her comprehensive study of reversal tendencies in reading and writing found similar results to those of Gates and Bennett (1933). Her subjects included the entire classes of primary grade children in three types of schools: public, private and a private Hebrew English school. The number of boys and girls in the three schools were fairly equally divided. The private school pupils were slightly younger than the public school pupils of the same grade levels. The latter pupils had advanced at a rate of a grade a year since school admission; the former pupils were repeaters of one or more semesters in each grade. Reading tests containing word pronunciation, oral reading paragraphs, and flash cards were administered to all third and fourth grade pupils in one public school, part of the test series were given to the second grades of the same school, and the same tests were given to the second grade private school pupils. The total scores of the reading tests
were used as a measure of reading success. Perception-copying tests were also administered to all the second, third and fourth grade pupils in the same public school, the private school and the private Hebrew-English school. In addition, the Kuhlmann-Anderson Intelligence Examination was administered to the public school pupils and the Stanford-Binet records were made available for all other pupils. The median intelligence quotient of all pupils in the three schools were: public school, 100; private school, 119; and Hebrew school, 116.

Observations were made of preferred handedness; as well, teachers were asked to furnish lists of all pupils who were dominantly left-handed or ambidextrous.

Hildreth's (1934) test data with respect to sinistrality and reversal errors refuted Dearborn's theory that indicated a possible connection between reversals and dominant handedness; i.e., that dominantly left-handed children "are more prone to make reversals than predominantly right-handed children" (p. 16). Her results were that "both left and right-handed children make reversals with about equal proportionate frequency. There is no marked predominance of reversals among the left-handed children" (p. 16).

Betts (1946) concluded that "the tendency to make
reversal errors is no greater among left-handed children than among right-handed children" (p. 346).

Gilkey and Parr (1944) conducted research to discover the relationship of reversal tendencies to age level, left-handedness, mixed dominance, physical and emotional difficulties and intelligence quotient. Fifty elementary school children out of 324 who made the greatest number of reversals were selected for intensive study. The subjects were given hand, eye dominance tests, intelligence and achievement tests. Parental interviews were conducted to discover emotional and physical disturbances and to gather data on the home conditions. Their conclusions in part, were that "left-handedness alone is apparently not responsible for the reversal tendency, as many children who appear to be right-handed reverse" (p. 291).

Gates and Bennett (1933), Hildreth (1934), Betts (1946), and Gilkey and Parr (1944) all presented evidence against Dearborn's (1928) theory that left-handedness influences reversals in reading. However, the most conclusive evidence against this theory was found by Krise in 1952. In conducting an experimental investigation of theories of reversals in reading, Krise obtained a non-significant coefficient of correlation between the tendency to reverse and
left-handedness. He concluded that left-handedness does not influence reversals in reading.

Following his theory of left-handedness etiologic to reversals, Dearborn (1931) examined another left dominance variable as a cause of reversal tendencies, which is left-eyedness. He analyzed the lateral dominance of approximately 100 cases of extreme difficulty in learning to read. The cases, with a preponderance of left-eyedness, lack of ocular and manual dominance, mixed conditions of ocular and manual dominance, were stated to be associated with reversals in reading and writing. Dearborn (1931) believed that in some cases, "they produce uncertainty about the correct ordering or sequence of letters in word forms" (p. 704). As a result, faulty and mutilated images are stored up in the mind. With reference to ocular dominance, Dearborn (1931) explained that "left-eyed children may tend to move in the opposite direction, to begin at the wrong end of words or to reverse the order or even to perceive letters in the wrong way as in seeing b as d, or boy as dog" (p. 704). This perception of distorted images did not agree with the phonetic sequence of words as required in reading; therefore, the recognition of words was difficult and impossible.
Gates and Bennett (1933) also found that eye-dominance was influential toward reversals. They concluded that pupils with left-eye dominance were more susceptible to reading difficulties and particularly to make reversal errors. Furthermore, they stated that, perhaps, ten percent of these cases were likely to have reading difficulties in general or to develop reversal tendencies. However, Witty (1949) and Kopel, found left-eyedness to be unrelated to reversal tendency.

Mixed Eye and Hand Dominance Theories

Dearborn (cited in Gates & Bennett, 1933) was also known to be an advocate of the idea that mixed eye and hand dominance causes reading difficulties and reversals. Monroe (1932), a proponent of Dearborn's theory of mixed dominance, stated that "a confusion in the directional movements of the hands, or of the hand and eye, may result in confusion of the right or left positions of patterns" (p. 106). As a result, Monroe added:

The child confuses the patterns which are alike in shape, but which are placed in different positions, as b, d; p, q; u, n; m, w; f, t; 'was', 'saw'; 'on', 'no', etc. He confuses the sequence of words and is often a fluent mirror-reader or mirror-writer. He sometimes traces the words or
letters with his finger in order to determine their position. He slides a finger along the text to give a cue to direction. His reading errors consist of reversals, repetitions, and sometimes, because of correlating the sequence of sounds with the reversed sequence of letters, of consonant and vowel errors (p. 106).

Gates and Bennett (1933), in their study of reversal and non-reversal groups concurred with the mixed hand and eye dominance theory, and stated that reversals are found in a slightly larger percentage of left-eyed, right-handed dominance cases. As well, Gilkey and Parr (1944), in their research to discover the relationship of reversal tendencies to mixed dominance, concluded that "mixed dominance seems to be related to reversals, since fifty-six per cent of the children tested were apparently right-handed and left-eyed, or left-handed and right-eyed" (p. 291).

Witty (1949) questioned the mixed eye and hand dominance theory. He disagreed with the allegations of researchers that stated that disturbances in the cortex are "traceable to physiological irregularities set up by conditions such as mixed eye-hand dominance" (p. 186). Moreover, he stated that the validity of this concept is questioned by some scientists. In support, Witty cited Kelly in the Journal of Experimental
Psychology, who concluded that "there is no known check on cerebral dominance which is sufficiently dependable to enable one to investigate the influence of that factor on the perception of the orientation of symbols" (p. 186).

Visual Related Theories

Vision Difficulties

Buswell, et al., (cited in Gates & Bennett, 1933) showed in their studies that children with vision difficulties coupled with the prolonged study of words may be expected to produce reversal errors. If a child's vision is unclear from any cause, more prolonged study and frequent fixations, back-and-forth reflexations are exhibited. As a result, the greater number of regressive movements, the more reversal errors in reading.

Gates and Bennett (1933) in their comparative study of reversal and non-reversal groups produced evidence concerning the relationship of visual defects and reversal tendencies. They stated that visual defects of some sort or sorts, would appear to be the most conspicuous characteristic of reversal groups.

Gilky and Parr (1944), researching the relationship of reversal tendencies to physical and emotional difficulties of 50 elementary school children
concluded that "eye difficulties appear to be definitely related to the reversal tendency, since twenty-eight per cent of the children had defective eyesight" (p. 291). However, Krise (1952) suggested from his experimental findings that visual deficiencies are not a causative factor of reversals.

**Visual Immaturity**

Cole (1938), in delineating the symptoms of inadequate eyesight in relation to the reading process, stated that visual immaturity is a contributing cause of the tendency to reverse words and letters. Immature vision in young children can be directly observed usually in oral reading, e.g., orally reading "saw" for "was" and "did" for "bib". Krise's 1952 findings from the investigation of theories of reversals in reading negated this finding of visual immaturity as a cause of reversal. His subjects were 20 adults, ranging in ages from 29-52 years. These subjects, he said, could not be considered to be visually immature, since all "committed reversals in reading the experimental symbols in three to seventy-one percent of the test words attempted" (p. 418).

**Regressive Eye-Movements**

Buswell, et al., (cited in Gates & Bennett, 1933) showed in their studies that regressive eye movements
when encountering unfamiliar words predisposed children to reversal errors. Buswell, et al., stated that when children begin to read, they make a prolonged study of unfamiliar words in context. They go back and forth over the words in whole or in part making as many as eight fixations. Forcing a child to study many difficult words extensively, is forcing the child to practice regressive movements, resulting in reversals in reading.

Bond and Tinker (1957) reported that "frequent occurrences of regressions within words tend to develop inappropriate directional habits in word perception" (p. 309). Similarly, Gates and Bennett (1933) suggested that variations of eye-movements before beginning to read causes reversals, semi-reversals, and other errors in reading. They explained that a child's first visual activity is studying objects in the environment such as "faces, chairs, bottles, books, flowers, pictures, lamps and windows" (p. 20). While observing and learning to recognize these objects, the eyes move "left to right, right to left, top to bottom, bottom to top, middle to top or bottom or right or left" (p. 29). Thus, when a child is first presented with words to study for recognition without instructions, the eye-movements are in various directions, patterns and sequences. The eye-movements
are therefore numerous such as right-to-left, left-to-right, back-and-forth, middle-to-end, and middle-to-beginning. Consequently, viewing words in the right-to-left direction produces errors such as "was" for "saw" and "tap" for "pat". Viewing words from middle-to-end results in "chin" for "inch" and viewing from beginning-to-middle results in "time" for "met". Other errors such as "dust" for "study", "tending" or "tender" for "instead", "swan" for "answer", and "vase" for "seven" are due to incomplete analysis during the different eye-movement patterns. These eye-movement habits are then transferred to the reading situation, causing reversals in reading.

However, in a later study Krise (1952) suggested "there is no relationship whatever between the tendency to commit reversals in reading and the tendency to transfer to reading the techniques or habits of studying or recognizing other objects" (p. 418). Wolfe (1939) also found evidence contradicting Gates and Bennett's (1933) theory and concluded that observing words right to left does not cause reversals in reading.

Witty (1949) stated that poor readers do make unnecessarily large numbers of fixation pauses per line. But eye-movements invariably improve and the number of fixation pauses decrease "... when he [the
poor reader] is given an opportunity to read much interesting material, chosen in accord with his ability, and increased and adapted to meet his improved status during a remedial program...." (p. 188).

