BRAIN LATERALITY AND EMOTIONAL PROCESSING IN CHILDREN

BY

JAMES H. M. WOODWARD

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1984
TO
MEG AND ANTHONY
ACKNOWLEDGEMENTS

I would like to express my appreciation to those people who have assisted me in the development of this study:

Dr. Don Avila, chairman of my doctoral committee, whose friendship and humanitarianism has encouraged my own scholarly pursuit;

Dr. Eileen Fennell, committee member, for patiently educating me in the field of neuropsychology;

Dr. Larry Loesch, committee member, for opening my eyes to the intricacies of educational research;

Dr. Steve Olejnik, committee member, for his invaluable advice and tutelage in the areas of research design and statistics;

Dr. William H. Edenfield, Supervisor of Psychological Services, Marion County School System, for professional leadership and encouragement;

Dr. Lee Rowell, Director of Student Services, Marion County School System, for his administrative and moral support;

Dr. Bruce Hartley, James Huckeba, Charles Porterfield, and Mike Mishkin who assisted me in data collection;

Mary Miale for her expertise and perseverance in the typing of this dissertation;
Janet and William Woodward, my parents, for their love and personal support;

And especially, my wife, Meg, and my son, Anthony, for their patience and understanding during these years of educational pursuit.
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Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

BRAIN LATERALITY AND EMOTIONAL PROCESSING IN CHILDREN

By
James H. M. Woodward

August, 1984

Chairman: Dr. Donald L. Avila
Major Department: Counselor Education

Recent studies in the area of brain functioning indicate that the left and right cerebral hemispheres tend to be dominant for differing functions. In particular, the left hemisphere has been found to be dominant for language processing, while research suggests that the right hemisphere plays a dominant role in the processing of emotional stimuli. The research literature also indicates that a relationship exists between the Wechsler Intelligence Scale for Children-Revised (WISC-R) and hemispheric processing. This study investigated the relationships between intelligence test scores, cerebral hemisphere dominance, and the means by which certain groups of children interpret emotion.

A total of 160 students with significant Verbal-Performance IQ differences on the WISC-R were presented with an audio tape of 32 emotional statements which varied on the dimensions of emotional content and emotional tone. A 2 x 2 x 2 factorial
design was utilized with Verbal-Performance IQ dominance, sex, and age as completely crossed independent factors. The dependent measure was the number of "content" answers to the audio tape.

A negative relationship was found between Full Scale IQ scores and response to the emotional content of the audio tape. A comparison of the 6-10-year-old and 11-15-year-old high Verbal groups found the older group responded significantly more often to emotional tone. A comparison of the older high Verbal and high Performance groups indicated the high Verbal group again responded significantly more often to the emotional tone of the taped statements. No significant differences were found between the younger age groups or between the high Performance groups. Sex was not found to evidence as a significant factor.

It was concluded that while there is no difference between the high Verbal and high Performance groups at the younger age level, as children grow older, the high Verbal students shift toward basing their interpretation of emotional statements upon the tone of the speaker. High Performance children, however, continue to respond similarly to the younger age groups. It was observed that the change in the response pattern of the high Verbal group coincides with Piagetian developmental stages and with brain myelination stages.
CHAPTER I
INTRODUCTION

This study investigated the relationships between intelligence test scores, cerebral hemisphere dominance, and the means by which certain groups of children interpret emotion.

Overview of the Study

As the understanding of human behavior becomes more complete, educators are discovering indications that each individual student has preferred modes by which he/she receives and interprets information. These preferred modes have sometimes been referred to as "learning (or cognitive) styles." Psychologists employ various diagnostic instruments in their efforts to determine these learning styles. Intelligence tests, for example, are designed to diagnose "intellectual potentials" as well as primary areas of strength and weakness for processing information received and consequent tendencies in terms of learning style.

Research relating to the styles and patterns of effective learning has taken many directions and in recent years increasing attention has been given to the left and right cerebral hemispheres of the brain and their respective functions. Research directed toward gaining additional understanding of the cerebral hemispheres and
their individual roles in the operation of the human organism has generated excitement in the educational community, particularly in respect to the potential value of this research when applied to the diagnosis of learning styles. Ley (1983) emphasizes this point in the following:

It should be noted that what best distinguishes each hemisphere is the way in which it works, rather than with what it works: differences in hemispheric functioning relate more to the kind of information processing, rather than to the information that is processed. It is not so much that each hemisphere is specialized to work with different material--the left with words, the right with spatial relationships--but that each is organized to provide a different cognitive style. The styles are more or less efficient in the processing of different types of information. For example, the left hemisphere has been described as a logical, analytic, and sequential processor for which words are most appropriate. The right hemisphere has been characterized as a holistic, gestalt, and diffuse processor for which spatial forms or patterns are most suited. (p. 255)

Some researchers have specifically investigated the effects of brain damage in the individual hemispheres upon subjects' abilities to comprehend the emotional content and emotional tone of verbal statements. They hypothesize that deficiencies, due to damage in one cerebral hemisphere or the other, may limit an individual's ability to interpret certain types of emotional cues provided by their environments. Damage to the right hemisphere is believed to impair the patient's ability to interpret the emotional tone of a verbal message while left hemisphere damage is believed to
impair his/her ability to comprehend the content of a verbal message.

One instrument which is commonly used in the diagnosis of learning problems in school children is the Wechsler Intelligence Scale for Children-Revised (WISC-R). This test yields both "Verbal" and "Performance" intelligence quotient scores, as well as a "Full Scale" IQ which, according to the manual, is designed to give an indication of "the overall capacity of an individual to understand and cope with the world around him" (Wechsler, 1974, p. 5). The Verbal-Performance dichotomy is "primarily a way of identifying two principal modes by which human abilities express themselves" (Wechsler, 1974, p. 9). Both the Verbal and Performance tests are made up of six subscales each (five of which are commonly used and one which is employed as a "supplementary" scale). Verbal-Performance dichotomies, as well as subtest combinations, may be useful in describing a child's learning profile (Kaufman, 1979; Sattler, 1974; Wechsler, 1974).

Recent studies, including a factor analysis by Kaufman (1975), have indicated that the Verbal portion of the WISC-R tends to measure left brain abilities while right brain abilities tend to be measured by the Performance section of the test. Additional analysis has also been completed by Kaufman regarding the individual subscales of the WISC-R and their factor loadings when applied to right and left hemisphere tasks.
In summary, there appears to be a relationship between lateral cerebral function and the ability to perform specific types of tasks. There also appears to be a relationship between lateral cerebral ability and the Wechsler Verbal-Performance dichotomy.

A great emphasis is currently being placed upon providing students with an education appropriate to their individually demonstrated needs. This trend has received particularly strong support in special education in the wake of federal legislation. Federal laws 89-313 and 94-142 speak specifically to the provision of "individual education plans" for handicapped children. This individualized approach is requiring school systems to look more closely at the individual student in order to assess and address any special needs. In the main, the major burden of this responsibility has been assigned to the school psychologist, who is asked to evaluate those students suspected of having unique difficulties in profiting from the regular curriculum and to make recommendations designed to help alleviate these difficulties.

The psychologist's evaluation is based largely upon the results of standardized test data. The increasing demand for precise identification of problem areas for students has resulted in increased research by psychologists as they seek to obtain more information and greater precision from their evaluative instruments (Sattler, 1974; Kaufman, 1979).
Statement of the Problem

The specific problem addressed in this study was that psychologists, particularly school psychologists, are in need of more definitive methods for diagnosing the learning and response patterns of students. The duties of the school psychologist include helping teachers to better understand the individual learning styles of students and to help students better understand themselves. This study attempted to help solve this problem by utilizing current research findings, such as those in the area of brain research, and by attempting to gain more information from the already widely used WISC-R.

Statement of the Need

This study was intended to provide more precise information regarding the widely used WISC-R by examining this test's relationship to children's abilities to interpret emotional cues from their environment. Significant results, relating WISC-R Verbal-Performance discrepancies with children's styles of processing emotional stimuli, would provide valuable information for both the practitioner and the researcher in the areas of theory, research, practice, and training. A practitioner, upon seeing a significant Verbal-Performance split in a child's WISC-R profile, would be able to predict whether the child is most likely to respond to the content of an emotionally-laden message or to the tone of the message. If the child has a significant
strength in the verbal area, the practitioner might attempt to help the child to become more aware of emotional tone as a means of improving the child's competence in social interaction. A child with a performance strength, who responds primarily to emotional tone, might increase interpretive accuracy when deciphering spoken language by learning to give more focus to the content of messages.

