

INFORMATION TO USERS

While the most advanced technology has been used to photograph and reproduce this manuscript, the quality of the reproduction is heavily dependent upon the quality of the material submitted. For example:

- Manuscript pages may have indistinct print. In such cases, the best available copy has been filmed.
- Manuscripts may not always be complete. In such cases, a note will indicate that it is not possible to obtain missing pages.
- Copyrighted material may have been removed from the manuscript. In such cases, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, and charts) are photographed by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each oversize page is also filmed as one exposure and is available, for an additional charge, as a standard 35mm slide or as a 17"x 23" black and white photographic print.

Most photographs reproduce acceptably on positive microfilm or microfiche but lack the clarity on xerographic copies made from the microfilm. For an additional charge, 35mm slides of 6"x 9" black and white photographic prints are available for any photographs or illustrations that cannot be reproduced satisfactorily by xerography.



8629743

Sorman, Peter B.

**A DOUBLE DISSOCIATION IN LEFT AND RIGHT FRONTAL LOBE PATIENTS:
PREDICTIONS FROM A MODEL OF COGNITIVE REGRESSION**

City University of New York

Ph.D. 1986

**University
Microfilms
International** 300 N. Zeeb Road, Ann Arbor, MI 48106

Copyright 1986

by

Sorman, Peter B.

All Rights Reserved



PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark .

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) _____ lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages _____
15. Dissertation contains pages with print at a slant, filmed as received
16. Other _____

University
Microfilms
International



A DOUBLE DISSOCIATION IN LEFT AND
RIGHT FRONTAL LOBE PATIENTS:
PREDICTIONS FROM A MODEL OF COGNITIVE REGRESSION

by

PETER B. SORMAN

A dissertation submitted to the Graduate Faculty in
Psychology in partial fulfillment of the requirements
for the degree of Doctor of Philosophy, The City
University of New York.

1986

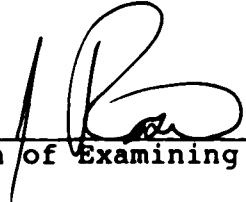
COPYRIGHT BY

PETER B. SORMAN


1986

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

6/12/86
date


Chairman of Examining Committee

June 23 1986
date


Executive Officer

Jeffrey Rosen, Ph.D.

Louis Gerstman, Ph.D.

Jeanette Wasserstein, Ph.D.

Supervisory Committee

The City University of New York

Abstract

A DOUBLE DISSOCIATION IN LEFT AND
RIGHT FRONTAL LOBE PATIENTS:
PREDICTIONS FROM A MODEL OF COGNITIVE REGRESSION

by

Peter B. Sorman

Advisor: Professor Jeffrey Rosen

Cognitive development within a Piagetian framework is partially described in terms of changes from egocentric to non-egocentric (decentration) thought, and is seen as occurring in non-social and social realms. This study examines these abilities in adult patients with focal cortical lesions and argues for neural substrates in cognitive regression. Specifically, all left frontal patients showed deficits in non-social cognition. The other frontal patients were defective in social cognition or both (right frontal and bilateral respectively). No regression occurred in other cortical patients. Findings are discussed in terms of clinical and research application.

v

for Carole and Audra

Acknowledgements

There were a number of people who helped make this dissertation possible. Primarily, my deepest appreciation goes to my wife Carole. Her love, understanding and unwavering support helped to sustain my motivation throughout my graduate career. I also thank my parents for their guidance and support; my father, for instilling 'emunah' and mother, the value of persistence.

I am also grateful to each member of the dissertation committee for their impact on my development. I thank Dr. Jeanette Wasserstein, my first mentor and advisor, for the years of support and invaluable training in the field of neuropsychology. Her trust and belief in my potential provided an important avenue in the pursuit of my professional career. Dr. Jeffrey Rosen, my sponsor and advisor, for his generous time and enthusiasm for all aspects of my research and clinical interests. While sharing his love for science, he taught me the valuable lesson of critical inquiry. Dr. Louis Gerstman, another source of advice, for his support of all phases of my graduate training.

Finally I would like to thank my two outside readers, Drs. Jane Healey and Russ Zappulla, for entrusting me in their service at Mt. Sinai Hospital College of Medicine.

TABLE OF CONTENTS

Chapter		
I.	INTRODUCTION	1
	Statement of the Problem	1
	Background	3
	Frontal Lobe Dysfunction.....	3
	An Effort to Understand Frontal Pathology From Within a Cognitive/ Developmental Psychology Framework	36
	Parallels with Frontal Pathology	55
	A Regression Model and Rationale for the Present Investigation	61
II.	ASSESSMENT OF DECENTRATION PERFORMANCE IN FRONTAL PATHOLOGY PATIENTS	73
	Method	73
	Subjects	73
	Tests and Procedures.....	75
	Results	84
	Section I- Subject Variables.....	84
	Section II-Interjudge Reliability.....	91
	Section III-Test Results.....	91
	Discussion	95
III.	ASSESSMENT OF LEVEL OF DECENTRATION PERFORMANCE IN FRONTAL PATHOLOGY PATIENTS	101
	Method	101
	Subjects	101
	Tests and Procedures	105
	Results	112
	Section I- Subject Variables.....	113
	Section II-Interjudge Reliability.....	113
	Section III-Test Results.....	120
	Discussion.....	130
	Summary of Findings	130

Cognitive Regression and Frontal Cortex Pathology	134
Dissociation of Function and Hemispheric Specialization	138
Clinical and Research Applications	140
Theoretical Links to Schizophrenia	142
Summary	145
APPENDIX A. Diagram of Frontal Cortex.....	146
APPENDIX B1. Drawings of Lesions for Each Brain-damaged Subject: Exp. 1	147
APPENDIX B2. Drawings of Lesions for Each Brain-damaged Subject: Exp. 2	165
APPENDIX C. Tables of Frequencies of Subject Variables and Clinical Character- istics of Brain-damaged Samples Experiment 1	184
APPENDIX D. Annett Scale.....	188
APPENDIX E. WAIS Information and PA Tests.....	189
APPENDIX F. Goldschmid-Bentler Test.....	194
APPENDIX G. Chandler Cartoons	198
APPENDIX H. Leahy Pro-Social Test.....	201
APPENDIX I. Tables of Frequencies of Subject Variables and Clinical Character- istics of Brain-damaged Samples Experiment 2	202
APPENDIX J. Controlled Oral Word Association Test.....	206
APPENDIX K. Matching Familiar Figures Test.....	207
APPENDIX L. Ekman-Friesen Photographs.....	212

APPENDIX M.	Goldschmid-Bentler Explanation Responses.....	213
APPENDIX N1	Case-by-Case Coefficients of Interjudge Reliability Experiment 1	250
APPENDIX N2	Case-by-Case Coefficients of Interjudge Reliability Experiment 2.....	251
BIBLIOGRAPHY	253

LIST OF TABLES

Experiment 1

Table	Page
1. Clinical and Pathological Characteristics of Neurological Sample	76
2. Comparison of Subject Variables Across Groups ..	85
3. Mean Characteristics of Neurological Sample	87
4. Performance on Non-Social and Social Cognitive Tasks	92
5. Mean Performance on Non-Social and Social Cognitive Tasks	94

Experiment 2

6. Clinical and Pathological Characteristics of Neurological Sample	103
7. Comparison of Subject Variables Across Groups ..	114
8. Mean Characteristics of Neurological Sample ...	116
9. Performance on Non-Social and Social Cognitive Tasks - Simultaneous Refocusing	121
10. Performance on Non-Social and Social Cognitive Tasks - Sequential Refocusing	122
11. Mean Performance on Non-Social and Social Cognitive Tasks - Simultaneous Refocusing ...	125
12. Mean Performance on Non-Social and Social Cognitive Tasks - Sequential Refocusing	126

LIST OF ILLUSTRATIONS

Figure	Page
1. Regions of the Cortex Subsumed Under Gross Location System.....	83
2. Composite Drawings of Bilateral Focal Pathology- Experiment 1	88
3. Composite Drawings of Left-Side Focal Pathology- Experiment 1	89
4. Composite Drawings of Right-Side Focal Pathology- Experiment 1	90
5. Composite Drawings of Bilateral Focal Pathology- Experiment 2	117
6. Composite Drawings of Left-Side Focal Pathology- Experiment 2	118
7. Composite Drawings of Right-Side Focal Pathology- Experiment 2	119

CHAPTER I

INTRODUCTION

Statement of the Problem

Though comprising nearly one-half of the cerebral cortex, the frontal lobes remain "uncharted provinces of the brain" (Goldman-Rakic, 1984). Historically, some investigators attributed the frontal cortex with the highest intellectual and moral functions (Halstead, 1947; Rylander, 1939) whereas others could not report exclusive roles for this brain region (Hebb, 1945; Mettler, 1949; Teuber, 1959).

More recent clinical observations have suggested that there may be some localization and hemispheric specificity of the personality and cognitive deficits associated with frontal lobe disease (e.g. Blumer & Benson, 1975; Kolb & Whishaw, 1980; Luria, 1980; Stuss & Benson, 1984). Attempts to characterize the nature of frontal lobe personality and cognitive deficits have included: 1) postulating symptoms of pseudopsychopathy, pseudodepression, egocentrism and lack of social awareness associated with right and/or bilateral frontal disease (Blumer & Benson, 1975; Kolb & Whishaw, 1980; Stuss & Benson, 1984) and 2) postulating deficits in multi-step logical operations, planning and reversal of perspective

associated with left and/or bilateral frontal disease (Milner, 1964, 1982; Teuber, 1964; Luria, 1980; Shallice, 1982; Stuss et. al., 1982, 1983). However, investigators agree that there is a confusing mixture of symptoms associated with frontal lobe pathology in both cognitive and personality spheres (Blumer & Benson, 1975; Lishman, 1978; Stuss & Benson, 1984). There are many descriptions of the phenomena associated with frontal disease (e.g. egocentrism, lack of social awareness, unrestrained and tactless behavior) many of which imply regression to childlike behavior. However, no overarching theoretical explanation is used to integrate these descriptions. In addition, few measures exist that will reliably dissociate left and right pre-frontal functions (Jones-Gotman & Milner, 1977; Borod et. al., 1983).

A model of cognitive regression is proposed to account for the personality and cognitive deficits associated with frontal lobe dysfunction. This study intended to: 1) provide a developmental theoretical construct, Piaget's egocentrism, for assessing frontal lobe pathology and 2) develop a method for dissociating right and left frontal lobe pathology in terms of social and non-social levels of decentration.

Background

Frontal Lobe Dysfunction

Classical Frontal Syndrome

Harlow (1868) provided one of the earliest accounts of changes in human behavior arising from a lesion of the frontal lobes. He described a case of a severe wound of the frontal lobes followed by marked personality changes, the release of primitive and animal instincts and the disturbance of the "balance between intellectual and animal traits". Similar accounts of gross disturbances in emotional life and dementia accompanied by euphoria after injury to basal and right frontal pole lesions were noted by Starr, Welt, Jastrowitz and Openheim in the late 19th century (Luria, 1980).

During the first third of this century, there developed a substantial majority opinion which ascribed to the frontal lobes all the highest conceivable functions. Abilities such as abstract behavior, foresight, intellectual synthesis, capacity for ethical behavior, control of affect, awareness

of self and recent memory were attributed to frontal lobe function (Ackerly, 1935; Brickner, 1936; Goldstein, 1936; Goldstein and Katz, 1937; Goldstein and Scheerer, 1941; Rylander, 1939, 1943). In the 1940's and 1950's, the pendulum swung in the other direction; toward a denial of any special importance of human prefrontal structures (Hebb, 1939, 1945; Mettler, 1949; Pollack, 1955; Teuber, 1959; Teuber et. al., 1951). It is noteworthy that both assertions, that of a crucial importance of frontal regions, and that of their being dispensable, have often been defended by reliance on the single case, group comparison and lobotomy studies.

It is not surprising that single case, group comparison and lobotomy studies can be complicated either by the presence of massive lesions extending beyond the frontal lobes or to lesions which are small, unilateral or asymmetrical, so that the effects are correspondingly small and easily compensated. In addition, inconsistent assessment procedures and subjective observation of symptomatology may contribute to differences in positive and negative findings.

This problem is well illustrated by the following contrasting cases. Brickner's (1934, 1936, 1939, 1952) famous patient, "Joe A.", with his seriously deteriorated behavior contrasts with the case of K.M., reported by Hebb and Penfield (1940), where bilateral removal of frontal tissue seemed to restore normal behavior (e.g. employment)

in a young man who had suffered a depressed bifrontal fracture at the age of sixteen. Brickner's case, upon autopsy, was found to harbor multiple meningiomas in addition to the one originally removed with his frontal poles (Brickner, 1952). One of these remaining tumors was the size of an apple and was found in the parieto-occipital region. This fact suggests that Joe A's behavioral deterioration may have resulted from multiple sites of cerebral pathology. In addition, discrepant findings on measures of personality adjustment were reported. Both investigators used the Rorschach and clinical observation as indices of personality adjustment. Each reported improvement in Rorschach responses 15-24 months postoperatively (the nature of such improvement was unspecified by the authors). However, reported differences in personality (e.g. lack of initiative, poor insight, inappropriate emotional response, Brickner, 1952; versus no abnormality in manner or conversation, Hebb and Penfield, 1940) were highly subjective and often derived from family reports and informal observation. This fact suggests that reported differences in personality may result from lack of operational specification of observed symptomatology.

The contradictions between past group studies of frontal patients are no less puzzling. Maximal deficits on measures of visual and tactile discrimination (e.g. form

board), abstraction (e.g. interpretation of proverbs) and recent memory (e.g. recall of position of small points of light in visual field) were found in patients with frontal tumors, as compared with tumors elsewhere in the brain, both by Rylander (1939, 1943) and Halstead (1947). However, attempts to replicate these findings (using similar tests and patient population) by Pollack (1960), Battersby, Krieger and Bender (1955) and Teuber (1964) were unsuccessful. Perhaps an important source of difficulty lies in the fact that in his 32 cases, Rylander included cases in which a tumor could not be completely removed, 1 case in which the anterior cerebral artery was believed to have been clamped at operation, and cases in which the tumor could be expected to recur (e.g. glioblastoma). These facts suggest that observed deficits on the aforementioned measures (e.g. form board, interpretation of proverbs) may be due to the surgical removal, to the added pathological destruction or both, but not necessarily due to excision of frontal lobe tissue. Another source of difficulty lies in Halstead's (1947) control group that, compared to the frontal pathology group, was unmatched for age, education and occupation. Finally, it is possible that at least one of Halstead's measures was insensitive to frontal lobe function. For example, it is unclear how visual and tactile discrimination, assessed by performance on a form board, is selectively sensitive to

frontal lobe pathology. Normative data on the Stanford-Binet Intelligence Scale suggests that successful completion of a form board task (similar to the measure mentioned above) is expected at the 2.0 year level. Moreover, Halstead's (1947) subjects were reported to be at least of low average intelligence (as assessed by the Stanford-Binet), suggesting they passed the form board subtest at year level II. It is thus not surprising to note the negative findings of Pollack (1960), Teuber (1964), and Battersby et. al. (1955) due to frontally insensitive assessment techniques.

Early studies of cases with surgical lesions, such as lobotomies (Partridge, 1950; Petrie, 1952) and topectomies (Mettler, 1949, 1952) present other difficulties. Lacking contrasting groups with lesions outside the frontal lobes, there is little way of determining whether any symptoms produced by frontal lesions are specific to frontal pathology or are equally expected with lesions in other lobes. Moreover, the surgical trauma is superimposed in most cases of psychosurgery on preexisting psychiatric illness or intractable pain states. Thus, failure to find effects in particular dimensions of behavior after psychosurgery might merely indicate that the pathology produced by ablation is submerged in the preexisting abnormalities. This point has been made most forcefully by Rosvold and Mishkin (1950) who showed that performance on intelligence tests after lobotomy

did not drop in relation to scores obtained just prior to operation. A question raised by Rosvold and Mishkin's (1950) study of lobotomized frontal patients bears upon anatomical location and unchanged postoperative performance on intelligence tests. Rosvold and Mishkin described the lobotomized lesions as bilateral. However, Greenblatt and Solomon (1953) demonstrated that there is a relation between type of operation and degree of change in intellect following operation. That is, compared to bilateral lobotomy cases serving as controls, Greenblatt and Solomon demonstrated that psychiatric patients with bimedial frontal resections showed improved postoperative intellectual functioning (as measured by the Stanford-Binet). Thus, location of surgical ablation may differentiate the clinically improved from unimproved cases.