Bond and Tinker (1957) stated that random searching patterns of eye movements in reading can lead to reversals. They explained that "when the vocabulary and comprehension load becomes too heavy, eye movements tend to fall into a random searching pattern..." (p. 310). The eyes "move forward and backward in the attempt to recognize words and find meanings" (p. 310). This confused random searching of the eyes "can lead to reversals in the order of words in a sentence as well as in letters within words" (p. 310).

Perceptual Immaturity Theories

Frank (1935), in her investigation to test her assumption that deficiencies are "based on the specific manner of a young child's perception" (p. 42), found indeed, that reading deficiencies were due to a child's immature mode of perception. Her subjects included 35 backward readers, boys and girls aged seven to 11 1/2 years old. Most of the subjects were of average intelligence, four above average, and five below average. The comparative group consisted of 350 children aged four to seven years from two infant schools.
The backward readers were given tests in reading, spelling, and writing from dictation. The infant groups copied, wrote small sentences from dictation, spelled words and read small sentences from books used in their classrooms. Frank found that both groups made "confusion of letters of the same structure which are a kind of mirror picture, and of letters and words of similar structure..." (p. 54). These are, respectively, "b-d", "p-q", "b-p", "p-d", "q-b", "u-n", and "m-w" (p. 45) She also found confusion of letters of similar visual or auditory structure, which included: "m-n", "i-l", "n-h", "t-l", "v-y", "u-v", "f-t", "ch-sh", "r-l", and "v-th" (p. 45).

Frank (1935) concluded that the mode of perception for both groups was at the same level, specifically, an immature level of perception. Thus, reading deficiencies comprised of confusions and reversals are naturally based on children's immature mode of perception.

Fernald (1943) claimed that inversions, reversions and the confusion of symbols in reading were due to a failure to distinguish between similar stimuli. She explained that "a part of the learning process in any complex situation consists in developing the recognition of like objects as separate entities" (p. 83). Most children with reading disabilities, who are
learning to read, fail to make progress in the discrimination of objects which would eliminate particular errors. Under study, all first and second grade children made errors such as confusing "was" for "saw" and "b" for "d". This confusion was, therefore, due to a failure to distinguish between two things that resembled each other.

Cohen and Schwartz (1975), in analyzing the relationship between perceptual factors and reading, stated that "perceptual immaturity is now generally accepted as one major cause of early reading difficulty" (p. 534), eliciting behaviors such as reversing letters, incorrect copying of particular shapes and sequences. They related this concept to Werner's (1948) stages of perceptual development in children. Cohen and Schwartz described Werner's stages as follows:

At the global stage figures are poorly defined and their characteristics cannot be sharply distinguished. They do not stand out clearly against background....

...the analytic or signal stage is evident when written words are differentiated on the basis of letter features.... Early in this stage, children are only minimally aware that there is a perceptual scheme inherent in word recognition....
With the synthetic or integrated stage, word recognition functions at its most mature level. Perceptual decentration permits the child to explore unfamiliar words. (p. 534-6)

Cohen and Schwartz (1975) stated that children may perceive words at the global or signal stage which leads them to confuse words that resemble each other. They explained:

When a child substitutes one letter for another of similar appearance, he may not have learned to distinguish salient features which discriminate between letters. This may account for what is commonly interpreted as reversals, and can be explained by the child's inability to make finer discriminations. Similarly, when a child responds to the beginning of the word, word configuration, or simply one isolated cue, he may not be scanning the word for its significant letter feature. (p. 536-37)

Cohn (1976), in his study exploring letter recognition difficulties claimed that errors often termed as reversals were due to errors of gross differentiation. In a study of 322 children, mostly first graders who had failed to decode three or more words in a word list from the Durrell Analysis of Reading Difficulty, Cohn
found various errors of gross differentiation. Visually, "b", "d", "p", and "q" share the obvious characteristic of having a long, straight line which is tangent to a circle. It becomes difficult to perceive and somewhat subtle to determine if the "circle is to the right or left of the straight line" or "is the circle tangent at the top or the bottom of the line" or "is the bottom of the line lower or at the same height as the bottom of most other letters" (p. 72). Other errors that were found suggested gross differentiation in another mode, the auditory. For example, some letters, e.g., "b", "d" and "p", resemble each other in that their letter names rhyme. Cohn claimed that "it might be expected that letters which resemble each other in both the visual and auditory modes would be extremely difficult for children to name correctly" (p.73). As well, many systematic errors were noted which did not reflect visual or auditory resemblances.

Pedagogical Theories

Gates and Bennett (1933) claimed that improper instruction of word-attack skills produces various reversal errors. Introducing instruction which emphasizes the ending of words prior to establishing habits of left to right progression, tends to establish habits of looking at the words, end first, and at the
middle and the beginning later. This is illustrated in the use of rhymes with the visual study of the final rhyming elements. Children thus form the habit of attending to the ending of words and then to the middle or beginning, resulting in reversals in reading.

Bond and Tinker (1957) attributed reversals to "a lack of systematic instruction in left-to-right orientation during the pre-reading period and during the initial stages of reading instruction" (p. 307). They explained that teachers frequently emphasize the left-to-right direction in reading lines of print, but fail to instruct proper orientation in word recognition. Consequently, children employ inappropriate methods of attack in the identification and recognition of unfamiliar words. It thus becomes difficult for children to recognize words properly and they also tend to make reversal errors.

Both Gates and Bennett (1933) and Bond and Tinker (1957) stated that the piecemeal observation required as an analytic method of studying words, hinders accurate recognition and leads to errors of perception such as reversal tendencies, particularly part reversals. They explained that when there is too great an emphasis on naming and sounding individual letters or digraphs, children tend to look back over the word in whole or part. This piecemeal type of word observation
cultivates regressive fixations within the word which interferes with the regular left to right eye work. As a result, there are reversals in reading.

Braun (1985) has observed in the primary classrooms of various countries and concluded that misguided teaching of children, contributes to difficulties in learning to read. He defined misguided teaching as the "instruction given to children by teachers who lack sufficient knowledge about the teaching of reading" (p. 20). With reference to the reversal errors that are more often made by weak readers as opposed to good readers, Braun stated that the teacher drills on the differences between "b" and "d", "was" and "saw", hoping through repetition children will make the appropriate discrimination, thus recognizing the "d" as a "d" and a "b" as a "b". Braun did not conclude that reversal errors are due to misguided teaching, but he implied that reversals may be due to misguided teaching when there is emphasis on repetitions.

Lack of Spatial Orientation Theories

Schonell (1946) implied that reversed or inverted positions of numbers or letters such as "7", "3", "b" and "d" are due to the law of object constancy. He explained that young children acquired structured solidity in their perception of things and tend to ne-
glect its spatial setting. Thus, young children aged five and seven-plus had difficulty remembering the correct orientation of letters, words, or figures.

Krize (1949) stated the reversals are due to lack of familiarity with the relation between letters and their background. Krize (1952) demonstrated "this difficulty by pointing out that when the symbol b is written, the most expert reader does not know whether it is 'p' or a 'd', because he does not know the intended relationship between the symbol and its ground" (p. 409). Krize's (1952) experimental findings supported his own theory that reversals are caused by "difficulties in space relations, confusions of figure-and-ground relationships" (p. 419).

Similarly, Cohn and Stricker (1976) presented a logical explanation with regard to letter recognition errors or so-called reversals that are due to spatial orientation. They explained that children previously learned a rule which says that "spatial orientation is of no value in object identification" (p. 162). Objects turned in various directions or positions are nevertheless still the same objects. But then, the rule no longer applies when viewing letters. Letter forms like "b-d", "p-q" and "u-n" are identical but their names are completely changed as the spatial orientation varies. Children do not realize this, and
become confused when there is a change in spatial orientation of letters. As a result, they name letters the same for different letters, regardless of their different letter names. They state that this is the source of letter recognition difficulties for "b-d", "p-q", "u-n" often termed as reversals. Spatial orientation, rather than distorted visual image is thus viewed to be the primary source of letter recognition difficulty.


while a child is growing up he comes to understand that an object retains its identity (name) no matter what its orientation in space. Thus, a cup is always a cup even if it is upside down or lying on its side. (p. 469)

Kampwirth, however, stated that this law needs to be amended when children confront two-dimensional printed symbols like letters and words. They need "to learn that these symbols change their identity if their orientation is changed" (p. 470). He explained that this is a simple adjustment for some children, while for others, they need years to deal with it. Implicit-
ly, the law of object constancy is deeply embedded for some children which influences reversals in reading.

**Psychological Theory**

Frith (1974) studied the effect of internal schemata for the orientation of letters. Subjects of different levels of reading ability and ages were used to vary the strength of schemata. The tasks involved copying and reversing normal and mirror reversed letters in order to separate perceptual and motor processes. Unfamiliar letterlike shapes in normal and reversed orientation were also used as a control condition.

Frith concluded that "reading difficulties may be caused by either too much dependence on schemata or poorly developed schemata ..." (p. 240). The experiment provided evidence that younger bad readers had weak schemata and older bad readers possessed a strong schemata. Her findings were that letter reversals are not due to a failure in stimulus discrimination, but are due to deficiencies in internal representations.

**Normalcy Theories**

Proponents of normalcy theories argue that reversal errors are a natural phenomena of younger children. Davidson (1934) stated that reversal errors made by
young children is a natural phenomenon since she found that these errors decreased with increasing age. Ilg and Ames (1950) emphasized the reversal of single letters, or of the order of letters in words at earlier ages were to be regarded as a developmental normality of behavior. Kennedy (1954) concluded that "the occurrence of reversal errors of all types studied are perfectly normal in the earliest grades and that it is equally normal for them practically to disappear as the child progresses through the first several grades" (p. 169).

Tinker and McCullough (1968) stated that it is normal for "children to make reversals when learning to read" (p. 603). Children in primary grades, and even in the upper elementary grades, make reversals or occasional reversals. As they progress through the grades, reversals ordinarily are less frequent.