Having cognitive emotional style information in the child's psychological profile would enable teachers and administrators to design teaching strategies tailored to the child's best advantage. A student found to have a verbal strength might respond most quickly and appropriately when the content of the message is clear and concise. Conversely, the student with a performance strength may interpret emotional stimuli in the environment on the basis of emotional tone and this factor would need to be considered in the teaching of most behavioral expectancies and many academic tasks.

Researchers interested in the right brain, left brain dichotomy may find significant results from this study to be useful in furthering the understanding of brain processes. It has been shown that adults appear to process emotional messages differently with the right brain than with the left (Heilman, Scholes, & Watson, 1975; Tucker, Roth, & Armeson, 1977; Wechsler, 1973). Both the adult version of the Wechsler (WAIS) and the WISC-R appear to relate well to
right and left brain abilities (Kraft, 1983; McGlone, 1978). It, therefore, seems reasonable that a relationship between the WISC-R Verbal-Performance Scales and right and left brain types of tasks would have implications for the development of the cerebral abilities of children.

Although much research designed to explore the brain functioning of adults has been completed in the past two decades, relatively little is known about the effects of brain laterality in children. In particular, there has been almost no research which specifically addresses emotion in children as it relates to right and left cerebral hemisphere processing in children.

Trainers in school and clinical psychology programs are interested in helping their students to diagnose the emotional traits and tendencies of children. Both disciplines also heavily employ the WISC-R. Trainers should find the results of this study useful in the education of their graduate level students.

**Purpose of the Study**

The purpose of this study was to investigate the relationship between Verbal-Performance WISC-R scores and children's abilities to interpret the emotional tone and emotional content of sentences.

There was an attempt to answer the formulated research questions and to provide for the uses elucidated in the areas of practice, training, research, and theory within the disciplines of school and clinical psychology.
Rationale for the Approach

The sample consisted of students found to have a significant difference of 12 IQ points between their Verbal and Performance scores on the WISC-R. These students were tested for their tendencies to respond to the content or tone of emotionally-charged messages by listening to an audio tape containing 32 such messages. Eight of the messages contained content which was consistent with the tone in which the message was spoken, but the remaining 24 messages had emotional content paired with contrasting emotional tone. The individual subject's tendency to respond primarily to the content or the tone of a message was compared with his/her strength in the Verbal or Performance area. These comparisons gave an indication of whether students with an IQ strength in one area tend to focus upon the content or the tone of a message and whether this tendency differs from that of students with an IQ strength in the opposite direction.

Although advances are occurring for directly measuring the physiological properties and processes of the brain, clinical assessment continues to be our most effective measure and, therefore, is also the most often used. The WISC-R has been chosen as it has been widely validated as an instrument for intellectual evaluation. From a practical standpoint, students who have been evaluated by this instrument and exhibited significant differences between their
Verbal and Performance scores are readily available. The age span which this test covers (6 through 17) also lends itself to the population to be studied.

The audio tapes containing the emotionally-laden messages have previously been used successfully with schizophrenic adults. School age children were expected to find the task novel and interesting. The task also allowed for group administration which was desirable in light of the number of subjects involved. Scoring was objective.

**Research Questions**

The research questions tested in this study were as follows: (1) Is there a positive relationship between children's preferences for interpreting the content of a verbal statement and a significant Verbal-Performance split on the WISC-R in favor of the Verbal score? (2) Is there a positive relationship between children's preferences for interpreting the tone of a verbal statement and a significant Verbal-Performance split on the WISC-R in favor of the Performance score? (3) Does the sex of the student have any effect upon research questions 1 and 2? (4) Does the age of the student have any effect upon research questions 1 and 2?

**Hypotheses**

This study tested the following null hypotheses concerning the relationships between Verbal-Performance discrepancies on the WISC-R, sex, and age as they related to the research subjects' scores on the content measure.
Null Hypothesis 1: There will be no significant three-way interaction between the high Verbal or high Performance groups, sex, and age on the content measure.

Null Hypothesis 2: Differences between males and females on the content measure will be the same across the two levels of age.

Null Hypothesis 3: Differences on the content measure between the high Verbal or high Performance groups will be the same for males and females.

Null Hypothesis 4: Differences between the high Verbal and high Performance groups on the content measure will be the same across the two age groups.

Null Hypothesis 5: There will be no significant difference between subjects over the age of 11 and those under the age of 11 on the content measure.

Null Hypothesis 6: There will be no significant difference between males and females on the content measure.

Null Hypothesis 7: There will be no significant difference between the high Verbal and high Performance groups on the content measure.

Scope of the Study

The interpretation of the results of this study needs to be made in the light of several limitations. The subjects used in the study were Marion County, Florida, students referred for psychological testing due to learning or behavioral problems or for intellectual giftedness. This is a special population whose characteristics may have influenced the results.
It should also be recognized that the audio tape employed as the evaluative instrument was originally designed for use with an adult population. Although the instrument's applicability for use with children was explored via a pilot study, certain individual students may have had inordinate difficulty with the task, particularly those of lower intelligence.

An additional concern regards the sex of the speaker on the audio tape. The speaker was female and it is possible that certain students may have responded differently if the speaker was a male.

**Definition of Terms**

*Anterior commissure*—A bundle of fibers connecting phylogenetically older portions of the right and left cerebral hemispheres.

*Cerebral hemispheres*—In the human brain, the two lateral halves of the cortex and underlying white matter.

*Cerebral localization*—The tendency for specific types of tasks to be governed by particular regions of the cerebral cortex.

*Corpus callosum*—The massive bundle of nerve fibers connecting the right and left cerebral hemispheres.

*Dichotic listening studies*—Brain research studies in which material is introduced auditorily to the right and left ears of subjects in separate presentations. Generally, measurements of rate and accuracy of understanding are taken.
Emotional content—The emotional mood implied by the semantic content of a verbal statement.

Emotionally-laden message—For the purposes of this study, a verbal statement containing emotional content and/or emotional tone.

Emotional tone—The emotional affect implied by the speaker's tone of voice.

Hemispherectomy—Surgical removal of one of the cerebral hemispheres.

Lateral cerebral function—Manner of processing stimuli or task specificity of a cerebral hemisphere.

Left cerebral hemisphere—The "verbal" hemisphere; it tends to analyze stimuli in a systematic sequential manner.

Myelination—The production of a white, fatty substance surrounding portions of nerve axons that acts to increase the speed and efficiency of nerve impulses.

Right cerebral hemisphere—Hemisphere which tends to analyze stimuli in a "holistic" or gestalt manner and is also believed by some authorities to mediate emotional processes.

Spatial recognition task—Research in which a subject receives clues through one or more sense modalities with which they are required to identify familiar forms or objects.

Tachistoscope—A device used to present visual stimuli of a short duration.

Temporoparietal (lesions)—An area of destroyed or removed brain tissue within the temporal or parietal lobes of the cerebral cortex.
Visuospatial functions—The analysis of the relationships between visually-perceived matter. Most often performed by the right cerebral hemisphere.

Overview of Remainder of Paper

Chapter II reviews the literature and discusses the theoretical frameworks underlying the various aspects of the study. Implications for theory, research, training, and practice are explored. Support for the instrumentation and assessment procedures are also presented.

Chapter III identifies and delineates the variables studied. The population is described and sampling procedures listed. Descriptions of the research design, research procedures, credential of participants, and data analysis procedures are provided. Methodological limitations of the study are discussed.

Chapter IV contains the data analysis and summary tables. Chapter IV also addresses the hypotheses in light of the research results.

Chapter V presents a summary of the paper. Implications for theory, practice, research, and training are discussed in light of answers to the research questions. Generalizability and limitations of the study are also examined.
CHAPTER II

REVIEW OF THE LITERATURE

This study addressed human brain functioning and how it can be measured. It specifically sought to understand the individual differences among children and how they interpret the statements of others. This chapter provides a historical perspective of brain research and provides research support for the current study. The variables of sex and physiological development are discussed as they relate to current brain research. The relationship between brain hemisphericity and the Wechsler scales is also examined.

