A Study of Hemispheric Preference As It Relates to Reading and Recalling Nonsense Words from a Card Reader

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A STUDY OF HEMISPHERIC PREFERENCE AS IT RELATES TO READING AND RECALLING NONSENSE WORDS FROM A CARD READER

Andrews University

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School of Education

A STUDY OF HEMISPHERIC PREFERENCE AS IT RELATES TO READING AND RECALLING NONSENSE WORDS FROM A CARD READER

A Dissertation
Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy

by
Charlotte V. Groff
March 1986
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A dissertation presented in partial fulfillment of the requirements for the degree Doctor of Philosophy

by

Charlotte V. Groff

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ABSTRACT

A STUDY OF HEMISPHERIC PREFERENCE AS IT RELATES TO READING AND RECALLING NONSENSE WORDS FROM A CARD READER

by

Charlotte V. Groff

Chairman: Robert D. Moon, Jr.
Title: A STUDY OF HEMISPHERIC PREFERENCE AS IT RELATES TO READING AND RECALLING NONSENSE WORDS FROM A CARD READER

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Date completed: March 26, 1986

Problem

Information was not found in the literature concerning whether an individual, beginning reader or problem reader, consistently recalled a greater percentage of nonsense words attempted from a card reader with the right ear and right visual field (a Left Hemisphere Method), or with the left ear and left visual field (a Right Hemisphere Method), and whether one of these two methods
achieved better results than using both eyes and both ears (the Both Hemispheres Method).

Method

This pilot study employed case study/clinical, formative methodology with eighteen boys and nine girls, ages 6-12 in preschool through grade four. The probability theory, based on the binomial distribution, was used to analyze whether any child, in six sessions, consistently recalled more words with the Left or the Right Hemispheric Method, and thus inferred a hemispheric preference. A chi-square was used to analyze whether a significant difference existed between the problem readers who were classified by their schools as making adequate progress, with a trend toward one hemispheric method, versus problem readers classified as making poor progress.

Careful observations made during the testing sessions offered educational insights.

Results

Two out of twenty-seven children recalled more words with the Left Method in all six sessions and were found to have a significant preference. None consistently preferred the Right Method.
Of twenty problem readers older than six, ten showed no trend toward either the Left or Right Methods—they were the poor readers. The other ten, who were making adequate progress, showed a trend toward one method.

Conclusion

Readers older than six may need a trend toward the Left or Right Hemispheric Method in order to make adequate progress. If so, readers without a trend may need help to develop a lead hemisphere.

Selected Observations

Multiple testings showed considerable daily variation in some subjects. This variation suggests that one day of testing may not adequately measure the way a child learns.

Excellent readers, when confronted with words written in a symbol-alphabet, behaved like poor readers. However, they began developing a phonetic structure. Such behavior suggests all readers may need to acquire a phonetic system to read well.
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CHAPTER I

INTRODUCTION

Background of the Study

When helping young children learn to read, teachers often drill their pupils on flash cards to increase the children's word recognition. In recent years, mechanical devices such as Califone Card Readers or Bell and Howell Language Masters allow the children to drill themselves on new words. Many children in first grade use these machines to learn "sight words," words which are recognized when seen, without having to be sounded out phonetically. Each word card has the word written at the top and recorded on magnetic tape at the bottom. The children place their cards into the card reader, look at the printed words, and listen to them being spoken through earphones on a headset. When the teacher is available, they read the cards aloud to demonstrate that they have learned the sight words. This procedure is a usual method for using card readers. Seemingly, no one has tested or questioned whether or not it is the best way to teach all beginning readers or problem readers who are receiving
remedial instruction in reading. Card readers simultaneously
direct stimuli to both the ears and eyes for memory and recall
of words. However, many researchers have focused only on
auditory or visual stimuli for recall.

Numerous studies (Ayres, 1977; Bakker & Van Rijnsoever,
1977; Berlin, Hughes, Lowe-Bell, & Berlin, 1973; Curcio,
Rosen, & MacKavey, 1976; Curry & Gregory, 1969; Geffner &
Hochberg, 1971; Hiscock & Kinsbourne, 1977; Hiscock,
Kinsbourne, Caplan, & Swanson, 1979; Hynd, Obruzut, & Weed,
1979; Kimura, 1961a, b, 1973); Lowe, Cullen, Berlin, Thompson,
& Willett, 1970; Mercure & Warren, 1978; Nagafuchi, 1970;
Safer & Leventhal, 1977; Varga-Khadem, Genesee, Seitz, &
Lambert, 1977; Yeni-Komshian, Isenberg, & Goldberg, 1975; and
others) indicated that a majority of the people tested had a
right-ear advantage (REA). An REA was determined by a
dichotic listening test which sent a different numeral or
syllable to each ear simultaneously through stereo earphones.
During recall, if the subject remembered a larger number of
the sounds presented to the right ear than to the left, an REA
was found to exist.

Similar studies (Bryden, 1965, 1973; Kimura, 1966;
MacKavey, Curcio, & Rosen, 1975; McKeever, 1977; McKeever &
Huling, 1970; and others) found that a right visual field
(RVF) was desirable for recalling single letters and words.
According to the illustrations of several authors (Groves &
an RVF was the nasal portion of the left eye's lens and the outer portion of the right eye's lens, or in other words, the part of each eye which sent stimuli to the left hemisphere of the brain. Kimura (1966, 1973) said that the speech center was usually found in this left hemisphere and that the right ear and right visual field had direct pathways to the left hemisphere. These pathways facilitated verbal input going quickly to the speech area.

The experiments noted above tested either the recall of letters or words on a tachistoscopic viewing test, where two different symbols were flashed simultaneously to the two visual fields to see which hemisphere recalled the most, or the experiments tested the recall of sounds on a dichotic listening test which, as previously noted, sent different sounds simultaneously to the two ears to learn which hemisphere recalled the best. Although these experiments were repeated often, no one seemed to ask if an individual recalled more sight words from flash cards when stimuli were directed to the left hemisphere, to the right hemisphere, or to both.

Bakker (1973) found that beginning readers used perceptual configuration to determine words, and Fries (1962) said the first step toward reading was distinguishing and recognizing shapes. Bakker (1979) found that children who were the best readers in fifth grade had a left ear advantage (LEA) in kindergarten. He equated an LEA with "Right Hemisphere Dominance" and a right ear advantage (REA) with
"Left Hemisphere Dominance" (p. 89). Thus, Bakker inferred that children with an LEA in kindergarten may have used right hemisphere strategies for word recognition in first grade. He found that these same best fifth-grade readers had shifted toward the end of their first-grade year to an REA (left hemisphere dominance). By inference, Bakker suggested that the best fifth-grade readers shifted from right hemisphere to left hemisphere learning strategies.

Sobotka, Black, Hill, and Porter (1977) observed that the Bender-Gestalt Test was a good predictor of reading ability up to age seven or eight. After that, reading ability was best predicted by problem solving and reasoning skills which the perceptual Bender-Gestalt Test did not measure. Possibly, perception and visual-motor skills were valid measures of reading ability only for young children. Did the fact that a perceptual test stopped predicting reading ability about age eight indicate that a shift toward reasoning skills and the left hemisphere had taken place? If so, the shift from perception to reasoning (right hemisphere to left hemisphere) might be similar to the shift Bakker found in ear dominance from the left ear to the right. Possibly both the LEA and the visual-spatial perception had shifted to left hemisphere functions.

Dorothy van den Honert (1977, 1983) developed a new method of reading instruction for her dyslexic (defective reading) students. She sent phonics to the right ear and
music to the left. At the same time, she presented phonetic words to the left eye and covered the right eye with special glasses. Later she discovered that the glasses she used were wrong, for they permitted a visual signal to go to each hemisphere simultaneously. It was possible that, because she used a narrow column of reading, and because the left eye saw it near the center of the right visual field, this procedure might have strengthened the signals to the left hemisphere as compared to the right. Theoretically, she should have covered the left visual field (the nasal portion of the right eye and the outer portion of the left eye---that portion of sight from each eye which goes directly to the right hemisphere).

Perhaps her experiment succeeded because she did strengthen the signals to the left hemisphere, or perhaps it succeeded in spite of her mistake of covering the whole eye, or possibly, as Sinatra and Stahl-Gemake (1983) suggested, her covering of one eye prevented competition from the other eye, and thus sent only one clear, visual image to each hemisphere. These authors noted that her procedure was the same one which "many pediatricians do to strengthen the eye teamwork of young children" (p. 32). In any case, her junior high students made two to three years' progress in one year under her method.

It was possible that the "novelty" of the procedure, which Sinatra and Stahl-Gemake (1983, p. 32) pointed out, was partly responsible for her students' success. Cook (1969) explained that the Hawthorne effect was present when the
subjects were aware of some special treatment. It tended to cause them to do their very best under all experimental conditions, and thus interfered with the results. To what degree van den Honert's pupils improved because they were receiving special, experimental attention was impossible to determine.

When one specific child could not learn through the left eye, van den Honert taught her through the right, and the child learned to read at grade level. No further reference to the left eye or left visual field (LVF) appeared in van den Honert's writing. A. J. Harris (1979) hailed the van den Honert treatment as "a striking new development" which "deserves replication under carefully controlled conditions" (p. 62). Such controlled conditions might examine what happens when stimuli is strengthened to the left hemisphere, is strengthened to the right hemisphere, and is sent in the usual way to both hemispheres.

Beginning readers might use their right hemispheres, or both hemispheres, for reading until nearly the end of first grade, at which time they might shift to their left hemispheres. It appeared, however, that no one had tested whether one individual, beginning reader or problem reader, consistently recalled a greater percentage of nonsense words attempted from a card reader (1) with the Left Hemisphere Method (LHM), a method which was theoretically designed primarily to direct visual and auditory word-stimuli to the
left hemisphere, or (2) with the Right Hemisphere Method (RHM), a method which was theoretically designed primarily to direct visual and auditory word-stimuli to the right hemisphere, and whether one of these two methods achieved better results than (3) the usual way in which both eyes and both ears send stimuli simultaneously to both hemispheres, the Both Hemispheres Method (BHM).

Statement of the Problem

The problem this study initially addressed was a lack of information concerning whether one individual, beginning reader or problem reader, consistently recalled a greater percentage of nonsense words attempted from a card reader (1) with the LHM, involving the right ear and right visual field, or (2) with the RHM, involving the left ear and left visual field, and whether one of these two methods achieved better results than (3) the BHM, involving both eyes and both ears.

As the research progressed, a secondary problem which was not originally considered was recognized and analyzed. This problem was: no information could be found concerning whether some observable differences that might be attributed to hemispheric processing existed between those poor readers who with remedial instruction were making adequate reading progress versus those poor readers who with remedial instruction were not making adequate reading progress. It
should be noted that this secondary problem is more general than the initial problem. The literature reviewed had considerable information about left hemisphere versus right hemisphere processing; however, the literature lacked information concerning what effect ambivalence, or a failure to have a trend toward either hemisphere, might have on recalling words.

**Purpose of the Study**

The original purpose of the study was to examine what has been stated as the initial problem: a lack of information concerning whether one individual, beginning reader or problem reader, consistently recalled a greater percentage of nonsense words attempted from a card reader with the LHM or with the RHM and whether one of those two methods achieved better results than the usual BHM provided.

As the study progressed, the purpose was expanded to study the more generalized problem: a lack of information concerning whether some observable differences that might be attributed to hemispheric processing existed between those poor readers who with remedial instruction were making adequate reading progress versus those poor readers who with remedial instruction were not making adequate reading progress.
Significance of the Study

The significance of this study is to learn if for an individual student the LHM or RHM consistently recalled a greater percentage of words attempted from a card reader and if either one of these methods achieved better results than the BHM, or whether the student showed little or no trend toward either hemispheric method. Results of this type of testing might help a teacher choose a learning method or style which will work best for a problem reader. Such results could suggest using methods which emphasize the left hemisphere, which emphasize the right hemisphere, or which teach in the usual way and send stimuli to both hemispheres simultaneously.

Definition of Terms

The terms used in this study are not presented in alphabetical order because the understanding of one term is dependent upon the understanding of the terms which preceded it.

Sight Words. As used in this paper, sight words are words which were recognized upon sight without being sounded out phonetically.

Learning Style. A learning style consists of the approaches or methods which an individual chooses to facilitate his/her learning.

Left/Right Hemispheres. The hemispheres are the two
halves of the human brain. Research supports that for most individuals the left side of the brain has the speech center and is best for processing verbal information; while the right side is usually superior for processing visual-spatial information.

Right Visual Field (RVF). As used in this study, the right visual field, or half-field, was the visual information on the right side of the viewer which entered through the right half of each eye's lens and went to the left hemisphere of the brain.

Left Visual Field (LVF). As used in this study, the left visual field, or half-field, was the visual information on the left side of the viewer which entered through the left half of each eye's lens and went to the right hemisphere of the brain.

Visual Half-Field Test. The visual half-field test was to determine the dominant visual field, or half-field. The person looked at a dot while different numerals were flashed rapidly through a device called a tachistoscope to the left and right of the fixation point. The observer told which numeral he/she saw, and the visual field or half-field with the greatest number of recalled numerals was considered dominant.

Tachistoscopic Viewing Test. As used in this study, a Tachistoscopic Viewing Test was another name for a Visual
Half-Field Test. It derived its name from the use of the tachistoscope.

Dichotic Listening Test. The dichotic listening test was to determine the dominant ear. Two different sounds were presented simultaneously to each ear through stereo earphones, and the person indicated which sound he/she heard. The ear with the greatest number of recognized sounds was considered dominant.

Right-Ear Advantage (REA). A right-ear advantage meant that the hearer correctly recalled more sounds sent to the right ear than to the left ear in a dichotic listening test.

Left-Ear Advantage (LEA). A left-ear advantage meant that the hearer correctly recalled more sounds sent to the left ear than to the right ear in a dichotic listening test.

Left Hemisphere Method (LHM). As used in this study, the Left Hemisphere Method required that the frames from special glasses should cover the non-dominant sighting eye and the left visual field of the dominant eye while the left ear heard rhythmic, orchestral music through one stereo earphone. At the same time, the right visual field of the dominant eye saw the nonsense word on the card in the card-reading machine and the right ear heard that word spoken through the other earphone. Theoretically, the LHM sent words to the left hemisphere.

Right Hemisphere Method (RHM). The Right Hemisphere Method, as used in this study, required that the frames from
special glasses should cover the non-dominant sighting eye and
the right visual field of the dominant eye while the right ear
heard rhythmic, orchestral music through one stereo earphone.
At the same time, the left visual field of the dominant eye
saw the nonsense word on the card in the card-reading machine
and the left ear heard that word spoken through the other
earphone. Theoretically, the RHM sent words to the right
hemisphere.

**Both Hemispheres Method (BHM).** As used in this study,
the Both Hemispheres Method used a card reader in the normal
way. The child saw the word with both eyes and heard it
through stereo earphones with both ears. The BHM sent words
to both hemispheres.

**Preferred Hemispheric Method.** As used in this study,
the preferred hemispheric method was a method for which a
subject showed a statistically significant preference.

**Hemispheric Trend.** A hemispheric trend, as used in
this study, meant that the subject failed to have a
statistically significant preference for either the LHM or
RHM, but did recall more words with one method than with the
other.

**Hemispheric Ambivalency.** As used in this study,
hemispheric ambivalency meant that the subject failed to show
a trend toward either hemisphere. The number of words
recalled by the LHM and RHM were equal.

**Problem Reader.** A problem reader was a child who was
having difficulty learning to read and who was receiving remedial instruction from a reading specialist either in school or at a reading clinic.

**Contralateral Pathways.** Contralateral pathways were the sensory routes which conducted sight from an eye or sound from an ear to the hemisphere on the opposite side of the brain.

**Ipsilateral Pathways.** Ipsilateral pathways were the sensory routes which conducted sight from an eye or sound from an ear to the hemisphere on the same side of the brain.

**Instant Auditory Memory.** As used in this study, instant auditory memory was the memory which enabled the child instantly to mimic aloud a word he/she had just heard.

**Short-Term Auditory Memory.** Short-term auditory memory, as used in this study, was memory which enabled the child to recall a word after five words had been mimicked.

**Recalled Words.** As used in this study, recalled words were words which were read from word cards and which were pronounced the same as they were instantly mimicked.

**Repeated Words.** Repeated words, as used in this study, were the words a child mimicked when he/she used instant auditory memory.

**Laterality.** As used in this study, laterality was the consistent use of one side of the body, rather than the other side.

**Cerebral Dominance.** Cerebral dominance, according to
Vitale (1985), was the view that one hemisphere activated first and carried the major responsibility for learning within a whole-brain framework.

**Assumptions**

Among many possible assumptions, this study concerned itself with only four. First, for practical purposes, it was assumed that children could learn to read words from a card reader if the words were seen, heard, mimicked, and read aloud to an examiner three times during a ten-minute testing session. Second, it was assumed that both hemispheres of an individual's brain had equal opportunity to be influenced by all the experiences of that person; thus, any differences in the way the two hemispheres learned would not be caused by external factors. Third, it was assumed that the sets of word cards in the measuring instrument were of equal difficulty, or if not, could be controlled for by design. Fourth, based upon the theories in the literature, it was assumed that the LHM could be designed to send stronger signals to the left hemisphere than to the right and that the RHM could be designed to send stronger signals to the right hemisphere than to the left.
Limitations and Delimitations

Since this research was a pilot case study of formative design based on the theory of Bloom, Hastings, and Madaus (1971), the methodology had low generalizability about populations. Instead, it focused on individuals and on obtaining information from which future, experimental hypotheses could be formed. Primarily, the subjects were limited to beginning readers or problem readers.

Outline of the Study

This study contains five chapters. Chapter 1 is an introduction which includes the background of the study, the purpose and the significance, the definition of the terms, the assumptions, and the limitations and delimitations. Chapter 2 contains the review of literature. The methodology used in the study appears in chapter 3. The findings concerning the test results and a discussion of the case studies are presented in chapter 4, while the summary, conclusion, inferences, and recommendations appear in chapter 5.
CHAPTER II

II. REVIEW OF LITERATURE

By using dichotic listening techniques, sending music to the left ear and reading instruction to the right, as well as an incomplete form of visual half-field methodology which screened the right eye, van den Honert (1977, 1983) found that the dyslexic students she was teaching made greater improvement with her method (which she said directed the stimuli to the left hemisphere) than with the other methods she had used previously. There was no indication that she had studied how her method might compare to one which directed stimuli to the right hemisphere. This research attempted to determine, through case studies, if an individual child recalled nonsense words better from a card reader when using a method which strengthened stimuli to the left hemisphere versus a method which strengthened stimuli to the right hemisphere, or if the child showed no trend toward either hemispheric method. It also attempted to determine if the child achieved better results with either method than with using both eyes and both ears in the normal way. A review of
the literature on the functioning of the two hemispheres might help to clarify their work.