Collectively, early studies of frontal lobe symptomatology provide contradictory evidence of frontal lobe functions. Sources of contradiction in single case, group comparison and lobotomy studies perhaps result from differences in lesion location and extent, inconsistent assessment procedures, lack of operational specification, absence of control groups and preexisting psychiatric symptomatology.

Notwithstanding these contradictions in the above evidence of the functions of the frontal lobes, early and

current clinicians succeeded in agreeing on the variables that affect the form of the "frontal syndrome" appearing especially in extensive lesions of the frontal lobes. That is, symptoms of "frontal syndrome" are thought to take different forms depending on the severity of the lesion, the extent to which subcortical formations are involved by the pathological process and the severity of the general cerebral manifestations (see Luria, 1980 for review). The variable of extent of lesion will now be reviewed (see Appendix A for diagram of frontal cortex).

In relatively mild lesions of the prefrontal divisions of the brain, clinicians have observed that, although "formal intellect" (as assessed by standard measures of intelligence) is intact, the patients show marked changes in behavior (e.g. Mettler, 1949; Damasio, 1979). Sometimes the whole picture of the disease is superimposed on depression*, in which case the patients lack in initiative, curtail their circle of interests and develop the defect that Kleist called "Mangel an Antrieb" (lack of drive)* (see Luria, 1980 for review). If the disease is accompanied by signs of irritability, the picture is complicated by uncontrollable impulsive actions*

* As the form of the "frontal syndrome" depends on severity and extent of lesion, current methods (e.g. CT scan) can reliably confirm locus and extent of pathology. Thus, retention of some classical descriptions of frontal lobe symptomatology (e.g. depression, uncontrollable impulsive actions) is justified by similar recent characterizations (e.g. pseudo-depression, pseudopsychopathy) that are based on confirmation of locus and extent of lesion by CT scan.

without regard to results or consequences. Often both of these states may coexist in the same patient, in which case loss of spontaneous activity is superimposed on a background of either diminished or increased excitation (Brain, 1969; Hecaen & Albert, 1975).

The frontal syndrome is especially prominent with extensive lesions of the frontal lobes associated with unambiguous pathognomic symptoms (e.g. snout, sucking and Babinski reflexes). In these cases the disturbances in initiative turn into gross adynamia and the emotional changes, into complete loss of critical appraisal and emotional indifference. Lucid consciousness gives way to confusion and the unity of the personality is destroyed (e.g. inattentiveness, distractibility, vacancy of facial expression, carelessness in dress, eating gluttonously; Luria, 1980).

Besides the disturbance of initiative and the other aforementioned behavioral disturbances, almost all patients with any lesion of the frontal lobes are reported to have a marked loss of their "critical faculty", i.e., a disturbance of their ability to correctly evaluate their own behavior and the adequacy of their actions. All of the above features of the frontal syndrome are firmly established in clinical psychiatry (Freedman et. al., 1976).

Despite the wealth of clinical observations in the

literature on mental disturbances caused by frontal lesions, these descriptions can by no means be regarded as constituting a unitary analysis of these complex phenomena. As recently as 1984, in their review of frontal lobe functions, Stuss and Benson state that the frontal lobe patient has been impressionistically described as "childlike" and "egocentric". Thus, clinical characterizations of the frontal lobe patient continue to lack operational descriptions. The absence of operational descriptions may be a reflection of the actual complexity of the problem.

More Current Findings and Conceptualizations

More recent clinical observations and neuropsychological studies have added to and corroborated classical descriptions of frontal lobe functions to include hemispheric specificity and have suggested that there may be some localization of the cognitive and personality deficits associated with frontal lobe disease. Moreover, as will be documented, there is a confusing mixture of symptoms associated with right and left frontal lobe pathology in both cognitive and personality spheres. In the next section Piaget's (1926, 1950, 1969) "egocentrism", a theoretical developmental construct, will be used to elucidate cognitive and personality changes associated with frontal lobe

pathology.

Personality Deficits- Blumer and Benson (1975) described two significantly different personality types based on bilateral structural damage to different portions of the frontal lobes. Following Kleist, they described several patients with dorsal-lateral convexity disturbances characterized by apathy, lack of drive, inability to plan ahead and total unconcern. These descriptions were based on clinical observation with no evidence for interjudge reliability. Blumer and Benson further noted that these patients appeared to have depressed mentation, but formal tests of intellectual functioning revealed average to above average capacities, so the term "pseudo-depressed" was suggested for this group. However, depression does not necessarily require a drop in intellectual functioning (Anastasi, 1976). Moreover, characterizations of depressed mentation, apathy, lack of drive, inability to plan ahead and unconcern are but a subset of the symptoms required to meet the criteria of a clinical depression (Diagnostic and Statistical Manual-III, 1980), and therefore only partially characterize this personality deficit.

By contrast, the second frontal personality abnormality suggested by Blumer and Benson was quite different. Patients were observed to be puerile, jocular, sexually

disinhibited and self indulgent with a corresponding lack of concern for others. Based on these characterizations, the term "pseudo-psychopathic" was suggested. As in the "pseudo-depressed" type, however, these characterizations were based on clinical observations with no evidence for interjudge reliability. Moreover, characterizations of puerile, jocular, sexually disinhibited and self-indulgent behavior are but a subset of the symptoms required to meet the criteria of a "sociopathic" or anti-social personality disorder (DSM-III, 1980). Several varieties of pathology produced this personality alteration but the common factor was location of pathology in the orbital aspect of the frontal lobe.

Although they noted that all of their cases had suffered bilateral frontal involvement, consistent with previous authors (e.g. Goldstein, 1952; Gainottti, 1972), Blumer and Benson suggested the possibility that frontal personality alterations might follow unilateral disease as well. The formulation of personality alteration and unilateral disease is consistent with recent models of hemispheric specificity of emotion (see Kinsbourne and Bemporad, 1984 for review). Specifically, left hemisphere disease has been associated with a variety of expressions of negative affect, i.e., catastrophic reactions to illness, depressive episodes and outbursts of crying (e.g. Goldstein,

1952; Gainotti, 1972). By contrast, right hemisphere disease has been associated with lability of affect, emotional disinhibition and aberrant emotional response (e.g. Smythies, 1966; Damasio and Van Hoesen, 1983). Based on the above differences in lateralization of emotional dysfunction, Kolb and Wishaw (1980) speculated that left hemispheric disease may be more likely to produce the pseudodepressed syndrome, and right hemispheric disease to produce pseudopsychopathy.

Partial support for Kolb and Wishaw's (1980) contention of a pseudodepressed personality and left hemispheric disease is suggested by the findings of Finset (1983) and Gasparrini et. al. (1978). Comparing patients with left and right hemiplegia, Finset (1983) noted that left frontals were more prone to depressive episodes (as measured by frequency of appetite and sleep disturbance, psychomotor agitation or retardation and suicidal ideation) and outbursts of crying, a finding consistent with Goldstein's (1952) and Gainotti's (1972) observation of left frontal catastrophic reactions to illness. Moreover, Gasparrini et. al. (1978) assessed left and right frontally lesioned patient groups (whose performance on tests of intelligence did not differ significantly) and reported that 7 of 16 left frontal patients and none of 8 right frontal patients had elevated MMPI depression scale scores. However, 9 of 16 left frontal patients were not elevated for depression on the MMPI, a

finding unspecified by the authors. In addition, there was no evidence for elevated MMPI psychopathy for the right frontal group, a finding expected on the basis of Kolb and Whishaw's model of pseudo-psychopathy.

As mentioned above, Kolb and Whishaw (1980) have suggested that pseudopsychopathic behavior, described as emotional disinhibition, lability of affect, impaired social judgment, and aberrant emotional response might be more common in right frontal lesion patients. Emotional disinhibition associated with right frontal damage is implied by the findings of Ross and Rush (1981), and Kolb and Taylor (1981). Ross and Rush (1981) presented three cases of patients with right frontal lesions and labile display of affect (as measured by frequency of uncontrollable laughing and crying spells). The patients commented that their emotional expressions were not always consonant with their actual feelings. However, whether lability of affect is more commonly found in right brain damaged patients than left brain damaged patients has not been systematically investigated. Kolb and Taylor (1981) reported a dissociation between left and right frontal lobe impaired patients. After left damage, patients spoke little if at all spontaneously. After right damage they spoke excessively (e.g. as assessed by noting each time a patient interrupted testing with comments about the test or extraneous remarks) relative to

patients with left damage. The reported association of emotional disinhibition (e.g. Ross & Rush, 1981; Kolb & Taylor, 1981) found in right unilaterally lesioned patients is consistent with Blumer and Benson's (1975) descriptions of disinhibited or pseudopsychopathic response in bilateral frontal patients. Bilateral frontal patients have also been observed to exhibit impaired social judgment. Impaired social judgment, defined as facetiousness, intolerance, self-indulgence, lack of concern for others and egocentrism, is considered by some authors as a subset of pseudopsychopathy found in bilateral frontal lesion patients (Smythies, 1966; Damasio and Van Hoesen, 1983). However, these descriptions of impaired social judgment have neither been systematically investigated nor related to right frontal disease.

Closely related to the aforementioned characterization of impaired social judgment is the association of right frontal pathology and aberrant emotional response. In general, right brain damaged patients are more impaired than those with left brain damage in remembering (Wechsler, 1973), interpreting (Heilman et al., 1975; Tucker et al., 1977) and expressing (Ross and Mesulam, 1979) emotion. More specifically, right hemisphere damaged patients 1) may lose the ability to appreciate facial expression of emotion (Cicone et al., 1980), 2) are impaired in matching photographs of different faces according to emotions

displayed (Kolb and Taylor, 1981), and 3) were more impaired than normals and left brain damaged patients (Borod et al., 1983) in a study that examined both perception and expression of facial emotions. Most significantly, within the right brain damaged group, patients with frontal involvement were more impaired on expression of emotions, while those with posterior lesions were more impaired on perception of emotions (Borod et. al., 1983). These findings thus suggest a possible difference of emotional processing between right and left frontal pathology groups; the former more significantly impaired. However, left and right frontal groups were not initially assayed for possible differences in emotional state (e.g. pseudodepressed vs. pseudopsychopathic) which could influence their subsequent perception and/or expression of emotionality. For example, Babinski (1914), Gainotti (1969, 1972) and Hecaen et. al. (1951) found patients with right frontal damage to deny illness or to be strangely indifferent to events that would arouse emotion in others (e.g. denial or indifference to hemiplegia). Thus, for the right frontal patient, inadequate processing of emotional information may represent a manifestation of their inability to distinguish their personal emotional indifference from different emotional states expressed by others (e.g. happiness, anger, sadness). Congruence between their initial states of emotionality and

subsequent judgments of test stimuli would lend credence to Stuss and Benson's (1984) description of the frontal lobe patient as "egocentric", suggesting a mechanism underlying frontal lobe personality types. This relationship has not been systematically investigated. Nonetheless this implies that frontal patients may be emotionally indifferent to the point of view of others. Goldstein (1952) has described the frontal lobe patient as unable to discover the essence of a situation which is not related to his own personality. Thus, emotional indifference may imply regression to childlike, egocentric behavior.

Related to studies of emotional indifference, Gardner, Ling, Flamm and Silverman (1975) assessed both right and left brain damaged patients' reactions to captioned and uncaptioned cartoons. The number of correct choices (e.g. selection of the "funny" cartoon in each set of four) and number of "mirth responses" (e.g. smiling, laughing, all verbal comments) were scored for each subject. Patients with damage to the left brain performed like controls (that is, correctly selected the humorous cartoon and gave only a few mirth responses to each cartoon). By contrast, right frontal patients tended to either laugh excessively or never laugh or confabulate answers to the cartoons. Similarly, Cicone, Wapner and Gardner (1980) found that right frontal patients may lose the ability to appreciate facial expression

of emotions. Wapner, Hamby and Gardner (1981) found that right frontal patients missed the point of stories and jokes (e.g. unable to select the correct moral to the "Golden Rule" story) though they had no difficulties with elementary language functions. They had difficulty using contextual cues (e.g. to account for the character's motivations for some of their actions), assessing the plausibility of a character's actions and integrating the elements of narratives. They parroted back verbal material when paraphrasing and had difficulty organizing and drawing inferences. They would add irrelevancies, embellishments or frank confabulations. Left frontals, by contrast, correctly apprehended the point of stories and jokes. They conveyed the point of stories and accounted for the character's motivation, with no evidence for embellishments or confabulation.

Collectively, some evidence suggests right and/or bilateral frontal lobe lesions are associated with inappropriate, reduced or labile emotionality. Bilateral frontal lesions have been related conceptually to personality symptoms of pseudodepression or pseudopsychopathy with limited evidence for unilateral involvement. Investigators have listed a subset of pseudopsychopathy to include impaired social judgment, egocentricity and lack of concern for others. These descriptions have not been systematically

investigated and rely on the methodology of clinical observation. Moreover, dissociation of personality symptoms in left and right frontal groups has been limited to tests and observations of emotional expression and perception, with right frontal patients more significantly impaired on expression. There is some limited evidence for localization. Many descriptions of frontal personality defects exist, however the relationship of the symptoms is not better understood. Moreover, no theoretical construct, tied to a suitable theory, is used to unify these diverse personality observations.

Cognitive Deficits- As previously stated, much of the controversy and confusion concerning frontal lobe function derives from the early observations and studies of cognitive functions in frontal lobe damaged patients. Historically, case study, group comparison, lobotomy and tumor studies suggested that bilateral frontal damage could result in cognitive deficiencies (Ackerly & Benton, 1948) and loss of abstract thinking (Malmo, 1942; Rylander, 1939). Certain evidence conflicted with this stand, however. The retention or preservation of "formal intellect" (i.e. as measured by standard intelligence scales) in frontal lesion patients has often been reported (Hebb, 1939; Pollack, 1960; Teuber, 1959).

More recent research has pointed out some possible reasons for the apparently discrepant findings. In general, the above observations have been correct (Stuss & Benson, 1984). However, underlying some of the demonstrated cognitive deficits there are often complicating disorders such as difficulties in attention, problems in planning and impaired monitoring of performance (Hecaen and Albert, 1975; Luria, 1973; Milner, 1964; Teuber, 1964). Based on the above, the following categories allow one to unify some of the characteristic cognitive deficits associated with frontal lobe pathology: 1) difficulties in "preliminary investigatory activities" and "multi-step logical operations", i.e., organization and planning deficits (Luria, 1980), 2) impaired ability to establish or change a set resulting in apparently random or marked perseverative behavior (Milner, 1964, 1982; Shallice, 1982; Stuss et. al., 1982, 1983) and 3) impaired reversal of perspective in perceptuomotor and personal orientation tasks (Teuber, 1964). Research over the last twenty years has gradually defined the above characteristic cognitive deficits in frontal lobe patients, with some evidence for hemispheric specificity, localization and dissociation of function.

Luria's contribution to the study of frontal lobe functions encompassed many years of extensive investigation.