The Development of Hemispheric Research

The human brain has presented as such a formidable subject for study, that it is only in the most recent of years that we have begun to make real advances into understanding the mechanisms of its operation. Although it had been long understood that the brain was divided into left and right cerebral hemispheres connected by bundles of fibers, it was not until the early parts of the nineteenth century that scientists began to suspect the brain of having physiological regions of specialization and could be studied from the viewpoint of "cerebral localization" (Springer & Deutsch, 1981). As the century progressed, Gall, Bouillard,
Dax, Broca, Jackson, and others specifically concentrated upon those medical patients who have lost the ability to produce speech and, via autopsy of these patients, concluded that the area responsible for speech production was localized in the left frontal lobe (Gibson, 1962). Other nineteenth century researchers, most notably Wernicke and Liepmann, discovered that the left hemisphere was also the seat of other less obvious functions. Wernicke found the left side to be dominant in the understanding of speech, while Liepmann was able to show that purposeful movement was the province of the left hemisphere, as well. Findings such as these led Jackson to propose, in 1865, that while the left hemisphere maintained control of language functions, the right hemisphere managed perception and visual ideation (Jackson, 1865/1958).

Nineteen hundred and thirty-five marked the first time in which a large group of brain-damaged subjects was studied intensively (Weisenberg & McBride, 1935). Subjects were administered a variety of psychological tests. In general, damage to the left hemisphere resulted in poorer language ability, while damage to the right hemisphere resulted in poorer scores on tests involving visuo-spatial abilities.

Research regarding the roles of the individual hemispheres in the functioning of the total human being began in earnest in the second half of this century and has incorporated a wide variety of innovative and ingenious techniques.
Much of this research was stimulated by the findings of Bogen and Vogel (1962) who performed a series of surgical operations on epileptic patients, whereby they severed the corpus callosum and the anterior commissure which connect the two cerebral hemispheres. Though the goal of this operative procedure was to control seizure activity, which was successfully accomplished, postoperative experiments with the patients demonstrated differing functions and abilities in the right and left hemispheres (Bogen, 1975; Gazzaniga, 1970; Levy, 1974; Levy-Agesti & Sperry, 1968; Levy & Trevarthen, 1976; Levy, Trevarthen, & Sperry, 1972; Sperry, 1968; Sperry, 1974). The left hemisphere was again shown to be much superior to the right in both the production and comprehension of language, while manual manipulation and perception of spatial relationships were indicated to be the province of the right hemisphere (Gazzaniga & Volpe, 1981).

Experiments conducted on patients under the effects of sodium amytal in which one cerebral hemisphere has been anesthetized have been useful in gaining estimates of the percentages of right and left-handed populations having speech represented in the left hemisphere (Rasmussen & Milner, 1977; Wada & Rasmussen, 1960). Rasmussen and Milner determined that over 95 percent of right-handers and 70 percent of left-handers have speech represented in the left hemisphere. Approximately 15 percent of left-handers have speech in the right hemisphere, while another 15 percent of
left-handers have speech bilaterally represented. These findings are in direct support of those obtained by Penfield and Roberts (1959) in which they mapped the speech areas of the brain via electrical stimulation of the brain's speech centers.

Brain Laterality and Emotion

Heilman, Scholes, and Watson (1975), in working with left and right hemisphere damaged patients, found that right hemisphere damaged patients had more difficulty in the comprehension of affective speech. Twelve subjects (six with right temporoparietal lesions and six with left temporoparietal lesions) were presented with tape-recorded messages in one of four emotional tones (happy, sad, angry, or indifferent) and asked to identify the emotion by pointing to the appropriate facial picture. Although all 12 subjects were able to consistently identify the verbal content of the sentences, the left hemispheric patients were significantly better able to identify the correct emotion, suggesting that the right hemisphere is integral in the interpretation of emotional material. These results are supported by others (Gainotti, 1972; Gardner, Ling, Flam, & Silverman, 1975; Ley & Bryden, 1981, 1982b; Wechsler, 1973) which also point to the right hemisphere as primary in the mediation of emotional processing.

In a similar study, Tucker, Watson, and Heilman (1976) found that right temporoparietal patients also had more
difficulty than left temporoparietals in their ability to express affect.

An interesting case study was reported by Smith (1966) in which a 47-year-old man received a left hemispherectomy (removal of the left cerebral hemisphere). For several months following surgery, the patient was able only to produce "expletives and short emotional phrases" such as "goddammit!" This patient was able to express affect, but nothing else with his remaining right hemisphere. This case suggests that while the patient's verbal hemisphere was removed, some highly emotional language apparently remained in his right hemisphere.

The direction in which a subject's eyes move when responding to particular types of questions has been linked to laterality of brain function (Bakan, 1969; Kinsbourne, 1972; Galin & Ornstein, 1974). Cognitive activity in one hemisphere is predicted to cause lateral eye movements (LEMs) toward the opposite hemisphere. Attempts to investigate the hemispheric location of emotional processing has been pursued via LEMs (Schwartz, Davidson, & Maer, 1975; Tucker, Roth, Arneson, & Buckingham, 1977). Emotional questions were found to elicit an increased number of left lateral eye movements, suggesting that the right hemisphere is dominant for emotional processing.

Yet another procedure used to study hemispheric differences is the dichotic listening technique in which stimuli
are presented auditorily to the individual ears in turn. Kimura (1967) reported a right ear and left hemisphere advantage in the processing of verbal stimuli. Dichotic listening experiments by Safer and Leventhal (1977), however, found a left ear and therefore right hemisphere superiority for the making of judgments regarding sentence content and speaker's tone of voice which has been interpreted as giving further evidence of the right hemisphere's importance in the processing of affective comprehension (Tucker, 1981). Identification of the affective tone of spoken passages was also demonstrated as an advantage for the left ear by Ley and Bryden (1982a). Carmon and Nachshon (1973) found left ear advantages for recognizing nonverbal but human produced sounds such as crying, laughing, and shrieking.

Dichotic listening tasks requiring the subjects to discriminate affect and content were presented by Saxby and Bryden (1984) to a group of kindergarten, fourth, and eighth grade students. A left ear advantage for the discrimination of emotion and a right ear advantage for the discrimination of content were reported. These results were interpreted as consistent with the left hemisphere superiority for language processing and the right hemisphere superiority for emotional processing previously indicated for adults. The results did not vary significantly among the age groups but indicated girls to demonstrate greater laterality effects than boys.
The individual hemispheres process visual information presented to the opposite visual field. The right hemisphere, for instance, processes information presented in the left visual field. Ley and Bryden (1979) and Safer (1981) report that subjects identified the emotions portrayed in photographs and drawings of faces more accurately and more quickly when they were presented in the left visual field. This evidence again suggests a right brain superiority for the processing of emotional stimuli.

A detailed review of the hemispheric literature investigating the lateralization of emotional activation, emotional recognition, or emotional processing of emotional stimuli has been conducted by Chaknis (1982). This review cites studies of clinical (Bear, 1983; Heilman & Valenstein, 1979; Morrow, Urtunsk, Kim, & Boller, 1981; Ross & Mesolam, 1979) and normal subjects investigated via dichotic listening techniques (Carmon & Nachson, 1973; Fennell & Mulheirn, 1981; Ley, 1980), lateralized presentations to visual half fields (Ley, 1980; Ley & Bryden, 1979; Safer, 1981; Strauss, 1983; Strauss & Moscovitch, 1981; Suberi & McKeever, 1977), lateralized eye movements (Schwartz, Davidson, & Maer, 1975), and EEG studies of hemispheric activation (as reviewed in Tucker, 1981). This review concludes general support for "RH superiorities in activation (i.e., GSR and EEG data), recognition (auditory or visual accuracies), or processing (i.e., reaction time) for emotional stimuli such as facial expressions or tones of voice" (Chaknis, 1983).
The research, then, indicates that for the great majority of individuals the cerebral hemispheres of the brain appear to have some degree of specialization in the operation of particular tasks and in the performance of particular functions. In essence, the left hemisphere has been found to be largely involved with language functions, while the right hemisphere manages the visuo-spatial realm. The research also suggests that while the left brain appears dominant for the operation of most speech functions, those functions involving the interpretation and expression of emotional stimuli seem most adequately performed by the right hemisphere.