Cohn and Stricker (1976) explained that letter recognition errors are within the normal stages of development for children. Letter naming difficulties result from the components of letter naming tasks. Children "must first receive the correct visual stimulus, and then must know what name to associate with that stimulus" (p. 162) in order to name letters correctly. Some children have not yet learned the names of the letters and therefore are uncertain which
name is associated with the letters that are similar in form. Letter naming difficulties are then, not caused by perceptual distortion; rather, they are considered to be normal stages of development.

**Directionality Theories**

Payne (1930), in her partial analysis of errors in word recognition secured from the oral responses of 400 Grade 2-5 children, stated that the tendency of some children to read words backwards was due to a circumstance in the initial learning or to some unknown cause. She explained that a child's first impression in the process of reading may have been a procedure moving from right to left or a habit of reporting first what was seen last. If this right to left procedure were a strong impression, it would be difficult to remove.

Tinker and McCullough (1968) claimed that lack of left-to-right orientation in reading results in reversals. He explained that a left-to-right progression of perception is essential in reading and must be learned. However, some children have difficulty in mastering this orientation and while reading, observe "letters in a reverse order or a partial reverse order" (p. 603). In consequence of, errors such as "say" for "was", "on" for "no", "won" for "own" and "pig" for "dig" are read.
Moyer and Newcomer (1977) in reviewing relevant research on reversals concluded that reversals are due to a "child's unfamiliarity with the concept of directionality as it relates to letter discrimination" (p. 424). In addition, they claim reversals are not caused by perceptual deficits.

Drake and Broneman (cited in Kirshner, 1977) stated that letter reversals are due to poor automation in the reading process. They believed that normal reading encompasses the automatic performance of decoding words, presumably right to left. If this directional process is not mastered, children hesitate in making judgements when encountering reversible letters in words.

Mather and Healey (1984) did a single subject experiment to determine whether reversals in reading and writing were due to a directional confusion. Their findings supported a theory stating that reversals represent directional uncertainties.

Language Related Theory

Wagner (1982) suggested that polyglot dyslexia may be considered in explaining reversals in reading. He defined polyglot dyslexia as the "difficulties in reading experienced in both languages spoken by bilinguals" (p. 1). The two languages spoken by an
individual may be confusing due to the dissimilarity of the two languages. For example, if one language has a left-right movement on the page while reading, the other language may have the opposite which is the right-left orientation. Consequently, the individual may confuse "was" for "saw" in English. Similarly Wagner (1984) suggested that the same type of error can show up, such as confusing "mas" for "sam" in Spanish.

Relationship of Selected Variables to Reversals in Reading

Age Level and Reversals

Schonell (1946) investigated the relationship of reading disability and laterality variables of backward readers and normal school children. As part of the investigation, the incidence of perceptual errors in reading at various age levels were examined. The subjects included 104 backward readers and 104 unselected school children, aged seven to 13, with intelligence quotients of 85 and above, except for a small group with intelligence quotient of 70-84. Schonell found that perceptual errors in reading existed at various ages. The confusion of letters such as "b" for "d"; "p" for "q"; and "w" for "m" persisted until age nine, male and female for the normal
children. For the backward readers, male and female, the same confusions persisted to age twelve. Furthermore, Schonell found that the latter group was more subject to the perceptual errors.

Ilg and Ames (1950), in their longitudinal study on the development trends of reading behavior of children, found that reversals occurred at different ages. Their findings were presented within a developmental frame of reference rather than elaborate statistical treatment of data. More than fifty children were studied up to five years of age where observations were conducted on their responses to reading. At aged five to nine years, thirty or more at each age level were studied. All children studied had above or average superior intelligence quotients. Children aged five to eight years were given the Gray Oral Check test for reading readiness; children aged six to nine years were given Gray Oral Reading paragraphs. The responses of the subjects were analyzed to determine the components of a reading gradient, which represented the developmental reading behavior and errors at different age levels. Four different types of reading errors were notable: letter substitutions in form and meaning; reversals; omissions; additions; and repetitions. The researcher found single letter reversals, such as "was" for "saw", "saw" for "was", to be the most common errors at five
and one-half to six years of ages. The reading of words in the wrong order did not occur at both age levels. At the age of seven years, single letter reversals and whole-word reversals were still common, but were fewer than at the preceding age level. Children at this age made eight per cent of reversals in the order of words within sentences as "Once there" is read for "there once" and "mother said" is read "said mother." Children at 8 years, made very few reversals of single letters or letters within words. However, twenty-four per cent reversed the order of words within sentences as "were then happy" for "were happy then." At 9 years of age, children did not reverse single letters. A few children when encountering different words reversed letters such as "profusion" for "profusion." Forty-six per cent reversed the order of adjacent words, occurring only once in one each.

Vernon (1957), in her book *Backwardness in Reading* summarized previous research findings regarding the age level in relation to reversals in reading:

Wilson and Fleming (1938) showed that the tendency to confuse letters persisted up to the age of 8-9 years, but it was chiefly confined to confusions between 'b' and 'd', 'p', 'q' and 'j'. Frank (1936) found confusions between reversed letters,
especially 'b' and 'd', to be very common in children of 6-7 years (p. 26).

Various other researchers also state that reversals are common at earlier age levels. Betts (1946) stated that reversals are common among young children. Kampwirth (1983), in agreement, also stated that reversals are common in kindergarten children, less common in grade one and uncommon in the grade two level. Mather and Healey (1984) claimed that reversals are developmentally common in young school aged children which "usually remit spontaneously in the first or second grade" (p. 89).

Gender and Reversals

Davidson (1934) in her study of reversals in young children, aged 5-6 years suggested a possibility of a sex difference of reversal errors. She found that in grade one, "10% more boys than girls made word reversal errors and 8% made more form reversals" (p. 461). For the average number of reversals per boys and girls by grades, Davidson found reversal errors tended to be greater for kindergarten boys than kindergarten girls, but grade one girls made slightly more reversal errors than grade one boys. In a later study, Davidson (1935) gathered data from the same subjects at the same time to study the extent by which children confused "b" with
"d" and "p" with "q". She found that there was no apparent sex difference among the kindergarten boys and girls. However, at the first grade level, a larger percentage of boys than girls made ten out of eleven letter form errors. These ten letter form errors were "d" for "b"; "d" for "p"; "d" for "q"; "n" for "u"; "q" for "p"; "q" for "b"; "q" for "d"; "b" for "d"; "b" for "p"; and "b" for "q.

Linguality and Reversals

In reviewing the research on reversals, it was found that there is considerable amount of research conducted into reversals in reading among monolingual English speakers. There is, however, a dearth of research pertaining to reversals in reading and bilingualism. However, there is an implication that dyslexia is present in bilingual speaking children. Wagner (1976) claimed that bilingual speaking children, when diagnosed as dyslexic, will probably exhibit similar or the same reading problems in both languages. He concluded that bilingualism is not the root of reading problems but are the characteristic signs of the dyslexic syndrome. Wagner (1982) termed this condition as polyglot dyslexia. However, bilingual speaking children encounter language problems other than the polyglot dyslexic syndrome.
**Linguistic Interference**

This subsection discusses the concept of Cree interference with English. Since the subjects in the study spoke Cree and/or English, it is important to understand what role linguality may play in the incidence of reversals and sequencing errors in reading.

Tochey (1985), in reporting oral English proficiency test results of Swampy Cree and English speaking students, concluded in part, that Swampy Cree speakers exhibited Cree language interferences in their pronunciations. Generally, when this is the situation, bilingual speakers substitute sounds from their original language into their acquired language. Sealey and Kirkness (1973) also stated that Cree sound substitutions are evident for Cree speakers. This is shown by the Cree language speakers' pronunciation of the English "sh" sound which is not a sound found in the Cree language. For example, when Cree speakers encounter words with the "sh" sound, they tend to substitute the more familiar "s" sound. Their pronunciation of words emerge as "sout" for "shout", "soogar" for "sugar", "mars" for "marsh", "was" for "wash", and "sooz" for "shoes". Other English sounds lacking in the Cree language are "b", "d", "f", "j", "g", "r", "v" and "x". Van Vliet (1985) listed 17 distinctive sounds in Plains Cree. They are: short vowel sounds "a",
"i", and "o"; long vowel sounds "a", "e", "i", and "o"; and consonants "c", "h", "k", "m", "n", "p", "s", "t", "w", and "y".

Cree speakers also encounter difficulties articulating the "th" sound in English words. Like the "sh" sound, the two "th" sounds as in "this" and "thigh" are substituted by a sound which is between the English "t" and "d". The phrase "Thank you for that" is read as "Tank you for dat" (Soveran, 1964). She stated that there is confusion among Cree speakers between English sound pairs like "p" and "b". These sounds are confused in words like "description" and pronounced as "descrebsen" or "desgrebsen". The letters "k" and "g" are also confused in the word "toboggan" consequently, pronounced as "tibuken", "tapakan" or "tipbogan"; "damage" as "damach"; and "guarantee" as "caranteeli".

The nearest Cree equivalent of the English "ch" sound varies in position of articulation and sounds almost like a "ts". The word "church", when pronounced, sounds like "tsurts". There also may be confusion between "ch" and "j", where "Joseph" is read as "Chosep" wherein the unvoiced form is used for "j". Soveran added that Cree speakers are conditioned to disregard English variations caused by voicing since voicing does not change meaning in Cree. Cree speakers
will confuse English pairs, such as "p", "b"; "t", "d"; "ch", "j"; and "k", "g".

The sound differences between Cree and English are notable and often result in mispronunciations and sound substitutions. These confusions in sounds may indeed transfer over into Cree speakers reading of English.

Reading Achievement and Reversals

Various researchers have commented on the relationship of reversals to reading achievement. Hildreth (1934) concluded that "there is some tendency for the poorest readers to make more reversals than good readers, just as the poorest readers made more kinds of all other types of errors than good readers" (p. 19). Bond and Tinker (1957) found that retarded readers as compared to reading achievers made more reversals when reading lowercase letters.