As in so many other studies on the frontal lobe, the importance of the results is somewhat limited by the choice of the subjects for experimentation. Most of Luria's patients had large bifrontal tumors, some intrinsic and some extrinsic. Some involved subcortical limbic system structures such as the septum. Some had associated hydrocephalus and some not. Most patients had associated nonfrontal dysfunction, due to mass effect or compromise of vascular supply elsewhere in the brain. The location within the frontal lobe was also variable. The limits of studies performed under such unsatisfactory methodology are obvious. Nevertheless, Luria's concept of impaired "preliminary investigatory activities" in frontal lobe patients provides one avenue for examining cognitive deficits.

According to Luria (1980), intellectual activity begins when the goal cannot be attained by available methods and where a definite task arises.

The first stage of intellectual activity consists of analysis of the conditions of the task and identification of its most important elements. Luria refers to "preliminary investigatory activity" as central to this process of orienting one's actions to task demands.

All subsequent stages of intellectual activity are based upon "preliminary investigatory" behavior and the planned character of heuristic processes (Vygotski, 1956;

Bruner, 1956; Newell et al., 1958). That is, the hypotheses generated by the orienting activity gives the subsequent course of intellectual processes their goal-directed and selective character. Steps or "connections" corresponding to hypotheses are more likely to appear, whereas "irrelevant connections" (to the task) are inhibited. Finally, the process of hypothesis searching is accompanied by a comparison between attempts made and the original plan to task demands. Luria considers these stages as the complex and selective character of intellectual activity.

Luria further observes that impairments in such intellectual activity are evident in frontal lesion patients (1980). As a rule, these patients do not begin to analyze the situation created by the task presented to them. The orienting basis of the intellectual action is either completely omitted or compromised. Individual elements of the task are not compared with one another and no hypotheses are generated on their basis, whereby the more appropriate connections would be more likely to arise and the less appropriate, not corresponding to the hypothesis, would be inhibited. Thus, "heuristic connections" are no longer effective but rather are irrelevant, random or perseverative; the process of intellectual activity "loses its selective character". The process of comparing the action performed with the conditions of the task is omitted. No effort is

made to ascertain if the action corresponds to the original purposes.

Luria notes that the disturbance of intellectual processes in patients with frontal lesions is observed both in verbal and non-verbal domains (1980). Non-verbal intellectual activity in the solution of constructive problems and verbal tasks of analysis of semantic structures, classification of objects and solution of arithmetical problems (Luria, 1980) are impaired in bilateral frontal patients. Common to both verbal and non-verbal deficits in intellectual activity is the frontal lesion patient's omitting the phase of preliminary investigation of the problem and failure to form a general plan for its solution. The inability to remain within the limits of the selective system of connections given by a task, emergence of irrelevant connections and inability to inhibit these irrelevant connections is classified by Luria (1980) as a disturbance of selective logical operations.

Basic arithmetical operations (e.g. addition and subtraction) are not compromised in patients with frontal lobe pathology. However, when problems involve multiple steps to arrive at a solution the patient responds impulsively, not analyzing the necessary steps for a correct solution. Luria and Tsvetkova (see Luria, 1980 for review) suggest that the mechanism requiring multi-step programs is

threefold: 1) retain the program given, 2) keep the necessary sequence of subprograms one must perform and 3) be able to switch from one to the other and inhibit the tendency to fall under influences not connected with the program. In frontal lesion patients, Luria asserts, the capacity to "switch" from one program to another in arriving at mathematical (and other) solutions appears impaired.

Closely related to impairments of switching, organizational deficits have also been associated with frontal lobe dysfunction. The Block Design subtest of the Wechsler Adult Intelligence Scale has been used to assess this deficit. Comparing pre-frontal leukotomy patients' pre and post-operative performance on Block Design, Walsh (1977) found that, with assistance by partial programming (e.g. organizing the external configuration of a design), performance increased significantly.

Planning, anticipation and completion of planned actions have also been described as deficient in patients with frontal lobe pathology (Luria, 1980). Luria has postulated that patients with frontal lobe pathology are unable to form "action plans" and cannot match response outcome with the original intention formulated by such plans (Luria, 1964; 1980). In his theory of the development of verbal self-regulation, Luria states that in young children, "plans" are kinaesthetically or visually controlled whereas

verbal mediation is of primary importance in older children and adults. In frontal lesion patients, a disorder of the regulation of voluntary movements by language is an early pathognomic symptom (Luria, 1980). In support of his theory, Luria has observed that patients with frontal lesions perform poorly on tasks that require the organization of a series of actions in response to verbal directives and which may to varying extents conflict with kinaesthetic or visual cues or the motor impellent function of speech. Though correctly apprehending task instructions and demands, frontal patients fail to use such knowledge to correct inaccuracies in performance. Similarly, they are able to produce correct verbal responses on the same tasks but these do not aid organization of motor responses of the hand. Luria's theory thus predicts a dissociation of verbal and motor behavior in frontal lesion patients. Luria asserts that the aforementioned deficits are associated with left frontal lesions (Luria, 1980). He assessed these deficits with tasks involving "press" and "don't press" responses, tasks involving responses with the left and right hands and conditional tasks in which the directive function of the stimuli conflict with the meaning given to them by verbal instructions (e.g. directed to hold up one finger when seeing two fingers and two fingers when seeing one).

Recent experimental investigation of Luria's theory of

impaired "action plans" in frontal lesion patients lends only partial support for the hypothesized dissociation of verbal and motor behavior (Drewe, 1975). Using similar tasks mentioned above, Drewe (1975) assessed groups of lateralized frontal and non-frontal cortical lesion patients and found that the hypothesized dissociation of verbal and motor behavior can be demonstrated in only specific instances. Specifically, disruption of motor performance by verbalization and inconsistency of motor and verbal responses was found only on tasks of compatible and incompatible discrimination (e.g. directive function of stimuli are either consistent or conflict with the meaning given to them by verbal instructions). In addition, only right non-medial frontal patients were significantly worse on "go right-go left" tasks (e.g. pressing right hand key to red light onset and left hand to blue light onset) compared to nonfrontal lesion controls. This finding questions Luria's assertion of left frontal pathology being exclusively associated with a dissociation of verbal and motor behavior in the formation of "action plans".

Planning and completion of planned actions has also been assessed by the Porteus Maze Test (Porteus, 1950). This task requires advanced planning a route to be followed, anticipation of blocked passages and carrying out of planned sequences. Several studies suggest impaired

performance by frontal leukotomy patients on this measure (Malmo, 1948; Mettler, 1952; Petrie, 1949; Porteus and Kepner, 1944; Porteus and Peters, 1947). In all studies, frontal patients correctly apprehended task instructions and demands, yet failed to use such knowledge to correct inaccuracies in performance. The paradigms noted above all employ signals of error to persuade patients to change their response-sets and thus it remains possible that patients with frontal lobe lesions might be able to change their behaviors if the stimuli signalling this change were of an appetitive kind. Based on Gray's (1970) argument that the orbitofrontal cortex responds selectively to signals of novelty, non-reward and signals of punishment, Canavan (1983) examined the effect of signal valency on stylus-maze performance in patients with frontal lobe lesions. Dividing frontal lobe patients into "reward" (e.g. feedback of number correct) and "error" conditions (e.g. signals of error), Canavan reported that experimental condition did not affect performance on the stylus-maze task. Thus, the valency of the signals and emphasis upon either errors or correctness does not appear to be an important factor in this task.

Closely related to organizational and planning deficits, frontal lobe damage can also impair the ability to establish or change a set, resulting in apparently random or marked perseverative behavior. The Wisconsin Card Sorting

Test (Berg, 1948) is a traditional measure of this frontal lobe impairment. The patient is shown four cards whose figures are different in color, form and number of elements (a red triangle, two green stars, three yellow crosses and four blue circles). The patient is given a pack of 128 cards varying in color, form and number and asked to sort each consecutive card from the pack (response cards) and place it before one of the four cards (stimulus cards) where he thinks it belongs. Following a choice, the patient is informed whether his approach is correct or incorrect and asked to use this information to make as many correct choices as possible. The first sorting criterion is color and any other choice is called wrong. Following ten consecutive color choices the sorting criterion changes without warning and any color choices are called wrong. A shift to form is next called correct and following ten correct choices shifts to numbers without warning. The procedure continues until all six changes have been completed.

Comparing frontally lesioned patients to other brain injured patients, Halstead (1940, 1947), using the Halstead Category Test (essentially same as Wisconsin Card Sorting Test) found the former more significantly impaired. Similarly, Milner (1963, 1964) assessed lobectomized patients' performance on the Wisconsin Card Sorting Test and found equally significant impairments in both left and right

frontally lesioned patients. The findings were interpreted as proof that the ability to shift from one strategy to another in a sorting task is more compromised by frontal lobe damage than by rolandic or posterior sensory cortex damage. Similarly, Shallice (1982) found that of 10 measures sensitive to frontal performance, only category sorting tasks discriminated prefrontal- posterior frontal differences.

Variables accounting for deficient performance on the Wisconsin Card Sorting Test were offered by many clinicians. Normal subjects can elucidate the three underlying criteria of form, number and color. By contrast, frontal lesion patients are unable to "change responses in accordance with varying environmental stimuli to overcome previously established response patterns" (Milner, 1964). The perseverative tendency (of previous responses) of frontal patients seems to parallel perseveration observed in frontal animals (Harlow and Settlage, 1948; Mishkin, 1964; Pribram et al., 1964). Luria (1973) refers to the process as a dissociation between knowing and doing; verbalization no longer controls active behavior. Knowing their errors, frontal patients fail to use such knowledge to correct their behavior. Pribram (1971) refers to this process as a "thought-action dissociation" between feedback and feedforward systems compromising error correction. Milner (1982) suggests that frontal patients fail to use external

cues in directing responses rather than having a verbal regulation deficit. Additionally, there is a "distinctive lack of self-criticism" described as a "general loss of some feedback system, a disturbance in signals of error, or an inadequate evaluation of the patient's own action... a deficit in matching action carried out with the original intention" (Luria and Homskaya, 1964).

Regardless of conjectures for deficient sorting behavior, a serious question raised by Milner's (1963, 1964) studies of lobectomized frontal patients bears upon anatomical correlation and cognitive deficit. Taylor (1979) reports that the Wisconsin Card Sorting Test is sensitive to function in dorsolateral areas of both frontal lobes, but more to the left than the right. Milner described the pertinent lesions as dorsolateral. However, at least 15 of the 18 patients had as much mesial involvement as they had dorsolateral. Furthermore the dorsolateral involvement varied considerably and judging from the diagrams, lesions were in some cases, restricted to prefrontal cortex while in some others, there seems to have been invasion of transitional and premotor cortex. Except for one case, the extent of orbital involvement was unknown. It is thus possible to conclude that the cognitive deficits of Milner's patients were correlated with extensive and bilateral frontal lobe damage, predominantly prefrontal but not necessarily

localized to dorsolateral, mesial, orbital or left-right differences.

By contrast, Teuber (1964) could not replicate Milner's findings on the Wisconsin Card Sorting Test. However, the discrepancy may have been due to the difference in type of lesion (gunshot wounds in Teuber's patients) and different experimental procedures (Teuber informed his patients there would be changes in sorting criteria).

Teuber's (1964) contribution to the problem of frontal lobe cognitive deficits examined impairment on a series of perceptuomotor tasks. This included tests of visuopostural orientation, visual-searching, body-orientation and reversal of perspective ability. The visuopostural task (Teuber and Mishkin, 1954) called for the mechanical setting of a brightly luminous rod in the vertical position. The test was conducted in a dark room with the patient under different conditions of body tilt. Frontal lobe subjects did poorly in this task. However, if the task was strictly visual and no intermodal (visuo-proprioceptive) conflict was established, the subjects performed normally. The visual search and body orientation tasks involved active head-and-eye movement in the search for certain patterns or rapidly shifting left to right, pointing responses on the patient's body. Dissociation between subject groups was also achieved on a perceptual orientation task. Right frontal-damaged patients

were more vulnerable on personal orientation tasks (i.e tests of personal space) but parietal lobe patients were inferior at tasks involving orientation in their surroundings (extrapersonal space). The reversal of perspective task was performed with two Necker cubes. The patient was requested to signify his perception of left or right perspective reversal by pressing levers placed to his left and to his right. Since all of these tasks are difficult for normal control subjects to perform, and probably more so for a brain damaged individual, the strength of the results lies in the verification that patients with nonfrontal brain damage performed consistently better than those with frontal disease.

Further study of cognitive function in frontal leukotomy patients suggests the necessity to examine distinctions between retention of "formal intellect" and inability to shift a perceptual set. Stuss et al. (1982, 1983) compared three groups of leukotomized schizophrenic patients with two control groups; a nonleukotomized schizophrenic group and normal control group. Tests administered were: the Wechsler Adult Intelligence Scale, a test of comprehension in metaphorical language (Winner and Gardner, 1977) a visual-verbal test of abstraction (Feldman and Drasgow, 1960) and the Wisconsin Card Sorting Test. The results suggested that patients with bilateral frontal

lesions retained general intellectual and basic abstraction capacities. However, verbalization of abstract responses, shifting perceptual sets and maintaining sequences of correct responses were all impaired.

Clear evidence for dissociation of cognitive function in right versus left frontal lesion patients has been limited to tests of verbal and non-verbal fluency. Using Thurstone's Word Fluency Test, Milner (1964) showed that patients with left frontal lobectomies, who were free of aphasia, scored very poorly compared to right frontal patients with similar resections. However, both groups performed equally well on tests of verbal memory suggesting the relative independence of the mechanism underlying fluency.

Using a non-verbal analogue of Thurstone's Word Fluency Test, Jones-Gotman and Milner (1977) compared left and right frontal patients' abilities to produce abstract designs. It was predicted that the task, testing fluency in a non-verbal mode, would tap the specialized abilities of anterior parts of the right hemisphere just as certain tests of word fluency tap those of the left frontal lobe. The results suggested right frontals to be more significantly impaired than left frontal patients thus emphasizing the importance of both side and site of lesion in performance of this task.

However, not all tests of word fluency discriminate decrements in performance. The Thurstone Word Fluency Test,

which does yield word fluency deficits in left frontal lesion patients, requires subjects to write down in 5 minutes as many words as they can beginning with the letter "S" and then in 4 minutes, as many four-letter words as they can beginning with "C". By contrast, Newcombe (1969) found no evidence for a specific contribution of the left frontal lobe to the performance of a fluency task requiring the listing of nouns in a particular semantic category (e.g. animals). Thus, tests sensitive to deficient verbal fluency (in left frontal lesion patients) appear phonemic in nature whereas semantic categorization may not evidence similar deficits (Guilford, 1967).

Collectively, evidence for cognitive deficits in frontal lobe lesion patients include: failure to carry out multi-step logical operations, organization, anticipation, attentional and planning deficits, a dissociation between knowing and doing, impaired performance of perceptuomotor tasks requiring shifting of perceptual sets and reversal of perspective, and phonemic verbal and non-verbal fluency deficits in left and right frontal lesion patients respectively.

There is some evidence that the personality and cognitive deficits associated with frontal lobe pathology can be more specifically localized to the right and left frontal regions respectively. However, the majority of studies

examining personality and cognitive deficits were drawn from samples of patients with large bifrontal tumors, gunshot wounds and/or lobectomy. In addition, modification of methodology and inconsistent subject selection across studies (using the same measures) have led to contradictory findings (e.g. Wisconsin Card Sorting Test). Moreover, characterization of patient symptomatology is variable with a myriad of descriptions applied to observations not systematically investigated. Varying symptom description may result from differences in tumor size and/or inconsistent assessment procedures. However, much of the confusion over frontal lobe symptomatology appears to stem from lack of formal operational constructs tied to a suitable theory.

An Effort To Understand Frontal Pathology From Within
A Cognitive/Developmental Psychology Framework

Analysis of the personality and cognitive changes associated with frontal lobe pathology suggests a commonality which occurs across a variety of themes. Specifically, personality and cognitive deficits described as "lack of social awareness", "indifference", "unconcern", "childlike egocentric behavior", "self-indulgence", "inappropriate perception and expression of emotionality", "inability to change sets with poor reversal of perspective", and

"deficient multi-step operations" are all reminiscent of Piaget's (1954, 1969) developmental construct of egocentrism. Piaget's construct of egocentrism, as will be reviewed, has been applied to behavioral observations in cognitive and social domains.