The Wechsler Scales and Brain Laterality

As described in the introduction, the WISC-R is a commonly used instrument in the practice of school psychology throughout the United States, offering both "Verbal" and "Performance" scales, as well as a "Full Scale" IQ score. Kaufman (1979) believes that there may be correspondence between the Verbal and Performance scales and left and right brain functioning. He states that "true differences in verbal and nonverbal intelligence may reflect greater dependency on one or the other cerebral hemisphere. The left hemisphere is specialized for processing linguistic stimuli, and the right hemisphere is adept at handling visual-spatial stimuli. Consequently, P>V may suggest a better developed right hemisphere, and V>P may imply an especially efficient
processing system in, or dependence on, the left hemisphere" (p. 27).

Fedio and Mirsky (1969) found that they could predict the side of lesion in 6-14-year-old temporal-lobe epileptics by observing the direction of Verbal-Performance discrepancies on the WISC (forerunner of the WISC-R). The work of Rourke, Young, and Flewelling (1971) further substantiates Kaufman's statement in their study of 9-14-year-old learning disabled children. Those students with V>P on the WISC outperformed students with P<V on verbal tasks, while the opposite was true for the students when faced with perceptual tasks.

Rudel and Teuber (1971) found that subjects with low Performance scores on the WISC had the greatest difficulty when confronted with a route-finding task and made the most "spatial errors." These same researchers (1974) also administered the WISC to a group of neurologically-damaged children and found that those with right brain damage had significantly higher Verbal than Performance scores. They also reported that although left brain damaged subjects had higher Performance than Verbal scores, they did not reach a level of significance.

A group of 9-14-year-old boys were compared regarding WISC scores and their performance on a variety of lateralized tasks (Rourke & Telegdy, 1971). It was found that these boys with V>P did better on "tasks thought to be subserved primarily by the left cerebral hemisphere (e.g.,
reading, spelling, arithmetic, speech-sounds discrimination)," while boys with P > V were found to do better "on tasks thought to be subserved primarily by the right cerebral hemisphere (e.g., spatial visualization, visual memory, complex visual-motor coordination)" (p. 882).

Kershner and King (1974) also presented the WISC to brain-damaged children and found that "left damaged were poorer than the right damaged on all of the verbal tests" and "with the exception of Mazes, the right damaged children were poorer than the left damaged on the visuo-spatial tests" (p. 1288).

A study employing the WISC-R was reported by Kraft (1983), the results of which "strongly support the hypothesis that laterality is related to Wechsler Intelligence Scale scores" (p. 86).

Research involving the adult version of the Wechsler scales, the Wechsler Adult Intelligence Scale (WAIS), provides additional evidence in support of correspondence between the Wechsler scales and hemispheric functioning. McGlone (1978) found that the WAIS, when administered to brain-damaged adult males, correlated strongly with the side of the brain injury. Injury to the left brain resulted in poorer Verbal scores, while injury to the right brain resulted in poorer Performance scores. No effects of the side of lesion were demonstrated for women.
A body of literature, therefore, exists linking the Wechsler scales, and the WISC-R in particular, with right and left brain abilities. The Verbal scale appears to be related to left brain abilities, while right brain abilities seem to be primarily measured by the Performance scale.

**Child Development and Learning Patterns**

Research studies conducted with children suggest that their learning patterns and learning capabilities change as a function of their age. The cognitive development of children includes several stages which determine the approach their analysis of stimuli in the environment can take.

The theory of developmental psychology as proposed by Jean Piaget and his followers describes these stages. Two of these stages are reported to occur between the ages of 6 and 15. These age parameters are also encompassed as the age limits for testing with the WISC-R. The first of the stages is that of "concrete operations" occurring approximately between the ages of 6 and 11. According to Fitzgerald and Strommen (1972), "the concrete operational child can apply operations to material which he is manipulating but he has difficulty when it comes to applying them to hypothetical situations. Moreover, he is not yet able to coordinate two or more operations" (p. 21).

The latter of these two developmental stages is the stage of "formal operations" occurring between the ages of
11 and 15. The formal operations child "can coordinate his operations into higher order operations, permitting him to use two or more operations in conjunction with each other. He also begins to examine his own thinking and becomes aware of and critical of his own ideas" (Fitzgerald & Strommen, 1972, p. 21). It appears, then, that approximately at the age of 11, a change occurs in the cognitive processes of children, moving them from a stage in which they learn to think logically to one in which they also learn to think abstractly. It is conceivable that this growth in mental ability may have some effect upon the manner in which the individual child interprets emotional stimuli.

Kraft (1980) examined the relationship of the physiological development of the nervous system to the observed Piagetian stages and theorizes that neuronal development in the form of myelination of nerve fibers facilitates the progression of the individual through the Piagetian stages:

There is reason to believe that the ability for interhemispheric integration develops during childhood which may be a function of myelin development in the brain. It is possible that Piagetian conservation tasks are behavioral measurements of interhemispheric integration and progression through Piagetian stages may parallel these cycles of myelin development. (p. 641)
There are, then, two forms of evidence, observational and physiological, which describe stages in the development of children and appear to correlate with each other. The "concrete operations" stage occurs between the ages of 6 and 11, while the "formal operations" stage occurs between the ages of 11 and 15. Evidence suggests that we may expect children in these two age ranges to solve problems by using different thinking styles and that these differing thinking styles may be due to physiological differences in the brains of the two age groups.

**Laterality and Sex**

The sex difference, demonstrated for adults in the McGlone (1978) study, has also been indicated in studies with children. Witelson (1976) examined 6-13 year old right-handed youngsters on spatial recognition tasks. Boys were found to do better with their left hands (and presumably right brains) than with their right hands, while girls showed no difference between hands.

In the aforementioned WISC-R study conducted by Kraft (1983), while finding that laterality is related to WISC-R scores, the author also states that "the results of this study confirm that there are sex differences in laterality favoring males" (p. 86).

Levy and Reid (1978) found that females are generally less lateralized than males for visuo-spatial functions typically measured by the WAIS performance subtests.
A study in which the researchers investigated the ability of the two hemispheres to recognize emotional words (Graves, Landis, & Goodglass, 1981) found that males demonstrated "a significant interaction in which the effect of emotional words was higher in the left visual field (and presumably right brain) than in the right visual field" (p. 100). The opposite was found for the females in the study, although the effect did not reach a level of significance. A similar study conducted by Strauss (1983) attempted to replicate the Graves et al. study but found that "the emotional quality of words did not improve recognition of the tachistoscopically-presented words in the left visual field" (p. 102) for either sex.

Females have shown fewer consistent visual field differences than males for many verbal tasks. In tachistoscopic studies, the magnitude of the right visual field advantage (left hemisphere) for linguistic stimuli has been greater for right-handed males than right-handed females (Bradshaw, 1980; Bradshaw et al., 1981; Bradshaw & Gates, 1978; Bryden, 1979; Hannay & Malone, 1976; Kail & Seigal, 1978; McGlone, 1980; Seigal, 1978).

McGlone (1980) reviewed dichotic testing studies, finding a majority of them to evidence no difference for men and women in the degree of right ear advantage for verbal material (Briggs & Nebes, 1976; Bryden, 1965, 1975, 1979; Carr, 1969; Demarest & Demarest, 1979; McGlone & Davidson,
1973; McKeever & Van Deventer, 1977; Scott, Hynd, Hunt, & Weed, 1979). Right-handed women were found to have larger right ear advantage for consonant-vowel syllables than right-handed men in one study (Dorman & Porter, 1975).

Alternately, Lake and Bryden (1976) found 94% of the men in their study to evidence a right ear advantage on a dichotic listening verbal task, compared with only 69% of the women. This finding of greater lateralization for males is supported to some extent by the studies of Thistle (1975), Harshmann, Remington, and Krashen (1974), and a reassessment by Bryden of a previous study (Bryden, 1965).

Mixed results have been obtained regarding the factor of sex and cerebral lateralization. Overall, it appears that the most definitive statement that can be made is that females may be somewhat less definitively lateralized than males.

**Summary of Research Implications**

The research reveals differences in right and left brain functioning. One important aspect of these differences is that regarding the processing of emotional stimuli. It appears that although the left brain is the primary processor for language, the right brain seems more involved with emotional processing, including the processing of emotionally charged language. The research also suggests a relationship between the WISC-R and right and left brain abilities. We may be able to conclude that if this is true, then there may
be a relationship between WISC-R Verbal-Performance scores and children's abilities to interpret language and emotion. We may even be able to say that children with significant differences in their Verbal and Performance WISC-R scores tend to rely more heavily upon one hemisphere when interpreting emotionally-laden messages. A child with a higher Verbal scores may seek to interpret the semantic content of a sentence, while a high Performance child may interpret the message according to the emotional tone of the speaker.