Tordrup (1966), in his study investigating whether retarded and normal readers will make the same reversals in the same words in reading and spelling, found that reversals were most characteristic of retarded readers and the within-group differences were greater than for the normal reader group. For example, many retarded readers (24 out of 103) made no reversals at all, but a few made many reversals, specifically five out of 103 retarded readers made 20% of all reversals.
Smith (1978), in analyzing the process of reading for good and bad readers, stated that reading reversals are evident in both categories but predominant for the bad readers.

Liberman, Shankweiler and Orlando (1971), analyzed the pattern of errors for second grade pupils in reading isolated words with respect to reversal of letter sequence and orientations. They found that poor readers make reversals. A 60 item word list was administered to the 59 subjects. Eighteen children were chosen that comprised the full lower third of the group in reading proficiency determined by their total error score on the word list. There were 15 boys and 3 girls, ages ranging from 7.25 to 9.25 with a mean of 8.25 years, and intelligence quotient ranging from 85-126 with a mean of 98.6. The subjects were given tasks, such as reading a word list of 60 real-word monosyllables, tachistoscopically matching single letters, and completing the Gray Oral Reading Test, Form A. The error analysis included error types such as reversals of sequence, reversals of orientation, other consonant errors, vowel errors, and the total errors made of all preceding error types. The researchers found that children ranking in the lower third of the class made reversals. They also found that individual differences existed in the reversal
tendencies; that only certain poor readers reversed. Furthermore, they found that only poor readers made a significant quantity of reversals of letter sequence and of letter orientation. These studies in general, point to the need to consider reversals in reading and its relationship to reading achievement. Lack of reading achievement may in part, be related to reading errors stemming from reversals.

Summary

This chapter reviewed the literature on the reversal phenomena in terms of four major focuses: a brief history of the concept of reversals in reading; classification of reversals in reading; theories on causes of reversals in reading; and the relationship of selected variables to reversals in reading. These focuses were chosen not only to provide a broad overview of reversals in reading but also to compile information on reversals which has not previously been easily accessible to teachers in general and to special education teachers and teachers of Native students in particular.

Historically speaking, the concept of reversals in reading was initially investigated in 1825. Perceiving the phenomena primarily in physiological terms, early
researchers used labels such as "word-blindness", "acquired word-blindness" and "congenital word-blindness" to refer to reversal phenomena. In 1925, Orton coined the term "strephosymbolia" as more appropriately descriptive of reversals in reading. His pioneering work in this area of research influenced more researchers to study the phenomena throughout the twentieth century. Today, reversals in reading are viewed as characteristics within the broader categories of dyslexia or learning disabilities. Reversal errors are considered by most researchers to produce disturbances in the reading function.

An overview of classifications schemes for the reversal phenomena depicted the various categorizations posed by researchers during the last half century. Reversals were in general viewed to be comprised of various error types. In this study, reversals were classified as inverting single letters while reading, such as reading "big" for "dig" or "lad" for "lap". These error types were distinguished from sequencing errors which were defined as the total or partial inversion of letters in words while reading, such as "was" for "saw" and "won" for "own".

The third focus of this chapter, theories on causes of reversals in reading, showed the evolution of thought concerning causal factors for the reversal
phenomena. Theories described in this section included ones which located causes of reading reversal errors in the physiological, psychological, pedagogical and linguistic realms. It was suggested that there may be no one factor which may account for all types of reversal errors.

Particular attention was given in the final section of this chapter to several factors, or variables, which may be related to reversals in reading. These variables included age, gender, and linguality. Review of the literature with regard to these particular variables provided the most specific context with regard to the three independent variables used in this study.
Chapter Three

PROCEDURES OF THE STUDY

The following section describes the research methodology, the description of the research site, population and sample, the data collection instrument and the data collection procedures. The section also presents the statistical hypotheses and the data analysis procedures.

The Research Methodology

The researcher used the causal-comparative research methodology in this study. This methodology "is aimed at the discovery of possible causes and effects of a behavior pattern or personal characteristic by comparing subjects in whom this pattern or characteristic is present with similar subjects in which it is absent or present to a lesser degree" (Borg & Gall, 1989, p. 537). The three personal characteristics which were considered in this study were gender, age, and linguality. Their effect on the number of reversal and sequencing errors made by Native students was the focus of investigation. Analysis of variance,
as a test of statistical significance, was "used to determine whether mean scores on one or more factors differ significantly from each other, and whether the various factors interact significantly with each other..." (Borg & Gall, 1989, p. 356). A three-way analysis of variance (2x2x2) was used to measure the effects of the three independent variables (gender, age and linguality) on the dependent variable (incidence of reversal and sequencing errors in reading). Subsequently, a two-way analysis of variance (2x2) was also employed to measure the effects of gender and linguality on the dependent variable focussing only the 7/8 year old students since reversals and sequencing errors in reading had virtually disappeared for the students aged 9/10 years old. The male and female, 7/8 year old subjects were then combined and a one-way analysis of variance was employed to measure the effects of linguality on the dependent variable.

Description of the Research Site

On September 9, 1876, Chief Seekaskootch and his band signed Treaty 6 at Fort Pitt, Saskatchewan. The Seekaskootch Indian Reserve, Band # 119 and Weemisti-cooseahwls (Makao) Indian Reserve, Band # 120 were designated as reserves in January 23, 1889. The
Seekaskootch Indian Reserve is within the Saskatchewan boundary while most of Makao Indian Reserve is within the Alberta boundary. Subsequently, the two reserves amalgamated on January 16, 1914 and became the Onion Lake Reserve. As a whole, Onion Lake Reserve straddles the Saskatchewan and Alberta boundary (Onion Lake Tribal Administration, n.d.).

Onion Lake Reserve, Onion Lake, Saskatchewan-Alberta is located 325 kilometers northwest of Saskatoon, Saskatchewan. The reserve has a band membership of 2,423 people (Pauls, personal communication, November, 19, 1990). The languages spoken are English and/or the y-dialect of Cree.

There are three educational facilities on the reserve, the Roman Catholic School (R.C. School), the Anglican Church of Canada (A.C.C. School) and the Chief Taylor School (C.T. School). The R.C. School includes Division I (Kindergarten to Grade 3) with 155 students; A.C.C. School includes Division I (Kindergarten to Grade 3) with 127 students; and C.T. School accommodates Division II (Grades 4-6), Division III (Grades 7-9) and Division IV (Grades 10-12) with a total of 445 students. The total student population of the three schools is 727 which is the largest Native school population within the North Battleford District for the Department of Indian and Northern Affairs,
Population and Sample

The target population of this study was Native students aged 7-10 years from the three schools located on the Onion Lake Reserve, Onion Lake, Saskatchewan-Alberta, Canada. The researcher collected Enrolment of Pupil Sheets, dated July 1, 1987 to June 30, 1988, from the homeroom teachers in Grades 1-3 at R.C. School, A.C.C. School and Grade 4 at C.T. School. The population consisted of 159 students (see Tables 1 and 2). In Table 1, the female and male totals are nearly equal with a difference of three more females than males. R.C. and A.C.C. schools contained the largest numbers of students in the target population. The largest age group (Table 2) were the eight year olds and the smallest age group were the 10 year olds. R.C. and A.C.C. schools had the largest number of students aged 7-10 years.

Sample Selection

The researcher collected data from the teachers of students involved in the study regarding linguality of
the student sample. Rating scales for linguality were utilized to rate students for facility in Cree and English. Four diagrams of the rating scales for facility in Cree and English languages were prepared as shown in Figures 1 and 2 of Appendix A and B (R. McLeod, J. McLeod, personal communication, May 30, 1988) and distributed to homeroom teachers and Cree Language Instructors. In explaining how to use the rating scales, the researcher provided instructions in Cree and English to those who received the rating scales. Appendix C shows the instructions that were provided to each teacher and Cree Language Instructor. The homeroom teachers and Cree Language Instructors were requested to rate students according to judgements based on school environment observations.

The Cree Language Instructors rated students, by first determining each student's facility in Cree language only on a 5-point scale starting from far above average, above average, average, below average and far below average. [These category labels have been slightly modified for reporting purposes.] The same rating scale was followed for facility in the English language as compiled by the homeroom teachers.
Table 1

Native Student Population by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total</th>
<th>R.C.</th>
<th>A.C.C.</th>
<th>C.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>81</td>
<td>44</td>
<td>35</td>
<td>2</td>
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<tr>
<td>Male</td>
<td>78</td>
<td>39</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>83</td>
<td>65</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 2

Native Student Population by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Total</th>
<th>R.C.</th>
<th>A.C.C.</th>
<th>C.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>42</td>
<td>25</td>
<td>17</td>
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<td>21</td>
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<td>6</td>
</tr>
<tr>
<td>10</td>
<td>24</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>83</td>
<td>65</td>
<td>11</td>
</tr>
</tbody>
</table>
The researcher later transferred the teachers' and Instructors' first ratings onto sheets entitled "Ages 7/8", "Ages 9/10" years that listed all students' names with numerical codes, chronological ages, gender, grades and schools attended. Bivariate matrices were devised for the two age groups as shown in Figures 3 and 4 (J. McLeod, personal communication, June 7, 1988). The numerical codes of all students were plotted in the appropriate cells according to ratings for facility in Cree and English language. The researcher then confirmed these initial ratings with each teacher or instructor, with minor rating changes being made.

There were major difficulties in obtaining large samples for each age group who were English dominant or bilingual Cree-English speakers. Most of the students' ratings fell outside the cells designated for English dominant and bilingual Cree-English on the bivariate matrices (see Figures 3 and 4). In Figure 3, the four top left shaded cells included the students who were predominantly English speaking and categorized as the English dominant group. The four top right shaded cells included students who were Cree-English speaking and categorized as the bilingual Cree-English group. Students numbered 29, 64, and 69 on the left side were also in the sample. Since there were only four stu-
dents Cree-English speaking on the right side, students numbered 34, 40, 47, 59, 62, 72, 7, 20, 75, 88 and 94 were included in the sample, in order that the two linguistic groups be close to equal in quantity. The total number of students on the bivariate matrix is 94.