This section examines how "egocentrism" can be used to unify under a single developmental construct the diverse descriptions of frontal lobe pathology. In addition, the evidence for dissociation of such egocentrism into cognitive and social domains, will be used as a rationale for predicting a similar dissociation for the personality and cognitive deficits observed in frontal lobe patients. It will be further argued that, egocentrism, when displayed by adults presupposes regression in the sense that it is the inverse of developmental progression. A regression model will then be proposed to account for the personality and cognitive changes observed in frontal lobe patients.

Piaget's General Model of Cognitive Development- A Brief Review

The most complete and systematic developmental theory of cognitive processes to date is that proposed by Piaget (Flavell, 1963; Hunt, 1961; Tuddenham, 1966). According to Piaget (1950), cognitive processes are defined as means of gaining information about the environment and about oneself in relation to this environment. Various levels of cognitive processes are distinguished and are considered stages in a lawful sequence of development. While these stages of cognitive development can be roughly identified with certain chronological age periods, Piaget's primary intent was to demonstrate the invariant order of this ontogenetic sequence of stages and document the qualitatively different processes which characterize each stage (Feffer, 1970).

Piaget (1926) has identified four major stages, each of which will now be briefly reviewed. The first stage is the "sensory-motor" period (from birth to approximately two years) during which the infant moves from a primarily reflexive organism, responding in an undifferentiated way to his environment, to "a relatively coherent organization of sensory-motor actions vis-a-vis his immediate environment" (Flavell, 1977). The second stage is that of "preoperational" or "egocentric" thought (from approximately

two to seven years) during which the child attempts to come to grips with the world of symbols and representational thought. However, his conceptual framework is grounded in the reality of his own subjective and egocentric perceptions, and his judgments are neither reflective nor logical (Piaget and Inhelder, 1969). The third major stage is that of "concrete operations" or "decentration" (from approximately seven to twelve years) by which time the child's reasoning processes or mental operations have become logical, and he has an orderly conceptual framework which he systematically brings to bear on the world of objects around him. The fourth and final stage of "formal operations" (from approximately twelve to fifteen years) is characterized by the occurrence of the child's ability for conceptualization and abstraction. That is, he can bring logical thought processes to bear not only on the real world of concrete objects and facts, but also on the world of the hypothetical. This dominance of conceptual thought, according to Piaget (1950), is coordinate with the ability to shift or "decenter" from one aspect of a situation to another in a flexible, balanced manner.

In summary, Piaget's general model of cognitive development delineates stages of increasing cognitive differentiation. The stages are viewed as reflecting both neurological maturation and environmental input, asymptoting

prior to adulthood, occurring in an invariant sequence and manifested in social and non-social realms.

The Egocentrism/Decentration Constructs

Piaget's (1954, 1969) concept of egocentrism is a theoretical developmental construct corresponding to the pre-operational stage of intellectual development. Though symbolic thought and language play a significant role during pre-operational development, egocentricism restricts cognitive operations characteristic of more mature thought. For example, although the child has acquired the concept of object, and may have a basic notion of certain classes of objects, his categories are based on but a single characteristic of the objects. He is unable to classify a variety of characteristics simultaneously. Similarly, in dealing with physical objects and quantities, he is capable of attending to only one aspect or dimension, to the exclusion of others. An example of this egocentric reasoning is provided by Piaget's (1926, 1954, 1969) classic conservation experiments on the child's judgment of the amount of liquid poured from one glass into a second taller and narrower glass. The egocentric child, focusing only on a single dimension may conclude that after the transformation there is more water in the second glass because it's higher.

Such thinking is dominated by the child's perceptions and the salience of particular physical attributes. More importantly, it is characterized by the absence of one of the most important logical operations in Piaget's system, namely reversibility, which is defined as the capacity to retrace conceptually a line of reasoning to its initial premise or a series of displacements to its initial state. In Piaget's theory, the "Schema of Conservation" represents a pivotal stage in the child's non-social cognitive transition from "preoperational" or "egocentric" thought to "concrete operational" thought. Piaget has found that with increasing age the child tends to rely relatively more on such abstract concepts as quantity, volume and weight, and relatively less on such specific attributes of the stimulus object as form and shape. Piaget and his associates (Piaget, 1946, 1952; Piaget and Inhelder, 1941; Piaget et al., 1960) have delineated many different types of conservation such as substance, weight, continuous and discontinuous quantity, number, area, distance, length and two- and three-dimensional space. Evidence relating egocentrism to deficient conservation behavior has been systematically investigated by Goldschmid and Bentler (1968). Findings of significant correlation among different tasks of conservation and total conservation scores have been argued to confirm the existence of an underlying cognitive construct of egocentrism.

At the preoperational or egocentric stage, the child's non-social and social reasoning is neither inductive nor deductive, but what Piaget (1951) terms "transductive". That is, he tends to relate the particular to the particular in an alogical manner. Thus if two objects or events are alike in one respect, they may be seen as similar in every respect. For example, Piaget (1951) notes that on an afternoon when his 7 year-old daughter did not take a nap she said: "I haven't had my nap so it isn't afternoon" (pg. 232). In this case, the child's thought proceeded from the nap (one particular) to the afternoon (the second particular) and concluded that the afternoon depended on the nap, when of course the relationship was of a different type. Thus, events may be related not because of any inherent cause-effect relationship but simply on the basis of spatial or temporal juxtapositions. Furthermore, the child is unaware and therefore unconcerned about possible contradictions in his logic. It is as if he is unable, as Flavell (1977) has aptly described it, "... to treat his own thought processes as an object of thought... to reconstruct a chain of reasoning which he has just passed through; he thinks but he cannot think about his own reasoning" (p.150).

Egocentric thought during this stage takes several interesting forms which Piaget has documented extensively (1929). At the core of these cognitive processes is the

young child's inability to clearly differentiate between self and the world, between the psychological realm of feelings and thoughts and the realm of objective reality and physical events. One form this takes is in what Piaget terms the child's "realism", for example, in his concept of dreams. Dreams are first conceptualized as external to the young child, as visible substantive events which occur outside him. Only at a much later stage does he come to the realization that dreams are the product of his own private thoughts and that this process is subjective and internal.

Piaget (1932) has also described how the child's egocentric notions of reality and causality influence his concepts of morality and justice. As Kohlberg (1964) has pointed out:

"Piaget believes that the cognitive limitations of the child three to eight lead him to confuse moral rules with physical laws and to view rules as fixed external things, rather than as instruments of human purposes and values" (pg. 395).

A good illustration of this characteristic pattern can be seen in Piaget's demonstrations of the egocentric child's view of "immanent justice", namely that punishment for wrong deeds is inevitable and inherent in the universe. This absolutism is further extended in the young child's judgment of the badness of an act in terms of its actual physical consequences.

All of these features type the preoperational child's

representation and symbolic functioning as egocentric, in the sense that his conceptual framework is grounded in the reality of his own subjective and egocentric perceptions and his judgments are neither reflective nor logical (Piaget and Inhelder, 1969).

As with all stages of Piaget's developmental framework, egocentric behavior is seen as occurring in social and non-social realms (Piaget and Inhelder, 1969). Non-social cognition may be broadly viewed as knowledge and reasoning about the physical world of objects (Flavell, 1977). Non-social cognition was formally illustrated above by deficient conservation behavior and transductive reasoning. By contrast, social cognition can refer to the intuitive or logical representation of others. That is, how an individual characterizes others and makes inferences about their covert, inner psychological experiences (Shantz, 1977). At the preoperational stage of development, the term "egocentrism" has definite social implications for the child is clearly the center of his own representational world. This characteristic is discernable in his inability to take the role or the point of view of another person, or to see things from a perspective other than his own (Piaget, 1969; Kohlberg, 1969). The inability to take another's viewpoint, in its literal sense, was documented in Piaget and Inhelder's (1969) classic study of spatial representation. Briefly, a

landscape of three different-sized mountains was presented to children and they were asked to identify the perspective of "another" (a doll) in various locations around the landscape. Three types of responses were used: reconstruction of the scene, selection of a photograph from a set which matched the doll's location, and placement of the doll to match a particular perspective. The ability to solve this task showed a clear developmental trend, but most important, the types of errors children made were informative. The predominant error was to attribute to the doll the child's own viewpoint regardless of the doll's location, a manifestation, Piaget asserted, of a pervasive difficulty of the child in self-other relations, namely, egocentrism.

Social perspective taking can be broadly categorized as: 1) role-taking involving a social dilemma wherein the child is questioned about his understanding of the dilemma from various viewpoints (Selman and Byrne, 1974; Chandler et. al., 1974), 2) intentionality and causal attributions wherein altruistic and moral judgments are rendered in conflict situations (DiVitto and McArthur, 1978; Karniol and Ross, 1976; Leahy, 1979) and 3) person descriptions emphasizing internal aspects (such as appearances and behaviors), the thoughts and recursive thoughts of others and qualification of descriptions by reference to temporal or situational variability or doubt about a trait description (Urberg and

Docherty, 1976; Livesely and Bromley, 1973; Peevers and Secord, 1973; Leahy, 1979).

Collectively, studies on perspective taking abilities in children confirm Piaget's (1954, 1969) concept of pre-operational egocentrism in social domains. Social egocentrism is theoretically defined and measured by the inability to separate one's point of view from another, deficient moral and altruistic judgments based on rewards congruent with the valence of outcome, and trait descriptions of others based on egocentric and concrete self-descriptions.

Through what Piaget (1969) and Feffer (1970) term the process of "decentering", the child learns during the preoperational stage to conceive of a spatial, temporal and causal world of events which exists independent of himself. Specifically, Feffer (1970) has proposed that there are three levels in the development of decentration. The first level, "egocentrism", is characterized by egocentrism or fixation on a single element or dimension as described earlier. This gives way to an intermediate level as the oscillation of attention to different dimensions through "sequential refocusing" (that is, the ability to attend to more than one aspect or dimension). Finally, at the third level (decentering) the child is able to simultaneously refocus on two or more dimensions and relate these dimensions to each other through a system of "compensatory relations" (Feffer,

1970). In non-social cognition, the most commonly cited example of decentering is where a child is able to simultaneously refocus on two dimensions (e.g. height and width) and coordinate these dimensions through a system of compensations or transformations (e.g. reversibility) in order to see that volume is conserved (Feffer, 1970). In the social domain, a commonly cited example of decentering is where a child is able to take the role or point of view of another person, or to see things from a perspective other than his own (Shantz, 1977).

In summary, non-social egocentrism was formally illustrated by deficient conservation behavior and "transductive" reasoning. Social egocentrism was formally illustrated as the inability to separate one's point of view from another (e.g. difficulties with perspective taking abilities), deficient moral and altruistic judgments and trait descriptions of others based on egocentric and concrete self-descriptions. Common to both cognitive and social egocentrism is the lack of decentration defined as the inability to sequentially and/or simultaneously refocus on two or more dimensions and recognize compensation relationships between dimensions (Feffer, 1970; Ginsburg and Oppen, 1979; Leahy, 1979). Decentration is thus a very important construct in Piaget's developmental framework as it is viewed to mediate social and non-social aspects of

cognition (Feffer, 1970). Moreover, the hierarchy of decentration has often been used as a measure of Piaget's construct of egocentrism. The next section addresses how these constructs are measured and the relationship between them.

Measures of Egocentrism, Findings and Implications

As mentioned above, Feffer (1970) has proposed that there are three levels in the development of decentration. Social and non-social cognitive measures reflecting various qualities of decentering have been distinguished (Leahy, 1979). Non-social egocentrism may be measured in at least three ways: 1) conservation behavior (as mentioned above), 2) divergent thinking (e.g. as attention deployment) and 3) reflection-impulsivity (e.g. as evaluation of one's response). Social egocentrism may also be measured in at least three ways: 1) role-taking, 2) spontaneous person descriptions (e.g. the number of descriptions offered and the use of central and qualifying statements), and 3) use of multiple cause schemes in altruistic judgments (e.g. causal inferences based on the intentions of others). The following subsection examines the evidence for the above measures of egocentrism. In addition, evidence for convergent validity of various tasks will be discussed with implications for the present investigation.

Based on Piaget and Inhelder's (1969) discussion of the development of perspective-taking, Feffer has suggested that the process mediating social and non-social cognition is decentration. Urberg and Docherty (1976) have supported Feffer's proposal by showing that social and non-social measures of egocentrism may be ordered by hierarchical clusters which correspond to the levels of decentering proposed by Feffer. That is, it is possible to draw distinctions among the cognitive and social cognitive tasks as they relate to either sequential or simultaneous decentering with compensations. The following tasks appear to involve sequential refocusing: divergent thinking, reflection-impulsivity, the number of descriptions offered and the use of central and qualifying statements. Similarly, role taking tasks, use of causal principles and conservation behavior appear to involve the ability to simultaneously refocus and to recognize compensating relationships (Leahy, 1979).

Evidence related to Feffer's claim generally supports the view of an association between decentering in non-social cognition and in social cognition (Feffer and Gourevitch, 1960; Rubin, 1973; Selman, 1976). Although these studies have used traditional Piagetian measures of decentration (conservation and class inclusion), Leahy (1979) examined the relationship between social cognitive measures and two

non-social cognitive measures, divergent thinking and reflection-impulsivity, which might be related to structural aspects of decentering. The aspect of decentering presumably involved in these two measures was that divergent thinking or a reflective cognitive style would be associated with the ability to sequentially refocus on one or more aspects of a situation. For example, divergent thinking ability, as a measure of creative thinking, has been conceptualized as reflecting individual differences in breadth of attention deployment, with several studies supporting this view (Dewing and Battye, 1971; Korlins et al., 1967; Ward, 1969). Thus divergent thinking may be related to the increased probability of attending to various dimensions or perspectives in interpersonal situations. Similarly, reflection-impulsivity is presumed to indicate the extent to which individuals evaluate their cognitive products in situations of response uncertainty (Kagan et al., 1964). Several studies support the view that reflection-impulsivity is related to decentering as measured by non-egocentric thought (Glenwick and Burka, 1975), conservation (Barstis and Ford, 1977) and the use of information about intention in moral and altruistic judgments (Schliefer and Douglas, 1973; Leahy, 1979).

A question raised by Feffer's formulation is whether different social cognitive measures share some structural

parallel as defined by decentering. There appears to be some question whether egocentrism forms a unitary trait when intelligence and chronological age are partialled out (Hudson, 1978; Kurdek, 1977; Rubin, 1973; Shantz, 1975; Waters and Tinsley, 1985) as well as the equally important issue of the interrelationship between egocentrism and other social cognitive measures.

In one study that addressed the convergent validity of various tasks, presumably measuring egocentrism, Kurdek (1977) found only a few significant relationships among measures. Three social cognitive measures were employed: role taking, peer description and use of multiple cause schemes. Difficulties arise in interpreting these results. It is unclear how "descriptiveness" (e.g. differentiating a peer from the environment) or "involvement" (e.g. mentioning self in describing a peer) reflect refocusing and compensating relationships (e.g. decentering). In addition, moderately low relationship ($r=.28$) between role taking and the use of causal schemes might have been due to attenuation of variation for the older children who generally use these schemes. Although Kurdek's study does indicate that conservation ability was unrelated to social cognitive measures, once again attenuation of range of responses for older children in conservation might have limited the association of variables.