Another variable pointed to by the research is that of age. There is evidence to suggest that children between 6 and 11 may perform differently than children age 11 through 15. A difference may be due to additional myelin sheathing of nerve fibers in the brains of the older groups.

The sex of the student may also be a factor in how they respond to emotionally-charged material. The research indicates that males may be more likely to evidence differences in lateral functioning. When comparing higher Verbal with higher Performance females, we may not find their processing styles to differ as much as the processing styles of similar IQ males.

This study attempted to combine the areas of brain laterality, psychometric evaluation, and child development. Previous research in each of the areas provided implications for emotional processing in children. If previous results held true in this study, it was expected that differences
would be found between the high Verbal and high Performance groups, between the two age groups, and between boys and girls.
CHAPTER III
METHODOLOGY

Overview of the Study

As stated in the introduction, increasing attention is being given to ascertaining the learning styles of individual students. Brain research, Piagetian theory, and psychometric investigation provide a base from which to further explore this area.

The specific problem addressed is that psychologists need more information from their instruments in order to better help teachers educate their students. The results of current brain research need to be more adequately incorporated into psychological practice.

The purpose of the study was to investigate WISC-R Verbal-Performance discrepancies and children's tendencies for depending upon semantic content or emotional tone for message interpretation; to investigate the relationship between age or stages of nerve fiber myelination and emotional cognition styles; and to investigate the relationship between sex and emotional cognition style.

Variables

Independent variables studied were IQ dominance (high Verbal-low Performance IQ profile on the WISC-R or low Verbal-high Performance IQ profile on the WISC-R; age (6-10
and 11-15); and sex. The dependent variable in all cases was the subjects' scores on an instrument designed to measure their reliance upon content versus tone of a statement when judging its emotional tenor.

**Subjects**

The subjects were selected from the population of students referred to the Psychological Services section of the Marion County, Florida, school system for testing in the past three years. The students were referred for learning problems, behavior problems, and for gifted program evaluation. The sample was selected from those students tested by a certified school psychologist and found to display Verbal-Performance discrepancies of 12 or more IQ points on the WISC-R. The 12-point difference figure was chosen as Kaufman (1979) states that such a difference is statistically significant at the 95% confidence level. The stability coefficient for the WISC-R is tabled in the manual as .95 over a four-week period (Wechsler, 1974, p. 33). Although the scores should, therefore, hold reasonably constant over time, it was decided that only IQ results up to three years old would be used. This three-year limitation was decided upon as test reliability tends to decrease with time and three years is recognized by many authorities, including Federal Law 94-142, as an appropriate period for results constancy. It was also believed that three years would provide the required number of subjects to meet the needs of this
study. Recency of testing was additionally important as the school population of Marion County, Florida, was subject to higher than normal turnover and some potential subjects were likely to move from the area prior to the completion of the study.

The sample consisted of 80 girls and 80 boys, half of whom were 11 years old on January 1, 1984, and half of whom were less than 11 on that date. The subjects were distributed equally regarding their WISC-R Verbal/Performance IQ strengths. A student found to be unable to perform the task was dropped from the study and replaced with an alternate subject of like characteristics.

The total sample included 160 subjects. The full scale IQs of the subjects approximated the normal curve and ranged from 50 to 148.

**Design**

A 2 x 2 x 2 balanced factorial design was utilized with the three dichotomous variables. There are eight cells with 20 subjects per cell (as shown in Figure 1).

Each cell contains a sample of students from each of the referred groupings (behavior problems, learning problems, and gifted).

**Instrumentation**

The subjects' responses to an audio tape containing emotionally-laden messages and previously used with adult schizophrenics served as the dependent variable. Additions
Verbal IQ on WISC-R 12 or more points higher than Performance IQ

<table>
<thead>
<tr>
<th>Age</th>
<th>Males</th>
<th>Females</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>11-15</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

8 cells x 20 subjects per cell = total of 160 subjects

Figure 1

2 x 2 x 2 FACTORIAL DESIGN
were made to the tape to better enable the younger subjects to manage the task. An introduction to the task and four example items preceded the test items on the tape (Appendix A). The audio tape contains 32 test items (Appendix B). The items were numbered on the tape to help the subjects stay in sequence on the answer sheet (Appendix C). Eight of the test items were spoken in an emotional tone consistent with their content to act as a check that the individual student understood the task. The introductory items also contained consistent content and tone. The remaining 24 items were spoken in tones which differed from their content. The answer sheets offered the subjects two choices for each item. The introductory and check items offered one correct choice and one incorrect choice. The test items offered one choice representing the content of the item and one choice representing the tone of the item. Each possible answer had both a facial and a printed description of emotion to help younger students and poor readers to better understand their choices. The student was requested "to put an X on the face which best describes the speaker."

The audio tape had previously been used by Fennell (1983) with both normal and schizophrenic adults and found to discriminate adequately between tone and content oriented subjects. That researcher also stated that the level of task complexity would be appropriate for children. The discriminatory ability of the instrument was also judged to be applicable to children.
The WISC-R is intended to use with 6 through 16-year-old children. It provides Verbal, Performance and Full Scale IQ scores and requires 50 to 75 minutes to administer. The test has a mean of 100 and a standard deviation of 15. The WISC-R was validated via correlational studies with other Wechsler scales and the Stanford-Binet Intelligence Scale. Correlations ranged from .73 to .95 (Wechsler, 1974). Internal consistency is stated in the manual as .96 for the full scale.

Procedures

The test items were administered to the research subjects singly or in groups of 2 to 15 students by Marion County School System staff psychologists certified in the state of Florida. The subjects were seated in a configuration which discouraged copying. They were directed to write their names at the top of the answer sheet and to indicate whether they were right-handed or left-handed as handedness may be used for post hoc research purposes. The tape was then played for the students. Lower functioning subjects, seen to be having difficulty with the task, were pulled from the group and readministered the test at a later time with additional instruction. Only three required this action and all from the high Performance, younger girls group. The task required approximately eight minutes.

Following the administration of the test, the items were totaled and each student received a score representing the number of content answers which he/she chose. Since they
chose from only two answers, a low content score indicated a tendency for an individual subject to respond to the tone of the items, while a high content score indicated that the subject attended primarily to the content of the items. Nine subjects, failing to correctly answer more than half of the check items, were dropped from the study from several groups and replaced with similar students.

The content score was the dependent variable and was used to compare levels of the independent variables of IQ dominance, age, and sex. Main effects for each of the independent variables were computed, as well as interactions among the variables.