"Laterality and Cerebral Dominance," the first section of this review, defines the terms, discusses the methods of determining the speech center, considers the various views of hemispheric dominance, discusses whether or not laterality increases with age, notes any sex differences in dominance, and examines the reading ability of both hemispheres. "Dichotic Listening," the second section of the review, notes how dichotic listening was used in this study, considers it as a measure of cerebral dominance, reviews the theory of the contralateral pathways, notes some methods used in dichotic listening tests, mentions any sex differences, and discusses right- and left-ear advantages. "Visual Half-Field Testing," the third section, notes the use of special glasses in this study and discusses the work of the two visual fields—faster form recognition by the LVF if the shapes are complex or unknown, and faster recall by the RVF if they are simple or familiar. "Learning and Memory," section four, explains the terms, mentions short- and long-term memory, notes Osgood's transfer of training, and discusses the phenomena of proactive and retroactive interference. Finally, section five, "The Hemispheres and Reading," reviews the need for using both hemispheres when learning to read (the right hemisphere for beginning reading, and the left hemisphere for advanced thinking), the shift toward the left hemisphere between ages 5
and 7, any sex differences in reading, a bisensory (auditory-visual) teaching method involving both dichotic listening and the visual half-fields (a technique which this study also used), and the use of "card readers" in other studies to ascertain whether this research project makes an original contribution to the field.

Laterality and Cerebral Dominance

A review of the research on laterality and cerebral dominance as it relates to the brain's speech center was appropriate for the introductory section of this study. The review attempted to learn if the literature suggested that the two hemispheres were exactly alike, or if one hemisphere were dominant for language. It also noted at what age dominance appeared. The research on cerebral dominance might have a bearing on any differences noted in recalling words.

Cerebral dominance was the idea that one hemisphere, frequently the left, ruled the other. Although such a view ignored the importance of the minor hemisphere, it is still currently quoted, according to Springer and Deutsch (1981). Leong (1980, p. 186) defined laterality as the consistent use of one side of the body. Thus, one side was preferred or dominant. Vitale (1985) defined dominance as "the hemisphere, or area of the brain, that activates first and handles the largest percentage of responsibility for a given task within a
whole-brain process." Sinatra and Stahl-Gemake (1983) thought that "cooperation rather than competition between the hemispheres seems to be the situation prevailing under most conditions" (p. 30).

Galaburda, LeMay, Kemper, and Geschwind (1978) observed that the left hemisphere of the brain was usually larger than the right. When one hemisphere is larger than the other, the brain is asymmetrical. Geschwind (1970, pp. 941, 944) reported that the enlargement in the left hemisphere appeared in Wernicke's area which was important to language and was thought to involve the comprehension of speech. Brain asymmetry seemed to be peculiar to man. Warren (1977, p. 278) observed that animals, except for the chimpanzee, did not have asymmetrical brains, while Geschwind (1970, p. 944) said that man was the only mammal with cerebral dominance.

Historically, Broca was the first to say that speech was located in the hemisphere opposite to the preferred hand (McNeil & Hamre, 1974, p. 376). Research by Kimura (1961a, 1966) did not support Broca's view. Rather, she found that the speech center of the brain was located in the hemisphere opposite the dominant ear.

The location of the brain's speech center was determined by the Wada test in which sodium amytal was injected into the carotid artery, according to Geschwind (1970). Speech ceased briefly if it were centered in the anesthetized lobe. McNeil and Hamre (1974) explained that the
risks of puncturing the carotid artery and the use of drugs reserved this method for medical patients only. It was necessary to find a safer test to determine the location of the speech center in normal persons.

Among the researchers who said that language was in both hemispheres were Molfese, Freeman, and Palmero (1975, p. 366). They observed that infants with left-brain damage learned speech with little loss—and even victims of left-brain strokes often relearned it. These researchers also noted that some portions of the brain were pre-programmed for speech before birth, and some speech perception was in the left hemispheres of pre-verbal infants. Likewise, non-speech sounds were lateralized to the right hemisphere. L. J. Harris (1973) suggested that infants might have right hemisphere dominance, while Gazzaniga (1967, p. 28) said that both hemispheres handled language about equally well until the child was four years old. Although adults had some language perception in the right hemisphere, it could not compare with the amount present in children. Maturation might inhibit the right hemisphere and permit the left to become dominant for language. Weingarten and Anisfeld (1981) found that younger children, aged 6-7, identified less complex word-relationships than older ones, aged 9-10. They surmised that a comprehension shift had taken place after age 7. Pines (1973, p. 47) believed that speech dominance was complete by the age of 10, while Bakker (1973, p. 17) suggested that for beginning
reading a child might profit from a bilateral hemisphere functioning. Other authors who also thought that both hemispheres were involved in reading were Kershner (1975), Yeni-Komshian et al. (1975), Gordon and Carmon (1976), Obuzut (1979), and Levy (1983). Since "learning to read means developing a considerable range of high-speed recognition responses to specific sets of patterns of graphic shapes" (Fries, 1962, pp. xv, 127), the first step in learning reading was learning to differentiate and to recognize those shapes. Miller and Turner (1973) noted that "younger children process words in a letter by letter fashion" (p. 175), while Carmon, Nashon, and Starinsky (1976, pp. 466-8) added that first graders have a left visual-field superiority for processing single letters. They suggested that verbal material in first grade might be processed as nonverbal configurations in the right hemisphere. Later, when the material was practiced, it would be processed in the left hemisphere. Mackworth (1976, p. 621) and Kershner (1975, pp. 274-5) both noted the importance of the right hemisphere for recognition of shapes; while Cashford (1979) added that the right hemisphere could use some words, but those words were not organized like traditional language.

The question of whether or not laterality increased with age produced conflicting reports. Miller (1981) said that it did increase, while Spellacy and Blumstein (1970, p. 354) found that it increased in the area of verbal sound as it
decreased in the area of musical sound, and vice versa. Likewise, Williams, Keough, Fisher, Seymour, and Tanner (1980, p. 1187) said that normal 6-year-olds, either right- or left-handed, used both hemispheres for verbal and spatial processing. In an opposite view, Carter and Kinsbourne (1979, p. 244) found no proof of progressive lateralization as a child grew older. They concluded that lateralization was complete by age 5.

Left-handed persons composed 5 percent of the total population, according to Ornstein (1973, p. 87). The problem of "handedness" invariably arose when lateralization was investigated. Although some researchers tried to predict the dominant hemisphere as opposite to the preferred hand, Bryden (1965, p. 2) and Yeni-Komshian et al. (1975, p. 83) noted that the preferred hand was not a good predictor of cerebral dominance in non-right-handed persons. Orton (1937) felt that children who made reversals often lacked a consistently preferred hand. He also thought each hemisphere mirrored the other so that "cat" in one had the letters backward in the other. His observations led him to suggest that a lack of hand preference and incomplete brain dominance were related. Springer and Deutsch (1981) said Orton was wrong about the hemispheres mirroring each other and about the lack of handedness indicating incomplete brain dominance. They did agree that some children have incomplete dominance and said, "Orton may have been right, but for the wrong reasons" (p.
Orlando (1972, p. 15) found that right-handed persons were usually better with their right hands, but left-handed persons were inconsistent. This inconsistency of left-handed persons would make any prediction of their cerebral dominance as opposite to their preferred hand difficult, if not impossible, to determine. Likewise, A. J. Harris (1979, p. 339) found that cerebral dominance in left-handed individuals was uncertain. Of the group, 70 percent had speech centered in their left hemispheres, 15 percent had it in both hemispheres, and 15 percent had it in their right hemispheres. After extensive research, Holland (1973, p. 208) found no implications for connecting cerebral dominance with lateral dominance of the eyes, hands, or feet.

Newman, Freeman, and Holzinger (1937, p. 139) discussed "mirror-image correspondence" in a pair of identical twins. They noted that the right hand of one was very similar to the left hand of the other. However, each twin's own two hands were quite different. The authors did not elaborate on how this phenomenon might relate to other portions of the body.

Sex differences might affect speech lateralization and thus the whole reading process. Kimura (1973, p. 78) felt girls gained speech lateralization earlier than boys. In the early grades, boys learned best through their right hemispheres while girls learned best through their left, according to Kane and Kane (1979, p. 166). Brown (1946, p. 49) found that boys shifted toward right dominance (preferred
use of the left hemisphere) between Grades 2 and 6, while Coren, Porac, and Duncan (1981, p. 448) also noted a shift toward preference for the right side as the preschool child approached young adulthood.

Some light on the facility of the right hemisphere in learning words came from epileptic patients who had had a commissurotomy, an operation which cut the thick bundle of fibers called the corpus callosum that tied the left and right brain hemispheres together. Sperry (1964, 1975) found that these patients had comprehension of spoken and written language in both hemispheres, but to what relative extent in the right was unknown. Their right hemispheres gave few, if any, correct responses when stimulated at the same time as the left (Teng & Sperry, 1973, p. 135), although Gazzaniga (1967, p.26) found that they could pick out a pencil with their left hands from among unseen objects. Hardyck and Haapanen (1979, p. 223) cautioned that the patients' epilepsy in early childhood or damage from the operation might have influenced their ability to use either hemisphere; thus, the experiments could not be considered characteristic of normal people.

In summary, the literature suggested that cerebral dominance did exist. One side of the human brain was normally larger than the other side. That larger side, usually the left hemisphere, was thought to be the language center. Young children might have some language in both hemispheres and might shift toward the left hemisphere after age 7. This
bilaterality of young children might suggest that they learned to read first with their right hemispheres. They might recall more words learned through the left visual field and left ear than through the right; however, girls seemed to learn through their right ears and right visual fields earlier than boys. Although Hardyck and Haapanen (1979, p. 223) cautioned that problems of reliability and measurement made it difficult to determine the language center for a particular person, Kershner (1975), Yeni-Komshian et al. (1975), Mackworth (1976), and Bakker (1979) all agreed that the visual half-field and the dichotic listening tests were the accepted best methods for determining the dominant hemisphere.

**Dichotic Listening**

Since dichotic listening was one of the approved methods for determining the dominant brain hemisphere, and since the LHM and RHM testing of children who learned words on a card reader in this study, involved sending rhythmic, orchestral music to one ear and words to the other—a dichotic listening technique—a review of the literature concerning this measuring device was determined to be relevant. Broadbent (1952a, b, 1954) was the first to use dichotic listening. He sent simultaneous messages to each ear, and the subject told which message he/she heard. Subsequent dichotic listening tests sent conflicting digits or syllables.
simultaneously through earphones to both ears. Again the subject reported which sounds he/she recalled. The work of Madsen, Rollins, and Senf (1970) extended the findings of Broadbent. Kawar (1973, p. 226) said that, theoretically, dichotic listening should measure hemispheric specialization for language. Most subjects had a right ear advantage which enabled them to recall more verbal input from the right ear than from the left because the right ear had a more direct contralateral pathway to the speech center in the left hemisphere of the brain. Contralateral pathways went from an ear to the hemisphere on the opposite side of the brain, while ipsilateral pathways went from an ear to the hemisphere on the same side of the brain. First Kimura (1961a, b, 1966), and then others, such as Studdert-Kennedy (1975) and Leong (1980), said that the right ear had an advantage for three reasons: (1) it had added neural connections of the contralateral pathways; (2) the input of the left ear had to take a longer route through the right hemisphere and across to the speech center in the left hemisphere; and (3) the contralateral pathways of the right ear were able to suppress the ipsilateral input. Bogen, Fisher, and Vogel (1965) did find one patient whose ipsilateral pathways took over to give her the use of her left hand upon command after her corpus callosum had been severed; however, Milner, Taylor, and Sperry (1968) found that in a dichotic-listening situation their patients' contralateral input suppressed the ipsilateral
input. Bakker and Van Rijnsoever (1977, p. 38-9) found a right-ear advantage even when the input went only to one ear at a time. Looking at all the evidence, Kawar (1973, p. 227) felt that the reports on the auditory pathways offered a strong support for using dichotic listening as a measure of hemispheric specialization for language although Bryden (1973) and Ayres (1977) cautioned that it was only an indirect and imperfect measurement.

Several authors used methods which could be replicated in a dichotic listening test. Bakker (1973, 1979) played digits, like "two" and "five," simultaneously through stereophonic earphones to each ear at the rate of two pairs per second. After four pairs were played, he counted the number of digits which were correctly recalled by the left ear and subtracted that number from the number of digits correctly recalled by the right ear. A positive score indicated right-ear dominance while a negative score indicated a dominant left ear. Milner et al. (1968) suggested reversing the earphones after half the test to compensate for any variance. In other studies, Ayres (1977) and Mercure and Warren (1978) used consonant-vowel (CV), nonsense syllables, "ba, da, ga, ka, pa, and ta," while Koomar and Cermak (1981) found that subjects scored higher on this CV format than on the digits. Perhaps the CV format tested abilities which matured earlier and did not change like the abilities required to recall numerals. Bakker, Van der Vlught, and Claushuis (1978) found that
dichotic listening test-retest reliability was highest in middle primary school and lowest in kindergarten. Was this an indication of a shift after age 5? The authors noted that a person with a dominant left ear was more likely to change to a dominant right ear than vice versa. Later, claiming a split-half and test-retest reliability of .70 to .85, Bakker (1979) stated that dichotic listening tests were "reasonably reliable instruments to measure hemispheric asymmetries" (pp. 85-6).

Several authors cautioned that certain sounds might influence a dichotic listening test. Goodglass (1973) found that stop consonants (like b, c, d, g, p, and t) might require a right-ear advantage; while Lowe et al. (1970) found that voiceless consonants (like c, f, h, p, and t) were more accurately recalled than voiced ones (like b, d, g, j, l, m, n, r, and z). Spellacy and Blumstein (1970, p. 351) said that a right-ear superiority for consonant recognition was greater when there were real words, not nonsense syllables, and that vowels were recognized more often than stop consonants in a dichotic setting.

Right-ear advantage begins very early in a child's life. Hiscock and Kinsbourne (1977) found that preschool children had it, and that they may have been lateralized from infancy. Ayres (1977) said that the right ear was dominant as early as ages 3-5, but seemed to be less dominant in older people. Ayres also noted that some subjects showed a low right-left ear ratio in a dichotic listening test. Thus,
nearly the same number of digits, or sounds, were recalled with either ear. When very little difference existed between the recall of the two ears, Ayres suggested that it might indicate an auditory-language deficit which interfered with learning (p. 444).

In a study done on disadvantaged children, Kawar (1973) noted that children from low socio-economic backgrounds were slower to develop an REA than more advantaged children.

Kimura (1973) found a left-ear advantage for some sounds. She said when two melodies were played dichotically to normal subjects, the one played to the left ear was the best recognized from a group of four. Sounds of laughing, crying, and coughing were also best recognized from the left ear. Kimura (1961a) found that those who had the speech center in the left hemisphere had a right-ear advantage (REA), but thirteen subjects who had a left-ear advantage (LEA) also had the speech center in the right hemisphere, according to the Wada test. As previously noted, the dominant ear was opposite to the dominant hemisphere containing the speech center.

In summary, this section noted four major ideas: (1) dichotic listening was an indicator of the location of the speech center; (2) the contralateral pathways gave the right ear an advantage, and the right ear was dominant as early as ages 3-5, although it seemed less dominant in older people; (3) the methods used in dichotic listening tests might be
replicated in other testing situations; and (4) most people had a right-ear advantage with the dominant ear usually found opposite the hemisphere containing the speech center.

Visual Half-Field Testing

Since visual half-field testing was noted as the other accepted measurement of cerebral dominance, and since this study used special glasses to screen the half-fields and strengthen the visual stimuli to one hemisphere, a review of the literature concerning half-field testing was also considered appropriate.

Leong (1980, p. 189) said that pictures on the nasal side of each retina flashed contralaterally to the opposite brain hemisphere; while pictures on the temporal hemi-retina (the outer portion of the retina) flashed ipsilaterally to the same side of the brain. Thus, images entering on the nasal side of the eye's lens crossed to the temporal hemi-retina where they were conducted to the hemisphere on the same side of the brain. Similarly, images entering on the outer side of the lens crossed to the retina on the nasal side and were conducted contralaterally to the opposite brain hemisphere. Schwartz (1973, p. 113), Levitt (1981, p. 208), Springer and Deutsch (1981, p. 32), Groves and Schlesinger (1982, p. 267), and Robinson and Uttal (1983, p. 145) presented drawings of the visual pathways which supported Leong's statement. Yeni-
Komshian et al. (1975, p. 84) said that generally the right visual field (RVF) was superior for words and the left visual field (LVF) for faces and forms. Unlike Kimura (1966, pp. 281-2), who found LVF superiority when material was presented laterally, MacKavey et al. (1975, p. 31) emphasized the robustness of the RVF which remained superior in each experiment whether words were presented vertically or horizontally. In contrast, Gibson, Dimond, and Gazzaniga (1972, pp. 464-5) found that the subjects read words aloud more accurately when the words were presented to the LVF. Geffen, Bradshaw, and Nettleton (1972, p. 25) as well as Bryden (1973) agreed that an LVF was needed for nonverbal tasks; however, Gordon and Carmon (1976, p. 1097), Bryden and Allard (1976, p. 198), and Umilta, Bagnara, and Simion (1978, p. 43) found that the LVF was superior only when the patterns were complex or unknown. If the patterns were simple or became familiar to the subject, an RVF superiority was found. Bakker (1979, p. 85) said that verbal information sent to the RVF went directly to the occipital lobe of the left hemisphere while verbal information sent to the LVF had to detour through the right hemisphere before being processed in the left. He questioned whether this lengthened trip caused a loss of some of the original input. This longer journey for the visual input from the LVF to the speech center was similar to the longer trip for auditory input from the left ear to the left hemisphere.
Recognition of letters showed mixed results in visual half-field testing. Geffen et al. (1972) found that letter pairs of the same name, such as A - a, were processed faster when presented to the RVF; however, identical letter pairs which looked alike, such as a - a, were processed faster when presented to the LVF. Sasanuma, Itoh, Mori, and Kobayashi (1977, pp. 551-2) worked with two Japanese alphabets, phonetic Kana, and non-phonetic Kanji. They found an RVF superiority for Kana. Although the LVF was not significantly better for Kanji, it indicated that Kanji is processed differently from Kana and may require both hemispheres for processing. Likewise, Pirozzolo and Rayner (1977, p. 259) said that words presented to the LVF were also processed in both hemispheres—the right for feature analysis and the left for identification and naming in the language center. Casting a negative shadow on RVF and LVF testing, Hardyck and Haapanen (1979, p. 225) questioned if the visual half-fields existed outside the laboratory methods which were used to investigate them, and if they had any connection with learning.