Leahy (1979) attempted to assure some variation of each of the measures by restricting the sample to a single age group (eight years), an age of transition in decentering, and by including social and non-social cognitive measures reflecting various qualities of decentering; that is, both sequential and simultaneous refocusing with compensations. Three non-social measures were employed: conservation, divergent thinking and reflection-impulsivity. Social cognitive measures were role taking, spontaneous person descriptions and use of multiple cause schemes in altruistic judgments. Based on these foregoing distinctions, one expectation might be that social cognitive tasks reflecting these two processes of decentering should load on different factors in a factor analysis. Moreover, non-social abilities (e.g. divergent thinking and reflection-impulsivity) should be more highly associated with factors marked by sequential refocusing, and conservation ability, by simultaneous refocusing with compensation.

Leahy's (1979) study addressed these questions and his results were in line with the stated predictions. However, in agreement with Kurdek's (1977) study, only a moderate interrelationship (e.g. $r = .40$) was found between egocentrism and other social cognitive measures. Even when age was held constant to permit variation on these measures, Leahy's (1979) results question Piaget's (1969) assertion of

egocentrism as a unitary construct. That is, Leahy's (1979) factor analysis suggests that there is not one unified dimension of egocentrism in the social and non-social domain, offering support to Kurdek's (1977) observation of moderate interrelationship among measures. Such a conclusion (of a unified egocentrism dimension) would have been justified if one factor accounted for a large proportion of the common variance in egocentrism. However, the findings of the factor analysis do suggest that there are some limited consistencies among tasks involving social and non-social egocentrism.

Supporting Leahy's claim, more recent evaluation of the discriminant and convergent validity of egocentrism suggests only moderate correlations between tasks (Ford, 1985; Waters and Tinsley, 1985). Tasks reviewed include non-social conservation and recursive thinking, social role-taking, privileged information, and use of multiple cause schemes in arriving at altruistic and moral judgments.

Ford (1985) interpreted moderate intercorrelation (e.g. $r=.40$) between egocentrism tasks as a problem with Piaget's theory of egocentrism. Specifically, Ford argues that Piaget's theory does not clearly differentiate egocentric responses from nonegocentric errors, or whether age related variance should be included in one's reliability and validity computations. By contrast, Waters and Tinsley (1985) defend Piaget's theory in general, but question whether the

Piagetian system implies trait-like consistency among egocentrism tasks. These authors suggest however, that researchers have not paid sufficient attention to psychometric considerations (e.g. sample size, reliability of measures) in task construction, data collection and meta-analysis.

Given the above evidence for psychometric limitations in research on egocentrism, this does not necessarily imply, as Ford (1985) suggests, a problem with Piaget's theory. Moderate reliability is not a property of egocentrism per se; it is entirely the consequence of the methods used to assess it. Thus researchers may need to address the fact that: 1) egocentric errors are more characteristic of some ages than others (thereby eliminating age related variance in reliability and validity computations) and 2) procedural variations that are relevant to specific limitations of children's thought at particular ages can clearly increase the rate of egocentric response (e.g. in spatial perspective taking, egocentric errors vary not only with age, but also with the form of the question, the complexity of the picture array from which the observer's view is selected and the position of the observer; Huttonlocher and Presson, 1973, 1979). However, systematic agreement suggests that measures of egocentrism in both social and cognitive spheres, are only moderately correlated (Kurdek, 1977; Leahy, 1979; Ford, 1985;

Waters and Tinsely, 1985). For purposes of the present investigation, a moderate correlation suggests egocentrism may not be a unitary construct and is perhaps dissociable to social and cognitive realms of egocentric behavior. Implications for understanding this in relation to frontal lobe functions will be elaborated in the next section.

Parallels With Frontal Pathology

Egocentrism can perhaps dissociate the personality and cognitive deficits associated with right and left frontal disease. It will be recalled that evidence was provided that personality or social deficits are consistent with right and/or bilateral frontal disease, and cognitive deficits, with left and/or bilateral frontal lobe disturbance. In part it was argued that confusion surrounding frontal lobe symptomatology stems from lack of formal operational constructs tied to a suitable theory. Piaget's egocentrism is a measurable developmental construct that can be applied to frontal lobe disturbance, particularly when viewed along social and non-social cognitive dimensions. The social and cognitive characteristics of egocentric behavior described by Piaget and others bear resemblance to the personality and cognitive deficits of the frontal lobe patient. These are developed below.

Left Frontal Pathology

Left and/or bilateral frontal lobe lesions produce disturbances of intellectual processes whose mediating cognitive transformations can be said to bear directly on shifts from decentration to egocentric modes of thought. Luria (1980) suggests that frontal lobe patients retain the capacity to understand the meaning of words and phrases or logical-grammatical relationships but quickly undergo profound changes when confronted with a problem solving task involving multi-step operations. Multi-step operations involve a "preliminary investigatory activity" comprised of the analysis of the conditions and identification of the essential connections and relationships. This preliminary activity forms the basis of hypotheses and further reasoning in solving the given task. In frontal lobe patients, this "preliminary investigatory activity" is profoundly defective.

The reversible operations required in decentration when a conservation task is presented consists of three developmental levels (Feffer, 1970). The first level is characterized by egocentrism or fixation on a single element or dimension. This gives way to an oscillation of attention to different dimensions through sequential refocusing. Finally, at the third level, the individual is able to simultaneously refocus on two or more dimensions and relate these dimensions to each other through a system of

compensatory relations.

It seems reasonable that if the frontal lesion patient is said to have profound deficits in the analysis and identification of essential connections and relationships in a task, which would ordinarily lead to hypotheses and further reasoning, decentration would seem to be compromised in such preliminary activity. There is empirical support for this argument from the neuropsychology literature.

Teuber's (1964) studies of deficient reversal of perspective and personal orientation in frontal lesion patients appears similar to the egocentric child's absence of reversible operations. The patients in Teuber's study showed a significant decrease in the number of reported reversals on a Necker Cube task suggesting fixation on a single dimension. Personal orientation on the tilted chair task was also defective suggesting an inability to simultaneously refocus self from the objective world of reality. Egocentric children likewise focus on a single dimension when confronted with tasks of reversibility and are unable to differentiate between self and the world (Piaget, 1926). An associated feature in childish egocentrism is the young child's unconcern about possible contradictions in his logic (Flavell, 1963). A similar finding was noted on frontal patient's deficient performance on the Wisconsin Card Sorting Task (Milner, 1963). Knowing their errors, these patients

failed to self-correct demonstrating a "distinctive lack of self-criticism" described as a "general loss of some feedback system" (Luria and Homskaya, 1964). Hence, another common feature between both egocentric children and frontal patients seems to be an inadequate evaluation of their own actions or inability "to reconstruct a chain of reasoning which he has just passed through; he thinks but he cannot think about his own reasoning" (Flavell, 1963).

Luria (1980) further identifies the specific deficit in frontal patients as "lapsing into irrelevant connections" which compromise logical operations. These "irrelevant connections" may in fact represent an egocentric cognitive structuring of the task suggested by Feffer's (1970) first level of decentration. Support for this inference derives from Goldstein (1952) who contends that frontal lobe lesions impair abstract capacity and result in the patient's inability to discover the essence of a situation which is not related to his own personality. He implicitly suggests an egocentric orientation in the frontal patient, which in the present context, may be viewed as a mediating cognitive process in solving intellectual tasks.

Right Frontal Pathology

Evidence for personality deficits in right and/or

bilateral frontal patients bears resemblance to Piaget's (1926, 1954, 1969) and others (Karniol and Ross, 1976; Leahy, 1979) descriptions of social egocentrism. As personality attributes intersect significantly within the social domain, it is not implausible to view frontal personality deficits as related to social egocentrism.

Deficiencies in moral judgment (Karniol and Ross, 1976; Leahy, 1979) related to social egocentrism is a finding similar to right frontal pseudopsychopathy or lack of concern for others (Kolb and Whishaw, 1980). In addition, the frontal lesion patient's indifferent reaction to self and others is consistent with children's attribution of blame judgments to escape harm or punishment (Leahy, 1979).

Children's inability to separate or take perspectives of others is closely aligned to descriptions of the frontal patient's "self-indulgence" and "egocentricity" (Stuss and Benson, 1984). That is, egocentric children cannot infer the perspective of others as they have not sufficiently developed empathy or the ability to "feel what the other is feeling" (Shantz, 1975). Similarly, right frontal lobe patients are often described as "intolerant" to the point of view of others, resorting to egocentric remarks and self-indulgent behavior (Blumer and Benson, 1975). Studies of right frontal patients' inability to interpret emotionality in both pictures and cartoons is strikingly similar to deficient role

taking (Chandler, 1973) in egocentric children. The failure of right frontal patients to successfully integrate the elements of narratives and draw inferences from captioned and uncaptioned cartoons (Gardner et al., 1975) relates strongly to the egocentric child's inability to simultaneously refocus on two dimensions and keep separate their point of view (Leahy, 1979; Chandler, 1973). Related to this finding is the egocentric child's difficulty in drawing inferences of others in person perception tasks (Livesley and Bromley, 1973; Leahy, 1979), often resorting to self descriptions. Similarly, a study by Wapner et al. (1971) found that right frontal patients missed the point of stories and added irrelevancies and self-confabulations suggesting an egocentric structuring of tasks.

In conclusion, Piaget's developmental construct of egocentrism was presented to examine similarities in frontal lobe cognitive and personality deficits. In the cognitive domain, similarities were noted between the egocentric child's lack of reversible operations and left and/or bilateral frontal patient's deficient mult-step operations, lapsing into irrelevant connections and deficient reversal of perspective and personal orientation. In the social domain, egocentric deficiencies in moral judgment, role taking and person perception was related to right and/or bilateral frontal patient's pseudopsychopathy, self-indulgence, and

aberrant interpretation of emotionality in self and others.

A Regression Model and Rationale For
The Present Investigation

If cognitive and personality deficits in adult frontal lobe patients can be understood in light of the developmental construct of egocentrism, then finding egocentrism in an adult population would imply the inverse of developmental progression, or regression. Numerous models (i.e. Jackson, 1932; Luria, 1980; Altman, 1978) of the nervous system stress hierarchic processing of information; that is, a correspondence between cognitive hierarchies and organic hierarchies that proceed from undifferentiated to highly differentiated functions. Based on such models and/or the parallels observed between frontal pathology and egocentrism, a model of cognitive regression will now be proposed to account for the personality and cognitive changes associated with frontal lobe pathology.

Piaget (1971) asserts that a parallel relationship exists between organic and cognitive differentiation. As cognitive processes differentiate from sensorimotor to formal operations, organic regulation presumably proceeds contemporaneously, to more highly differentiated and integrated states. Piaget's model suggests that levels of mentation and the hierarchical organization of the human

central nervous system are interdependent. This is similar to many models of the nervous system which stress hierarchic cognitive processing (Luria, 1973; Altman, 1978); that is, units of the brain that are hierarchical in structure and correspond to hierarchies in cognitive function. Thus, proceeding from sub-cortical to cortical regions of the brain, there is an increasing differentiation and integration of information.

For example, Luria (1973) distinguishes three principal functional units of the brain that are hierarchical in structure and whose participation is necessary for any type of mental activity. One unit is for regulating tone and waking, a second unit for obtaining, processing and storing information and a third unit for programming, regulating and verifying mental activity. Each of these units itself is hierarchic in structure and consists of at least three cortical zones built one above the other: the primary or projection area which receives impulses from or sends impulses to the periphery, the secondary (projection-association), where incoming information is processed and programs prepared and finally, the tertiary (zones of overlapping), the latest systems of the cerebral hemispheres to develop and responsible in man for the most complex forms of mental activity requiring the concerted participation of many cortical areas.

Frontal lobe functions may be viewed as one example of the hierarchic relationship between cognitive and organic differentiation. Frontal lobe functions program, regulate and verify human mental activity via rich connections with the upper part of the brainstem and thalamic structures and with all other cortical zones (Luria, 1973). Consisting of the upper layers of the cortex anterior to the rolandic fissure and above the sylvian fissure, the frontal lobes are superimposed not only over the secondary zones of the motor cortex but in fact over all the other formations of the brain. In view of their highly differentiated processes, the frontal lobes regulate increasing complex cognitive functions.

For example, for any mental process to take place, a certain level of cortical tone is necessary. The frontal lobes regulate this state of activity and participate in the regulation of the activation processes lying at the basis of voluntary attention. As optimal cortical tone and voluntary attention are basic to all forms of conscious activity, the frontal lobes constitute an apparatus with the function of forming stable plans and intentions capable of controlling the individual's subsequent conscious behavior. The formation of stable plans and subsequent conscious behavior permit regulation of mnemonic and consecutive programming of intellectual actions.

The sequence of frontal lobe functions, from maintenance of cortical tone to higher complex mental activities, are at once integrated processes. However, it is possible to examine the functional organization of the frontal lobes and hierarchic differentiation of cognitive functions. For example, maintenance of cortical tone, a precursor for all higher states of mental activity, involves medial frontal lobe connections with the lower structures of the reticular formation and thalamic nuclei (Homskaya, 1972). By contrast, proceeding from lateral to the most anterior (pre-frontal) regions of the frontal cortex coincides with the formation of stable plans and programming of higher mental activity.

To summarize, Piaget (1971) hypothesizes that cognitive processes are reflections of the essential mechanisms of organic autoregulation, and the nervous system, a specialized organ of functional regulation and instrument of cognitive function. These statements imply a correspondance between cognitive hierarchies and organic hierarchies. Knowledge of functional units of the brain, their hierarchical structure and cortical zones built one above the other suggest a correspondance between organic and cognitive differentiation. This hypothesis was exemplified by frontal lobe functions which are hierarchically organized and differentiated in their structural relationships with higher forms of mental

activity.

Conversely, in cases of cerebral pathology, numerous investigators (Jackson, 1932; Goldstein, 1944; Arieti, 1974; Luria, 1980) have suggested a regression or dedifferentiation of neurological, cognitive and/or social-affective functioning. Regression or dedifferentiation are often considered as development in reverse; the direction is from higher to lower levels of integration (Jackson, 1932).

According to Jackson's principle (1932), in neurological and mental diseases, the functions last to develop are the first to be lost. In every disease, two kinds of symptoms emerge: 1) negative; the loss of high functions and 2) positive; the emergence of supremacy of the functions of the level that remains intact (Arieti, 1974). For example, neurological signs of frontal lobe pathology consist of (but are not limited to) the release of primitive forms of reflex response (Damasio, 1979). The more significant are the grasp reflex, groping reflex and the snout and sucking reflexes. Traditionally, these positive symptoms have been interpreted as an indication of primitive forms of reflex response, kept in abeyance by normal inhibitory function of frontal lobe structures. Dedifferentiation of frontal lobe functions is one example of regressive symptomatology found in cases of cerebral pathology. Cognitive and social-affective regression have

also been investigated in cases of dementia, focal cortical pathology and psychiatric illness.

Regression in cognitive functioning has been investigated in dementia using Piaget's theory of development (Ajuriaguerra and Tissot, 1968; Constantinidis, 1978). Piaget's developmental theory affords analysis of cognitive decline by determining competency at different levels of operational behavior. Patient's with both presenile and senile dementia were examined for deterioration of operational, mnemonic, instrumental and motor functions. Investigation of these functions suggested both orderly regression in levels of operational behavior and association between regression in these levels and instrumental function deficits (Ajuriaguerra and Tissot, 1968). Using Piagetian tasks sensitive to formal and concrete operations (e.g. conservation), Constantinidis (1978) found that, in dementia patients, the sequence of regression through levels of operational behavior was the inverse of developmental progression; that is, the inverse of the sequence found during development of the child. Concurrent regression in operational levels and the instrumental behaviors of praxis and language was as follows. At the highest level of formal operations, inability to find the right word and constructional apraxia was evident. At the level of concrete operations, substitution of words and ideomotor apraxia

appeared. At the preoperational level, mistakes when forming individual words and ideational apraxia were observed. These studies suggest joint disintegration of cognitive operations and instrumental behaviors as the inverse of developmental progression.