**Methodological Limitations**

The crucial factor in this study was the subjects' performance on the dependent measure, the tape of emotional statements. Although the tape had been used successfully with schizophrenic adults and those researchers had stated its appropriateness for use with children, there existed no hard evidence to demonstrate its discriminatory value with the intended population. A pilot study was, therefore, performed. One elementary and one middle school regular education classroom were randomly selected. The elementary classroom consisted of nine girls and 12 boys from ages 7 through 9. The middle school classroom consisted of 18 girls and 15 boys from ages 13 through 16. Of the total group, only two of the younger students evidenced any difficulty with
the task. Content scores ranged from 7 to 23 in the younger age group and from 0 to 22 in the older age group, giving an adequate indication of variability among the scores. A tendency was noted for the younger students to respond primarily to the content of the items, while the older students tended to respond primarily to the tone of the items. Since the pilot study groups evidenced a minimum of difficulty with the task and an adequate variation in scores was represented, no changes in the task format were made prior to presenting the task to the research subjects.
The purpose of this study was to investigate the relationship between Verbal-Performance WISC-R scores and children's abilities to interpret the emotional tone and emotional content of sentences. The study was based on a balanced (n = 20) 2 x 2 x 2 factorial design with high Verbal or high Performance IQ group, sex, and age as completely crossed independent factors. Major hypotheses predicted no significant differences between the variables of high Verbal or high Performance group, sex, and age on the dependent measure. The dependent measure was the number of "content" answers in response to an audio tape which required the subjects to interpret the emotional state of the speaker on the dimensions of either emotional content or emotional tone. Before presenting the results of the hypothesis test, summary calculations describing the sample in terms of standardized IQ scores are presented. The mean Verbal, Performance, and Full Scale IQ's for each group are offered in Table 1. Marginal means are presented in Table 2. Tests of the two-way and three-way interactions between levels of the three independent variables were nonsignificant at the .05 level. Significant differences in Verbal IQ's (F = 100.1; P ≤ .0001), Performance IQ's (F = 4.94; P ≤ .0277), and Full Scale IQ's
<table>
<thead>
<tr>
<th></th>
<th>High Verbal</th>
<th></th>
<th>High Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>V</td>
<td>120.70</td>
<td>120.20</td>
<td>84.35</td>
</tr>
<tr>
<td></td>
<td>(21.52)</td>
<td>(21.01)</td>
<td>(22.01)</td>
</tr>
<tr>
<td>P</td>
<td>101.50</td>
<td>98.40</td>
<td>103.55</td>
</tr>
<tr>
<td></td>
<td>(21.02)</td>
<td>(20.44)</td>
<td>(19.99)</td>
</tr>
<tr>
<td>FS</td>
<td>112.90</td>
<td>110.80</td>
<td>93.30</td>
</tr>
<tr>
<td></td>
<td>(23.43)</td>
<td>(22.59)</td>
<td>(22.94)</td>
</tr>
<tr>
<td>V</td>
<td>109.15</td>
<td>116.30</td>
<td>82.25</td>
</tr>
<tr>
<td></td>
<td>(23.40)</td>
<td>(27.28)</td>
<td>(16.84)</td>
</tr>
<tr>
<td>P</td>
<td>91.60</td>
<td>94.80</td>
<td>102.20</td>
</tr>
<tr>
<td></td>
<td>(21.29)</td>
<td>(24.93)</td>
<td>(16.29)</td>
</tr>
<tr>
<td>FS</td>
<td>101.45</td>
<td>107.10</td>
<td>91.50</td>
</tr>
<tr>
<td></td>
<td>(24.65)</td>
<td>(28.46)</td>
<td>(17.34)</td>
</tr>
</tbody>
</table>

V = Verbal IQ  
P = Performance IQ  
FS = Full Scale IQ
TABLE 2

MARGINAL MEAN SCORES FOR LEVELS
OF THE THREE INDEPENDENT VARIABLES

<table>
<thead>
<tr>
<th>Group</th>
<th>Verbal</th>
<th>Performance</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Verbal</td>
<td>116.59</td>
<td>96.58</td>
<td>108.06</td>
</tr>
<tr>
<td>High Performance</td>
<td>83.60</td>
<td>103.59</td>
<td>92.66</td>
</tr>
<tr>
<td>Girls</td>
<td>99.11</td>
<td>99.71</td>
<td>99.79</td>
</tr>
<tr>
<td>Boys</td>
<td>101.08</td>
<td>100.45</td>
<td>100.94</td>
</tr>
<tr>
<td>6-10</td>
<td>103.89</td>
<td>103.24</td>
<td>104.09</td>
</tr>
<tr>
<td>11-15</td>
<td>96.30</td>
<td>96.92</td>
<td>96.64</td>
</tr>
</tbody>
</table>
(F = 19.35; P ≤ .0001) were found between the high Verbal and Performance groups. As expected, the high Verbal group had significantly higher Verbal IQs, while the high Performance group had significantly higher Performance IQs. Not expected was the result that the Verbal IQ group also had significantly higher Full Scale IQs than the high Performance group.

Significant differences were also found between age groups in Verbal IQ (F = 5.30; P ≤ .0227), Performance IQ (F = 4.01; P ≤ .0471), and Full Scale IQ (F = 4.53; P ≤ .0349) with the younger age group having significantly higher IQs in all three areas.

In order to control for initial differences in IQ, the ANCOVA analysis strategy was used to test seven hypotheses of primary interest. This procedure assumes that the within group regression slope for content on IQ is the same for all groups in the study. The within cell correlations for Full Scale IQ with content are presented in Table 3. Testing that assumption resulted in a computed F value of 1.40 with a p value equal to .2072. Since the probability of the observed event was greater than the criteria set for statistical significance (.10), there was insufficient evidence to indicate that the slopes were unequal. Similar results were computed for content on Verbal and Performance IQs. Testing the assumption shows F value of 1.39 and 1.34 with p values equal to .2113 and .2358, respectively.
TABLE 3
WITHIN CELL CORRELATIONS FOR FULL SCALE IQ WITH CONTENT

<table>
<thead>
<tr>
<th>Age</th>
<th>High Verbal Girls</th>
<th>High Verbal Boys</th>
<th>High Performance Girls</th>
<th>High Performance Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10</td>
<td>.033</td>
<td>-.189</td>
<td>-.150</td>
<td>.240</td>
</tr>
<tr>
<td>11-15</td>
<td>-.664</td>
<td>-.091</td>
<td>-.401</td>
<td>-.023</td>
</tr>
</tbody>
</table>
The test for the relationship between Full Scale IQ and content indicated a negative slope (−.0373) which was significant (p < .0364). Since the scale on which the dependent variable was measured was ipsitive, this finding indicated that the relationship between Full Scale IQ and tone was positive.

The seven null hypotheses proposed in Chapter I are examined here in light of the research results.

Null Hypothesis 1 stated that the three-way interaction between IQ dominance, sex, and age as not significant. A computed F ratio for the three-way interaction was equal to 0.14. The probability of obtaining a computed F value of this magnitude or greater if the null hypothesis was true was equal to .7079. Since the probability of the observed event was greater than the criteria set for statistical significance (.05), there was insufficient evidence to reject the null hypothesis.

Null Hypothesis 2 stated that differences between males and females on the content measure as the same across the two levels of age. The computed F ratio for the two-way interaction was equal to 2.02. The probability of obtaining a computed F value of this magnitude or greater if the null hypothesis was true was equal to .1577. Since the probability of the observed event was greater than the criteria set for statistical significance (.05), there was insufficient evidence to reject the null hypothesis.
Null Hypothesis 3 stated differences on the content measure between the high Verbal and high Performance groups as the same for males and females. The computed F ratio for the two-way interaction was equal to 0.33. The probability of obtaining a computed F value of this magnitude or greater if the null hypothesis was true was equal to .5651. Since the probability of the observed event was greater than the criteria set for significance (.05), there was insufficient evidence to reject the null hypothesis.

Null Hypothesis 4 stated differences between the high Verbal and high Performance groups as the same across the two age groups. The computed F ratio for the two-way interaction was equal to 6.17. The probability of obtaining a computed F value of this magnitude or greater if the null hypothesis was true was equal to .0141. Since the probability of the observed event was less than the criteria set for statistical significance (.05), there was sufficient evidence to reject the null hypothesis. Table 4 presents the adjusted mean content scores with IQ as a covariate for the groups involved in this interaction. Since gender was not a factor, scores for males and females were collapsed.

A difference of 1.311 content score points is evidenced between the high Verbal and high Performance groups at the younger age level. This difference was not statistically significant ($P \leq .2428$). For the older age group, a mean content score difference of 2.48 points was statistically
# TABLE 4

ADJUSTED MEAN CONTENT SCORES

<table>
<thead>
<tr>
<th>Age</th>
<th>High Verbal</th>
<th>High Performance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
</tr>
<tr>
<td>6-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 20</td>
<td>14.42</td>
<td>12.64</td>
<td>n = 20</td>
<td>12.39</td>
</tr>
<tr>
<td>11-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 20</td>
<td>9.49</td>
<td>10.45</td>
<td>n = 20</td>
<td>11.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n = 20</td>
<td>13.08</td>
</tr>
</tbody>
</table>

ADJUSTED MEAN CONTENT SCORES
(Collapsed for Sex)

<table>
<thead>
<tr>
<th>Age</th>
<th>High Verbal</th>
<th>High Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 40</td>
<td>13.53</td>
<td>12.22</td>
</tr>
<tr>
<td>11-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 40</td>
<td>9.97</td>
<td>12.45</td>
</tr>
</tbody>
</table>
significant \((P \leq .0270)\), with the high Performance group having the higher mean content score.

The younger high Verbal group had a mean content score of 3.56 points higher than the older high Verbal group, which was statistically significant \((P \leq .0013)\). The mean content difference between the high Performance groups of 0.23 points across age was not significant \((P \leq .8346)\).