In Figure 4, the four top left shaded cells included the students who were predominantly English speaking and categorized as the English dominant group. The four top right shaded cells included the students who were Cree-English speaking and categorized as the bilingual Cree-English group. Since there were only six students Cree-English speaking on the right side, the students numbered 47, 48, 49, 62, 6, 8, 21, 54, and 61 were included in the sample, in order that the two linguistic groups be close to equal in quantity. The total number of students on the bivariate matrix is 65. The sample selected for this study, therefore narrowed down to 55 students out of a target population of 159 Native students.

Description of the Sample

The sample for this study is composed of 55 Native students. As shown in Table 3, the female and male totals in the study sample were nearly equal with a
Figure 3.

Bivariate Matrix for Facility in Cree and English for Age Group 7 to 8.

<table>
<thead>
<tr>
<th></th>
<th>FAR BELOW AVERAGE</th>
<th>BELOW AVERAGE</th>
<th>ABOVE AVERAGE</th>
<th>FAR ABOVE AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CREE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAR ABOVE AVERAGE</td>
<td>1 16 2 4</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ABOVE AVERAGE</td>
<td>75 95</td>
<td>9 11 21 28</td>
<td>15</td>
<td>6 12</td>
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<tr>
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<td>22 64</td>
<td>30 35 36 37</td>
<td>34 39 47</td>
<td>7 20 75</td>
</tr>
<tr>
<td>FAR BELOW AVERAGE</td>
<td>90</td>
<td>52</td>
<td>31 33 45</td>
<td>8 19 60 61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42 63 66</td>
<td>43 50 78</td>
<td></td>
</tr>
</tbody>
</table>

| **ENGLISH**      |                   |               |               |                   |
|                  | 39 65 80 76       | 83 87 93      | 73 74 77 80   |                   |
|                  | 30 41 48 54       | 55 56 57 58   | 60 61 70 71   |                   |
|                  | 34 49 52 72       | 7 20 75       | 88 94         |                   |
|                  | 32 44 51 67       | 68 62 85 91   | 8 19 60 61    |                   |
|                  | 52                | 42 63 66      | 43 50 78      |                   |

Note. The bivariate matrix obtained from J. McLeod, personal communication, June 7, 1988.
Figure 4

Bivariate Matrix for Facility in Cree and English for Age Group 9 to 10.

<table>
<thead>
<tr>
<th></th>
<th>FAR BELOW AVERAGE</th>
<th>BELOW AVERAGE</th>
<th>AVERAGE</th>
<th>ABOVE AVERAGE</th>
<th>FAR ABOVE AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAR ABOVE AVERAGE</td>
<td>16 20</td>
<td>2 3 17 18</td>
<td>1</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>ABOVE AVERAGE</td>
<td>65</td>
<td>9 12 13 25</td>
<td>22 23 27</td>
<td>11 24</td>
<td>7 23</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>34 35 43 63 64</td>
<td>31 33 44 45 60 65</td>
<td>47 49 60 62</td>
<td>6 8 21 54 61</td>
<td></td>
</tr>
<tr>
<td>BELOW AVERAGE</td>
<td>15 38</td>
<td>28</td>
<td>39 40 41 42 57</td>
<td>29 37 52 56 59</td>
<td>58</td>
</tr>
<tr>
<td>FAR BELOW AVERAGE</td>
<td>14</td>
<td></td>
<td>32 36 55</td>
<td>30</td>
<td>5 51</td>
</tr>
</tbody>
</table>

Note. The bivariate matrix obtained from J. McLeod, personal communication, June 7, 1988.
difference of three more females than males. R.C. and A.C.C. schools contained the largest number of students in the sample. The largest age group (Table 4) comprised the nine year olds and the smallest age group were the 10 year olds. R.C. and A.C.C. schools had the largest number of students aged 7-10 years in the sample.

Figures 3 and 4 of the bivariate matrices shows the English dominant and bilingual Cree-English groups according to age levels. For the 7/8 year olds (Figure 3) there were 17 students who were predominantly English speaking and categorized as the English dominant group. These students are designated in the shaded areas on the left side of the bivariate matrix. Students numbered 16, 17 and 29 were excluded from the sample. Student 16 was a six year old and student 17 exhibited difficulty in reading the words. Student 29 was non-Native and replaced by student 69 by random selection. There were only four students who were Cree-English speaking, therefore 11 students from the ‘average’ cells were included and categorized as the bilingual Cree-English group. These students are designated in the shaded areas on the right side of the bivariate matrix. Students numbered 40 and 75 were excluded from the sample, the former being hearing impaired, the latter consistently absent from school.
Table 3

**Native Student Sample by Gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total</th>
<th>R.C.</th>
<th>A.C.C.</th>
<th>C.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>29</td>
<td>13</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Male</td>
<td>26</td>
<td>10</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>23</td>
<td>25</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 4

**Native Student Sample by Age**

<table>
<thead>
<tr>
<th>Age</th>
<th>Total</th>
<th>R.C.</th>
<th>A.C.C.</th>
<th>C.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>12</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>9</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>20</td>
<td>7</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>55</th>
<th>23</th>
<th>25</th>
<th>7</th>
</tr>
</thead>
</table>
As a whole, there were 17 students categorized as English dominant, 13 students as bilingual Cree-English, to a total of 30 students aged 7/8 years old.

For the 9/10 year olds (Figure 4) there were 11 students who were predominantly English speaking and categorized as the English dominant group. These students are designated in the shaded areas on the left side of the bivariate matrix. Student numbered 66 was non-Native and excluded from the sample. There were only six students who were Cree-English speaking, therefore nine students from the 'average' cells were included and categorized as the bilingual Cree-English group. These students are designated in the shaded areas on the right side of the bivariate matrix. As a whole, there were ten students categorized as English dominant, 15 students as bilingual Cree-English, to a total of 25 students aged 9/10 years old.

Data Collection Instrument

The Test of Directional Attack on Words is a diagnostic test developed by F.J. Schonell and F.E.Schonell (1954) for the primary purpose of revealing reversals or part reversals (see Appendix D). The test is to be administered individually and
completed in 5-10 minutes (Pringle, 1959). It consists of twelve groups of words, each group comprising four words containing the same letters but in different positions (McCulloch, 1959). The total number of isolated monosyllable words on the test is 48.

The instrument utilized in this study was a revised version of the Schonell test (McLeod, 1988). The revised test consisted of 60 monosyllable isolated words, typeset in black letters on white unlined paper. The student response sheet contained lines followed by the same words as on the test. Reproductions of the test and the student test response sheet are included in Appendices E and F. The Test of Directional Attack on Words with revision was considered to be appropriate to measure the number and type of reversal and sequencing errors made by students reading the list of words.

The Pilot Study

In order to determine the administrative ease of the instrument, the time in seconds required to read each word, the time factor for completion of test and if the words were at the students' reading level and of reversible nature, the Test of Directional Attack on Words was administered to 18 Native and non-Native students, male and female, aged 7-10 years from St.
Augustine School, Saskatoon, Saskatchewan in January, 1988. The test was modified in its application from the oral reading of words on a list, to the oral reading of words on the monitor of a computer. The researcher observed and recorded student feedback on the mechanics of the computer programmed test.

The results of the pilot study were that the mechanics of the computer programmed test indicated some difficulties for some students. For example, some students either missed pressing the Return key on the keyboard or pressed it immediately before the words disappeared on the monitor. As well, a flashing square on the monitor indicated distractions for some students. The time in seconds varied for students to read each word on the monitor. The time factor indicated no difficulties as the students completed the test within 5-10 minutes that was required for the Schonell test. The reading level of words on the test presented no major difficulties for the students. The words as read by the students indicated their suitability as potentially reversible words. Since there were problems with the mechanics, and possible inaccessibility of computers at Onion Lake Schools, the computer programmed test was not utilized for this study.
Reliability and Validity

The Test of Directional Attack on Words is a non-standardized test, therefore data on the standardization, reliability and validity were not available (Pringle, 1959). However, the capacity of the test to measure reversal and sequencing errors in reading rests on validity. This was notable when the test was administered to the students during the pilot study. The test measured what Schonell (1946) purported it to measure, i.e., reversals and partial reversals in reading.

Data Collection Procedures

The researcher met with members of the Education Authority and the Band Council at the Onion Lake Band Office, Onion Lake, Saskatchewan, in early May 1988. The purpose of the meeting was to discuss the proposed study and to seek permission to do research with Native students on the Reserve. Subsequently, permission to undertake the research was granted by letter (See Appendix G).

On May 25, 1988, the researcher visited and introduced the topic of research to the teaching staff and the Cree Language Instructors in Grades 1-3 at R.C. School, A.C.C. School, and Grade 4 at C.T. School. In
order to establish rapport with the students, the researcher observed in the classrooms, participated in substitute teaching and interacted with the students for the remainder of May 1988.

Actual testing of individual students began on June 13, 1988. The students were tested individually in a quiet room in each school. Instructions in Cree and English were given to each student in the sample. Each student, seated opposite from the researcher, orally read the words from the test. The researcher transcribed the student's exact pronunciation of the words on the student test response sheet during the test administration. Testing of individual students concluded on June 22, 1988. During the duration of stay at Onion Lake, the researcher maintained a journal for future reference with regard to data collection activity.

**Statistical Hypotheses**

In this study the following statistical hypotheses were tested:

**Hypothesis 1:** There will be no significant difference in the incidence of reversal and sequencing errors in reading as measured by a revised version of
the Test of Directional Attack on Words between male and female Native students.

Hypothesis 2: There will be significantly more reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words by Native students aged 7/8 years than by Native students aged 9/10 years.

Hypothesis 3: There will be significantly more reversal and sequencing errors in reading as measured by a revised version of Test of Directional Attack on Words by bilingual Cree-English Native students than by English dominant Native students.