Regression in cognitive functioning has also been studied in the psychiatric domain. Freud (1900) too was influenced by Jackson in postulating the concept of regression. In schizophrenia, the libido would revert to the narcissitic stage. Other investigators postulated that schizophrenic cognition regresses from the abstract to the concrete (Goldstein, 1939, 1943; Kasanin, 1944). Arieti (1974) proposes a principle of "progressive teleologic regression"; that is, regression in schizophrenia is progressive. Schizophrenics reintegrate their functioning at lower levels and by going to lower levels of integration utilize earlier methods of purposeful activity that brings about solutions to problems. One of these earlier methods or cognitive transformations Arieti calls "teleologic causality". Here the schizophrenic finds personal motivations as the cause of events rather than physical explanations. This transformation seems to parallel Goldstein's (1952) contention that frontal lobe patients use an egocentric, personological problem solving approach to tasks. Consistent with these findings is Arieti's

postulation that a functional alteration of the nervous system in schizophrenia likely occurs in the pre-frontal cortex. Supporting his position are recent findings implicating left and/or bilateral frontal dysfunction in schizophrenia (Ariel and Golden, 1983; Henn and Nasrallah, 1983; Namba, 1982). The cortical alteration, Arieti believes, is responsible for schizophrenic symptomatology. Of particular compromise in the pre-frontal cortex is "seriatum functions"; the organization or synthesis of skilled actions or thoughts into an orderly series. Seriatum functions imply 1) the ability to anticipate a goal and 2) to organize and synthesize acts or thoughts in a given temporal sequence for the purpose of reaching the anticipated goal. This loss or compromise of seriatum functions seem analogous to shifts from decentration to egocentric thinking in problem solving tasks as refocusing on two or more dimensions is required for both reaching a goal or solving a problem. For the schizophrenic, the cognitive transformation of teleologic causality might occur in both social and non-social realms replaced by personological and/or egocentric thought. This would imply regression in cognitive and social-affective functioning. Regression in cognitive and social-affective functioning has been studied in psychotic children using Piagetian scales of development. Drawing an analogy between Piaget's (1954) description of the

sensorimotor child's egocentrism and that of psychotic children, Ertel and Voyat (1982) hypothesized that psychotic children show an atypical development pattern, not progressing through the ontogenetic stages. Their development according to the authors, "can be conceived of simultaneously reflecting regression to the lowest levels, fixation at some transitional stage and retardation in terms of lower mean-stage level functioning". Ertel and Voyat (1982) presented the Uzgiris and Hunt Ordinal Scales of Psychological Development to 15 psychotic children with a mean age of 6.8 years. Compared to age-matched controls with non-psychotic personality disturbance (e.g. schizoid personality), psychotic children were observed to have severe sensorimotor deficits. The authors interpreted these findings as evidence for psychotic children's regression to egocentric thought, who agewise should have long ago developed sensorimotor capacities. However, there is no definitive information as to whether the psychotic children ever performed age-appropriate developmental tasks (e.g. pre-morbidly). Therefore, it is unclear whether the findings imply cognitive regression or simply a developmental "lag" in cognitive functioning that has been associated with childhood psychosis (e.g. Achenbach, 1974).

In a related study, Voyat and Shakelford (1982) presented a series of Piagetian tasks assessing the

development of concrete operations (e.g. class inclusion, one to one correspondence; conservation of matter, weight and volume) to various groups of schizophrenic children. The investigators found that the commonly observed invariant hierarchy of stages indigenous to normal development was not appreciated in these schizophrenic subjects. For example, some children had attained the most advanced levels of conservation yet were incapable of correctly performing the simplest task of one-to-one correspondence. Other children could solve certain tasks only when the nature of the test material was affectively neutral. These investigators determined that psychotic children manifested both intratest and intertest heterogeneity. In all cases it appeared as if children who should be concrete operational (given age and IQ) still performed at preoperational levels on many tasks.

Collectively, evidence for neurological and cognitive regression in cases of dementia and psychotic illness generally support Jackson's (1932) principle. Moreover, cognitive regression indexed as the inverse of Piagetian development, was found in cases of adult cortical dementia and childhood psychosis. The evidence of cognitive regression in neurological cases provides a rationale for investigation in cases of frontal lobe pathology. The paradigm being developed is that: 1) observation of egocentrism in adult frontal pathology patients is the result of

regression in cognitive functioning and 2) dissociation of function can be specified for left and right frontal patients along non-social and social measures of decentration.

Objective

Cognitive development within a Piagetian framework is partially described in terms of changes from egocentric to non-egocentric (decentration) thought, and is seen as occurring in social and non-social realms. This study examines these abilities in adult patients with frontal lobe pathology and argues 1) cognitive regression parallels their neural deterioration and 2) this specific regression underlies most phenomena associated with frontal lesions.

The aim of the first experiment is to examine a model of cognitive regression in relation to shifts in two specific stages, "concrete" to "pre-operational" thought (characterized by shifts from decentration to egocentric thinking) in adults with frontal cortex pathology. Further, based on Luria's description of "preliminary investigatory activities", the following outcomes are anticipated:

- 1) if frontal lobe patients would show the most cognitive regression (compared to other cortically lesioned patients), then this regression should occur in social and/or non-social realms dependent on the side of lesion.
- 2) given evidence for localization of personality and

cognitive deficits associated with right and left frontal pathology respectively, it is further anticipated that if left frontal lobe patients would show regression in non-social cognition and right frontal patients in social cognitive tasks, then bilateral frontal patients would show regression in both spheres.

The second experiment examines further the cognitive changes in frontal lobe patients with deficient concrete operations by analyzing the level of decentration involved. The measures used in experiment one required the highest level of decentration, simultaneous refocusing. Decentration however also consists of intermediate and lower levels of centration in both social and non-social spheres.

Based on these foregoing distinctions, experiment 2 proceeded with the assumption that frontal lesion patients demonstrated a deficit in simultaneous refocusing in social and non-social cognition and predicted that:

3) if frontal lobe patients were assessed for deficient concrete operations at lower levels of decentration (in social and non-social spheres) then deficits in sequential refocusing would suggest full regression to egocentric (preoperational) thought.

CHAPTER II
ASSESSMENT OF DECENTRATION PERFORMANCE
IN FRONTAL PATHOLOGY PATIENTS

Method

The aim of the first experiment was to examine a model of cognitive regression in adults with frontal lobe pathology. Cognitive regression was anticipated if frontal lobe patients evidenced shifts from decentration to egocentric thinking. This regression was further anticipated to occur in social and non-social realms dependent on side of lesion; i.e. a dissociation if left frontal patients would show a specific pattern of impairment in non-social cognition, and right frontal patients, regression in social cognitive tasks. Finally, a combined deficit was expected if bilateral frontal lesion patients would show regression in both spheres.

Subjects

All patients (n=42) with focal cortical pathology, and no gross organic mental syndrome, admitted to the neurosurgery service at Mount Sinai Hospital College of Medicine between 2/82 and 9/83 were screened. Patients excluded from the study were either left handed for writing and/or had a recent cerebral infarct. Cerebral organization

may have been unclear in the left handed group and localization of focal pathology can be obscured in patients with recent cerebral infarct. Finally, the attending neurosurgeon ruled out (by visual field examination) the presence of visual field defects in patients accepted for study. Most patients had neoplastic growths of various types. Reconstructions of focal pathology for each subject are shown in Appendix B1.

A sample of 18 patients (9 right BD, 6 left BD, 3 bilateral BD) comprised the brain damaged groups. For the left-side (LBDs), right-side (RBDs) and bilateral brain damaged (BBDs) groups, distributions of age, sex, pathology type, extent and level of education are shown in Appendix C (Tables A through G respectively). There were no significant differences between the groups on any of the above variables (Fisher's Exact P Test used). Locus of lesion was determined by computer axial tomography (CAT Scan, General Electric, Model # 8800) in all cases and most regions of the brain were represented. On the basis of CT scan analysis, subject breakdown of locus of pathology was: 3 bilateral frontal, 4 left frontal, 1 left temporal-parietal, 1 left occipital, 4 right frontal, 1 right temporal-parietal, 3 right parietal and 1 right parietal-occipital (both left occipital and right parietal-occipital patients were without visual field defects). Clinical and pathological characteristics of

individuals in this neurological sample are shown in Table 1, and include age, sex, education, pathology type, locus and extent. Mean ages were 42.6, ranging from 22-64 for the BBDs, 41.1, ranging from 25-69 for the RBDs, and 32.5, ranging from 17-57 for the LBDs. For left and right brain damaged patients, most regions of the brain were represented.

Collectively, patients were fairly well matched on all clinical and pathological characteristics, including age and level of education.

Tests and Procedures

Screening Procedures

All subjects were given a brief preliminary questionnaire assessing sex, age, education and occupation. Handedness was assessed by the best predictor items from the Annett Scale (1970) (Appendix D). In addition, all subjects received the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955) Information and Picture Arrangement subtests to estimate pre-morbid IQ and control for sequencing ability, respectively. Scaled scores of 9 and above was minimally required on both subtests to insure average intellectual and sequencing abilities. Insuring average sequencing ability was a necessary prerequisite for patient comprehension of Chandler stimuli (to be reviewed in Testing Procedures) as

Table 1

Clinical and Pathological Characteristics
of Neurological Sample, Individual Cases (N=18)

Bilateral Focal Pathology

S#	Age	Sex	Type	Locus	Extent (in Cm)	Tested	Hand	Educ
1	64	M	Art.O	Bi-F	3	PRE-OP	2	3
2	42	M	Men	Bi-F	5	POST-OP	1	5
3	22	M	Abs.	Bi-F	4	POST-OP	1	2

Left Focal Pathology

S#	Age	Sex	Type	Locus	Extent	Tested	Hand	Educ
4	57	M	Men	F	5	PRE-OP	2	4
5	54	M	Men	F	3	PRE-OP	1	1
6	17	M	AVM	F	1	PRE-OP	2	3
7	21	F	AVM	F	2	PRE-OP	2	4
8	22	M	Men	T-P	4	PRE-OP	1	3
9	24	F	Men	O	3	PRE-OP	1	5

Right Focal Pathology

S#	Age	Sex	Type	Locus	Extent	Tested	Hand	Educ
10	69	F	Glio	F	5	PRE-OP	1	1
11	25	F	Men	F	5	PRE-OP	1	3
12	28	M	Abs.	F	2	PRE-OP	2	4
13	29	F	Glio	F	3	PRE-OP	1	5
14	30	M	Men	T-P	2	PRE-OP	1	6

Table 1 (continued)
 Clinical and Pathological Characteristics
 of Neurological Sample, Individual Cases (N=18)

Right Focal Pathology

S#	Age	Sex	Type	Locus	Extent (in Cm)	Tested	Hand	Educ
15	26	M	Glio	P	3	PRE-OP	1	4
16	61	F	Glio	P	4	PRE-OP	1	3
17	59	F	Men	P	6	PRE-OP	1	3
18	43	F	AVM	P-O	2	PRE-OP	1	3

Focal Pathology Type: Men= meningioma; Glio= glioblastoma, astrocytoma; AVM= arteriovascular malformation; Abs.=abscess; Art.O=arterial occlusion

Focal Pathology Locus: Bi-F= bilateral frontal; F= frontal; T-P= temporal-parietal; P= parietal; P-O= Parietal-occipital; O=occipital

Handedness: 1= all right handed on Annet; 2= right handed but positive family history (e.g. aunts, uncles)

Education: 1= elementary school; 2=some high school; 3= high school graduate; 4= some college 5= college grad 6= graduate/professional school

right frontal patients have been reported to exhibit deficient performance on the Picture Arrangement subtest (McFie and Thompson, 1972). Information and Picture Arrangement subtests both share a strong association with overall intelligence (.80 and .76, respectively) (Anastasi, 1976). In addition, when taken together, these subtests predict pre-morbid intelligence reasonably well (multiple regression = .78). Administration of the Wechsler Adult Intelligence Scale (WAIS) Information and Picture Arrangement subtests conformed to standard procedures (Appendix E).

Testing Procedures

Subjects were then given the remaining measures in the following order: Concept Assessment Kit of Conservation, Chandler Cartoons and the Leahy Pro-Social Behavior Task. All testing was individually administered and completed in one session. Total time ranged from 45 minutes to 1 hour. These measures were specifically designed to assess concrete vs. pre-operational thought, or as indicated, decentration vs. egocentric thinking.

Non-social cognition was assessed by the Concept Assessment Kit of Conservation (Goldschmid and Bentler, 1968). This test assesses six areas of Piaget's concept of conservation: number, substance, weight, discontinuous quantity, two-dimensional space and continuous quantity.

Scoring is either pre- or concrete operational for each task, with behavior and explanation dimensions (Appendix F).

For example, in the well-known Piagetian "continuous quantity" task, two standard glasses filled with the same amount of water are shown to the subject. The water from one of the glasses is then poured into a tall, thin glass and the subject asked whether the tall glass contains the same amount of water as the standard glass. Conservation behavior or decentration is a binary same/different decision indexed by the subject's report that despite transformations in volume, the quantity remains the same. By contrast, egocentric behavior is scored if the subject reports the quantity is not the same.

Extending Piaget's task, Goldschmid and Bentler (1968) require subjects to provide an explanation for their conservation behavior. Principles of invariant quantity ("they were the same before and you did not change the volume"), compensation ("this glass is taller, but it is also thinner"), or reversibility ("if we put this back into this glass, it would be the same") are acceptable explanations for decentration. A magical and/or confabulated ("my doctor told me"), perceptual ("they look the same") or description of part of the procedure ("you poured the water into this glass") constitutes an egocentric explanation.

For both behavior and explanation dimensions of an

item, a correct or decentration response is scored as 1, an incorrect or egocentric response as 0; the range of scores for the Goldschmid-Bentler is thus 0-6 for each dimension, with a maximum score of 12 indexing decentration. There were no time limits for this measure and the experimenter adapted the administration of the test to the subject's speed.

Social cognition was assessed by Chandler's (1973) Cartoons and Leahy's (1979) Pro-Social Behavior Task. Both tests have been validated as measures of social cognition and parallel measures of non-social cognition (Ford, 1985; Waters and Tinsley, 1985). Chandler's Cartoons require the subject to take another person's perspective on a sequence of events and keep it separate from their own.

For example, in the Bakery story (Appendix G), subjects report two accounts of the cartoon sequence. The first report includes a complete account of the action and events in the entire sequence. In the second report, subjects adopt the perspective of the partially informed witness and begin the sequence with the introduction of the second character. In this story, any attribution to the baker which implies that he knows why his cookies made the girl sad is egocentric. Similarly, in the Broken Window story, any attribution to the father who would know the specific basis of the boy's fear is egocentric. Chandler's Cartoons had no time limit. The instructions are in Appendix G.

Leahy's Pro-Social Behavior Task (Appendix H), based on Kelley's (1967, 1972) models of social cognition, assesses the subject's understanding of multi-determinants in actions of story characters. Similar to Chandler's Cartoons, subjects take another person's perspective and arrive at causal judgments in response to sets of altruism cues. Rewards are allocated (e.g. giving lunch to a friend) to the actor who is most altruistic. In arriving at causal attributions, subjects who use an additive principle (by allocating greater rewards for behavior which led to positive consequences for the actor or avoided negative consequences) are judged egocentric. By contrast, use of discounting (e.g. allocating rewards to the actor who's altruism was rendered in situations not motivated by positive or negative consequences) and augmentation principles (e.g. allocating rewards to the actor who was altruistic despite threat of harm) is scored as decentration.

The Leahy Pro-Social Behavior Task had no time limit. Subjects responded to a set of 10 cues or short descriptions of a person giving some of his lunch to the other person. The experimenter read the cues twice before the subject indicated a response. The following statement was read to the subject:

I'm going to tell you some short stories about different make-believe kids. Each kid gives another kid some of his lunch. After each story, you tell me how many nickels you would give each kid. More nickels (0-5) should be given

to the person who does the nicest things.

Scores on the Leahy task range from 0-5 in each of four conditions, with a maximum score of 20 indexing decentration.