Null Hypothesis 5 stated no significant difference between subjects over the age of 11 and those under the age of 11 on the content measure. Since there is a significant interaction between IQ dominance and age, a discussion of main effects is inappropriate. As shown in Table 4, results of the interaction discussed above indicated a significant difference between the high Verbal age groups, but not the high Performance age groups.

Null Hypothesis 6 stated no significant difference between males and females on the content measure. The computed \(F\) ratio for the variable of sex was equal to 0.00. The probability of obtaining a computed \(F\) value of this magnitude or greater if the null hypothesis was true was equal to .9683. Since the probability of the observed event was greater than the criteria set for statistical significance (.05), there was insufficient evidence to reject the null hypothesis.

Null Hypothesis 7 stated no significant difference between the high Verbal and high Performance groups on the
content measure. Since there was a significant interaction between IQ dominance and age, a discussion of this main effect for age is inappropriate. However, as shown in Table 4, the analysis of the interaction indicated that there was a significant difference between the high Verbal and high Performance groups at the older age level but not at the younger age level.
CHAPTER V

SUMMARY, DISCUSSION, CONCLUSIONS, IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the relationship between Verbal-Performance WISC-R scores and children's abilities to interpret the emotional tone and emotional content of sentences.

A 2 x 2 x 2 factorial analysis was designed with the independent variables consisting of Verbal-Performance IQ dominance, sex, and age. The dependent measure was the subjects' content scores on a task requiring them to respond to either the emotional content or the emotional tone of messages presented on an audio tape.

A total of 160 subjects were assigned to the eight cells of the design with 20 subjects represented in each cell. Both the WISC-R administrations and the dependent measure evaluations were conducted by school psychologists certified in Florida.

Discussion of Results

The specific questions to which the study was addressed were (1) is there a positive relationship between children's preferences for interpreting the content of a verbal statement and a significant Verbal-Performance split on the WISC-R
in favor of the Verbal score; (2) is there a positive relationship between children's preferences for interpreting the tone of a verbal statement and a significant Verbal-Performance split on the WISC-R in favor of the Performance score; (3) does the sex of the student have any effect upon research questions 1 and 2; (4) does the age of the student have any effect upon research questions 1 and 2?

Since there was a significant interaction between IQ dominance and age, research questions 1 and 2 cannot be answered directly, but are addressed in the context of research question 4.

Research question 4 addressed the variable of age as it relates to IQ dominance. A review of the research literature suggested that children exhibiting a Verbal IQ strength on the WISC-R would be left brain dominant (Fedio & Mirsky, 1969; Kaufman, 1979; Kershner & King, 1974; Kraft, 1983; Rourke & Telegdy, 1971; Rourke, Young, & Flewelling, 1971; Rudel & Teuber, 1971) and, theoretically, more likely to interpret an emotional message by attending to the emotional content of the message (Saxby & Bryden, 1984). Conversely, the research literature suggested that the children exhibiting a Performance IQ strength on the WISC-R would be right brain dominant and, theoretically, more likely to interpret an emotional message by attending to the emotional tone of the message. Neither of these theoretical implications was supported by the analyses. The high Verbal and high Performance
groups did not differ significantly in their choice of content and tone at the 6-10-year-old level. At the 11-15-year-old level, however, there was a significant difference between the high Verbal and high Performance groups, but the difference was in the opposite direction of that which was expected, as the high Verbal group attended primarily to the tone of the messages.

Although some of the research literature had suggested that different modes of responding might be expected between the younger and older age groups (Fitzgerald & Strommen, 1972; Kraft, 1980), Saxby and Bryden (1984) found no differences between age groups in a dichotic listening study which required children to discriminate verbally-presented sentences as the same or different along the parameters of content and tone. The current study produced mixed results regarding the age factor. The analyses indicated that the high Performance subjects did not differ significantly in their choice of content and tone between the 6-10 age group and the 11-15 age group. The analyses did indicate, however, a significant difference between the content and tone choices of those high Verbal subjects in the 6-10-year-old group and those in the 11-15-year-old group, with the older subjects choosing tone significantly more often. In summary, the older high Verbal children chose tone responses significantly more often than did any of the other groups.

Research question 3 addressed the factor of sex as it relates to hemisphericity and dependence upon emotional
content or tone when children interpret a verbal message. Numerous research studies investigating differences between the sexes as regards brain laterality have produced mixed results. A similar situation exists in studies with children. Kraft (1983) and Witelson (1976) found a greater degree of laterality in males than in females, while Saxby and Bryden (1984) reported a greater degree of laterality for females. The analysis of the current study indicated that sex was not a significant factor in determining whether the research subjects responded to the emotional content or the emotional tone of a verbally-presented message. This finding does not support a difference in laterality favoring either sex.

Conclusions

The results of this study indicate that IQ dominance has no effect upon the emotion interpretation strategies of children under the age of 11 when they are confronted with an emotional statement. Results do indicate, however, that as children with Verbal IQ dominance pass the age of 11, they begin to rely less upon the emotional content of emotional statements and more upon the emotional tone of those statements when attempting to judge the emotional meaning of the speaker. Children with Performance IQ dominance, however, do not exhibit this maturational pattern and continue after the age of 11 to interpret emotional statements in the same manner as children of lesser age.
Implications and Recommendations

The major theoretical implication of this study is that left hemisphere dominant children are not only superior to right brain dominant children on the types of tasks presented by Verbal IQ tests, but as they mature, their emotional comprehension of verbally-presented statements becomes more sophisticated than that of right brain dominant children of similar Full Scale IQ levels. Following the age at which nerve cell myelination is judged to be complete in the development of the child, it appears that left brain dominant children begin to rely more heavily upon the tone of a speaker's voice. It appears that these children begin to understand that verbal communication is composed of more than the concrete words that make up the message and that emotional tone and nuance give fuller meaning to the speaker's words. The right brain dominant children, however, do not seem to exhibit this change in pattern of emotional analysis following myelination and continue to interpret emotional messages in the more concrete manner of younger children. These findings run somewhat counter to those of previous research studies in which the right brain has been postulated to play an important role in the mediation of emotion.

It is possible that the results of this study are due to a difference in the nature of the task from previous studies. The Saxby and Bryden (1984) study, for instance, which reported right hemisphere specialization for mediation of
auditory emotional stimuli, differs from the current study in its approach. The subjects in that study were required to make a discrimination between target and comparison sentences as to whether they were the same or different. Also, the sentences did not differ in emotional content, but differed only in semantic content. It is suggested that the task presented by the current study, in which the subjects were required to identify the emotional state of the speaker, may have demanded a greater degree of subjective judgment than previous studies. It should also be remembered that the task was presented in a verbal mode. Assuming that sophistication of subjective judgment increases with age, those children in the formal operations stage might be better able to interpret emotional nuance (the hallways of junior and senior high schools at class changing time are filled with double entendres). It may also be reasonable that the verbal nature of the task would encourage sophisticated responding by highly verbal students, while failing to tap the performance abilities of right brain dominant students.

Similar reasoning might also explain the tendency for intellectually superior students to score higher on the dimension of tone. While students of both higher and lower intellectual standing would be expected to correctly interpret the "concrete" semantic content of a sentence, the higher IQ student might possess a greater variety of response formats and, therefore, be better able to make
use of the speakers's tone when making more "formal" judgments regarding the speaker's emotional state.

Additional research appears warranted in order to more fully understand the respective roles of the left and right cerebral hemispheres in the comprehension of verbally-presented emotional material. The results of this study indicate that the development of right brain abilities is insufficient in the complete deciphering of verbally-presented emotional messages without the concomitant development of left brain skills. It does, however, appear that left brain dominant children with significantly poorer right brain development learn with age to be more fully aware of emotional tone as an important indicator of verbal intent.

A significant negative correlation was indicated for Full Scale IQ with content and, therefore, indicated a positive correlation for Full Scale IQ with tone. Researchers, however, might pursue additional findings by studying a more normalized population and by seeking alternative methods of measuring children's sensitivity to emotional stimuli.

Additional investigation into the relationship between hemispheric dominance and progression through Piagetian stages also appears necessary. The results of this study indicate that left brain dominant children make the transition from the concrete operations stage to the formal operations stage more completely than right brain dominant
children in the comprehension of verbally-presented emotional material. This transition is vitally important to the developing child. Investigators need to be cognizant that hemisphericity appears to be a factor in this transition and should explore how hemispheric dominance is involved in other areas of child development.