The criterion for rejecting the hypotheses was at the 95 per cent level of confidence, i.e., when p < 0.05.

Data Analysis Procedures

For the purpose of analyzing the data, the responses to the Test of Directional Attack on Words were scrutinized to determine the number of errors and types. The error types comprising reversals and sequencing errors in reading were tallied into frequency counts for each subject. (J. McLeod, July 1988, personal communication; J. McLeod, September 1990, personal communication). In order to test the
statistical hypotheses that there were no significant differences at the .05 level, means and standard deviations were computed and a three-way (2x2x2) ANOVA was performed. In addition, means and standard deviations were computed for a two-way (2x2) ANOVA and a one-way analysis of variance which were performed with regard to the 7/8 year age group only.
Chapter Four

DATA ANALYSIS AND RESULTS

This purpose of this chapter is to present the statistical analyses of data, the findings and the results with regard to each hypothesis.

Data Analyses and Findings

The three hypotheses posed in this study were tested by a three-way (2x2x2) analysis of variance. This analysis measured the effects of the independent variables (gender, age and linguality in Cree and/or English) in relation to the dependent variable (the incidence of reversals and sequencing errors in reading).

Means and standard deviations were computed for reversals and sequencing errors in reading as related to age, gender and linguality in Cree and/or English (see Table 5). The mean scores for reversals and sequencing errors decreased appreciably from ages 7/8 to 9/10, for both males and females and for both linguistic groups. For the English dominant males, the mean score changed from 2.6 for the 7/8 year olds to
0.8 for the 9/10 year olds. The mean scores for females decreased from 1.9 for the 7/8 year olds to 0.6 for the 9/10 year olds. For the bilingual Cree-English group, the mean score for males decreased from 3.2 for the 7/8 year olds to 0.9 for the 9/10 year olds. For female bilinguals mean error scores decreased from 3.6 for the 7/8 year olds to 0.5 for the 9/10 year olds. For all subjects, the number of errors decreased appreciably as the students became older.

The results of the analysis (see Table 6), were that a significant difference was found between students of different ages in the incidence of reversals and sequencing errors in reading ($\chi^2_{16.293} (1,47)$ $p < 0.05$). No significant difference was found in the number of reversal errors made by males and females nor by English dominant or bilingual Cree-English students.

When age only was measured in relation to the incidence of reversals and sequencing errors in reading, the results again were that, the mean scores decreased for the 9/10 year olds (see Figure 5). For the English dominant group, the mean error score changed from 2.3 for the 7/8 year olds to 0.7 for the 9/10 year old group. The mean error score for the 7/8 year olds, bilingual Cree-English group was, 3.5 compared to 0.7 for the 9/10 year old students.
Table 5

**Means and Standard Deviations Based on Age, Gender and Linguality**

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>English</th>
<th>Cree/English</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>7/8</td>
<td>Male</td>
<td>2.6</td>
<td>2.11</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1.9</td>
<td>1.64</td>
</tr>
<tr>
<td>9/10</td>
<td>Male</td>
<td>0.8</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.6</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Table 6

**Analysis of Variance in Incidence of Reversals and Sequencing Errors Based on Age, Gender and Linguality**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Age)</td>
<td>61.287</td>
<td>1</td>
<td>61.287</td>
<td>16.293*</td>
</tr>
<tr>
<td>G (Gender)</td>
<td>.425</td>
<td>1</td>
<td>.425</td>
<td>.113</td>
</tr>
<tr>
<td>L (Linguality)</td>
<td>.933</td>
<td>1</td>
<td>.933</td>
<td>.248</td>
</tr>
</tbody>
</table>

Interactions

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A x G</td>
<td>.117</td>
<td>1</td>
<td>.117</td>
<td>.031</td>
</tr>
<tr>
<td>A x L</td>
<td>9.113</td>
<td>1</td>
<td>9.113</td>
<td>.423</td>
</tr>
<tr>
<td>G x L</td>
<td>2.898</td>
<td>1</td>
<td>2.898</td>
<td>.770</td>
</tr>
<tr>
<td>A x G x L</td>
<td>0.000</td>
<td>1</td>
<td>0.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Error 176.789 47 3.761

Total 251.527 54

* p << 0.05.
Figure 5

Mean Reversal and Sequencing Errors in Reading Based on Age and Linguality

AGE GROUP

Cree/English ——
English ———
Since the data revealed that most reversal and sequencing errors in reading had disappeared by the age of 9/10 years, three subsequent analyses of variance focussed on the 7/8 year age group and the other two independent variables.

First, means and standard deviations were computed for reversals and sequencing errors for gender and linguality for the 7/8 year age group. For the English dominant males, the mean score was 2.6 compared with a mean of 3.2 for the bilingual Cree-English group. For the English dominant females, the mean score was 1.9 compared with a mean of 3.6 for the corresponding bilingual Cree-English group.

A two-way analysis of variance was then used to measure the effects of gender and linguality on the incidence of reversals and sequencing errors in reading (Table 8). The results of this analysis showed that there was no main effect for gender; that is, there was no significant difference between the male and female subjects with regard to reversals and sequencing error scores in reading. Furthermore, the results were that there was no significant difference between the error scores for English dominant and bilingual Cree-English groups. It is noteworthy, however, that even though statistical significance was not found for differences between the linguistic groups, a greater number of
Table 7

Means and Standard Deviations of Gender and Linguality for Ages 7/8

<table>
<thead>
<tr>
<th>Linguality</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>English</td>
<td>10</td>
<td>2.6</td>
</tr>
<tr>
<td>Cree/Eng</td>
<td>5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Table 8

Analysis of Variance in Incidence of Reversal and Sequencing Errors Based on Gender and Linguality for Ages 7/8

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>L (Linguality)</td>
<td>10.04</td>
<td>1</td>
<td>10.04</td>
<td>1.718</td>
</tr>
<tr>
<td>G (Gender)</td>
<td>0.00</td>
<td>1</td>
<td>0.00</td>
<td>0.000</td>
</tr>
<tr>
<td>L x G</td>
<td>2.83</td>
<td>1</td>
<td>2.83</td>
<td>.484</td>
</tr>
<tr>
<td>Error</td>
<td>151.93</td>
<td>26</td>
<td>5.84</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>164.80</td>
<td>29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
reversals and sequencing errors occurred among bilingual Cree-English group than among the English dominant groups of both males and females.

Since there was no effect for gender, males and females were collapsed into a single group. Increasing the sample size to 30 enhanced the possibility of detecting an interlingual group difference that may have been missed because the samples were too small. The increased sample size of 30 (male and female combined) comprised the second analysis undertaken on the 7/8 year age group.

Means and standard deviations were computed for reversals and sequencing errors for the two linguistic groups of 7/8 year olds. As shown in Table 9, the bilingual Cree-English group made more reversal and sequencing errors than did the English dominant group. For the bilingual Cree-English group, the mean score was 3.5 and decreased to a mean of 2.3 for the English dominant group. A one-way analysis of variance (Table 10) confirmed that the difference in the number of errors made by 7/8 year old males and females was still not significant statistically.

Visual inspection of the errors made by the students indicated that the two linguistic groups made essentially the same number of sequencing errors and that it was in reversal errors where the major
Table 9
Means and Standard Deviations for the Incidence of Reversals and Sequencing Errors Based on Linguality For Ages 7/8

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>Cree-English</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Mean</td>
<td>2.3</td>
<td>3.5</td>
</tr>
<tr>
<td>S.D.</td>
<td>1.96</td>
<td>2.62</td>
</tr>
</tbody>
</table>

Table 10
Analysis of Variance in Incidence of Reversal and Sequencing Errors Based on Linguality for Ages 7/8

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>10.04</td>
<td>1</td>
<td>10.04</td>
<td>1.82</td>
</tr>
<tr>
<td>Within Groups</td>
<td>154.76</td>
<td>28</td>
<td>5.53</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>164.80</td>
<td>29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
difference occurred (see Appendix H). Each student's responses were therefore examined and the number of reversal errors extracted. The third analysis conducted on the 7/8 year age group was thus regarding reversal errors only.

The means and standard deviations were computed for reversal errors only, for the two linguistic groups. As shown in Table 11, the bilingual Cree-English group made almost twice as many reversal errors as did the English dominant group. For the English dominant group, the mean score was 0.7 compared with a mean of 1.6 for the bilingual Cree-English group.

A one-way analysis of variance was employed to test for significant differences for reversal errors only, i.e. reversal errors separate from sequencing errors (see Table 12). Although the F-ratio was higher than in previous analyses, statistical significance was still not achieved.

Statistical Findings Related to Hypotheses

Hypothesis 1: There will be no significant difference in the incidence of reversal and sequencing errors in reading as measured by a revised version of
Table 11

**Means and Standard Deviations of Linguality (Reversal Errors Only)**

<table>
<thead>
<tr>
<th>Linguality</th>
<th>Age</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>7/8</td>
<td>17</td>
<td>0.7</td>
<td>0.824</td>
</tr>
<tr>
<td>Cree/English</td>
<td>7/8</td>
<td>13</td>
<td>1.6</td>
<td>1.903</td>
</tr>
</tbody>
</table>

Table 12

**Analysis of Variance in Incidence of Reversal Errors Based on Linguality**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6.09</td>
<td>1</td>
<td>6.09</td>
<td>2.91</td>
</tr>
<tr>
<td>Within Groups</td>
<td>58.61</td>
<td>28</td>
<td>2.09</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64.70</td>
<td>29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
the Test of Directional Attack on Words between male
and female Native students.

Since there was no significant difference found in
the number of reversal and sequencing errors in reading
made by male and female Native students, Hypothesis 1
was accepted.

**Hypothesis 2:** There will be significantly more
reversal and sequencing errors in reading as measured
by a revised version of the Test of Directional Attack
on Words by Native students age 7/8 years than by
Native students age 9/10 years.