CT Scans

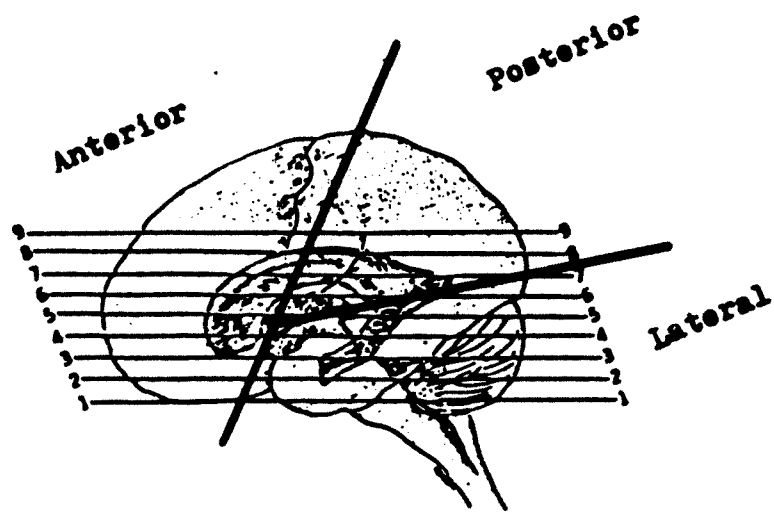
The CAT scans were done with and without enhancement maximizing discrimination of areas of involvement. For all 18 patients, scale drawings of areas of involvement were made by the attending neurosurgeon (Dr. R. Zappulla, Instructor of Neurosurgery at Mount Sinai Hospital) on an atlas of brain for use in computer-assisted tomography (Schoultz, Morrison and Calhoun, 1976). Location, extent and depth of pathology was determined from these drawings by defining the boundaries of the perimeter on a projection system. By examining successive horizontal CT cuts for presence of pathology (each cut 10mm or 1cm) extent was classified as: 1cm= small, 2cm= medium, 3cm= large, 4cm or more= very large.

Locus of pathology was divided into gross categories for purposes of group comparisons of areas of involvement in the three samples. The gross categories consisted of anterior (including prefrontal, frontal and pari-rolandic loci), posterior (including parietal, parietal-occipital and occipital loci) and lateral (including temporal, temporal-parietal and temporal-occipital loci) areas. Figure 1 shows the regions which correspond to the location system.

Figure 1

Regions of the Cortex Subsumed Under

Gross Location System



Results

Organization of Data

Results are presented in three sections. Section I presents data which 1) examines subject variables (e.g. age, sex, WAIS Information and Picture Arrangement subtests) and summary of extent of lesions with composite drawings for bilateral, right and left pathology groups. Section II contains a comparison of interjudge reliability between current and published findings for each measure of egocentrism. Section III presents test results which examines evidence for 1) performance decrements of frontal patients generally, 2) a complete double dissociation of left and right frontal pathology groups along non-social and social measures of decentration respectively and 3) a combined deficit in both spheres for bilateral frontal patients.

Section I- Subject Variables

There was no evidence for effects attributable to age, sex, pre-morbid IQ or sequencing ability (Table 2), education, extent or handedness (Table 3) (Fisher Exact P Test used). Figures 2, 3, and 4 show three composite drawings of pathology of the bilateral, left and right sided patients, respectively.

Table 2

Mean Characteristics of Neurological Sample

Group	Age	Sex	Education
FRONTAL			
Bilateral-Frontal			
Mean	42.6	1.0	3.3
S.D.	21.0	0	1.5
n=3			
Left-Frontal			
Mean	37.3	1.2	3.0
S.D.	21.1	1.1	1.4
n=4			
Right-Frontal			
Mean	37.7	1.7	3.3
S.D.	20.9	.5	1.7
n=4			
POST-ROLANDIC			
Left Temporal-Parietal			
Left Occipital			
Mean	23.0	1.5	3.3
S.D.	1.4	.7	1.4
n=2			
Right Temporal-Parietal			
Right Parietal			
Right Parietal-Occipital			
Mean	43.8	1.6	3.8
S.D.	1.6	.5	1.3
n=5			

Table 2 (continued)

Mean Characteristics of Neurological Sample

WAIS

Group	Extent	Handedness	Info	PA
FRONTAL				
Bilateral-Frontal				
Mean	4.0	1.6	9.3	9.3
S.D.	1.0	1.1	.6	.6
n=3				
Left-Frontal				
Mean	2.8	2.2	11.3	10.0
S.D.	1.7	1.0	2.1	1.1
n=4				
Right-Frontal				
Mean	3.7	1.5	11.0	10.0
S.D.	1.5	1.0	2.1	2.0
n=4				
POST-ROLANDIC				
Left Temporal-Parietal				
Left Occipital				
Mean	3.5	1.0	10.5	10.0
S.D.	.7	0	.7	1.4
n=2				
Right Temporal-Parietal				
Right Parietal				
Right Parietal-Occipital				
Mean	3.4	1.0	11.6	10.4
S.D.	1.6	0	2.8	2.6
n=5				

Table 3

Individual Case-By-Case Performance on WAIS
(age corrected scaled scores)

Group	S#	Information	Picture Arrangement
Bi-F	1	10	9
	2	9	10
	3	9	9
L-F	4	11	11
	5	9	9
	6	14	11
	7	11	9
R-F	10	10	9
	11	9	9
	12	14	13
	13	11	9
L-TP	8	10	11
L-O	9	11	9
R-TP	14	16	15
R-P	15	10	9
	16	13	10
	17	9	9
R-PO	18	10	9

Bi-F= bilateral frontal
L-F= left frontal
L-TP= left temporal-parietal
L-O= left occipital
R-F= right frontal
R-TP= right temporal-parietal
R-P= right parietal
R-PO= right parietal-occipital

Figure 2

Composite Drawings of Bilateral
Focal Pathology

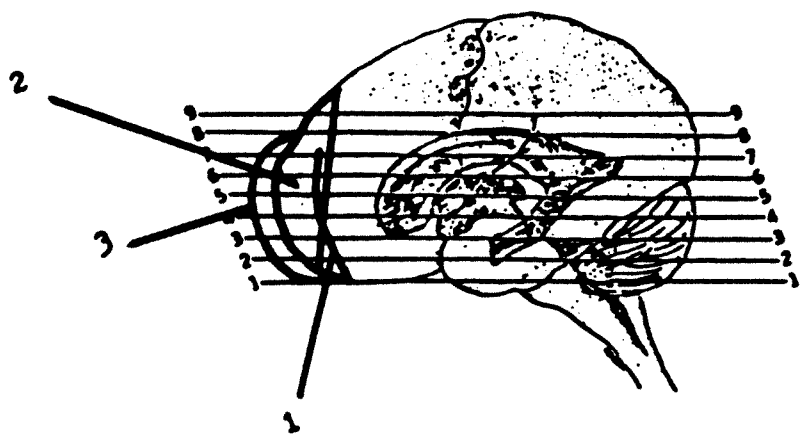


Figure 3

Composite Drawings of Left-Side
Focal Pathology

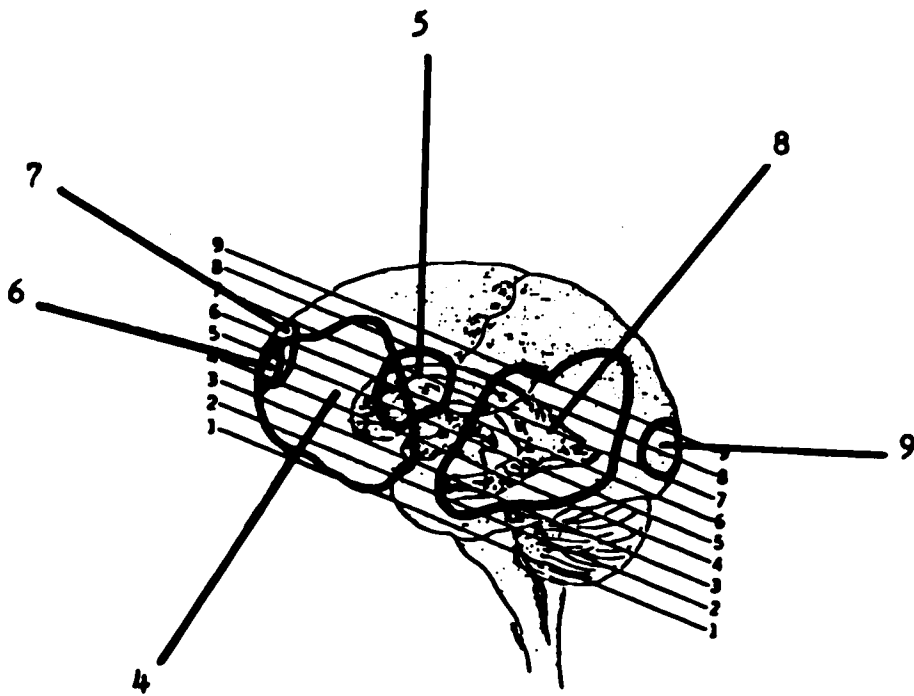
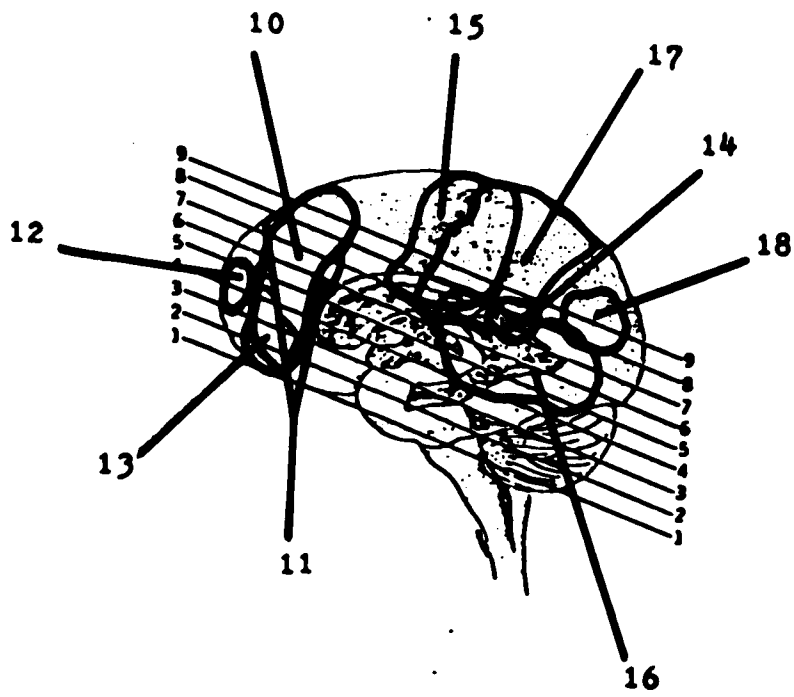


Figure 4

**Composite Drawings of Right-Side
Focal Pathology**



Section II- Interjudge Reliability

The Concept Assessment Kit of Conservation (Goldschmid and Bentler, 1968) determined the subject's level of conservation by his conservation behavior and comprehension of the principles involved. Comprehension was assessed by the subject's explanation for his judgment. Interjudge reliability for the explanation dimension in the present study was high ($r = .94$). High interjudge reliability is also reported by Goldschmid and Bentler (1968) for the explanation dimension in a normative sample of children ranging in age from 4 to 8 years ($r = .98$).

Chandler's Cartoons (1973) required the subject to adopt the perspective of the partially informed witness and begin the sequence (by telling the story) with the introduction of the second character. The interjudge reliabilities for both the Bakery and Broken Window stories were high (r 's = .92 and .90, respectively), in agreement with published data (r 's = .94 and .89, respectively; Chandler, 1973). Case-by-case coefficients for interjudge reliability on Goldschmid-Bentler explanations and Chandler's Cartoons are presented in Appendix N1.

Section III- Test Results

Focal cortical patients' performance on social and non-social tasks are summarized in Table 4. Patients are grouped according to side and locus of pathology.

Table 4

Case-By-Case Performance on Non-Social and Social Decentration Tasks

		Non-Social Goldschmid-Bentler (max=12)		Social Chandler (max=8)		Leahy (max=20)
	S#	Total	Behavior	Explanation		
		(max=6)	(max=6)	(max=6)		
FRONTAL						
Bi-F	1	4	2	2	0	6
	2	1	1	0	2	5
	3	2	2	0	2	6
L-F	4	5	3	2	8	18
	5	0	0	0	7	17
	6	6	6	0	8	17
	7	8	6	2	8	17
R-F	10	10	6	4	1	9
	11	11	6	5	1	6
	12	12	6	6	1	6
	13	10	5	5	4	7
POST-ROLANDIC						
L-TP	8	12	6	6	8	18
L-O	9	12	6	6	8	20
R-TP	14	12	6	6	8	19
R-P	15	12	6	6	8	17
	16	12	6	6	8	18
	17	12	6	6	8	16
R-PO	18	11	6	5	7	18

All frontal patients demonstrated performance decrements which was dissociated from pre-morbid IQ and one other estimate of sequencing ability. By contrast, all other cortical patients, irrespective of locus and side, performed at or close to ceiling on both social and non-social measures. Most importantly, the predicted side by lesion differences have been supported. Specifically, a complete double dissociation was found.

Inspection of means in Table 5 revealed no overlap between left and right frontal groups on both social and non-social measures of decentration. Left frontal patients performed like other cortical patients on social cognitive tasks (Chandler, $\bar{X}=7.8$, S.D.=.5; Leahy, $\bar{X}=17.3$, S.D.=.5). They were significantly worse than right frontal patients ($t(6)=3.46$, $p < .01$) on the non-social cognitive measure (Goldschmid-Bentler, $\bar{X}=4.7$, S.D.=3.4). Conversely, right frontal patients were intact on the non-social task (Goldschmid-Bentler, $\bar{X}=10.8$, S.D.=.9), but uniformly depressed on all social cognitive tasks when compared to non-frontal and left frontal pathology patients (Chandler, $\bar{X}=1.7$, S.D.=1.5, $t(6)=7.72$, $p < .005$; Leahy, $\bar{X}=7.0$, S.D.=1.4, $t(6)=13.91$, $p < .005$). Bilateral frontal patients showed consistent deficits in both non-social (Goldschmid-Bentler, $\bar{X}=2.3$, S.D.=1.6) and social cognitive tasks (Chandler, $\bar{X}=1.3$, S.D.=1.1; Leahy, $\bar{X}=5.6$, S.D.=.6). Their

Table 5
 Mean Performance on Non-Social and Social Decentration Tasks

	Goldschmid-Bentler			Chandler	Leahy
	Total	Behavior	Explanation		
	(max=12)	(max=6)	(max=6)		
FRONTAL					
Bilateral-Frontal					
Mean	2.3	1.6	.7	1.3	5.6
S.D.	1.6	.6	-	1.1	.6
n=3					
Left-Frontal					
Mean	4.7	3.7	1.0	7.8	17.3
S.D.	3.4	2.8	1.1	.5	.5
n=4					
Right-Frontal					
Mean	10.8	5.8	5.0	1.7	7.0
S.D.	.9	.5	.8	1.5	1.4
n=4					
POST-ROLANDIC					
Left Temporal-Parietal					
Left Occipital					
Mean	12.0	6.0	6.0	8.0	19.0
S.D.	0	0	0	0	1.4
n=2					
Right Temporal-Parietal					
Right Parietal					
Right Parietal-Occipital					
Mean	11.8	6.0	5.8	7.8	17.6
S.D.	.4	0	.4	.4	1.1
n=5					

performance did not differ significantly from left frontal ($t(5) = 1.13$, ns) and right frontal patients ($t(5) = .38$, ns; $t(5) = 1.61$, ns) on the Goldschmid-Bentler, Leahy and Chandler tasks, respectively.