The results of this study may be useful to trainers in the fields of school psychology, clinical psychology, education, and child development. The utility to trainers will consist of the foregoing theoretical implications, as well as the provision of practical implications which trainees and other practitioners may employ in their respective fields.

The results of this study may be particularly useful in special education classrooms and in psychotherapeutic settings. The WISC-R is routinely administered to nearly all special education students and to many children receiving mental health services. Professionals in both fields, understanding the attentional focus of children with significant Verbal-Performance discrepancies in their WISC-R profiles, can more accurately formulate verbal communication and instructional procedures to meet the needs of these children.

The research indicates that most children under the age of 11, as well as those children over the age of 11 who have a significant Verbal-Performance discrepancy on the WISC-R in favor of the Performance score, are not likely to focus upon the emotional tone of a verbal message. Emotional tone is not
likely to be more effective than sentence content when communicating with these children. Children with significant Verbal-Performance discrepancies in favor of the Verbal score who are over the age of 11, however, may respond more readily to the emotional tone of a verbally-presented message. A teacher or therapist attempting to communicate an educational concept or behavioral alternative may find that what they say is most effective with younger and right brain dominant students, while how they say it best gets the message across with older left brain dominant students.

**Limitations and Generalizability**

A major limitation of this study involves the characteristics of the research sample. Each student involved in the study was referred to the Psychological Services section of the Marion County, Florida, School System due to learning or behavioral problems or suspected intellectual giftedness. Generalizing the results of this study to a wider population should be attempted in light of the restriction which this limitation imposes.

Although research studies have been cited relating the WISC-R Verbal and Performance scales to left and right brain abilities, respectively, neither of the scales has been shown to exclusively measure the province of a single hemisphere. While implications for hemispheric functioning may be gained from this study, the making of absolute predictions for individual students may not be warranted.
Although the audio tape, used as the dependent measure, has been validated for use at the clinical level, validity and reliability estimates have not been obtained. The pilot study and the eight check items in the instrument helped to justify its use for the purposes of this study. As mentioned in Chapter III, however, the tape represents an experimental instrument and how well it measured the subjects' proclivities poses as a question mark in this study. The use of this instrument for diagnostic purposes without further validation is not recommended.
APPENDICES
Appendix A
INTRODUCTION TO THE TASK

The exercise in which you about to take part is designed to give us information which we will be able to use in order to help other Marion County students. Now, please listen carefully to the instructions. You will first hear four example sentences. The person speaking will be sad, happy, mad, or will have no feeling at all. For each sentence, you will have two choices. Put an X on the face that you believe best describes the speaker. Please do every one. If you are not sure of the answer, make your best guess. Now find example A at the top of the answer sheet. Now listen carefully to the speaker.

"Oh, what a wonderful surprise."

Does she have no feeling or is she happy? That's right, you should have put an X on the happy face. Now listen carefully to example B.

"Darn that dog."

Is she mad or sad? That's right, she's mad and you should have put an X on the mad face. Now listen carefully to example C and put an X on either the no feeling face or the mad face.

"The light is on."

That's right, she has no feeling. Now listen carefully
to example D and put an X on the face which best describes the feeling of the speaker.

"I lost all my money."

That's right, she is sad and you should have put an X on the sad face.

We are now going to begin the exercise. Remember to put an X on the face which you believe best describes the way the speaker feels. Please do every one. If you are not sure of the answer, make your best guess.
## APPENDIX B

### TAPED EMOTIONAL MESSAGES

<table>
<thead>
<tr>
<th>Content</th>
<th>Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>The broom is in the hall closet.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>I wish you didn't have to go.</td>
<td>Sad</td>
</tr>
<tr>
<td>Paintings hang on the walls.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>She's going to miss her old stuffed bear.</td>
<td>Sad</td>
</tr>
<tr>
<td>Paper was scattered around the room.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>The boy went to the store.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>Is there a tennis match today?</td>
<td>Indifferent</td>
</tr>
<tr>
<td>The broom is in the hall closet.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>The carpet is blue and green.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>Don't ever do that again.</td>
<td>Angry</td>
</tr>
<tr>
<td>Those bums lost again.</td>
<td>Angry</td>
</tr>
<tr>
<td>Isn't it a beautiful day?</td>
<td>Happy</td>
</tr>
<tr>
<td>The ball went over the fence.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>The screen door is open.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>The windows are made of tinted glass.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>I wish you didn't have to go.</td>
<td>Sad</td>
</tr>
<tr>
<td>Don't ever do that again.</td>
<td>Angry</td>
</tr>
<tr>
<td>The windows are made of tinted glass.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>Paintings hung on the walls.</td>
<td>Indifferent</td>
</tr>
<tr>
<td>That's just what I always wanted.</td>
<td>Happy</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>21.</td>
<td>The ball went over the fence.</td>
</tr>
<tr>
<td>22.</td>
<td>The boy went to the store.</td>
</tr>
<tr>
<td>23.</td>
<td>The chairs are made of wood.</td>
</tr>
<tr>
<td>24.</td>
<td>Paper was scattered around the room.</td>
</tr>
<tr>
<td>25.</td>
<td>Isn't it a beautiful day?</td>
</tr>
<tr>
<td>26.</td>
<td>The carpet is blue and green.</td>
</tr>
<tr>
<td>27.</td>
<td>Is there a tennis match today?</td>
</tr>
<tr>
<td>28.</td>
<td>Those bums lost again.</td>
</tr>
<tr>
<td>29.</td>
<td>She's going to miss her old stuffed bear.</td>
</tr>
<tr>
<td>30.</td>
<td>That's just what I always wanted.</td>
</tr>
<tr>
<td>31.</td>
<td>The chairs are made of wood.</td>
</tr>
<tr>
<td>32.</td>
<td>The screen door is open.</td>
</tr>
</tbody>
</table>
APPENDIX C

SCORING SHEET FOR THE TAPED EMOTIONAL MESSAGES
Examples:

A. No Feeling  Happy

B. Sad  Mad

C. No Feeling  Mad

D. Happy  Sad

1. No Feeling  Happy

2. Mad  Sad

3. No Feeling  Happy

4. Sad  Mad

5. Mad  No Feeling

6. No Feeling  Happy

7. Sad  No Feeling

8. Mad  No Feeling

9. No Feeling  Happy

10. Mad  Happy

11. Happy  Mad

12. Sad  Happy

13. No Feeling  Sad

14. Mad  No Feeling

15. No Feeling  Sad

Name: _______________
16. Happy Sad
17. Mad Sad
18. No Feeling Mad
19. Sad No Feeling
20. Happy Mad
21. No Feeling Happy
22. Sad No Feeling
23. No Feeling Mad
24. Mad No Feeling
25. Happy No Feeling
26. Happy No Feeling
27. No Feeling Sad
28. Mad No Feeling
29. No Feeling Sad
30. Happy Mad
31. No Feeling Happy
32. Mad No Feeling
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BIOGRAPHICAL SKETCH

James H. M. Woodward was born October 29, 1948, in Petoskey, Michigan. He graduated from Ottawa Hills High School in Grand Rapids, Michigan in June of 1966. Following a business career, during which he served as president of a chain of retail sports and clothing stores in Michigan and Florida, he received a Bachelor of Science degree in Psychology from Michigan State University in June of 1976. He was subsequently admitted into the doctoral program in experimental psychology at the University of Miami in Miami, Florida. While attending the University of Miami, he received a graduate assistantship at the Mailman Center for Child Development. He transferred to the University of Florida in September of 1976. He received the degrees of Master of Education and Specialist in Education through the Department of Counselor Education in August of 1979. While attending the University of Florida, he was employed as a graduate assistant in P. K. Yonge Laboratory School. He is presently a school psychologist for the Marion County School System in Ocala, where he has been employed while pursuing the degree of Doctor of Philosophy.

James has been married to his wife, Meg (Vescolani) for eight years, and has a 15-year-old son, Anthony. He is a member of the National Association of School Psychologists.
and the Florida Association of School Psychologists, for which he has served on the Executive Board as Representative-at-Large and Chairman of the Articles of Incorporation Committee.
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Donald L. Avila, Chairman
Professor of Counselor Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eileen B. Fennell, Associate Professor of Clinical Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Larry C. Loesch
Professor of Counselor Education

This dissertation was submitted to the Graduate Faculty of the Department of Counselor Education in the College of Education and to the Graduate School, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1984
Dean for Graduate Studies and Research