Broman (1978, p. 588) found that right-handed, 7-year-old boys recognized letters faster in a tachistoscopic test when those letters were flashed to their LVF, but their LVF superiority decreased with age. Likewise, O'Leary (1977) "demonstrated a shift from LVF to RVF superiority at about the age of 7 in right-handed boys" (pp. 32, 23), or between first and second grade. Brown (1946) also found a "definite
increase in right-eye dominance among the older children" (pp. 3, 44), a 4.6 percent increase between Grades 2 and 6, with a resulting decrease in left-eye dominance. Girls were more right-eyed than boys in Grades 2 and 4; however, there were more right-eyed boys than girls in Grade 6. Kimura (1973) found that males were superior to females in visual-spatial areas. She suggested that right hemisphere specialization may be greater in males than in females. The fact that a shift in eye dominance may take place during or shortly after Grade 1 in many males should be of interest to reading teachers.

In summary, this section reviewed the work of the two visual half-fields--faster recognition of complex or unknown forms by the LVF and of familiar ones by the RVF. The implication for learning words from cards might suggest that whole-word recognition would be faster in the left visual field than in the right.

**Learning and Memory**

The methodology examined the immediate and the short-term recall of nonsense words; therefore, this review of literature would be incomplete without a reference to learning and memory. Levitt (1981) said, "Memory refers to the storage of information" as opposed to learning which "refers to the acquisition of new information" (p. 445). He added that memory had three main components: (1) registration took place
when an individual perceived a stimulus and took notice of it; (2) retention meant the permanent storage of a registered experience (it was the usual meaning of the word "memory"); and (3) retrieval was the recall of previously learned material. Registration, retention, and retrieval were all necessary parts of the memory process.

Levitt (1981, pp. 446, 485) also explained the difference between short- and long-term memory. Short-term memory was limited to about seven items, such as phone numbers, which were remembered for a few seconds and then forgotten. He suggested that a process of consolidation might cause the short-term retention to become long-term retention which lasted indefinitely—even for a lifetime. Levitt added that the retrieval of learned material was possible if the individual had a state that approximated the original learning situation. An exact duplication of the original learning state was not necessary for retrieval.

Hardyck and Haapanen (1979) suggested "that the left hemisphere might contain long-term memory storage for language" (p. 226). However, Levitt (1981, p. 488) found that no one portion of the brain was totally responsible for memory; rather most areas of the brain facilitated learning. Memory might be scattered through many parts of the brain.

Travers (1967) discussed the "phenomena" called "transfer of training" (p. 235). When the learning of one skill helped the learning or retention of another skill, a
positive transfer of training was said to exist. Likewise, when a learning of one skill hindered the learning or retention of another skill, a negative transfer of training took place. The student who had learned to add two columns of numerals was likely to have a positive transfer of training when learning to add three columns. Similarly, the student who practiced a piano selection incorrectly, might have difficulty in relearning it correctly because of a negative transfer of training.

Osgood (1949, p. 140) made a three-dimensional model to explain transfer of training. In a discussion of this model, Travers (1967, p. 24) observed that Osgood showed that positive transfer between two tasks depended on the similarity of the tasks to each other and the similarity of their responses. The greater the difference between the tasks and/or the responses, the greater the amount of negative transfer. Thus, Osgood's model predicted when positive and when negative transfer could be expected.

Further phenomena of learning are proactive and retroactive interference. Following Osgood's model, Bower and Hilgard (1981) offered an example of retroactive interference: the subject learned one list, learned a second list, waited for a time, and then tried to recall the first list. The extent to which learning the second list interfered with the recall of the first is called retroactive interference. An example of proactive interference occurred when the subject
learned one list, learned a second list, waited for a time, and then had trouble recalling the second list because of the earlier learning of the first one. The authors added that "Proactive effects are minimal immediately after A-C (the second list) learning, but they increase over a retention period" (p. 157). These phenomena of learning and recall are present in all subjects and in all experimental studies.

In summary, this section noted that learning was the acquisition of new knowledge, while memory was the storage of that knowledge. It noted the difference between short- and long-term memory and observed that no one portion of the brain was responsible for recall. Finally, it recognized the phenomena of transfer of training and proactive and retroactive interferences which are present in all learning situations.

The Hemispheres and Reading

Fries (1962) and Smith (1971) found that there were several stages in learning to read. Agreeing, Bakker (1973, p. 17) noted that early readers used perceptual configurations to discriminate words while older readers, who had internalized the word shapes, used comprehension clues for meaning. As previously noted, Gibson et al. (1972, pp. 463-5) found that all subjects were more accurate in reading words aloud when the words were presented to the LVF, and Bakker
(1979, pp. 87-91) said that children in the early grades who used right or bilateral reading processes had an advantage because accuracy was desired and slowness was accepted.

Several authors mentioned a shift between the ages of 5 and 7. Curcio et al. (1976, p. 36) thought a shift might occur about age 5 when young children began to use syntactic organization because kindergarten children tended to process words in isolation rather than to use the sentence for syntactic clues. Other authors, mentioned previously, who thought a shift occurred were: Brown (1946) who found a shift toward the right ear, O'Leary (1977) and Broman (1978) who found a shift in the direction of the right eye, Weingarten and Anisfield (1981) who surmised a comprehension shift took place after age 7, and Coren et al. (1981) who found a shift toward preference for the right side of the body. These shifts might be the result of growth. Epstein found brain growth-spurts at 3-10 months, 2-4 years, 6-8 years, 10-12 years, and 14-16 years. Except for the first and last, these spurts were similar to Piaget's stages (Epstein & Toepfer, 1978, p. 657). A similar growth-spurt might occur in reading. Bakker (1979, p. 92) found that children with an LEA in kindergarten read better in fifth grade than those who had an REA in kindergarten; however, those who had an LEA at the end of first grade tended to read worse in fifth grade than first graders with an REA. Thus, those who shifted from an LEA in kindergarten to an REA by the end of first grade were the best
readers in Grade 5. Speaking of this same research, Levy (1983) said that these children "displayed a right hemisphere superiority at letter and word recognition in first grade and gradually shifted to a left hemisphere superiority as the recognition process became automatized" (p. 67). In a similar view, Miller and Turner (1973, pp. 174-5) found that familiar words presented to the left or right of a fixation point were recognized equally well at Grade 2. Recognition in the RVF became stronger after Grade 4 and was strongest in Grade 6. Bakker (1979, p. 91) decided that, ideally, a child would have right-hemisphere control of speech at the earliest stages of reading and left-hemisphere control at the later stages. A shift to the left hemisphere (right ear) at about ages 6 or 7 might be normal for many children.

The consensus of opinion from this research seemed to indicate that both hemispheres were involved in reading. Since both hemispheres were required, McCallum and Glynn (1979, p. 270) thought that teachers should try to develop their students' left and right hemisphere skills. Likewise, McNeil and Hamre (1974, p. 381) said that those who strove for better educational principles should learn why the brain-behavior problem existed and find teaching methods to remediate it. Similarly, Matthews (1982, pp. 14-6) found that the left-hemisphere child learned best through a phonetic and structural analysis approach while the right-hemisphere learner required "sight words," pictures, configuration clues,
and, possibly, ways to visualize spelling words as wholes rather than as phonetic parts. Witelson (1977, p. 311) suggested that it might be possible to find an approach for dyslexics (defective reading students) which balanced linguistic processing, a phonetic approach, with the "look-say" wholistic method. The need for such an approach was emphasized by Tarnopol, Breed, Tarnopol, and Ozaki (1977) who found that "disadvantaged children were lacking in visual-motor and auditory-perceptual areas much like the learning impaired students" (p. 147). While poor environment might have caused their problem, such students could profit from the same educational interventions used by the learning-impaired children.

Unfortunately, the problem was more complicated than merely training both hemispheres of the brain. Crane (1985) found that many students with learning problems were bilateral; they could use either hemisphere equally well but seemed unable to have one hemisphere activate first and bear the major responsibility for learning. Such students needed help to develop a dominant hemisphere which would take the lead so learning could occur.

Vitale (1982) found that children who tested right-brained on her "screening instrument seemed very sensitive to color" (p. 67). During a lecture and demonstration, Vitale (1985) added that the more color-sensitive the individual was, the greater was the right-hemisphere dominance. She also
found that left-hemisphere persons were not color sensitive. Vitale's demonstration included placing a swatch of the reader's favorite color felt within his/her visual field on the page. A color-sensitive reader would dramatically read faster and smoother when seeing the color. Likewise, left-hemisphere readers showed no reading improvement when looking at color. Vitale reported her private interview with neurologist Dr. Frank Duffy, of Boston's Children's Hospital, in which he revealed that the area of the brain which processes color is directly connected to the speech center in some stroke victims. Thus, he felt that looking at color would improve reading in some individuals.

As previously described, van den Honert (1977) attempted a phonetic approach designed to facilitate the work of the left hemisphere. She sent music to the left ear, reading instruction to the right, and covered one eye. A. J. Harris (1979) said that van den Honert's method was "the first to be based on modern knowledge of cerebral dominance. The auditory part of the procedure makes theoretical sense; the visual does not" (p. 62). As noted in chapter 1 (p. 5), Sinatra and Stahl-Gemake (1983) felt that van den Honert's visual procedure was one commonly used by pediatricians, and one eye "may have sent clear, uncompeting images to both brain hemispheres" (p. 32). Likewise, Cook (1969) recognized that a novel procedure could cause a Hawthorne effect in which subjects made gains under all conditions because they were
aware of an experiment being carried out. Regardless of the criticisms, authors like Pettit and Helms (1979, p. 76) recommended the van den Honert method and urged that it be implemented with children at as early an age as possible. They also suggested that dichotic listening presented in graduated intensity over a period of time to the right ear might be another way to stimulate the left hemisphere to do its work.

Only two researchers appeared to use a card reader in a bisensory (auditory-visual) method. Senf (1969, pp. 4, 16) used a Bell and Howell Language Master without earphones. After subjects auditorily heard three numerals which were paired to three other visual numerals, they were asked to repeat all six from memory. Another of his experiments paired color with a line drawing---one was seen, the other heard. Again the subject had to recall the pairs. Obruzut (1979, p. 306) replicated Senf's first experiment again using a Bell and Howell Language Master without earphones. With these two exceptions, research involving card readers was not found.

In summary, this section noted that, although both hemispheres were involved in the reading process, the right hemisphere seemed to be most involved with beginning reading skills while the left hemisphere was primarily involved with advanced reading. Possibly a shift occurred at about age 6-7 when young children changed from right-hemisphere dominance to left-hemisphere dominance in reading abilities. Only two
researchers, van den Honert and Vitale, appeared to develop teaching techniques based upon cerebral dominance, with only van den Honert using an auditory-visual approach, while only two researchers appeared to use a card reader in their experiments. Neither of the latter used the card readers to measure the recall of words, or nonsense syllables, for which the readers were designed. Although the literature in the field of cerebral dominance was extensive, almost nothing was found on the methods of recalling words from a card reader.
CHAPTER III

METHODOLOGY

This study examined whether one individual, beginning reader or problem reader, consistently recalled a greater percentage of nonsense words attempted from a card reader with a Left Hemisphere Method (LHM) or with a Right Hemisphere Method (RHM) and whether one of these two methods achieved better results than the usual Both Hemispheres Method (BHM). The methods were designed so that the LHM theoretically sent auditory and visual word-stimuli primarily to the left hemisphere of the brain; the RHM sent word-stimuli primarily to the right hemisphere; and the BHM sent word-stimuli simultaneously to both hemispheres as normally occurs.

General Research Methodology

The research methodology used a case study/clinical approach in that it focused on observations made of individuals rather than the statistics pertaining to samples of a population. Webster's Collegiate Dictionary (1948) defined clinical as "occupied with investigation of disease in the living subject by observation, as distinguished from controlled experiment" (p. 189). Although most reading problems are not thought to be caused by disease (malady or illness), the possibility that they might be the result of some physical malfunction or dysfunction warranted detailed observations via case studies.

The research methodology could also be described as formative, in that, by design, results of initial parts of this study were examined to determine additional secondary (spin-off) questions and the appropriate methodology needed to consider them. In their book on formative and summative evaluations, Bloom, Hastings, and Madaus (1971) stated that "Summative evaluation takes place at the end of a period of instruction in order to grade or certify students" while the purpose of formative observations "is not to grade or certify the learner; it is to help both the learner and the teacher focus upon the particular learning necessary for movement toward mastery" (pp. 61, 88). This method of formative evaluation might be applied to research in that the observations after one phase of a study might determine new
steps in the research procedure. The opposite of formative research would be the summative method which would compare group/treatment interactions.

The study was a pilot (or exploratory) study in that no previous experiments which measured the number of sight words one individual learned using the left and right hemispheres were found in the literature. Since this project was pioneering research in the area of hemispheric-method, word-card recall, all observations and findings were new information. Predictions were difficult if not impossible to make about an initial investigation. Usually, experimental designs have large samples and test pre-determined hypotheses. This study's methodology required a case study approach because the logical way to determine if one hemispheric method recalled more words than the other, was to count the number of words each method recalled in the same individual. If only one hemispheric method per subject had been tested for a large sample of persons, there would have been a 50 percent chance that the non-preferred method had been measured. Similarly, if both hemispheric methods had been tested only once per subject, there would have been a possibility that the individual's method of hemispheric learning varied from day to day. Only through repeated measures of the same individual was it possible to test for a hemispheric-method preference of a given person and gain added insights into the way that individual recalled words from a card reader.
Since this was pilot (or exploratory) research, it was appropriate to examine questions which, if answered, might make it possible later to develop experimental research with pre-determined hypotheses for testing. Some hypotheses did develop. As the research progressed, observations made of single individuals led to a categorization of some aspects of the individual responses in a manner that allowed for the testing of hypotheses about these categories. These hypotheses were an outgrowth of the case study methodology and were not originally anticipated.

In summary, this research project was case study/clinical because it focused on individuals and because the examiner had many opportunities to observe a subject's recall characteristics during the repeated testing sessions. It could also be referred to as formative in that the results obtained from initial stages of the study could lead to additional types of observations, changes in procedures, and selection of other types of subjects in order to clarify questions which arose. If only one predetermined, rigid format had been followed, valuable leads would have been ignored until someone did another study. Likewise, important data concerning individual differences would have been lost. Finally, it was a pilot study because it was initial research in an unexplored area.
Although some hypotheses were later generated and tested based on the initial results of this study, at the beginning of this pilot research there was not adequate background information for stating research hypotheses. Instead, five initial questions for consideration were formulated, and later, based upon the results from studying the initial questions, four secondary questions were developed and examined. These questions dictated the methodology, the design, the subjects, the equipment and instruments, the testing procedures, the data collection, the limitations, the delimitations, and the statistical analyses necessary for this project. The initial questions were:

1. For each child, is there a preferred method, LHM or RHM, for recalling words?
2. If a preferred hemispheric method is found, does the child recall a significantly different number of words using it, from the number recalled by both hemispheres using both eyes and both ears?
3. Are there specific subjects whose learning behaviors merit additional study?
4. Are there other observations of the children which provide insights about learning and/or the learning environment which might suggest a need for further research.
5. Which method--LHM, RHM, or BHM--recalls the
largest average number of words on the third trials and on all trials for each child?

The secondary questions generated from studying the five initial questions were:

6. Is it reasonable to accept that the observed distribution for greatest recall by a method is the result of chance, if each of the three methods has an equal expectation of being the best method for any given child?

7. What happens to a good reader when presented with symbol representations of words which contain no phonetic clues?

8. Are there any characteristics related to the LHM and RHM which differentiate between problem readers classified by the school as making poor progress versus problem readers classified by the school as making adequate progress?

9. In kindergarten and first-grade children, is it possible to observe any behaviors that might relate to Bakker's (1979) idea of shifting from the right hemisphere to the left during the kindergarten-first grade age level?
In the research design used to answer the initial questions, the dependent variable was the number of words recognized after playing a set of five cards through the card reader. The independent variable was the three methods of seeing and hearing the words—LHM, RHM, or BHM.

An overview of the three experimental methods may help to differentiate among them. The Left Hemisphere Method (LHM) theoretically directed the strongest word-stimuli to the left hemisphere through the right visual field and right ear while the non-sighting eye and left visual field were screened and the left ear heard rhythmic, orchestral music. The Right Hemisphere Method (RHM) was the exact reversal of the LHM. The RHM directed stimuli to the right hemisphere through the left visual field and left ear while the non-sighting eye and right visual field were screened and the right ear heard rhythmic, orchestral music. The Both Hemispheres Method (BHM) directed stimuli to both hemispheres simultaneously through both eyes and both ears using a card reader in the usual manner. The specific equipment used to test these three methods is described in detail in the section "Equipment and Testing Instruments" (pp. 57-65), and the specific testing methods used are described in detail in the section "Testing Procedures" (pp. 65-68).

Subjects were assigned to one of two patterns to determine the order for testing the LHM and RHM. Those in
Pattern I began with an LHM test while those in Pattern II had the RHM first. Initially, only one testing of the BHM took place in Sessions One and Eight. After ten subjects were tested, it was felt that two measurements of the BHM should be made at the beginning and ending of the sessions. Since this study was using formative methodology, a second set of word cards using the BHM was added in Sessions One and Eight. Table 1 indicates the testing sequence used with the last twenty-one subjects.