The effect of age on the dependent variable
(reversal and sequencing errors in reading) was found
to be statistically significant ($p < 0.05$) and errors
in reading were in the direction of more errors made by
Native students age 7/8 than by Native students age
9/10. Hypothesis 2 was therefore accepted.

**Hypothesis 3:** There will be significantly more
reversal and sequencing errors in reading as measured
by a revised version of The Test of Directional Attack
on Words by bilingual Cree-English Native students than
by English dominant Native students.

The independent variable linguality was found to
have no statistical significance ($p < .05$) in relation
to the number of reversal and sequencing errors made by
bilingual Cree-English students. Hypothesis 3 was therefore rejected.

Summary of Findings

In this chapter, the statistical analyses of data have been presented. These analyses included a three-way analysis of variance which tested the three hypotheses posed in this study as well as subsequent analyses of variance which considered the 7/8 year age group only. The findings of the study were that there were more reversal and sequencing errors made by the 7/8 year olds than by the 9/10 year olds but that there was no significant difference in the number of errors made by male and female students. There also was no significant difference in the number of reversal and sequencing errors made by English dominant and bilingual Cree-English students. The findings were confirmed when the 7/8 year olds were analyzed as a sub-group of the original sample. It was noted, also, that while the differences between English dominant 7/8 year olds and bilingual Cree-English 7/8 year olds were not statistically significant, the latter group made more reversal and sequential errors in reading than did the former.
Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to provide a summary of the study and the findings related to the research hypotheses. This chapter also presents the conclusions and makes recommendations for further research and for educators.

Summary of the Study

Research literature has suggested that Native students experience various problems during their in-school years. The problems frequently result in incompletion of high school. Native students are also found to experience problems relating to success within the schools. Some Native students are age-grade discrepant, and less successful in school than their non-Native counterparts. Test scores indicate that very frequently lack of school success hinges on difficulties in reading and writing in English. This study explored several facets of the question: "Do Native students experience reversal and sequencing errors in reading?"
Research literature states that the tendency to make reversals in reading is a problem for many students. Orton (1937) claimed that reversals form an obstacle in learning to read, as well as blocking progress in reading. Monroe (1932) claimed that reversals impeded progress in reading. Reversals in reading interfere with children's normal reading progress (Carmichael & Dearborn; Teegarden cited in Bond & Tinker, 1957) as well as interfering with the ability to read (Cohn & Stricker, 1979).

The Study

The primary purpose of this study was to investigate the differences in the incidence of reversal and sequencing errors in reading among male and female Native students who were of different ages and who were either English dominant or bilingual Cree-English. The Native students were in Grades 1-3 at R.C. School, A.C.C. School and Grade 4 at C.T. School at Onion Lake Reserve, Onion Lake, Saskatchewan-Alberta.

The dependent variable of the study was the number of reversal and sequencing errors in reading. Reversals in reading are defined as the inversion of single letters, such as "big" for "dig" and "lad" for "lap". Sequencing errors in reading are the total or partial inversion of letters in words, such as "was" for "saw"
and "won" for "own". The independent variables in this study consisted of gender, age, and linguality in Cree and/or English. These variables were based on dichotomies, such as male or female, ages 7/8 years or 9/10 years, and English dominant or bilingual Cree-English classifications.

Three questions were formulated to set parameters for the hypotheses to be tested:

"Is there a difference in the incidence of reversal and sequencing errors in reading between males and females?"

"Do 7/8 year old Native students exhibit a higher incidence of reversal and sequencing errors in reading than 9/10 year old Native students?"

"Do bilingual Cree-English speakers exhibit a higher incidence of reversal and sequencing errors in reading than English dominant speakers?"

From these questions three research hypotheses were formulated:

Hypothesis 1: There will be no significant difference in the incidence of reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words between male and female Native students.

Hypothesis 2: There will be significantly more reversal and sequencing errors in reading as measured
by a revised version of the Test of Directional Attack on Words by Native students aged 7/8 years than by Native students aged 9/10 years.

Hypothesis 3: There will be significantly more reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words by bilingual Cree-English Native students than by English dominant Native students.

The target population of Native students was derived from Enrolment of Pupil Sheets, dated July 1, 1987 to June 30, 1988, and consisted of 94 students aged 7/8 years and 65 students aged 9/10 years for a total of 159 students. All of these students were rated by the homeroom teachers and Cree Language Instructors for facility in Cree and English utilizing rating scales. Students’ numerical codes were then plotted in the cells on the bivariate matrices according to the ratings for facility in Cree and English. Most of the students’ language ratings fell outside the cells designated for English dominant and bilingual Cree-English speakers (see Figures 3 and 4). Therefore, the sample for this study consisted of 55 Native students from the target population of 159 students. The sample break-down was as follows: 29 females and 26 males; 12 seven years olds, 18 eight year olds, 20 nine years olds and 5 ten year olds; 17
English dominant and 13 bilingual Cree-English students aged 7/8 years; and 10 English dominant and 15 bilingual Cree-English students aged 9/10 years.

The Test of Directional Attack on Words developed by Schonell and Schonell (1954) is a diagnostic test of 48 words of which the primary purpose is to reveal reversals and part reversals. The words are arranged into twelve groups, each group comprising four words. No data were available on the standardization, reliability and validity of the Schonell test. The Schonell test was revised by McLeod (1988) and used to collect data on the number of reversal and sequencing errors in reading. The revision included the deletion of five out of 48 words and the addition of 17 words, to a total of 60 monosyllable words (McLeod, 1988).

The testing of individual students began on June 13, 1988. The test was administered individually in a quiet room in each school. Each student was seated opposite from the researcher. The student orally read the words from the test and the exact pronunciations of the words were transcribed onto the student response sheets. The testing of individual students concluded on June 22, 1988.
The Findings

Frequency counts of error scores were taken for each student. To test the three hypotheses which were initially posed, a three-way analysis of variance was used. This ANOVA (2x2x2) measured the effects of gender, age, and linguality in Cree and/or English, on the incidence of reversal and sequencing errors in reading. No significant difference in reversal and sequencing errors in reading was found between male and female Native students (Hypothesis 1). With regard to Hypothesis 2, a significantly greater number of errors were made by students aged 7/8 years than by those aged 9/10 years. The younger group made more reversal and sequencing errors in reading than did the older group. There was no significantly greater number of reversal and sequencing errors in reading made by bilingual Cree-English Native students than by English dominant Native students (Hypothesis 3).

Since the three-way ANOVA revealed that reversal and sequencing errors in reading had virtually disappeared for the 9/10 year old group, a two-way analysis of variance was conducted on the 7/8 year old group only, testing the effects of gender and linguality in Cree and/or English on the incidence of reversals and sequencing errors in reading. Neither gender nor linguality was found to have a significant
effect on the number of error scores. The bilingual Cree-English group tended to make more reversal and sequencing errors than did the English dominant group but not at the level of significance. Since there was no difference found between the error scores of male and female students, they were combined for a further test of differences between the two linguistic groups. A one-way analysis of variance was employed to measure the effects of linguality in Cree and/or English on the incidence of reversal and sequencing errors. The bilingual Cree-English group tended to make more reversal and sequencing errors in reading than did the English dominant group, but again the difference was not statistically significant.

In light of the observation made that the difference that there was between the linguistic groups was almost entirely due to reversal differences, a final one-way analysis of variance was employed in order to measure the effects of linguality on reversal errors independently from sequencing errors. While the difference between the English dominant and bilingual Cree-English in reversal errors was not statistically significant, again, the bilingual Cree-English group tended to make more reversal errors than did the English dominant group.
Summary of Findings Related to the Hypotheses

Hypothesis 1

The first hypothesis stated that there would be no significant difference in the incidence of reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words between male and female Native students.

Hypothesis 1 was tested by the three-way analysis of variance. There was no difference found at the 0.05 level of significance when the data were analyzed; therefore, Hypothesis 1 was accepted. This finding indicated that there was no significant difference between the number of reversal and sequencing errors in reading made by male and female Native students.

Hypothesis 2

The second hypothesis stated that there would be significantly more reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words by Native students aged 7/8 years than by Native students aged 9/10 years.

The three-way ANOVA was used to test Hypothesis 2 at the 0.05 level of significance. There was a significant difference found when the data were analyzed and this difference was in the direction of more such er-
rors in reading being made by the 7/8 year olds. Therefore, Hypothesis 2 was accepted. This finding indicated that there were a greater number of reversal and sequencing errors in reading made by Native students aged 7/8 years old than by Native students aged 9/10 years old; this difference was well beyond the 0.05 level of statistical significance, with the 7/8 year olds making more reversal and sequencing errors than the 9/10 year olds. Because a significant difference was found between the two age groups and errors had virtually disappeared in the 9/10 years age group, further analyses were performed on the 7/8 years age group independent of the 9/10 years age group.

Hypothesis 3

The third hypothesis stated that there would be significantly more reversal and sequencing errors in reading as measured by a revised version of the Test of Directional Attack on Words by bilingual Cree-English Native students than by English dominant Native students.

Hypothesis 3 was tested by the three-way ANOVA. There was no significantly greater number of errors made by the bilingual Cree-English group; therefore, Hypothesis 3 was rejected. This finding indicated that there was no difference between the number of reversal
and sequencing errors in reading made by English dominant and bilingual Cree-English Native students. The finding held up when a one-way analysis of variance was performed on the combined male and female group of 7/8 year olds and when a one-way analysis of variance was performed to test for the number of reversal errors only (i.e., independent of sequencing errors) on this same collapsed group.

Conclusions and Discussion

This study investigated the effects of gender, age and linguality on the number of reversal and sequencing errors made in reading by elementary Native students at Onion Lake, Saskatchewan-Alberta. It was concluded that age was related to the number of errors which students made, but neither gender nor linguality affected the incidence of errors.