### TABLE 1

**TESTING SEQUENCE FOR PATTERNS I AND II**

<table>
<thead>
<tr>
<th>Number of Session</th>
<th>Sequence Pattern I</th>
<th>Sequence Pattern II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>BHM/BHM</td>
<td>BHM/BHM</td>
</tr>
<tr>
<td>2nd</td>
<td>LHM/RHM</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>3rd</td>
<td>RHM/LHM</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>4th</td>
<td>LHM/RHM</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>5th</td>
<td>RHM/LHM</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>6th</td>
<td>LHM/RHM</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>7th</td>
<td>RHM/LHM</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>8th</td>
<td>BHM/BHM</td>
<td>BHM/BHM</td>
</tr>
</tbody>
</table>

More detailed information concerning the assignment of words to the testing sessions is included in the section, "Equipment and Testing Instruments" (pp. 57-65).

Both the LHM and RHM were tested during six sessions.
One method was judged to be significantly preferred over the other if the subject recalled more words on the third trial with that method on all six occasions. If one hemispheric method were preferred in all six testing sessions, an additional sequence of testing was attempted to determine if that method were significantly different from the BHM. To be significantly different from the BHM, the subject had to recall more words on the third trial with that method than with the BHM in all six testing sessions. Table 2 shows the testing sequence for the additional sessions in which the BHM was tested against the preferred hemispheric method (P). More detailed information concerning the assignment of words to these additional sessions is included in the section "Equipment and Testing Instruments" (pp. 57-65).

**TABLE 2**

**ADDITIONAL SEQUENCE FOR TESTING PREFERRED HEMISPHERIC METHOD AGAINST BHM**

<table>
<thead>
<tr>
<th>Number of Session</th>
<th>Sequence of Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th</td>
<td>BHM/P</td>
</tr>
<tr>
<td>10th</td>
<td>P/BHM</td>
</tr>
<tr>
<td>11th</td>
<td>BHM/P</td>
</tr>
<tr>
<td>12th</td>
<td>P/BHM</td>
</tr>
<tr>
<td>13th</td>
<td>BHM/P</td>
</tr>
<tr>
<td>14th</td>
<td>P/BHM</td>
</tr>
</tbody>
</table>
Subjects

The study primarily focused on problem readers but included some beginning readers and good readers so that their behavior could be contrasted with those having difficulty. A total of thirty-one rural, Caucasian children coming from public and parochial schools in Berrien County, Michigan, were examined between March 1984 and March 1985. These included twenty boys and eleven girls who ranged in age from 6 years 3 months to 12 years 6 months and in grade placement from preschool through Grade 6. The subjects examined included: three excellent readers who could read the nonsense words from sight; five beginning readers who were just learning to read and could not be classified as adequate or inadequate readers; one good reader who volunteered for the project because his twin brother was participating as a problem reader; one girl reading at grade-level who was tested at the request of her teacher and her mother (who was also a teacher) because they felt her reading progress was inadequate when compared to her intelligence and potential; one boy reading at grade-level with such highly developed phonetic skills that he frequently recalled all the nonsense words with either the LHM or RHM, so the test was inappropriate for him, but he could not qualify as an excellent reader because of his problems with comprehension, and thus his data was unuseable; and twenty problem readers—ten of whom were categorized by the school, according to the "Reading Criteria" (pp. 56-57), as making
adequate reading progress while the other ten were categorized by the school as making poor reading progress. Problem readers were those who had so much trouble learning to read that they were receiving special remedial help in school or at a reading clinic. Table 3 shows the classification of the subjects according to age and sex, table 4 according to grade and sex, and table 5 according to reading category.

Most of the children were recommended by their teachers or remedial tutors. A few volunteered because they wanted to try out the special equipment they had seen in the examiner's classroom. All the subjects had normal vision, and all but one had normal hearing, according to their school records. That one was found to have a hearing loss after he became a subject; however, he repeated well the words he had just heard, so he was allowed to continue the testing. All the children had parental permission to receive special help with sounds and syllables.

The children were told that they were helping the examiner to test some new equipment to see which way it worked the best. They were assured that they could not be wrong. If one way did not work well, it was because the equipment worked better another way.

All the children were randomly assigned to two testing groups, Pattern I or Pattern II, which are discussed below with the testing instruments. As previously noted, two girls
### TABLE 3

**AGE AND SEX OF THE THIRTY-ONE SUBJECTS**

<table>
<thead>
<tr>
<th>Age of Subjects</th>
<th>Frequency of Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td>6 yrs.</td>
<td>3</td>
</tr>
<tr>
<td>7 yrs.</td>
<td>5</td>
</tr>
<tr>
<td>8 yrs.</td>
<td>4</td>
</tr>
<tr>
<td>9 yrs.</td>
<td>6</td>
</tr>
<tr>
<td>12 yrs.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Column Totals</strong></td>
<td>20</td>
</tr>
</tbody>
</table>

### TABLE 4

**GRADE AND SEX OF THE THIRTY-ONE SUBJECTS**

<table>
<thead>
<tr>
<th>Grade of Subjects</th>
<th>Frequency of Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Preschool</td>
<td>1</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>2</td>
</tr>
<tr>
<td>1st</td>
<td>2</td>
</tr>
<tr>
<td>2nd</td>
<td>8</td>
</tr>
<tr>
<td>3rd</td>
<td>5</td>
</tr>
<tr>
<td>4th</td>
<td>2</td>
</tr>
<tr>
<td>6th</td>
<td>1</td>
</tr>
<tr>
<td><strong>Column Totals</strong></td>
<td>20</td>
</tr>
</tbody>
</table>
### TABLE 5

**NUMBER OF SUBJECTS BY READING CATEGORY**

<table>
<thead>
<tr>
<th>Reading Level</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent Readers</td>
<td>3</td>
</tr>
<tr>
<td>Beginning Readers</td>
<td>5</td>
</tr>
<tr>
<td>Good Reader</td>
<td></td>
</tr>
<tr>
<td>Twin to a problem reader</td>
<td>1</td>
</tr>
<tr>
<td>Grade-level Readers</td>
<td></td>
</tr>
<tr>
<td>Working below potential</td>
<td>1</td>
</tr>
<tr>
<td>Data unuseable*</td>
<td>1</td>
</tr>
<tr>
<td>Problem Readers</td>
<td></td>
</tr>
<tr>
<td>Adequate progress</td>
<td>10</td>
</tr>
<tr>
<td>Poor progress</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>

*Data was unuseable because the child frequently recalled all the words with the LHM and RHM, so no preference could be determined; he was not an excellent reader because of poor comprehension.*

Who were excellent readers, one in fourth and the other in second grade, did so well on their first test that they were given the opportunity to read the rest of the test words aloud from sight. They did this perfectly. Since the test was too easy for them, they were reassigned to a different aspect of the project which would answer Secondary Question Seven: "What happens to a good reader when presented with symbol representations of words which contain no phonetic clues?" At that time the last subject, a sixth-grade boy, was selected...
and added to the special aspect of the project because he was an excellent reader with a WISC-R IQ of 135.

As mentioned previously, one boy frequently recalled all the words with both the LHM and RHM, but the test was too easy for him, so no conclusions about his hemispheric-method preferences could be determined, and his poor comprehension kept him from being an excellent reader; therefore, he was dropped from the study. When the three excellent readers and this boy were removed, a total of twenty-seven subjects provided data to answer the initial questions and Secondary Question Six in this research. These twenty-seven were divided as follows: Pattern I had fourteen children—nine boys and five girls, and Pattern II had thirteen children—nine boys and four girls.

Reading Criteria

The following criteria were used by the school to determine whether or not a problem reader was making acceptable progress at the time of the test:

Criterion One

A child was considered to be making adequate reading progress if, with remedial instruction, he/she were reading
and passing the skills tests no less than a half-year below grade level in a basal reading textbook.

**Criterion Two**

A child was considered to be making inadequate reading progress if, with remedial instruction, he/she were reading and working on skills more than a half-year below grade level in a basal reading textbook.

These criteria categorized all twenty problem readers. Their data was used to answer Secondary Question Eight: "Are there any characteristics related to the LHM and RHM which differentiate between problem readers classified by the school as making poor progress versus problem readers classified by the school as making adequate progress?"

**Equipment and Testing Instruments**

Special equipment had to be adapted or constructed to test the three hemispheric methods (LHM, RHM, or BHM) for reading and recalling words from a card reader. The equipment included: A "Califone 4450" model card reader; 280 nine-inch, Bell and Howell Language Master cards; a "Panasonic" model cassette recorder; a tape of rhythmic, orchestral music; a small handbell, six inches tall; a "Realistic Pro IIA" model headset with stereo earphones; a custom-made sound-control
box; two patching cords; a headset adapter; two empty, sunglass frames for each subject; "Scotch Magic Tape"; a special sighting chart; a sheet for recording data; an observation checklist; and two diaries for recording daily notations about each child's learning.

Figure 1 shows the diagram of the electronic equipment. The card reader and cassette player were connected to the custom-made sound-control box by the two "patching cords." The sound-control box had two sound meters to monitor the volume, a switch to direct the words and/or music to either ear, and a receptacle into which the stereo headset or the headset adapter for both ears could be plugged.

![Diagram of electronic equipment with child and examiner](image)

Fig. 1. Placement of units in the electronic equipment with child and examiner

The examiner determined the child's dominant eye for sighting as described in "Testing Procedures" (pp. 65-68). After the dominant sighting eye was found, special equipment
for directing stimuli to one visual field had to be constructed. A white construction-paper chart with two half-objects meeting on a line down the center was made. As the child faced the chart, half a green shamrock was on the left, and half a red heart was on the right. This chart was hung on the wall by a clip above the center line where the two half-objects met. Two pairs of empty sunglass frames were used. The frame of the non-sighting eye was covered with "Scotch Magic Tape" which admitted light but did not permit vision. The tendency to move the eyes toward the light was lessened when light was admitted. The child put on one pair of glasses with the non-sighting eye covered. The sighting eye looked at the clip centered above the chart. A card was used to cover the right side of the empty frame until the child could not see the red heart. The spot was marked, and the examiner covered the right portion of the frame with "Scotch Magic Tape." The same procedure was followed for the other pair of glasses, only the open frame was covered on the left side until the green shamrock was no longer visible. The frame with the opening on the nasal side was named for the hemisphere on the same side of the body as that eye. The frame with the opening on the outer portion of the eye was named for the hemisphere on the opposite side of the body. With the exception of the previously mentioned two notebooks containing daily notations about each child’s learning, the sheet for recording the words recalled, and an observation
checklist (See appendixes B and C), no other physical equipment was required for testing.

A testing instrument was devised to answer the initial research questions. Each "pseudo-word" in this instrument had two regular phonetic syllables composed of three letters each (consonant-vowel-consonant-consonant-vowel-consonant, cvccvc). The vowels were all short and appeared an equal number of times in each word-set. Since there were five vowels, A E I O U, the word-sets had five nonsense words each, one for each short vowel, but these nonsense syllables did not sound like real words. Even a syllable like "KOL" was discarded because it sounded like "CALL" (see appendix A, for a list of word-sets). Similarly, the nonsense syllables did not offer memory clues of ascending letters like "l" or descending letters like "p." Instead, they were all printed in capital letters one centimeter high on small white cards. Each of the initial syllables in a set began with a different consonant sound, and each ending syllable also began with a different consonant sound from the other ending syllables in that set. Since some letters are silent or influence the vowel sounds, the following six letters were not used in this study: H, Q, R, W, X, and Y. Finally, when two word-sets were matched for the same testing session, no syllable in one set rhymed with a syllable in the other set. At least thirty revisions took place before a suitable list of words was made.

According to the foregoing specifications, matched
word-sets were created and given letter names A - T. Enough extra sets were constructed so that alternative sets were available for substitution if needed. Finally, the last syllable of each nonsense word was reversed with the first syllable ("CAMPOL" became "POLCAM") to form a second word-set, like A', built from the first. The small printed cards were stapled onto card-reader cards, and the nonsense words were recorded twice on the magnetic tape at the bottom. Finally, the cards were ready to be played through the card reader.

This testing procedure was unique among tests and procedures reviewed because it gave subjects the chance to instantly mimic what they heard on the card reader and then recall the same sounds when they read the words less than two minutes later. No other testing instrument and procedure was found in the literature which measured the child's ability to instantly mimic and later recall the nonsense word when prompted by the sight of a word card.

A Testing Sheet was constructed which offered a counter-balanced order of testing. During the testing sessions of both the regular and special alphabets, half the subjects followed Pattern I, the others Pattern II, as shown in tables 6 and 7.

As noted in the section "Research Design" (pp. 49-51), the first ten subjects, which included the three good readers assigned to a special aspect of the project, had the BHM
### TABLE 6
**PATTERN I SEQUENCE OF WORD-SET PRESENTATION**

<table>
<thead>
<tr>
<th>Number of Session</th>
<th>Word-Sets</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>A &amp; T'</td>
<td>BHM/BHM</td>
</tr>
<tr>
<td>2nd</td>
<td>B / C</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>3rd</td>
<td>D / E</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>4th</td>
<td>F / G</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>5th</td>
<td>B'/ C'</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>6th</td>
<td>D'/ E'</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>7th</td>
<td>F'/ G'</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>8th</td>
<td>T &amp; A'</td>
<td>BHM/BHM</td>
</tr>
</tbody>
</table>

### TABLE 7
**PATTERN II SEQUENCE OF WORD-SET PRESENTATION**

<table>
<thead>
<tr>
<th>Number of Session</th>
<th>Word-Sets</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>T &amp; A'</td>
<td>BHM/BHM</td>
</tr>
<tr>
<td>2nd</td>
<td>B / C</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>3rd</td>
<td>D / E</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>4th</td>
<td>F / G</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>5th</td>
<td>B'/ C'</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>6th</td>
<td>D'/ E'</td>
<td>RHM/LHM</td>
</tr>
<tr>
<td>7th</td>
<td>F'/ G'</td>
<td>LHM/RHM</td>
</tr>
<tr>
<td>8th</td>
<td>A &amp; T'</td>
<td>BHM/BHM</td>
</tr>
</tbody>
</table>
tested only once in Sessions One and Eight. Pattern I began with word-set A in Session One and ended with A' in Session Eight; while Pattern II started with word-set A' and ended with A. The last twenty-one subjects followed Pattern I or Pattern II according to tables 6 and 7.

Pattern I began with word-sets A and T' in Session One and concluded with word-sets T and A' in Session Eight, using the BHM. Sessions Two through Seven presented word-sets B - G and B' - G' in a counterbalanced design as illustrated. This design was intended to control for fatigue. Pattern II also began with word-sets T and A' in Session One and concluded with word-sets A and T' in Session Eight, using the BHM. Similarly, Sessions Two through Seven presented word-sets B - G and B' - G' in a counterbalanced design, but it was the exact opposite of the design in Pattern I. Thus, the words in the two patterns exactly reversed each other. The examiner had a sheet for each subject which listed the student's assigned pattern and the words to be tested in each session.

As noted in "Research Design" (pp. 49-51), those who had a significantly preferred hemispheric method, LHM or RHM, were given an additional sequence of testing which measured the BHM against the preferred method. One child who had a preferred hemispheric method was tested according to the sequence illustrated in table 8.

The first child who qualified for the BHM versus the
Preferred sequence was one of the ten subjects who had not had two BHM tests in Sessions One and Eight. As a result, word-sets T and T' were used in this sequence. Since the addition of this testing sequence lengthened the tests considerably, there was a fear of over-testing the young children and deteriorating the quality of their responses. After using this sequence with one child, it was not repeated on the other child who qualified for it.

To answer Secondary Question Seven--"What happens to a good reader when presented with symbol representations of words which contain no phonetic clues?"--an alphabet was constructed from Greek and Russian letters as well as from some picture-writing symbols. One symbol was assigned to each letter of the alphabet and consistently represented it in all the nonsense words tested; however, that symbol looked very
different from the letter it replaced. Then the word-sets were translated into the symbolic writing and copied with a felt pen, in symbols two centimeters high, onto 1 1/2 x 5 inch index cards which were affixed to the center of Language Master cards. The words were recorded twice on the magnetic tape at the bottom of the Language Master cards. Thus, parallel sets of the word cards were formed except that they were not written in a recognizable alphabet.

**Testing Procedures**

Initial Question One asked: "For each child, is there a preferred method, LHM or RHM, for recalling words?" The first step in the procedures used to answer Question One required determining the dominant sighting eye. This eye was determined by using a test for eye dominance employed at Andrews University's Reading Center. The child fully extended his/her arms and was asked to form a peephole with the fingers. While the child sighted an object through the peephole, the examiner walked in front of the child and looked through the hole to see which eye was being used. The eye which sighted an object two consecutive times was considered to be the dominant one for sighting.

The next step involved establishing a fixation point. This point was formed by the examiner centering a small, six-inch handbell behind the card reader. During the first
session of the BHM, the testing procedure was established. Before each card was shown, the examiner said, "Look at the little bell." The card moved in front of the bell as the word on the card was played through the card reader. The sound went into the sound-control box and was sent to the child's ears through stereo earphones. Immediately, the child was asked, "What did you hear?" The child saw and mimicked each word in the set of five cards; then the cards were shuffled and the child attempted to read the cards from sight. The examiner recorded the words recalled and returned the cards to the order in which they were first presented. This procedure was practiced twice, and the third score was accepted. A total of five was possible if the child recognized all the cards on the third trial. A score of fifteen was possible if the child recognized all the words on all three trials. A child who did not mimic the nonsense word correctly, but who read the same sounds he/she mimicked, received credit for an accurate recall even if the word were incorrectly perceived. However, if he/she mimicked the word correctly, but failed to read it correctly, no credit was given. Two sets of five cards were tested during the first session for the final twenty-one subjects. This procedure was the BHM which involved both eyes and both ears simultaneously and was the normal way to use a card reader.

At least one day after the first session which tested the BHM, the two hemispheric methods, LHM and RHM, were
measured. The order in which they were tested was determined by whether the child was assigned to testing Pattern I or Pattern II as described in "Equipment and Testing Instruments" (pp. 57-65). A test of the LHM and RHM comprised one testing session, and only one session was attempted per day.

When testing the LHM, the examiner asked the child to put on the appropriate glass frames which covered the non-sighting eye and the left visual field. The handle of the handbell served as a fixation point which helped the sighting eye not to move and allowed the glasses to screen the left visual field. At the same time, rhythmic, orchestral music was played on the cassette recorder and sent through the sound-control box into the left stereo earphone. The child saw the word with his/her right visual field and heard it though the right stereo earphone. Two meters on the sound-control box insured that the sounds to both ears remained at a constant, comfortable level.

The RHM was just the reverse of the LHM. This time the glasses covered the non-sighting eye and the right visual field. At the same time, the right ear heard the music and the left ear heard the nonsense word while the left visual field looked at it. The same testing format was followed as for the other methods. In contrast to the van den Honert approach, it constituted the RHM.

As noted with the BHM, a total of five words was possible if the child recognized all the cards on the third
trial with one hemispheric method. In case of a tie between the two hemispheric methods, the method with the most cards recalled on all three trials received the point for that session. A score of fifteen words was possible if the child recognized all the words on all three trials with one hemispheric method. If the LHM and RHM recalled the same number of words on all three trials, the session was retested on another day with alternative sets of words. If the child recalled all the words on all three trials with both the LHM and RHM, or if the child recalled no words on any trial with either method, those sessions were not retested, they were listed as a tie with .5 given to each method. In a few cases, where the retest score was also tied, the child was not retested again; rather, the session was listed as a tie with .5 again sent to each method.

During Session One and Session Eight, the child recalled two sets of words with the BHM. The average number of words recalled during these two sessions formed the baseline for that individual child. An increase in the number of words recalled by the BHM during Session Eight over the number of words recalled during Session One possibly indicated practice effect; however, when the BHM score was lower than the scores of either the LHM or RHM it might have demonstrated that the difference was due to the treatments used.
Data Collection and Recording Procedures

The examiner had a sheet listing the sets of words in the order they were to be tested for that child (either Pattern I or Pattern II). Each word was followed by three blanks to record if it were recalled on each trial. Every session was dated. One point was given to the hemispheric method, LHM or RHM, used to recall the most words on the third trial in that session, including the steps followed in case of a tie, as described in the "Testing Procedures" (pp. 65-68). The sheet also had blanks for recording the additional tests of the BHM and preferred method in the event the child had a significantly preferred hemispheric method of recall.

Careful notes were kept in a diary about the child's recall during the session. An observation checklist was also developed so that the characteristics of each child's learning habits could be readily observed. (See appendix C.)

Statistical Procedures

Five of the research questions required specific statistical analysis. Three of these were initial research questions, and two were secondary questions which grew out of the data found. The statistical analysis used is discussed in four sections: (1) which examined Questions One and Two, (2)
which examined Question Five, (3) which examined Question Six, and (4) which examined Secondary Question Eight.

Analysis for Examining Questions One and Two

Initial Question One asked: "For each child, is there a preferred method, LHM or RHM, for recalling words?" Initial Question Two asked: "If a preferred hemispheric method is found, does the child recall a significantly different number of words using it, from the number recalled by both hemispheres using both eyes and both ears?" The statistical design for answering these two questions was based on the binomial distribution, and the number of nonsense words recalled by a child with the LHM and RHM were measured on six occasions. As previously noted, the order in which the methods were tested was counterbalanced to control for fatigue. Likewise, only one method, LHM or RHM, received a credit of one point for each session, except in the case of ties when a credit of .5 was given to each method.

Since the six sessions required a forced choice of either an LHM or an RHM, a total of 64 possibilities existed. Such probabilities associated with the binomial distribution are sometimes referred to as Pascal's triangle (Ferguson, 1976, p. 85). When 2 is expanded to the 6th power, the probability coefficients are 1, 6, 15, 20, 15, 6, and 1. Table 9 indicates these probabilities.
TABLE 9
PROBABILITIES FOR NUMBER OF LEFT POINTS

<table>
<thead>
<tr>
<th>Number of Left Points</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1/64</td>
</tr>
<tr>
<td>5</td>
<td>6/64</td>
</tr>
<tr>
<td>4</td>
<td>15/64</td>
</tr>
<tr>
<td>3</td>
<td>20/64</td>
</tr>
<tr>
<td>2</td>
<td>15/64</td>
</tr>
<tr>
<td>1</td>
<td>6/64</td>
</tr>
<tr>
<td>0</td>
<td>1/64</td>
</tr>
</tbody>
</table>

There was only one chance in 64 that a student who consistently recalled more words with the same hemisphere on all six occasions did so as the result of mere chance. For the scores to be statistically significant at the .05 level, one hemispheric method had to recall more words than the other in all six testing sessions. The scores of each subject in this study were compared to table 9 to learn if the subject had a significant preference for one hemispheric method.

If either the LHM or RHM showed a significant preference for learning words, that hemispheric method was retested with the BHM on six additional occasions. (See table 8.) Later, the results were compared to table 9 to determine if the preferred hemisphere learned a significantly different number of word cards from the BHM. This additional sequence of testing was done with only one child in the study.

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As shown in table 10, it was recognized that a child might have a trend toward one hemispheric method although he/she did not recall more words with that method for all six testing sessions. The scale shown in the first column was used to indicate the number of sessions in which the LHM had greater word recall than the RHM. Table 10 might be interpreted according to the following criteria: A score of zero indicated a significant preference for the RHM. Scores

<table>
<thead>
<tr>
<th>Number of Sessions the LHM Had Greater Word Recall than the RHM</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>
of 1 or 2 were considered to show a trend toward the RHM. Scores of 2.5 - 3.5 were felt to show ambivalence toward either method. Scores of 4 - 5 were considered to indicate a trend toward the LHM. Finally, a score of 6 indicated a significant preference for the LHM. Scores such as .5, 1.5, and 5.5 did not appear because no subject achieved them.

Analysis for Examining Question Five

Initial Question Five asked: "Which method—LHM, RHM, or BHM—recalls the largest average number of words on the third trials and on all trials for each child?" To answer this question, it was necessary to find the average scores for each child. All the words a child recalled on the third trial by the LHM were counted and divided by the number of sessions tested to determine the third-trial average for the LHM. The third-trial average for the RHM was found in the same way. The baseline average for the BHM was determined by counting all the words a child recalled on the third trial with the BHM and dividing that number of words by the times the BHM was tested. In a similar manner, the all-trials averages were found, except that all the words recalled on all three trials were counted and divided by the number of times that method was tested. Thus, the averages could be compared to determine
which method achieved the largest average number of words recalled for a particular child.

**Analysis for Examining Question Six**

Secondary Question Six arose from comparing the averages in Question Five. Question Six asked: "Is it reasonable to accept that the observed distribution for greatest recall by a method is the result of chance if each of the three methods has an equal expectation of being the best method for any given child?" This question was analyzed. The method used was to construct two 3 x 1 contingency tables to show the all-trials and third-trials observed and expected number of subjects who learned best with the LHM, RHM, and BHM. A chi-square with 2 degrees of freedom using *Yates' Correction for Continuity* (as applied to small samples) was employed to test the two null hypotheses.

\( H_0: 1. \) There is no significant difference at the .01 level between the observed and expected number of students who recalled a greater average number of words with each of the three hemispheric methods, LHM, RHM, and BHM, on all trials.

\( H_0: 2. \) There is no significant difference at the .01 level between the observed and expected number of students who recalled a greater average number of words with each of the three hemispheric methods, LHM, RHM, and BHM, on third trials.

Table 11 shows the general format of the contingency
tables used for testing both null hypotheses except that for $H_0$: 2 the words "all trials" were changed to "third trials."

### TABLE 11

FORMAT USED TO PRESENT DATA CONCERNING THE OBSERVED NUMBER OF SUBJECTS WHOSE AVERAGE WAS HIGHEST WITH THE LHM, RHM, OR BHM ON ALL TRIALS VERSUS THE EXPECTED NUMBER

<table>
<thead>
<tr>
<th></th>
<th>METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LHM</td>
</tr>
<tr>
<td>Observed Subj.</td>
<td></td>
</tr>
<tr>
<td>Expected Subj.</td>
<td></td>
</tr>
</tbody>
</table>

Analysis for Examining Question Eight

An examination of the data obtained from studying Initial Questions One through Five resulted in Secondary Question Eight: "Are there any characteristics related to the LHM and RHM which differentiate between problem readers classified by the school as making poor progress versus problem readers classified by the school as making adequate progress?" This question arose after the examiner compared the averages for each child of the two hemispheric methods, LHM and RHM. The method for determining these averages was
described in the analysis for Question Five (pp. 73-74). The examiner observed among the problem readers older than the usual age for kindergarten and first grade that if the average of one hemispheric method exceeded the other's by more than .5 on the all-trials comparison, and if the average of that same method were also greater on the third-trial comparison, the problem reader was making adequate reading progress according to the school criteria outlined in "Reading Criteria" (pp. 56-57). Similarly, the examiner observed that a problem reader older than the normal age for kindergarten and first grade who failed to have one hemispheric method exceed the other by more than .5 on the all-trials average and/or who failed to have that same method exceed the other on the third-trial average, was making poor progress in reading, according to the school criteria.

These observations appeared to warrant further analysis to learn if they were statistically significant. Of the twenty-seven students who provided data for the initial questions, twenty were old enough to be in second grade or above and were problem readers who could be categorized by the reading criteria of the school. Thus, a 2 x 2 table with 1 degree of freedom and a chi-square with Siegel's Correction for Continuity, which is used with small samples, was employed to test the third null hypothesis.

$H_0$: 3. There is no significant difference at the .01 level between the observed and expected number of problem
readers who were classified as making adequate progress and showing a trend toward the LHM or RHM versus those problem readers who were classified as making poor (not adequate) progress and showing a trend toward the LHM or RHM.

Table 12 indicates the format for presenting the categorized data to be tested by a chi-square.

**TABLE 12**

<table>
<thead>
<tr>
<th>Reading Progress</th>
<th>Toward LHM or RHM Trend</th>
<th>No Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor (Not adequate)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Limitations**

This study was limited by the fact that it dealt with specific children rather than trying to generalize about a population as a whole. It was limited by the fact that children, because of their school schedules, were not available for testing at the same time for each session. It
was also limited because children who rode buses could not stay after school; instead, they had to be tested during their lunch recess. As a result, most of the subjects lived in the school neighborhood where they could walk home. The study was further limited by the number of children involved because of the large number of days required for the examiner to test one child. In addition, it was limited by the number of tests one child could take without developing test aversion. It was possible that some stimuli might affect one hemisphere differently from the other and thereby, limit the study.

Finally, the research was limited because there was no way to block-out all the verbal signals to one hemisphere while the other was being tested. The best that could be done was to strengthen the verbal signals to the hemisphere being tested at the same time the covered glasses and music were weakening those signals to the opposite one.

**Summary**

In summary, this chapter has described the case study/clinical, formative, pilot methodology employed in this research. It was case study/clinical in the manner in which careful observations of single individuals were made. It was formative because the findings at one stage could determine other steps to be taken, and it was pilot research because a similar study in this area was not found in the literature.
The lack of information in the literature made this type of methodology necessary. Without prior research, initial hypotheses could not be formed because no one could anticipate what the results might show. Instead of hypotheses, five initial research questions were investigated. Information gathered in the investigation of the initial questions resulted in four secondary questions. Secondary Questions Six and Eight lent themselves to the formulation of null hypotheses which were appropriately tested. Two statistical methods were employed: (1) binomial distribution for analyzing individuals, and (2) chi-square for analyzing group characteristics. The answers to those nine research questions appear in chapter 4.
CHAPTER IV

RESULTS

The results of the study are reported in this chapter in ten sections. Sections one through nine report data and findings pertaining to the five initial and four secondary research questions; section ten summarizes the findings.

Results Pertaining to Question One

Question One asked, "For each child, is there a preferred method, LHM or RHM, for recalling words?"

To answer this question, table 13 indicates the number of sessions in which the LHM was credited with greater word recall than the RHM for the twenty-seven subjects who provided data for answering the initial research questions. Those twenty-seven subjects included everyone tested except the three excellent readers and the one boy with unuseable data.

For one hemispheric method to be accepted as having a significantly different score from the other, the subject...
TABLE 13

NUMBER OF SESSIONS WHEN THE LHM HAD GREATER WORD RECALL THAN THE RHM FOR TWENTY-SEVEN SUBJECTS

<table>
<thead>
<tr>
<th>Number of Sessions the LHM Had Greater Word Recall than the RHM</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>3.5</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>4.5</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Total 27

needed to score either six times left or zero times left. Scores of 1 or 2 were considered to show a trend toward the RHM while scores of 4 or 5 were considered to show a trend toward the LHM. Scores from 2.5-3.5 were considered to be ambivalent toward the LHM and RHM. From these criteria, table 13 may be interpreted as follows: Two subjects always preferred the LHM. No one consistently preferred the RHM. Five subjects showed a trend toward the RHM, and eleven showed a trend toward the LHM. The mode, most popular score, was 4, and the mean was 3.5. However, a trend or preference toward
the LHM, as compared to a trend or preference toward the RHM, did not discriminate between problem readers making adequate progress and problem readers making poor progress as determined in chapter 3, "Reading Criteria" (pp. 56-57).

The two subjects who scored left on all six occasions met the probability criteria for \( p < .05 \) as found in the binomial chart shown in table 9. In other words, there was fewer than five chances out of 100 that this would occur as the result of chance. One of those two subjects did score higher with the RHM just before his Halloween Party; however, his excitement and lack of attention to the testing situation made the whole testing session questionable. Thus, the session was discarded, and the tests were repeated another day with alternative word-sets. With the exception of that party day, the child always scored higher with the LHM.

Therefore, the answer to Initial Question One was, "Yes." For two children there was a significantly preferred method, the LHM, for recalling words from a card reader.

**Results Pertaining to Question Two**

Question Two asked, "If a preferred hemispheric method is found, does the child recall a significantly different number of words using it, from the number recalled by both hemispheres using both eyes and both ears?"

The first child who significantly preferred the LHM was tested in six sessions which measured the LHM against the BHM
in a counter-balanced sequence shown in table 8. In the first three sessions, this child always scored higher on the LHM. However, in the last three sessions the words from the first sessions, which had been heard and recalled by the LHM, were presented to the BHM with the syllables reversed so that "LINBOD" became "BODLIN." On the last three sessions the BHM scored higher than the LHM. Seemingly, sounds which were first introduced to both hemispheres did not aid recall in the left. However, sounds presented first to the left hemisphere, when later given in reverse-syllable order, were apparently more easily recalled by both hemispheres in this child.

The second child who significantly preferred the LHM was given a number of other types of tests as well as additional measures of the BHM following his basic eight sessions. It was feared that more testing would adversely affect the quality of his responses. Thus, he did not take the added six sessions shown in table 8 as the first child had done. The number of words he recalled on all trials in every session with either the LHM or RHM always exceeded the BHM's baseline average.

Thus, the answer to Question Two was inconclusive. New words presented with the preferred hemispheric method (LHM) were recalled better than new words presented with the BHM; however, words presented first with the LHM were later easier to recall with the BHM in one child. The other child always recalled more words on all trials in every session with the
LHM than with the BHM according to the averages. Neither child showed a statistical preference for the LHM over the BHM.

Results Pertaining to Question Three

Question Three asked, "Are there specific subjects whose learning behaviors merit an additional study?"

The answer to this question was "Yes." Six subjects exhibited behaviors which were deemed worthy of further study. Additional testing of various types, including background information, and further observations were used to examine these six children. Among the subjects who learned words from a card reader were two who significantly preferred the LHM; two who showed no hemispheric trend; one who had no hemispheric trend, but who changed from an ambivalency which leaned toward the LHM to an ambivalency which leaned toward the RHM; and one who always had a nonsignificant, RHM trend.

Case One

The first child was an eight-year-old girl who used her right eye for sighting dominance. Her recall for words with the LHM was consistently greater than her recall for words with the RHM in all six testing sessions. Her average number of words recalled on the third trial with the LHM was 1.17 greater than the average number recalled with the RHM.
Likewise, the average number of words recalled on all trials with the LHM was 2.0 greater than the average number of words recalled on all trials with the RHM.

The girl's non-dominant, left eye was also tested for four sessions. Again she recalled more words with the LHM on all four occasions. Her LHM preference with the dominant eye was statistically significant at the p < .05 level. When the four sessions of the non-dominant eye were included, she preferred the LHM all ten times to be statistically significant at the p < .001 level. In other words, there is less than one chance in a thousand that this girl's preference is the result of chance.

She was tested with the BHM before and after the six sessions with the dominant eye. Her LHM and RHM averages exceeded the BHM average in the third-trial and the all-trials recall. Following the eight initial sessions and the four sessions with the non-dominant eye, she was tested in six sessions that measured the LHM against the BHM. In Sessions Nine to Eleven, the LHM recalled more words, but in Sessions Twelve to Fourteen the BHM recalled more. Since the words had first been presented and recalled in the LHM, perhaps they were more easily recalled later with both hemispheres, even though the syllables were presented in reversed order. An initial learning and recall with the LHM may have made a second learning easier for the BHM. Seemingly, the reverse was not true. Nonsense words presented first to both
hemispheres were not as easily recalled when they were presented later to the LHM.

This girl showed many problems with the mimicry and recall of consonants and vowels in both the LHM and RHM. She tended to reverse the order of letters during recall, especially with the RHM. She also changed "b" and "f" to "p" while recalling sounds. Other consonant errors involved "b-d" and "f-v." Through intensive phonetic practice, she attempted to compensate for her problems with auditory memory.

She had good thinking skills which gave her context clues as she decoded words. This girl gained nine months in reading from May 1984 until May 1985 according to her Gates-MacGinitie Reading Test C, Form 2. She also began to read at grade level in her basal reading textbook.

Her favorite-color felt, which Vitale (1985) mentioned, was used during her oral reading. This felt had no apparent influence on her reading fluency. The lack of effect by the felt was consistent with Vitale's statement that left-hemisphered learners were not color sensitive.

This child's history is one of growth and improvement. She has made a hemispheric preference, and with remedial help in decoding and auditory memory, she is progressing toward self-sufficiency in reading.
Case Two

The only other subject whose preference for the LHM was statistically significant, p < .05, was an eight-year-old boy. This child shifted between his two eyes for sighting dominance, but finally used his right eye two consecutive times, so it was tested as the dominant eye.

He consistently learned and recalled words in fewer trials with the LHM. In one testing session, he did recall more words with the RHM, but that session was tested on Halloween just before he got dressed for his party. Since it was an unusual situation, that session was retested another day. With the exception of the discarded test which he took on Halloween, he recalled more words with the LHM in six out of six testing sessions. There was only 1 chance in 64, or less than 5 chances out of a 100, that this would happen as the result of chance. The average number of words he recalled on the third trial was 1.0 more with the LHM than with the RHM. Likewise, the average number of words he recalled on all trials was 2.83 more for the LHM than for the RHM.