The finding that younger students in the sample made more errors than the older group was consistent with the literature on reading reversals (Davidson, 1934; Tinker, 1968). Ilg and Ames (1950) found that single letter and whole-word reversals were common at the age of seven but that children aged eight years made very few reversals of single letters or letters within words and children aged nine did not reverse
single letters. Frank (cited in Vernon, 1957) found letter confusions to be common in children aged six to seven years. Wilson and Fleming (cited in Vernon, 1957) and Schonell (1946) stated that the tendency to confuse letters persisted up to ages eight and nine.

The conclusion that gender did not effect number of reversal and sequencing errors was opposite that found by Davidson (1934) when boys were found to make more errors. However, Davidson found ambiguous results in a study the following year when she found no difference at the kindergarten level and more errors percentage-wise made by boys than girls in Grade 1.

While it must be concluded from the analyses of data in this study that there was no significant difference in the number of reversal and sequencing errors made between English dominant and bilingual Cree-English Native students, the observation that the bilingual Cree-English students made more reversal and sequencing errors in reading than did the English dominant students in all of the statistical tests conducted is noteworthy. Examination of statistical tables reveal that if the difference between group means obtained in this study were maintained, a larger sample may have produced a main effect (statistical significance) for linguality. For example, with regard to the 7/8 year age group, in order for statistical
significance at the 0.05 level to be achieved for the effect of linguality on reversal and sequencing errors in reading, a sample of at least 32 subjects in each category (English and Cree-English) would be necessary. For a comparable test regarding reversal errors only, a sample of at least 23 would be needed. If a larger sample such as the one originally proposed in this study (N=159) had been utilized, then the differences between the linguistic groups may have been statistically significantly different. The conclusion regarding the effect of linguality on the number of reversal and sequencing errors in reading, then, is better conceived as there being no effect for linguality in this study but the results being sufficient to suggest that a more comprehensive follow-up study might reveal a main effect for linguality.

An effect for linguality would be consistent with Wagner's (1976) finding that reversals may be present in reading by bilingual children. It is possible that Cree language interference in the pronunciations of words as discussed by Toohey (1985) may have played a role for the bilingual Cree-English students. Toohey stated that bilinguals substitute sounds from their original language into their acquired language. Sealey and Kirkness (1973) also suggest the concept of sound substitutions for Cree speakers. Lacking in Cree
language are the sounds for "b", "d", "f", "j", "q", "v", and "x". It is possible that the bilingual Cree-English group may have used sounds from the Cree language to pronounce words in the test. The sound "b" in words may have caused difficulties for the bilingual Cree-English students. The letter "b" in words like "big", "bad", "but", "bed", "boy", "job", "tub", and "dab" may have been substituted by the letter "p".

Since voicing in Cree does not relate to a change in meaning, there may have been confusion between English word pairs as "pots" and "bots", "put" and "but", "top" and "tob" and "stop" and "stob" which may account for more errors for the bilingual Cree-English students. The sounds used in the Cree language may have influenced the reading of words in the test.

Since the letter "w" is used in the Cree language, words like "now" may have been read as "won", "how" for "who", "raw" for "war" and "saw" for "was."

It is possible that the bilingual Cree-English students were influenced by the languages spoken by their parents. If the Cree language is predominant in the home or spoken fluently by the parents, the bilingual Cree-English students could be influenced by the sound substitutions made by the parents. These substitutions could then be transferred to reading the words in the test.
As previously reported, the English dominant students made fewer reversal and sequencing errors in reading than did the bilingual Cree-English students. The English dominant students possibly made fewer errors due to greater fluency in the English language. If English is the first language, it is possible that there would be no influence for sound substitutions, nor problems in variations of voiced and unvoiced sounds.

The language background of young Native students, then, may be an important consideration for teachers of such students, especially in terms of teaching and assessing reading skills. A firm background in the sounds of the Cree language would seem essential for teachers working with young Native students, especially teachers engaged in reading remediation situations or in diagnosis of reading problems of bilingual Cree-English students. Furthermore, teacher-training programs which specialize in Indian and northern education should incorporate coursework in Native languages as they impact reading skills of young bilingual children. Possible linkages between reversal and sequencing errors in reading and Cree-English bilinguality merit further consideration among researchers, teachers and teachers-in-training who are concerned with the education of Native students.
Recommendations

The recommendations for this study are twofold: for further research and for educators.

1. It is recommended that further research be conducted on bilingual Cree-English and English dominant students in relation to the incidence of reversal and sequencing errors in reading.

2. It is recommended that this study be replicated with a larger sample and with an inbuilt reliability check on the test instrument. It is possible that with a larger sample, a significant difference would be found between the number of errors made by English dominant and bilingual Cree-English students.

3. It is recommended that further research be conducted on the relationship between the structure of Cree language and reading ability of bilingual Cree-English students.

4. It is recommended that educators be made aware that reversal and sequencing errors in reading may contribute to the reading problems of Native students, especially at the 7/8 year age level. This awareness could be generated through in-service training for teachers of Native students and through teacher-training programs' inclusion of coursework on Native
languages, especially as they impact reading skills of bilingual students.

5. It is recommended that educator's plan remediation activities for those students who continue to make reversal and sequencing errors in reading and that they take into account the possible effect of bilinguality.
REFERENCES


Onion Lake Tribal Administration. (n.d.). Onion lake band atlas, Seekaskootch and Makajo.


Soveron, M. (1964) From Cree to English. part one: The sound system. Saskatoon, Saskatchewan: University of Saskatchewan.


APPENDICES
APPENDIX A

Student Rating for Facility in Cree, Ages 7 to 8

[Rating Scale identical for ages 9 to 10]
Figure 1

Student Rating for Facility in Cree, Ages 7 to 8.

APPENDIX B

Student Rating for Facility in English, Ages 7 to 8

[Rating Scale identical for ages 9 to 10]
Figure 2

Student Rating for Facility in English, Ages 7 to 8
APPENDIX C

Instructor Scale for Rating Students' Facility
In Cree and English
Instructor Scale for Rating Students' Facility in Cree and English

1. First rate all the students in the class for facility in Cree (i.e., ability to use in conversation, preferred language, etc.)

2. After rating all the class, then rate the same students for facility in English.

The students should be rated on a 5-point scale, from A to E. The most effective method of rating the students is as follows:

1. Pick out all the As. Do this by selecting the best 5% (e.g., 3 out of a class of 50). It does not matter greatly if you pick only 2, or if you pick 4 or 5, but try to keep to approximately 5% of the total.

2. Pick out all the Es. Again pick 5%, or near 5% — this time the ones with the poorest facility in the language being rated.

3. Next pick out the Bs. These should be the next best 20% (e.g., 6 out of a class of 30) after the ones who have already been identified as As.

4. Select the Ds. These are the poorest 20% of those remaining after the Es have been eliminated.

5. The rest of the groups will make up the C ratings.
APPENDIX D

Test of Directional Attack on Words
**Test of Directional Attack on Words**

The list of words is as follows [Note. From Diagnostic and Attainment Testing (p.66) by F.J. Schonell & F.E. Schonell, 1954, Edinburgh: Oliver and Boyd Limited]:

<table>
<thead>
<tr>
<th>bed</th>
<th>pot</th>
<th>sad</th>
<th>who</th>
</tr>
</thead>
<tbody>
<tr>
<td>dig</td>
<td>pit</td>
<td>put</td>
<td>now</td>
</tr>
<tr>
<td>bad</td>
<td>top</td>
<td>stop</td>
<td>whose</td>
</tr>
<tr>
<td>boy</td>
<td>got</td>
<td>lap</td>
<td>how</td>
</tr>
<tr>
<td>of</td>
<td>on</td>
<td>rag</td>
<td>saw</td>
</tr>
<tr>
<td>for</td>
<td>to</td>
<td>gas</td>
<td>wash</td>
</tr>
<tr>
<td>from</td>
<td>dog</td>
<td>push</td>
<td>was</td>
</tr>
<tr>
<td>ton</td>
<td>no</td>
<td>what</td>
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<tr>
<td>men</td>
<td>job</td>
<td>every</td>
<td>pig</td>
</tr>
<tr>
<td>new</td>
<td>do</td>
<td>yes</td>
<td>quite</td>
</tr>
<tr>
<td>wet</td>
<td>tub</td>
<td>very</td>
<td>leap</td>
</tr>
<tr>
<td>tar</td>
<td>sit</td>
<td>never</td>
<td>felt</td>
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</tbody>
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APPENDIX E

Revised Version of the

Test of Directional Attack on Words
Revised Version of Test of Directional Attack on Words

<table>
<thead>
<tr>
<th>big</th>
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<th>on</th>
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<td>how</td>
<td>do</td>
<td>sit</td>
</tr>
<tr>
<td>wash</td>
<td>dig</td>
<td>dab</td>
<td>lap</td>
<td>of</td>
</tr>
<tr>
<td>god</td>
<td>sad</td>
<td>raw</td>
<td>saw</td>
<td>to</td>
</tr>
<tr>
<td>row</td>
<td>no</td>
<td>tub</td>
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<td>from</td>
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<td>dog</td>
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<td>left</td>
<td>very</td>
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<tr>
<td>show</td>
<td>peal</td>
<td>job</td>
<td>war</td>
<td>for</td>
</tr>
<tr>
<td>pot</td>
<td>wet</td>
<td>but</td>
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APPENDIX F

Student Test Response Sheet
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<td>pot</td>
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<td>but</td>
<td>won</td>
<td>boy</td>
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</table>
APPENDIX G

Letter of Permission
May 20, 1988

Ms. Shirley Mentuck

Please be advised that the Education Authority of the Onion Lake Band have given their approval for you to conduct research with our 7 - 10 year olds. We anticipate many benefits from your study of reversal problems. The schools and the teachers involved will be notified and will give you every cooperation and assistance.

We are looking forward to receiving a copy of your results and we wish you every success in your studies

Sincerely,

Pat Dillon
Chairman
APPENDIX H

Error Scores for Study Sample, Ages 7 to 8
Error Scores for Study Sample, Ages 7 to 8

### English Dominant

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**Group Totals** 23 11 34

### Bilingual Cree-English

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**Group Totals** 24 21 45