Similarly, the number of words recalled by the LHM was always greater than the number of words recalled by the BHM. Possibly some interference was present when he used both eyes and both ears. The fact that his sighting-dominance shifted somewhat may suggest that his two eyes did not work together in sending visual signals to the brain. Covering one eye
permitted the other eye to send visual information to the two hemispheres without competition.

Following the third session, a retest of the BHM indicated a score of 5 on the third trial and 13 on all trials. The third trial was perfect as in the LHM, but the all-trials recall score was two words less than the LHM score. Although this child had just practiced and recalled the words three times for both the LHM and RHM during Session Three, he did not recall the words as well with the BHM at the end of the session as he had just done with the LHM. This fact supports the theory that some interference occurred when he used both eyes and both ears. After Session Eight, he took two BHM tests with music as well as words in each ear. The third-trial results were 5 and 4, respectively, while the all-trials recall was 13 on each test. Thirteen was the highest score he ever achieved on any all-trials measurement of the BHM, but he achieved 15, a perfect score, in three different all-trials measurements of the LHM. Thus, he learned more words with the LHM than with the BHM. It was not deemed necessary to continue further comparisons of the LHM with the BHM because of the high degree of consistency found. There was also a concern that the child would become frustrated because of the many testing sessions.

This boy had trouble recalling the vowel sounds with both the LHM and RHM, and trouble recalling consonants especially with the RHM. He recalled words on the first and
second trials, and quite often forgot them on the third with the RHM, but forgot them only once with the LHM. His recall was consistently weaker when he used the RHM.

A few days after the testing sessions, this child was asked to silently read a Gray Paragraph at second-grade level. He then answered five oral questions about what he had read. He correctly recalled two out of five answers for a score of 40 percent. Then he silently read a second-grade McGrath Paragraph while music went to his left ear (theoretically sending the strongest signal to his right hemisphere). Again, he achieved the same score—two out of five oral comprehension questions correctly answered. Another day, he tried a Reading Skill Card A at the 2.5 reading level. After reading it silently, he answered three out of six questions correctly for 50 percent accuracy. The next day he read another card of the set at the same level. This time he wore the special glasses and heard the music according to the LHM. His score of five out of six questions correctly answered indicated 83 percent accuracy, or an increase of 33 percent over his normal way of reading.

Such findings might suggest that music alone did not increase his comprehension, but music plus the special glasses did. Such a finding would support van den Honert's (1977) statement that either music or glasses alone did not increase her students' reading achievement, but the two working together succeeded. It is recognized that a single
observation supports the trend, but for it to be statistically significant, there would have to be repeated measurements. Unfortunately, there were not enough normed, comparable sets of materials to do repeated measurements of this type.

It is possible that other factors such as the subject matter of the paragraphs or his own emotions may have caused his scores to increase; however, he said he did not like the noise of his own classroom, but enjoyed the quiet of the reading room. Perhaps the music helped to mask the background classroom noises for him.

His teacher reported that some days he did excellent work, and on others he was failing. Vitale's (1985) colored felts did not seem to affect his reading. Such a finding was consistent with his LHM preference. He could read quite well orally, but had trouble telling anyone what he had just read aloud. He was making progress in his basal reading book where he was working about a half-year below his grade placement. Between May 1984 and May 1985, he showed only two months growth in reading according to his Gates-MacGinitie Reading Test C, Form 2; however, the 1984 test had a paragraph written under four pictures, and he had to mark the one picture that the paragraph described. In contrast, the 1985 test had a different format. It contained a paragraph followed by two written questions. Each question had four multiple-choice answers of which he had to pick the correct one. This
complete change in testing, with no picture clues, might account for his seeming lack of growth in reading.

Because of concern that classroom noise caused this child to score low, he was given the comprehension section of a Gates-MacGinitie Reading Test C, Form 1. He had music sent to his left ear as in the LHM, but he chose to have his whole right eye uncovered rather than just one visual field. Since the test lasted thirty-five minutes, he was permitted this choice. His score was only two months higher than his Form 2 comprehension score had been. Perhaps failing to screen out his LVF had hurt his score. It was also possible that his emotions had interfered with his recall. That morning his class had gone on a field trip and a picnic. He had to take the test that afternoon because the school year was over.

During the initial testing, Session Five came on Halloween, and as previously noted, was discarded because he was excited over his party. Usually he recalled all the words with the LHM and about two-thirds of the words with the RHM. On the day of his party, he did just the opposite. He recalled all the words with the RHM and only two-thirds of them with the LHM. The following day and in all succeeding sessions, he again recalled more words with the LHM than with the RHM. Positive, emotional excitement might have caused him to recall with the RHM.

His higher RHM score on Halloween and his reading score on Picnic Day might suggest that emotions play an important
role in this child's ability to use his most effective learning style. He appeared to be highly sensitive to any classroom situation.

Case Three

A case of no hemispheric trend involved a nine-year-old girl who was having difficulty in reading. She used her left eye for sighting dominance, often covering her right eye with her hand as she read. One day she could not recognize a word in her reading book. After covering her right eye, she read the word accurately. Another time, she had trouble reading a page from her book until her right eye was covered; then she read the page fluently. Possibly her eyes did not work together. Her right eye was covered during the hemispheric testing. In six sessions, she scored higher on the RHM three times and on the LHM three times—interpreted to mean that there was a lack of trend toward a hemispheric method.

She had four extra testing sessions using her non-dominant, right eye. Again the RHM recalled more words half the time and the LHM the other half for a total lack of trend.

She also showed no trend when the average was taken of the number of words recalled using the dominant eye. The average number of words recalled on the third trial showed a .5 trend toward the RHM, but the average number of words recalled on all trials was exactly the same for both the LHM
and RHM. Her BHM third-trial and all-trials baseline average exceeded her LHM and RHM third-trial and all-trials averages. Thus, the BHM was her most effective learning method. These findings support the view that this girl lacked a trend toward either the LHM or RHM.

Her memory for short-vowel sounds was very inconsistent, resulting in inaccurate recall. She might say a short "i" correctly on one trial and sound it as a short "e" or a short "u" on the next. She remarked that she often forgot what vowel sound the letter made. Often, she appeared inattentive and wiggled or played with the earphone cord during the testing sessions. Several times she said the background music sounded like Sylvester, the Cat, chasing Tweety Bird. She seemed more interested in her surroundings than in recalling the words on the test.

Shortly after the sessions ended, she was diagnosed as having a learning impairment in reading. In February 1985, her Special Education teacher let her choose her favorite-color felt to place on her reading book. She chose lavender. Then she began reading library books at home. By the Spring of 1985, her teacher said she had become the best reader in her room. She appeared to be very sensitive to color. Possibly, the color helped one hemisphere to take the lead. She grew nine months in reading from May 1984 until May 1985, according to her Gates-MacGinitie Reading Test D, Form 2.
Case Four

Like the girl in Case Three, who showed no trend toward either the LHM or RHM, a nine-year-old boy also failed to show a trend toward a hemispheric method. In six sessions, he scored higher three times with the LHM and three times with the RHM. His right eye was dominant for sighting, so it was used for the six sessions. Later, the non-dominant, left eye was also tested. In four sessions, it showed 2 RHM/1 LHM/1 TIE for a total of 2.5 RHM/1.5 LHM. The left eye appeared to show a small trend toward the RHM which was different from the dominant eye. Possibly this boy's eyes did not work together.

A comparison of the BHM baseline average with the LHM and RHM averages showed that he recalled more words with the LHM than with the BHM on the third trials, but he recalled more words with the BHM on the all trials. When only the LHM and RHM averages were compared, the LHM average exceeded the RHM by .33 on the third trial and by .5 on the all trials. According to the criteria established in chapter 3, "Analysis for Examining Question Eight" (pp. 75-77), the difference between these two averages was too small to expect good reading progress although it might indicate that this young man was growing toward a dominant hemisphere which would activate first and carry the major responsibility for reading.

This child had particular problems with mimicry. He could not recall the "m-n" sounds well, so animal was "aminal." He also added "1" to many words to make blends.
Both hemispheres were involved in his mimicry and recall problems with consonants. Poor recall of vowel sounds appeared most often in the RHM. He often mimicked the word incorrectly, and then read it accurately on the recall test. Seemingly, he had not combined phonetic visual and listening skills. When he saw the word visually with no auditory interference, he was able to pronounce it correctly. He had had intensive phonetic training, but he had not integrated his auditory and visual learning well enough to mimic correctly. His teacher reported a similar problem when he read aloud. She also observed that he had the ability to correctly sound out words but failed to use the technique unless required to do so. He appeared to prefer guessing rather than doing the work involved in decoding.

His teachers had recommended retention since first grade. In 1984, he finally was retained because he was reading two years below grade level. One year later, he had gained fourteen months in reading according to his Gates-MacGinitie Reading Test D, Form 2. Although he was still working four months below grade level, and even though his oral reading was often inaccurate, he had made progress. Perhaps if the testing sessions had been done in 1985, he would have shown a trend toward one hemispheric method. Instead, the testing was done while he was still working far below grade level. After his retention, his teacher insisted that he must read on grade level in his basal textbook.
Forcing him to keep up with his class appeared to be beneficial for him.

There was evidence that emotional problems from a variety of causes might have contributed to his learning difficulties. It appeared that he needed techniques which would be emotionally supportive and would strengthen his self-concept.

**Case Five**

Case five was an eight-year-old girl who was ambivalent toward the LHM and RHM in the six testing sessions. However, a comparison of the LHM and RHM averages showed a slight leaning toward the LHM. Five months later she was retested. She again was ambivalent toward the LHM or RHM in the six sessions, but a comparison of the LHM and RHM averages showed a change had taken place. Based upon these averages, a trend toward the RHM had occurred.

Since this girl used her right eye for sighting, it was the eye used for all the testing sessions. During the initial sessions, she scored higher on the LHM three times, on the RHM twice, and tied once for a score of 3.5 LHM/ 2.5 RHM. The average number of words she recalled on the third trial was .16 greater with the LHM than with the RHM. The average number of words she recalled on all trials was .33 greater
with the LHM than with the RHM. Thus, her leaning toward the LHM was very slight.

A comparison of the BHM baseline average with the LHM and RHM averages indicated that she learned best with the LHM on the third trial and on all trials. Apparently, she recalled more words with a single hemispheric method than with both eyes and both ears.

She was reading two months above her grade placement and was spelling four months below it, according to her WRAT Test, but her decoding skills were so poor that she was failing her daily work in her basal reading workbook. She was unsure of the consonant sounds for "t" and "z" and did not know the sounds of "f" and long "a." Her teacher noted that her reading performance was not keeping pace with her Cognitive Abilities deviation IQ of 110.

The Wepman Test gives a student two words auditorily, and the child decides if the two words are the same or different. This girl made four errors on the test. According to Wepman (1958), more than three errors for children eight and older indicates "inadequate development" (p. 3). Thus, she was functioning below her age level in auditory discrimination.

Similar discrimination problems appeared during the testing sessions. She mimicked nonsense syllables incorrectly, and incorrectly recalled consonant sounds with the RHM. She incorrectly recalled vowels with the LHM, while
she reversed the order of the syllables with the BHM. This girl recalled words on the first or second trials and forgot them on the third with all three methods: LHM, RHM, and BHM. As a result of her poor auditory memory, she scored very low on recall in the sessions.

She may have had some spatial problems as well as auditory ones. While practicing for a ballet performance, she consistently turned the opposite direction from the other dancers with the result that she kept bumping into them.

After the initial testing, she received intensive phonetic training. Her classroom teacher also introduced color felts, which were placed on her reading book. Usually, the teacher asked children to sit up straight with both feet on the floor while reading. After listening to Vitale's (1985) suggestion that movement increases learning in some children, the teacher permitted more freedom of body movements during work time. This child especially moved her foot while she was reading. Her teacher noted that she began making fine reading progress.

Since she was making good progress, the teacher requested that the testing sessions be repeated to see how much growth had taken place. Alternate sets of word cards were used. In these sessions, the LHM recalled more words twice, and the RHM recalled more words three times with one tie for a total of 3.5 RHM/2.5 LHM which was still ambivalent toward the LHM or RHM. When the averages were compared, the
RHM third-trial average of 3.16 exceeded both the LHM and BHM third-trial averages. Similarly, the RHM all-trials average of 7.83 exceeded the LHM and BHM all-trials averages.

The comparison of the third-trial averages revealed that the RHM exceeded the LHM by .5. Similarly, the all-trials average recall showed a difference of 1.0 in favor of the RHM. This increase in words recalled and the shift of the averages from the LHM to the RHM might suggest that the colored felts and the body movements caused the right hemisphere to activate first and take the lead in learning.

This child grew fourteen months in reading between May 1984 and May 1985 according to her score on the Gates-MacGinitie Reading Test B, Form 2.

Case Six

The final case involved a seven-and-a-half-year-old boy who showed a statistically nonsignificant trend toward the RHM. He used his right eye for sighting and recalled more words with the RHM in four sessions and with the LHM in two, for a trend toward the RHM.

This trend was weakened when the averages were compared. The BHM had a third-trial average of 2.0. This average was higher than the third-trial averages for the LHM and RHM which tied at 1.5. Thus, there was not a trend toward a hemispheric method on the third trial. Similarly, the BHM
all-trials average was 4.5. This average was again higher than the LHM all-trials average of 3.33 or the RHM average of 3.66. Apparently, this child learned best with both eyes and both ears, but when the LHM and RHM were compared, there was a slight trend toward the RHM.

This boy mimicked nonsense words incorrectly immediately after hearing them with the RHM, and he recalled a nonsense word on the second trial, but forgot it on the third. He recalled more words with the RHM than with the LHM; however, he often failed to attempt a word unless he was sure of it. As a result, he did not recall many words.

A few weeks after the sessions ended, he took a Kaufman Assessment Battery for Children. The psychologist reported that he did not have a learning impairment, but he tended to be a simultaneous (right-hemisphered) learner rather than a sequential (left-hemisphered) learner. Such a finding corroborated the results of the testing sessions which found him to have a slight RHM trend.

In February 1985, this child was having many problems recognizing words in his reading book. When his reading teacher let him choose a color felt to place on his page, she reported that his word recognition soared dramatically. He liked chartreuse. His reading, which had been halting and expressionless, became smooth and meaningful. His mother heard that he was reading better and came to visit school. He
read for her using his color felt, and she was astonished. She exclaimed, "He reads beautifully!" Then she bought him some chartreuse felt to use at home. He put the color on his comprehension worksheets and began doing perfect work. His classroom teacher also encouraged him to use color and movement as he worked. Apparently, this child was color sensitive according to Vitale's (1985) theory. He grew nine months in reading between May 1984 and May 1985 according to his Gates-MacGinitie Reading Test B, Form 2. Most of that increase came between February and May 1985 because he was still reading first-grade basal textbooks in February, but he began reading second-grade books after he started using the colored felt.

These six case studies have offered insights into the ways certain children learned and recalled nonsense words from word cards on a card reader. Their learning behaviors were felt to merit additional studies.

Results Pertaining to Question Four

Question Four asked, "Are there other observations of the children which provide insights about learning and/or the learning environment which might suggest a need for further study?"

To answer Question Four, some specific observations about the subjects were made in addition to the six cases
previously studied. These observations involved how emotions may influence learning, how identical twins' recall may be different, and how two children diagnosed as dyslexic reacted to the testing.

As noted in Case Two, the boy appeared to change his learning pattern from the LHM to the RHM in the excitement just before his Halloween Party. A six-year-old girl also changed from the LHM to the RHM on two non-consecutive days when the test came just before her gym class. On days when she did not have gym following the session, she recalled more words with the LHM. Whether or not she was excited about the prospect of going to gym could not be determined, but it was possible that her anticipation influenced her learning method. The day after she recalled more words with the RHM, she returned to recalling more words with the LHM on both occasions.

A seven-year-old boy also showed a shift toward the RHM just after his teacher apologized to him for suggesting that an eraser he had found was hers. He appeared happy as he entered the testing session. That was the only day he recalled more words with the RHM.

An eight-year-old girl who had a trend toward the RHM occasionally showed a tendency to forget her testing session even though she had been reminded of it less than five minutes before. On her "forgetful days," she recalled more words with the LHM. Her teachers also remarked that she appeared to be
in a dream world at times. Perhaps her lack of attention occurred when she changed to her opposite hemisphere, or perhaps it was the result of her emotions. Possibly, those subjects with an RHM trend changed to the LHM when their emotions were aroused.

The histories of these four children suggested that emotions might change their hemispheric method and might cause learning to shift to the opposite one. There were not enough cases to support statistically that emotions could change the LHM to the RHM or vice versa, but these cases did suggest that emotions might play a major role in learning and might be a variable difficult for teachers to control.

Among the children tested was a pair of male twins who appeared to be identical. One twin showed a trend toward the LHM four out of six times; while the other showed a trend toward the RHM, likewise, four times out of six. Perhaps their opposite trends were similar to the mirror-image phenomena sometimes present in identical twins which Newman, Freeman, and Holzinger (1937) mentioned. If the twins actually did mirror each other's hemispheric learning, then the LHM and RHM tests appeared to be sensitive enough to discover this fact.

A boy, whose mother said he had dyslexia, was among those who showed no hemispheric method trend in the average number of words recalled. He recalled just as many words with one hemispheric method as with the other. The speech teacher
found that he had a hearing loss after the testing sessions had been started, but he mimicked nearly all the words correctly, so he must have heard them. He received credit for incorrectly mimicked words provided that he recalled them as he mimicked them. His major problem was in recall. He did not have consistent sound-symbol association, so the vowel "a" sound might be a short "a" on one trial and a short "i" the next. His recall was very weak. McKeever (1977, p. 34) also noted the poor recall of dyslexics and suggested that they might have a general or a sequential memory impairment.

Another boy, later diagnosed as having visual dyslexia, insisted he had recalled the words in one set during a previous session. He had seen the syllables in reverse order, but had not seen the exact words before. Perhaps his visual reversals caused him to think the reversed syllables were the same words. He was the only subject to say that he had seen the words before.

Thus, the answer to Question Four was, "Yes." The selected observations gave glimpses of how the subjects learned the nonsense words in these tests. Knowing how some children learned might suggest ways to help others learn more efficiently. Recommendations for areas of further study appear in chapter 5.
Results Pertaining to Question Five

Initial Question Five asked, "Which method—LHM, RHM, or BHM—recalls the largest average number of words on the third trials and on all trials for each child?"

To answer Question Five, averages were calculated for each child on all of the three methods. Chapter 3, "Statistical Procedures" (pp. 69-77), described how these averages were computed. A comparison of the all-trials averages for each of the twenty-seven children involved revealed that one child had a tie between the LHM and RHM which was greater than the BHM. In that case, .5 was added to the LHM and RHM totals. Thus, 6.5 children showed the LHM to be the greatest; 1.5 children indicated the RHM was best; and nineteen children, or 70 percent of the group, recalled more words with the usual BHM, as shown in table 14.

Eight students, or 29.6 percent of the group, appeared to have greater all-trials recall of words with a single hemispheric method; rather than using the normal both eyes and both ears approach. The third-trial averages for the three methods—the BHM baseline versus the LHM and RHM—presented slightly higher results in favor of the single hemispheric methods, as shown in table 15.
### TABLE 14

**NUMBER OF SUBJECTS WITH THE GREATEST ALL-TRIALS RECALL AVERAGE BY THE LHM, RHM, OR BHM**

<table>
<thead>
<tr>
<th>Method with Greatest Recall Average</th>
<th>Number of Subjects*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHM</td>
<td>6.5</td>
</tr>
<tr>
<td>RHM</td>
<td>1.5</td>
</tr>
<tr>
<td>BHM</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

*If the LHM and RHM exceeded the BHM and had a tie score for one subject, each method received a .5.

### TABLE 15

**NUMBER OF SUBJECTS WITH THE GREATEST THIRD-TRIAL RECALL AVERAGE BY THE LHM, RHM, OR BHM**

<table>
<thead>
<tr>
<th>Method with Greatest Recall Average</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHM</td>
<td>7</td>
</tr>
<tr>
<td>RHM</td>
<td>2</td>
</tr>
<tr>
<td>BHM</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>
According to table 15, seven students had the highest average on the third trial with the LHM; two showed that the RHM was the highest; and eighteen had the highest average with the BHM. Nine students, or one-third of the group, recalled words better on the third trial with a single, hemispheric method rather than with both eyes and both ears, and the others recalled better with the BHM.

From the results shown in tables 14 and 15, about one-third of the students (eight or nine) seemed to recall words best through the LHM or RHM; while about two-thirds of them (eighteen or nineteen) recalled best through the normal BHM using both eyes and both ears. The fact that some children showed a trend toward one hemispheric method as compared to another should not lead anyone to expect that they would not do better receiving stimuli in the normal manner defined in this study as the BHM. The concept is that those who recalled more words with the LHM or RHM instead of with the normal BHM might have the type of problem in which stimuli coming to both hemispheres somehow interacted to cause interference. Such children might need a special hemispheric method (LHM or RHM) to screen out this interference so better learning could take place. Whether a subject recalled best with the LHM, RHM, or BHM did not seem to differentiate between those making adequate and poor reading progress according to the Reading Criteria (pp. 56-57) established.

Therefore, the answer to Question Five appeared to be
that about two-thirds of the subjects learned words better with the usual method involving both eyes and both ears, and about one-third of the subjects learned better with a single, hemispheric method. Of the one-third who recalled best with a single, hemispheric method, 77 percent learned best with the LHM on all trials, and 61.5 percent learned best with the LHM on the third trial. The RHM had the smallest number of learners with 23 percent on all trials and 38.4 percent on the third trial. Thus, most subjects recalled best with the BHM, some recalled best with the LHM, and very few recalled best with the RHM.

Results Pertaining to Question Six

Question Six asked, "Is it reasonable to accept that the observed distribution for greatest recall by a method is the result of chance, if each of the three methods has an equal expectation of being the best method for any given child?"

Secondary Question Six grew out of the data found for Initial Question Five. Twenty-seven subjects provided that data. To answer Question Six, two null hypotheses were constructed.

\[ H_0: \] There is no significant difference at the .01 level between the observed and expected number of students who
recalled more words with each of the three hemispheric methods, LHM, RHM, or BHM, on all trials.

\[ H_0: \] There is no significant difference at the .01 level between the observed and expected number of students who recalled more words with each of the three hemispheric methods, LHM, RHM, or BHM, on the third trials.

These hypotheses were tested separately on 3 x 1 contingency tables with 2 degrees of freedom using a chi-square with Yates' Correction for Continuity which is often used with small samples. Table 16 indicates the observed and expected frequencies for the all-trials test; while table 17 indicates the observed and expected frequencies for the third-trial measurement.

**TABLE 16**

OBSERVED NUMBER OF SUBJECTS WHO RECALLED MORE WORDS WITH THE LHM, RHM, OR BHM ON ALL TRIALS VERSUS THE EXPECTED NUMBER

<table>
<thead>
<tr>
<th>Methods</th>
<th>LHM</th>
<th>RHM</th>
<th>BHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Subj.</td>
<td>6.5</td>
<td>1.5</td>
<td>19</td>
</tr>
<tr>
<td>Expected Subj.</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
TABLE 17

OBSERVED NUMBER OF SUBJECTS WHO RECALLED MORE WORDS WITH THE LHM, RHM, OR BHM ON THIRD TRIALS VERSUS THE EXPECTED NUMBER

<table>
<thead>
<tr>
<th>Methods</th>
<th>LHM</th>
<th>RHM</th>
<th>BHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Subj.</td>
<td>7</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>Expected Subj.</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

A chi-square with Yates' correction and 2 degrees of freedom was calculated for table 16, $x^2 = 15.91$. It was significant at $p < .001$; therefore, null hypothesis 1 was rejected and an alternative hypothesis was accepted.

$H_a$: 1. There is a difference between the observed and expected number of students who recalled more words with each of the three hemispheric methods, LHM, RHM, and BHM, on all trials.

Similarly, a chi-square with Yates' correction and 2 degrees of freedom was calculated for table 17, $x^2 = 12.97$. It was significant at $p < .01$; therefore, null hypothesis 2 was rejected and an alternative hypothesis was accepted.

$H_a$: 2. There is a difference between the observed and expected number of students who recalled more words with each
of the three hemispheric methods, LHM, RHM, and BHM, on third trials.

Since the two null hypotheses were statistically rejected, the answer to Question Six was that the observed distribution for greatest recall by a method was not likely to be the result of chance.

Results Pertaining to Question Seven

Question Seven asked, "What happens to a good reader when presented with symbol representations of words which contain no phonetic clues?"

To answer Question Seven, two girls, one in second grade and the other in fourth, and a sixth-grade boy with a WISC-R IQ of 135 were assigned to this aspect of the project because they were excellent readers. The words were written in Greek, Russian, and picture-writing symbols as described in chapter 3, "Equipment and Testing Instruments" (pp. 57-65). As previously noted, one symbol in this alphabet consistently replaced "b," another "c," and so on. When a nonsense word was rewritten in these symbols, it looked like six unknown shapes.

The second-grade girl showed no trend toward either the LHM or RHM. She indicated frustration and shook her head and her hands as she tried tensely to recall the words without alphabetical clues. After five sessions, her lack of trend
was apparent, so the testing was ended. The fourth-grade girl recalled more words with the LHM than with the RHM, but she recalled the most words with the BHM, so her sessions were also terminated. Both girls exhibited the same types of recall problems with the picture symbols that the poorest readers among the subjects had shown when they used the regular alphabet. Both girls recalled a word on one trial and forgot it on the next. One also reversed the syllables during recall so that "BODLIN" became "LINBOD." Even one's mimicry was impaired so that "GUFDOM" became "DUFDOM," and "FUDZAL" changed to "TUGZAL" and "PUGZAL." Seemingly, the girls depended heavily on phonetic clues to read and recall words. The alphabet and its sounds appeared to be almost as much of a puzzle to poor readers as these unknown picture symbols were to excellent readers like the two girls.

The sixth-grade boy also aided in this project for one testing session. When he attempted to recall the words from the picture symbols, he remarked, "I saw that arrow with a head like a sideways triangle. I remembered that triangle started with a "t" just like the word, so I knew what the word was." He was attempting to decode the symbols through association. Apparently, he also depended heavily on phonetic clues from the alphabet to recognize unknown (nonsense) words. When those clues were not available, he attempted to build his own phonetic system.

The answer to Question Seven appeared to be that good
readers, when deprived of phonetic clues, had great difficulty with reading in a manner that attempted to force "a pure sight approach." As they coped with this approach, it appeared they were attempting to build their own phonetic system to compensate for the missing alphabet.

Results Pertaining to Question Eight

Question Eight asked, "Are there any characteristics related to the LHM and RHM which differentiate between problem readers classified by the school as making poor progress versus problem readers classified by the school as making adequate progress?"

Twenty problem readers, ten who were making adequate progress and ten who were making poor progress, provided the data to answer Question Eight. This data should not be confused with the data used to answer Question Five. Question Five found that whether a person learned more words with the LHM, RHM, or BHM did not differentiate between readers making poor and adequate reading progress. The data used to answer Question Eight compared only the two hemispheric methods, LHM and RHM, to see if any characteristics related to them differentiated between those problem readers making poor and adequate progress in reading.

The answer to Question Eight was, "Yes." The criteria for differentiating between poor and adequate reading progress
was shown in chapter 3, "Reading Criteria" (pp. 56-57). When the problem readers were placed by the school in categories of poor and adequate reading progress, there did appear to be a relation between the test results and the category to which each had been assigned. Those in second grade and older, who did not have a trend toward either the LHM or RHM, were in the category of problem readers making poor progress.

The following criteria were used as evidence that the subject's word-recall averages had a trend toward one method, LHM or RHM: a child had to have the all-trials word-recall average for one method exceed the other by more than .5, and the third-trial word-recall average for that same method also had to exceed the other's average.

Table 18 shows the categorization of the twenty problem

<table>
<thead>
<tr>
<th>Reading Progress</th>
<th>Toward LHM or RHM Trend</th>
<th>No Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Poor (Not adequate)</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
readers. This data was analyzed using a chi-square with the Siegel Correction for Continuity, which is used for small cells, and 1 degree of freedom. Null hypothesis 3 was constructed and tested.

\[ H_0: \text{There is no significant difference at the .01 level between the observed and expected number of problem readers who were classified as making adequate progress and showing a trend toward the LHM or RHM, versus those problem readers who were classified as making poor (not adequate) progress and showing a trend toward the LHM or RHM.} \]

A total of twenty students were old enough to be in second grade or above and could be categorized as problem readers making adequate progress and problem readers making poor progress. Ten students failed to show, on all-trials recall, a trend toward one hemispheric method whose average exceeded the other's average by more than .5, and/or they failed to have that same hemispheric method show a higher average during a comparison of the third-trial, LHM and RHM averages. These same ten students were also making poor progress in reading according to the "Reading Criteria" (pp. 56-57) established by the school. The other ten students had a trend toward one hemispheric method whose average was more than .5 greater than the average of the opposite method in a comparison of the all-trials word-recall. These children also showed that same hemispheric method to have a higher average than the other when the third-trial, LHM and RHM averages were
compared. These ten students were all making adequate progress in reading according to the criteria of the school.

After the Siegel Correction for Continuity, a $x^2 = 16.2$ was calculated. It was significant at $p < .001$. Thus, null hypothesis 3 was rejected, and an alternative hypothesis was accepted.

$H_a$: 3. There is a difference between the observed and expected number of problem readers who were classified as making adequate progress and showing a trend toward the LHM or RHM, versus those problem readers who were classified as making poor (not adequate) progress and showing a trend toward the LHM or RHM.

From the findings, the answer to Question Eight appeared to be that problem readers old enough to be in second grade and above whose average word-recall was similar for both the LHM and RHM were those making poor reading progress; while problem readers whose average word-recall for the two methods was different were those making adequate reading progress.

Results Pertaining to Question Nine

Question Nine asked, "In kindergarten and first-grade children, is it possible to observe any behaviors that might relate to Bakker's (1979) idea of shifting from the right
hemisphere to the left during the kindergarten-first grade age level?"

The answer to Question Nine was, "Yes." Among the subjects, only five children, aged 6 years 3 months to 6 years 11 months, were too young to be in second grade. According to their teachers, all of them were making good progress as beginning readers. However, only one kindergarten boy's all-trials averages on word-recall indicated a score greater than .5 for one method (the RHM) and also showed a slight trend toward that same method when the LHM and RHM third-trial averages were compared. The other four six-year-olds showed little or no difference between the averages of the two hemispheric methods. Since the group was so small, these children's lack of a trend toward a hemispheric method could not be tested statistically, but it was possible that a preferred method, LHM or RHM, for recalling words is not often found among children at the preschool, kindergarten, or first-grade levels. It was possible that they were in the process of making the shift that Bakker (1979) suggested.

Summary

In summary, this chapter has presented the research findings to answer nine research questions, five initial questions and four secondary ones which arose from the data found to answer the initial inquiries. Some of the findings
felt to be most meaningful were: (1) For problem readers old enough to be in second grade or above, the word-recall average for one hemispheric method exceeded the other by greater than .5 in all-trials comparisons and also exceeded the other in third-trial comparisons among those categorized by their schools as making adequate reading progress; those categorized by their schools as making poor reading progress did not achieve this criteria. (2) Emotions appeared to interfere with, or even change, a child's learning style. (3) Possibly, identical twins used opposite hemispheric methods for learning. (4) Good readers were highly dependent upon a phonetic system for word recognition and recall. (5) Children in kindergarten and first grade did not appear to need one hemispheric method for learning word cards; instead, they appeared to learn equally well with both methods. (6) Finally, remediations like Vitale's (1985) colored felts appeared to increase reading in some children. Although several of these findings were not tested statistically, they suggested possible hypotheses for future research.
CHAPTER V

SUMMARY, CONCLUSION, INFERENCES, AND RECOMMENDATIONS

This chapter is divided into four major sections: the first summarizes the study; the second offers a conclusion with the educational implications and rationale; the third presents the inferences with the educational implications and rationale for each; and the fourth makes recommendations for future research and for remedial techniques.

Summary

This study used formative research methodology to examine whether each individual, beginning reader or problem reader studied, consistently recalled a greater percentage of nonsense words attempted from a card reader with a Left Hemisphere Method (LHM) or with a Right Hemisphere Method (RHM) and whether one of these two methods achieved better results than the usual Both Hemispheres Method (BHM). The methods were designed so theoretically the LHM sent auditory and visual word-stimuli primarily to the left hemisphere of
the brain; the RHM sent stimuli primarily to the right hemisphere; and the BHM sent stimuli simultaneously to both hemispheres. If a preferred method were found, it was examined as to whether or not the number of words recalled by that method exceeded the average number recalled by the baseline of the BHM.

The study employed case study/clinical, formative, pilot methodology. It was case study/clinical because it used careful observations of individuals. It was formative because the findings at one stage were sometimes used to determine a next step to be taken, and it was pilot research because a similar study in this area was not found in the literature. The lack of such information in the literature made this type of methodology necessary. Nine questions were investigated. Two statistical methods were employed: binomial distribution for analyzing individuals and chi-square for analyzing group characteristics.

A total of thirty-one Caucasian children from rural, public, and parochial schools in Berrien County, Michigan, took part in the study between March 1984 and March 1985. Of this group, two had to be reassigned to another aspect of the research because they could read the nonsense words from sight, and a third excellent reader joined them. Another boy had to be dropped because he frequently recalled all the words with the LHM and RHM, but his comprehension problems kept him from qualifying as an excellent reader. After these four were
removed, twenty-seven children aged 6 years 3 months to 12 years 2 months in preschool through fourth grade completed all the testing sessions. Each subject followed a symmetrically balanced order of testing the LHM and RHM.

A set of five initial research questions and four secondary ones which arose from an examination of the initial data were answered.

Question One asked: "For each child, is there a preferred method, LHM or RHM, for recalling words?" The answer was, "Yes," two children significantly preferred the LHM while no one significantly preferred the RHM.

Question Two asked: "If a preferred hemispheric method is found, does the child recall a significantly different number of words using it, from the number recalled by both hemispheres using both eyes and both ears?" No answer could be ascertained for this question because only one subject was retested, and neither the LHM nor BHM was statistically preferred; therefore, the results were inconclusive.

Question Three asked: "Are there specific subjects whose learning behaviors merit additional study?" The answer was, "Yes," and six case studies were presented. Two cases were subjects who significantly preferred the LHM; two were subjects who showed no trend toward either the LHM or RHM; one was a subject without a trend, only a slight leaning toward the LHM, who changed after five months to a slight leaning
toward the RHM; and a subject who always showed a slight RHM trend.

Among the meaningful observations were: (1) the tendency for emotions to change a child's learning from one hemispheric method to the other; (2) the improvement in some children's reading after they used the colored felts which Vitale (1985) suggested; and (3) the indications that some children's eyes did not work together.

Question Four asked: "Are there other observations of the children which provide insights about learning and/or the learning environment which might suggest a need for further research?" The answer was, "Yes." Those insights suggested that (1) some identical twins may learn with opposite hemispheric methods; and (2) children diagnosed as dyslexic may demonstrate memory problems and/or visual reversals.

Question Five asked: "Which method--LHM, RHM, or BHM--recalls the largest average number of words on the third trials and on all trials for each child?" The answer was that (1) almost two-thirds of the subjects learned best with both eyes and both ears; (2) of the remaining one-third, most learned best with the LHM; and (3) a few learned best with the RHM.

Question Six asked: "Is it reasonable to accept that the observed distribution for greatest recall by a method is the result of chance, if each of the three methods has an equal expectation of being the best method for any given
child?" The answer was "No"—p < .01 for the third trials and p < .001 for all trials. Thus, this distribution was not likely to be the result of chance.

Question Seven asked: "What happens to a good reader when presented with symbol representations of words which contain no phonetic clues?" The answer was that the three excellent readers showed behavior patterns similar to those of poor readers, and attempted to build their own phonetic system because they appeared to be unable to read without a phonetic framework.

Question Eight asked: "Are there any characteristics related to the LHM and RHM which differentiate between problem readers classified by the school as making poor progress versus problem readers classified by the school as making adequate progress?" The answer was, "Yes." Among all the ten problem readers who were categorized by the school as making adequate reading progress and who were old enough to be in second grade or above, a comparison of the all-trials averages for the LHM and RHM showed that one method exceeded the other by more than .5 and that that same method was greater than the other when the third-trial averages were compared. The other ten problem readers categorized by the school as making poor reading progress failed to meet this criteria—the poorest readers showed almost no trend toward either the LHM or RHM. The possibility that the observed difference between the
scores of adequate and poor problem readers was the result of chance was statistically rejected $p < .001$.

Question Nine asked: "In kindergarten and first-grade children, is it possible to observe any behaviors that might relate to Bakker's (1979) idea of shifting from the right hemisphere to the left during the kindergarten-first grade age level?" The answer was, "Yes." Of the five children who were six years old, only one showed a trend toward a hemispheric method. The rest were ambivalent toward the LHM or RHM, but they were all good readers according to their teachers. A hemispheric trend did not appear to be needed by very young children.

Although the observations made while answering Questions Four, Seven, and Nine were not tested statistically, those observations are useful in suggesting hypotheses for future research.

Conclusion

In this section, the conclusion discussed is the one judged to be most meaningful to educational practice. The conclusion reached is stated first followed by the educational implications and rationale for that conclusion.
Statement of the Conclusion

Problem readers older than the typical age for kindergarten and first grade, who seemed to have no trend toward either the LHM or RHM, were those who were most likely to have difficulty making progress in reading.

Educational Implications and Rationale for the Conclusion

As noted in the preceding summary, the problem readers categorized by the school as making poor reading progress failed to have the average number of words recalled on all trials greater than .5 for one hemispheric method, and that same method greater than the other when the third-trial averages were compared. In short, the poor readers were those who recalled about the same number of words with either hemispheric method.

The phenomenon of recalling words with either the LHM or RHM might be similar to "handedness." Children learn to write well with either the right or left hand, but those who write one word with one hand and the next with the opposite hand may have trouble learning directionality. In school, they often hesitate and appear unsure which hand to use.

A man whose non-dominant left hand had undergone surgery demonstrated this view. He reported to the researcher that he frequently dropped things with his uninjured right
hand because he lacked the body balance of the two hands working together. When his left hand was well again, his right hand behaved normally, and he stopped dropping things.

Possibly, a similar situation exists with the hemispheres. Unless one hemisphere consistently takes the lead for the same learning task, a state of confusion (poor recall) may result. Such a concept is consistent with views expressed by Pines (1973) who quoted Gazzaniga as noting "a problem in decision-making" when neither hemisphere was the leader. He said it was "like a husband and wife trying to decide what to have for breakfast; one of them's got to take the lead" (p.48).

Orton (1937) thought reading reversals were the result of incomplete brain dominance. As noted in chapter 2, (pp. 22-23) some of his ideas have been judged incorrect, but he may have been close to the truth that one hemisphere had to take the lead (be dominant). As Springer and Deutsch (1981) said, "Orton may have been right, but for the wrong reasons" (p.161). This study had results which could be interpreted to suggest that readers making adequate progress had a lead hemisphere while readers making poor progress did not.

Vitale (1985) said that the dominant hemisphere activated first and carried the major responsibility for the learning task within a whole-brain framework. As noted in chapter 2 (pp. 18-19), her definition was in keeping with Sinatra and Stahl-Gemake's (1983) view that "cooperation
rather than competition between the hemispheres seems to be the situation prevailing under most conditions" (p. 30). If a child were ambivalent toward both the LHM and RHM, neither hemisphere would appear to be carrying the major responsibility for the learning; thus, according to Vitale's (1985) definition, a lack of hemispheric dominance might be inferred.

As noted in chapter 2 (pp. 28-29), Ayers (1977) suggested that when very little difference existed between the recall of the two ears, this fact might indicate an auditory-language deficit which interfered with learning (p. 444). Such a finding would appear to be consistent with this research which found poor readers recalling about the same number of words with either the LHM or RHM.

Similarly, Crane (1985) found that those with no trend toward either hemisphere (the bilateral) were having trouble learning. Perhaps these findings support Witelson's (1977) view that both hemispheres behave the same way in problem learners when she wrote, "Developmental Dyslexia: Two Right Hemispheres, and None Left." Maybe both hemispheres were equal when neither one carried the major responsibility for a learning task. Such equality might result in confusion and poor learning for a child with no trend toward either hemisphere.

The van den Honert (1977) method might have forced ambivalent hemispheric learners to use the LHM for learning.
Her method prevented the covered right eye from sending any signals to the two hemispheres; thus, the left eye's signals were free from competition. With music sent primarily to the right hemisphere through the left ear, and reading instruction sent primarily to the left hemisphere through the right ear, van den Honert might have imposed a left hemispheric learning situation on the student. After many such sessions, the student may have been conditioned to create this method in his/her mind even when the glasses were not present.

In the same way, Vitale (1985) might have used the colored felts to impose a right-hemispheric learning situation on other ambivalent learners. It might be that Duffy's stroke victims, whom Vitale described as having suffered speech impairments, were also helped by color because it encouraged their right hemispheres to take the lead rather than their possibly damaged left hemispheres.

**Inferences**

The term "inferences" is used rather than "conclusions" because of the exploratory nature of this study. It is intended that what is referred to as "inferences" should be viewed in a more tentative way than as if the term "conclusions" had been used. Consistent with the nature of an exploratory or pilot study, it is hoped that these "inferences" will serve as a basis for formulating further
research which may result in what is commonly referred to as "conclusions."

Inference One

Some children who showed a trend toward the RHM or were ambivalent toward the LHM-RHM may be helped by looking at colored felt as Vitale (1985) suggested.

Educational Implications and Rationale for Inference One

This approach was based upon the work of Vitale (1985), who suggested that such a technique might succeed because color was connected to the speech center of the brain. Two boys who showed a trend toward the RHM surprised their mothers with their fluent reading after looking at chartreuse felt. Their reading worksheets also improved dramatically when the color was present. An ambivalent girl was judged by her teacher to be the best reader in her Special Education class after looking at lavender felt. Eighteen problem readers were tested with color. When classified according to "trend" or "no trend" as established in answering Question Eight (pp. 113-116), the eighteen subjects were categorized as follows: four had an LHM trend; four had an RHM trend; and ten were ambivalent (had no trend toward either method). Of this group, one with an RHM trend and five ambivalent subjects
appeared to be helped by the colored felts. The other three with an RHM trend were progressing well enough that it was impossible to determine whether or not color improved their reading. No subject with an LHM trend was helped by the color. For six children, the colors seemed to increase word recognition, fluency, reading rate, and comprehension.

Inference Two

All readers used phonetic clues to assist themselves in word recognition and recall.

Educational Implications and Rationale for Inference Two

In this study, readers with a good phonetic background used the letter-sounds they already knew to help themselves recall the nonsense words on the cards; while readers with a poor memory for phonics often mimicked and recalled the words incorrectly. At times, these poor readers appeared to be grasping at any sounds or substituting real words to make up for their lack of phonetic skill.

The degree to which good readers depended on phonetic clues did not become clear until the nonsense words were written in Greek, Russian, and picture symbols for three top students. When two girls with an excellent phonetic background were given words written in these symbols, they
made the same types of errors as the poorest readers who used the alphabet. The girls recalled words on one trial, but forgot them on the next. They reversed syllables during recall and showed signs of frustration when they could not find clues to help themselves recall accurately. One even remembered a word she had heard in an earlier session. They seemed to be particularly lost without a beginning and ending clue to the words they were trying to recall.

A sixth-grade boy with a WISC-R IQ of 135 was added to the subjects for the symbol-aspect of the project. When he discovered that letter-sound clues were missing, he tried to use visual association to build his own phonetic system. Having associated an arrowhead with a triangle, he said that since both the triangle and the nonsense word started with "t," he could remember the word. Seemingly, a bright student tried to compensate when a necessary item was missing. Such an attempt at compensation might indicate the importance of phonetic clues to good readers.

From the observations made in this study, there was no such thing as a "sight word." Instead, the reader used the phonetic clues for those words with such skill that they appeared to be read from sight. Phonics offered a method for generalizing sounds and gave the structure which many poor readers seemed to lack. This structure may be present to some
In all word recognition regardless of the reader's ability.

Inference Three

Excitement may cause learners to change to a nonpreferred hemispheric approach.

Educational Implications and Rationale for Inference Three

Three subjects who usually recalled more words with the LHM appeared to switch to the RHM when they were excited. A boy dramatically recalled more words with the RHM just before a Halloween party. A girl on two non-consecutive days recalled more words with the RHM just before her gym class, although she recalled more words with the LHM in all the other sessions. Finally, a second boy recalled more words with the RHM right after his teacher apologized to him. It was uncertain whether the recall of more words by the LHM in children who had a trend toward the RHM was due to their emotional state. These cases might suggest that conditions surrounding the learning activity interact with the subject's emotions to sometimes cause changes in learning style.
Inference Four

Great care should be used in making judgments about a student from a single testing session.

Educational Implications and Rationale for Inference Four

This study found that some children varied greatly from day-to-day. Emotional excitement, alertness, forgetfulness, and daydreaming appeared among some of the subjects. One girl who had a trend toward the RHM was forgetful on the days when she recalled more words with the LHM. Probably none of the subjects were consistently the same in all testing sessions. This variability of children would suggest that a single testing session may often be inadequate to evaluate a child.

It is possible that chemical changes in the bodies of children cause some of their variations. Situations at home or in school might also be factors. A high degree of structure in the learning environment might help to control some of the causes. While no one can control all the causes, a wise examiner would try to take measurements on more than one day before making a final decision about any child.
Inference Five

A child's eyes may not work together during the reading process.

Educational Implications and Rationale for Inference Five

Three of the six children reported in the case studies gave evidence that both eyes did not work together. One boy always scored higher with the LHM than with both eyes and both ears. He appeared to have some interference present when he tried to learn words from cards in the normal fashion. A girl who could not recognize a word with both eyes, often covered one and was then able to read the page correctly. Another boy showed no trend toward either the LHM or RHM with his sighting eye, but showed a slight trend toward the RHM with his non-sighting eye. These cases suggested that both eyes might not be working together in some remedial reading students. Possibly the eight or nine subjects who recalled better with one hemispheric method rather than with both eyes and both ears should have been checked to see that both their eyes were working together.

As previously noted, this study controlled for problems with the two eyes by covering the non-sighting eye and permitting only one signal from the sighting eye to go to each
hemisphere. Perhaps in-depth vision tests should be required by the school whenever a child shows problems with reading.

Inference Six

After hearing words through earphones, children should mimic the word they have just heard before they attempt to recall it later.

Educational Implications and Rationale for Inference Six

Some children in this study had trouble mimicking the sounds they had just heard although they had no hearing problem. Children who use earphones in school run the risk of learning the words incorrectly because they fail to perceive the sounds accurately. If the child mimics the word aloud to an adult right after hearing it, there is less chance that the word is learned incorrectly. The teacher could also determine whether or not the child was combining auditory and visual skills.

Recommendations for Further Research and Remedial Techniques

This was a pilot study; therefore, many of the areas which needed further investigation were beyond the scope of
this dissertation. The area of hemispheric preference, as it relates to the age of the students and to learning to read in general, was not explored with statistical research hypotheses and designs. Remedial techniques also were not investigated to determine their appropriateness according to the age and needs of the learner. Much investigation remains for future researchers.

**Recommendation One**

The instrument used in this research and other hemispheric testing instruments, need to be refined and used with an appropriate cross-section of the population of children who are just learning to read to determine age norms for hemispheric preference.

**Recommendation Two**

Other measures for determining hemispheric preference versus hemispheric ambivalence need to be used to learn if those who are hemispherically ambivalent are also "at risk" of failure in reading, and if they are "at risk," at what age did this risk of reading failure develop.
Recommendation Three

A study needs to be devised to find out if emotional excitement causes learning to change from one hemispheric method to another in a statistically significant number of subjects.

Recommendation Four

Many careful case studies of problem readers need to be made which study the child wholistically. Influences such as dietary habits, body chemistry, allergies, TV habits, home and school atmospheres, and emotional stability, in addition to academic environment, may account for poor learning.

Recommendation Five

A "blind" study needs to be done to determine if Vitale's theory of color actually improves a child's oral reading. A child's reading could be taped before the color was introduced and again while color was present. A panel of experts would listen to the two tapes presented in random order and would then pick the one in which the child reads better. The researcher could tabulate the experts' choices and see if they picked the tape made while the color was
present. Thus, a researcher could determine whether or not color significantly improved oral reading in a child.

**Recommendation Six**

Approaches need to be devised and used to help ambivalent hemispheric learners develop a "lead" hemisphere which will activate first and carry the major responsibility for reading. This is analogous to what teachers have done for years with children who did not develop a hand preference. Methods such as Vitale's colored felts or van den Honert's music and special glasses may be appropriate for such children.

**Recommendation Seven**

Attempts need to be made to develop a unified theory which can relate the findings of those who seek a "lead" hemisphere for reading to the findings made by the proponents of the auditory and visual modalities. Those who are interested in the modalities say that sight and hearing must be integrated within the learner. This integration takes place within the learner's brain; thus, the hemispheres are involved in the integration of sight and hearing.

In view of the similarity of interests between the proponents of the modalities and the proponents of the
hemispheres, logic dictates that an effort should be made to incorporate research from both groups into a single body of knowledge which can relate the neurological findings regarding the hemispheres to remedial techniques involving the auditory and visual modalities. Such an approach could provide a unified attack on reading problems. At present, the knowledge is fragmented among various groups, and the classroom teacher has to search endlessly to obtain the needed information for remedial instruction. Efficiency demands a single body of knowledge which will incorporate all the ideas.
APPENDIX A

WORDS ON READING CARDS USED IN RESEARCH

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## APPENDIX B

### A TESTING WORKSHEET

#### TESTING PATTERN I

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GUPKAS -- -- -- SEFBAM -- -- --
SEKZUB -- -- -- DOPTEG -- -- --
LATGIP -- -- -- MUNPID -- -- --

13th = B
   (J')
JISGAK -- -- -- ZOBMAG -- -- --
NOZKEV -- -- -- SUGBEF -- -- --
MEFSIB -- -- -- LANFIK -- -- --
TUPBOV -- -- -- NIDPOB -- -- --
FAVLUD -- -- -- PELCUV -- -- --

14th = P
   (I')
VIDBAP -- -- -- DUBTAF -- -- --
LUNGEM -- -- -- SANLEP -- -- --
SOLPIF -- -- -- LODGIS -- -- --
TEZFOB -- -- -- NESPOV -- -- --
DATMUP -- -- -- JITFUB -- -- --
### TESTING PATTERN II

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PREFERRED AND BOTH (PATTERN II)
13th = \( P \)

\( (J') \)

\( B \)

\( (K') \)

14th = \( B \)

\( (L') \)

\( P \)

\( (M') \)

\begin{align*}
JISGAK & -- -- ZOBMAG -- -- -- \\
NOZKEV & -- -- SUGBEF -- -- -- \\
MEFSIB & -- -- LANFIK -- -- -- \\
TUPBOV & -- -- NIDPOB -- -- -- \\
FAVLUD & -- -- PELCUV -- -- -- \\
VIDBAP & -- -- DUBTAF -- -- -- \\
LUNGEM & -- -- SANLEP -- -- -- \\
SOLPIF & -- -- LODGIS -- -- -- \\
TEZFOB & -- -- NESPOV -- -- -- \\
DATMUP & -- -- JITFUB -- -- -- \\
\end{align*}
APPENDIX C

OBSERVATION CHECKLIST

--- 1. Used ___ eye for sighting-dominance.

--- 2. Tested the dominant eye.
--- a. The dominant eye significantly preferred the ___ hemisphere.
--- b. The dominant eye showed no significant preference for either hemisphere.
--- c. The dominant eye showed a nonsignificant trend toward the ___ hemisphere.

--- 3. Tested the nondominant eye.
--- a. The nondominant eye preferred the ____ hemisphere.
--- b. The nondominant eye prefers (the same, a different) hemisphere from the dominant eye.

--- 4. Mimicked a nonsense word correctly immediately after hearing it with the ___ hemisphere.

--- 5. Mimicked a nonsense word incorrectly immediately after hearing it with the ___ hemisphere.

--- 6. Recalled vowel sounds incorrectly after a two-minute delay with the ___ hemisphere.

--- 7. Recalled consonant sounds incorrectly after a two-minute delay with the ___ hemisphere.

--- 8. Recalled nonsense syllables in reverse order with the ___ hemisphere.

--- 9. Recalled a nonsense word correctly on the 1st or 2nd attempt, but forgot it on the 3rd trial with the ___ hemisphere.

--- 10. Is reading at or above grade level in school.

--- 11. Is reading below grade level in school.
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Miscellaneos


VITA
VITA

Personal Data

Charlotte Virginia Groff was born August 9, 1932, in Hinsdale, Illinois, the daughter of Robert Earle and Virginia Boone Groff of 108 S. Kephart Lane, Berrien Springs, MI

Education

B.A. with honors in English, May 1954 from Emmanuel Missionary College (now Andrews University), Berrien Springs, MI

M.A. in English summa cum laude, August 1965 from Andrews University, Berrien Springs, MI

Graduate work in Reading, 1973-74 from Western Michigan University, Kalamazoo, MI

Doctoral candidate, 1986, for the Ph.D. degree in Educational Psychology from Andrews University, Berrien Springs, MI

Work Experience

Elementary teacher, 1954-55, St. Joseph Public Schools, St. Joseph, MI

Elementary teacher, 1955-56, Benton Harbor Public Schools, Benton Harbor, MI

Elementary teacher, 1956- , Coloma Community Schools, Coloma, MI

Includes: teaching Early Ele 1956-60

teaching 1st and head teacher 1960-74

teaching 1st 74-75

reading specialist 75-

Instructor in English, 1965-66, Lake Michigan College Night College, Benton Harbor, MI

Teacher of 5-6 year-olds, Coloma Summer Migrant Program, 1968-79, 1982-

Guest lecturer in Wordsworth at Andrews University 1965-75.
Publishing Experience


Editor, E.M.C.A. Tatler, 1949-50.

Religion Editor, Student Movement, 1953-54.


Script writer, Your Story Hour Radio Program, 1954.

Editor, Career Development Centered Curriculum Project, ESEA Title IV-C, Kindergarten through Sixth Grade Units, Coloma Community Schools, Coloma, MI, c1975.


Memberships

Seventh-day Adventist Church (Deaconess)
Phi Delta Kappa
International Reading Association
Michigan Reading Association
Tri-County Reading Association
Algonquin Chapter DAR
Colonial Dames XVII Century
Dames of the Magna Charta
Michigan Society of Mayflower Descendants (Life Mem.)
Genealogical Association of Southwestern Michigan
Four Flags Genealogical Association
Alden Kindred of America
Van Kowvenhoven-Conover Family Association