Discussion

The following is a review of the major findings in this first experiment. There was no evidence that the present findings were influenced by differences in pre-morbid IQ, sequencing ability, age, sex, level of education, extent of pathology or handedness. In terms of sequencing ability, right frontal patients did not evidence performance decrements on the Picture Arrangement subtest ($\bar{X} = 10.0$, S.D.=2.0) relative to left frontal ($\bar{X} = 10.0$, S.D.=1.1), bilateral frontal ($\bar{X} = 9.3$, S.D.=.6) and other cortical lesion patients (left post-rolandic, $\bar{X} = 10.0$, S.D.=1.4; right post-rolandic, $\bar{X} = 10.4$, S.D.= 2.6). Deficient performance on Picture Arrangement by right frontal patients has been documented (e.g. McFie, 1972; Newcombe, 1969; Walsh, 1977). The present findings conflict with these studies. One variable perhaps distinguishing depressed from non-depressed performance on Picture Arrangement may be locus of lesion. That is, studies by Newcombe (1969), McFie (1972) and Walsh (1977) were conducted with right frontal patients suffering

from missile wounds, head trauma and frontal leucotomy. Deficient performance on Picture Arrangement could thus be due to mass effect or compromise of vascular supply elsewhere in the brain. By contrast, patients in the present study had tumors localized to the pre-frontal region suggesting that a subset of right pre-frontal patients may not evidence deficits in Picture Arrangement. In addition, all groups were closely matched on these variables, yet a complete double dissociation was found on performance of non-social and social cognitive tasks dependent on locus and side of pathology.

It was nominally expected that bilateral frontal patients would be impaired in both domains. They should be at least as impaired in social and non-social cognition as right and left frontal patients, respectively. In fact, their pattern of performance suggests a "floor" effect. Examination of their responses on the Goldschmid-Bentler suggests egocentric responses for both behavior ($\bar{X}=1.6$, S.D.=.6) and explanation ($\bar{X}=.7$, S.D.= 0) dimensions. Similarly, left frontals evidenced egocentric responses for behavior and explanation dimensions. Their thinking was compromised by egocentric perceptual explanations ("they look the same") and/or describing part of the procedure ("you poured the water into this glass") (explanation, $\bar{X}= 1.0$, S.D.= 1.1). Bilateral and left frontal patients did not

differ significantly on egocentric responses for both behavior ($t(5) = 1.25$, ns) and explanation ($t(5) = .93$, ns) dimensions (see Table 5). Right frontal patients performed at or close to ceiling on this measure of non-social cognition evidencing knowledge of compensation rules.

Bilateral and right frontal patients' performance on the Chandler and Leahy tasks suggested egocentric attribution of privileged information and use of an additive principle in arriving at causal attributions. On these measures of social decentration, bilateral and right frontal patients did not differ significantly (Leahy, $t(5) = 1.61$, ns; Chandler, $t(5) = .38$, ns). By contrast, left frontal patients performed at or close to ceiling on these measures of social cognition. All other focal cortical patients performed at ceiling on most measures, a finding expected on the basis of normative data for age and IQ. For example, normative data on the Goldschmid-Bentler (1968), Chandler's (1973) Cartoons and Leahy's (1979) Pro-Social Behavior Task suggests that children 8 years of age and above (including adults enrolled in graduate school) demonstrate: 1) conservation behavior and knowledge of compensation rules, 2) perspective taking abilities and 3) use of discounting and augmentation principles in arriving at causal attributions. It is thus not surprising that all non-frontal cortical lesion adult patients performed at ceiling on most measures.

Findings argue for the importance of the frontal lobes in the mediation of concrete operations (or decentration) as well as support current evidence for localization of cognitive and social cognitive deficits in frontal pathology patients. Moreover, findings support a model of cognitive regression in adults with frontal lobe pathology. Regression was anticipated if frontal lobe patients evidenced shifts from decentration to egocentric thinking. Frontal patients evidenced performance deficits generally on measures of decentration as well as the predicted dissociation of cognitive and social cognitive deficits for left and right frontal patients respectively. The pattern of general performance deficits (particularly bilateral frontal patients who were deficient in both spheres) in frontal lobe patients is consistent with previously mentioned studies of cognitive regression (as measured by Piagetian tasks) in adult pre-senile and senile dementia patients (e.g. Ajuriaguerra and Tissot, 1968; Constantinidis, 1978). The present study suggests that performance deficits on Piagetian measures of decentration (e.g. egocentrism) may be further specified to patients with frontal lobe pathology. However, a question arises as to whether the present findings imply regression in functioning or merely demonstrate a performance deficit specific to frontal lobe patients. To address this question, a closer look at the concept of decentration is required.

That is, according to Feffer (1970), decentration emerges over three hierarchic levels of development. It will be recalled that levels of decentration, from highest to lowest are: 1) simultaneous refocusing with compensations, 2) sequential refocusing and 3) egocentrism. The present study utilized tasks sensitive to the highest level of decentration, simultaneous refocusing. Thus, frontal patients demonstrated performance deficits on simultaneous refocusing tasks. If performance deficits (by frontal lobe patients) can be demonstrated on tasks sensitive to sequential refocusing (hence evidencing egocentrism), then full regression along the ontogenic axis of decentration would be supported. Experiment II will address this hypothesis.

It will be recalled from Chapter I, page 49, that following Urberg and Docherty (1976) and Leahy's (1979) structural analysis of role taking tasks, it is possible to draw distinctions among the social and non-social cognitive tasks as they relate to either sequential or simultaneous decentration. Experiment 1 utilized tasks sensitive to simultaneous refocusing for both social and non-social decentration through coordination of perspectives and rules of compensation. By contrast, the following tasks appear to involve sequential refocusing, a level of decentration more primitive than simultaneous refocusing: divergent thinking

(as attention deployment), reflection-impulsivity (as evaluation of one's response), recursive thinking, the number of descriptions offered, the use of central and qualifying statements and judgement of emotional expressions. These tasks have been previously described and will be reviewed briefly in the next chapter.

Based on these foregoing distinctions, Experiment 2 proceeded with the assumption that: 1) frontal pathology patients demonstrated a deficit in simultaneous refocusing in that: 1) frontal pathology patients demonstrated a deficit in simultaneous refocusing in both social and non-social cognition and 2) frontal pathology patients would also show similar deficits in sequential refocusing compared to other patients with cortical pathology.

CHAPTER III
ASSESSMENT OF LEVEL OF DECENTRATION PERFORMANCE
IN FRONTAL PATHOLOGY PATIENTS

Method

The aim of the second experiment was to extend the findings of experiment 1 by identifying the deficient level of decentration associated with frontal lobe pathology. Full cognitive regression was anticipated if frontal lobe patients evidenced shifts from decentration (e.g. sequential refocusing) to egocentric thinking. This full regression was further anticipated to occur in social and non-social realms dependent on side of lesion; i.e. a dissociation if left frontal patients would show a specific pattern of impairment in non-social cognition, and right frontal patients, regression in social cognitive tasks. In addition, a combined deficit was expected if bilateral frontal lesion patients would show full regression in both spheres. Finally, replication of findings from experiment 1 was anticipated if the same measures (e.g. simultaneous refocusing tasks) were given to second group of frontal pathology patients.

Subjects

Subjects (n=63) were screened by the same criteria as in experiment 1, and evaluated in the neurosurgery service at

Mount Sinai Hospital College of Medicine between 3/84 and 2/85. Similar to experiment 1, patients excluded from the study were those left-handed for writing, having had a recent cerebral infarct and/or visual field deficits. Reconstructions of focal pathology for each subject are included in Appendix B2.

A sample of 19 patients (8 RBD, 8 LBD, 3 BBD) comprised the brain damaged groups. For the bilateral (BBDs), left-side (LBDs), and right-side (RBDs) brain damage groups, distributions of age, sex, pathology type, locus, extent, handedness and level of education are shown in Appendix I (Tables A-G respectively). There were no significant differences between the groups on any of the above variables (Fisher's Exact P Test used). Locus of pathology was determined by computer axial tomography (CAT Scan, General Electric, Model #8800) in all cases and most regions of the brain were represented. On the basis of CT scan analysis, subject breakdown of locus of pathology was: 3 bilateral frontal, 5 left frontal, 2 left temporal, 1 left parietal, 4 right frontal, 1 right temporal-parietal, 2 right parietal and 1 right parietal-occipital. Clinical and pathological characteristics of individuals in this neurological sample are shown in Table 6, and include age, sex, pathology type, locus, extent, ambidexterity and level of education. Mean ages were 55.6, ranging from 42-66 for the BBDs, 55.1,

Table 6

Clinical and Pathological Characteristics
of Neurological Sample, Individual Cases (N=19)

Bilateral Focal Pathology

S#	Age	Sex	Type	Locus	Extent (in Cm)	Hand	Educ
1	66	M	Glio	Bi-F	2	1	5
2	59	F	Men	Bi-F	3	2	3
3	42	M	Glio	Bi-F	2	1	3

Left Focal Pathology

S#	Age	Sex	Type	Locus	Extent	Hand	Educ
4	59	F	Glio	F	3	2	4
5	64	F	Men	F	3	1	3
6	34	M	Glio	F	2	1	5
7	44	M	Men	F	2	2	5
8	69	F	Men	F	2	1	3
9	25	F	AVM	T	1	2	4
10	59	M	Men	T	3	1	2
11	87	F	Men	P	5	1	2

Right Focal Pathology

S#	Age	Sex	Type	Locus	Extent	Hand	Educ
12	37	M	Men	F	3	1	3
13	72	F	Men	F	3	1	2

Table 6 (continued)
 Clinical and Pathological Characteristics
 of Neurological Sample, Individual Cases (N=19)

Right Focal Pathology

S#	Age	Sex	Type	Locus	Extent (in Cm)	Hand	Educ
14	25	M	Men	F	2	1	4
15	54	M	Glio	F	2	2	3
16	28	F	Glio	T-P	3	2	3
17	57	M	Men	P	2	2	4
18	32	F	Men	P	2	1	3
19	61	F	Men	P-O	1	1	3

Focal Pathology Type: Men=meningioma; G= glioblastoma;
 AVM=arteriovascular malformation;

Focal Pathology Locus: Bi-F=bilateral frontal; F=frontal;
 T=temporal; T-P=temporal-parietal;
 P=parietal; P-O=parietal-occipital

Ambidexterity: 1= all right handed on Annet; 2= right handed
 but positive family history
 (e.g. aunts, uncles)

Education: 1=elementary school; 2=some high school; 3= high
 school graduate; 4=some college; 5=college grad
 6=graduate/professional school

ranging from 25-87 for the LBDs, and 45.8, ranging from 25-72 for the RBDs. For left and right brain damaged patients, most regions of the brain were represented.

Collectively, patients were fairly well matched on most clinical and pathological characteristics, including age and level of education.

Tests and Procedures

Screening Procedures

All subjects were given the identical questionnaire and handedness inventory from experiment 1 (Appendix G), as well as the Wechsler Adult Intelligence Scale Information and Picture Arrangement subtests to assess pre-morbid IQ and sequencing ability, respectively (Appendix H). In addition, the Controlled Oral Word Association Test (Form 1; Benton and Hamsher, 1977) was administered (Appendix J) to control for possible verbal fluency deficits in left and right frontal pathology patients (Milner, 1964). Insuring verbal fluency for all patients was a necessary prerequisite for performance on a measure of ideational fluency (to be reviewed in Testing Procedures). This test requires the patient to give words beginning with a particular letter ("C", "F", "L") exclusive of proper nouns and similar forms of the same word for one minute each. Total score is

adjusted for sex, age and level of education and converted to a percentile.

Testing Procedures

Subjects were then given the remaining measures in the following order: Concept Assessment Kit of Conservation, Chandler Cartoons, Leahy Pro-Social Behavior Task, Alternate Uses Task, Matching Familiar Figures Test, Description of Peers Task, Affect Adjective Checklist and Judgment of Emotional Expressions Task. Total time ranged from 1.5 - 2 hours. These measures were specifically designed to assess concrete versus preoperational thought along the hierarchical decentration dimensions of simultaneous and sequential refocusing, respectively.

All social and non-social cognitive measures from experiment 1 were employed to assess simultaneous refocusing.

The Concept Assessment Kit of Conservation, Chandler Cartoons, and Leahy Pro-Social Behavior Task were administered with identical procedures from experiment 1. The present experiment also utilized social cognitive measures and two non-social cognitive measures (divergent thinking and reflection-impulsivity) which have been related to the sequential refocusing aspect of decentration (Leahy, 1978). These measures were reviewed in Chapter I (subsection Measures of Egocentrism) and will be highlighted for the

present discussion.

Non-social cognition was assessed by the Alternate Uses Task (Wallach and Kogan, 1965) and Matching Familiar Figures Test (Kagan et. al., 1964). Both measures have been validated as measures of non-social cognition and parallel measures of social cognition (Leahy, 1979; Urberg and Docherty, 1976).

The Alternate Uses Task (Wallach and Kogan, 1965), a measure of divergent thinking ability, has been conceptualized as reflecting individual differences in breadth of attention deployment with several studies supporting this view (Dewing and Battye, 1971; Karlins et. al, 1967; Ward, 1969). Divergent thinking ability may thus be related to the increased probability of attending to various dimensions or perspectives. Subjects are asked to name all possible uses of five test items (a newspaper, shoe, knife, key and chair). Responses are scored for ideational fluency (total number of responses), spontaneous flexibility (total number of categories used) and very high quality fluency (total number of imaginative and/or original responses).

A second measure of non-social cognition, the Matching Familiar Figures Test (Kagan et. al., 1964), assesses reflection-impulsivity and is presumed to indicate the degree to which individuals evaluate their cognitive products in

situations of response uncertainty. Thus a reflective cognitive style may be related to the ability to inhibit an initial response in judging others or inferring the perspectives of others in order to consider alternative hypotheses about other causes or perspectives. The Matching Familiar Figures Test is a 12 item match to sample task, each item containing one standard and six variants. The subject is instructed to find the one variant that is identical to the standard. Both the number of errors and the latency to the first response is recorded. For each of two forms (Child and Adolescent) the range of possible scores is 0-12.

Both forms of the Matching Familiar Figures Test were administered (samples from each form Appendix K). The instructions appear in the appendix.

Latency to the first response was recorded (in seconds) and total number of errors for all 24 items.

Two measures of social cognitive decentration, the Description of Peers Task (Livesley and Bromley, 1973) and Affect Adjective Checklist (Spielberger, 1967) with the Judgment of Emotional Expressions Task (Ekman and Friesen, 1975) were employed to index sequential refocusing.

The first measure of social cognitive decentering is the Description of Peers Task (Livesley and Bromley, 1973) reflected by the subject's spontaneous person descriptions. This task assesses three areas of sequential refocusing:

first, emphasis on the internal aspects (such as appearances and behaviors); second, emphasis on the thoughts and recursive thoughts of others; and third, qualification of descriptions by reference to temporal or situational variability or doubt about the accuracy of a trait description. Subjects are asked to think of somebody they like who is not a member of their family and tell "what kind of person he/she is". Following Livesley and Bromley (1973), each transcribed description is rated along three dimensions. First, following Barenboim (1978), three levels of recursive thinking are differentiated: mentioning the other person's thoughts about a third person's or the subject's thoughts (Level 2), mentioning the other person was thinking about actions or objects (Level 1) and no mention of the other's thoughts (Level 0). Second, descriptions are also rated for the number of central statements (with central statements referring to psychological characteristics or behavioral dispositions). Third, the number of qualifications of central statements is scored including statements about the probability of occurrence (e.g. "sometimes") or the intensity (e.g. "very", "quite") of a behavior, doubt and situational or temporal variability and those instructing the listener not to make the usual inference from a previous central statement.

The second measure of social cognitive decentering is

the Affect Adjective Checklist (Spielberger, 1967) and Judgment of Emotional Expressions Task (Ekman and Friesen, 1975). The Affect Adjective Checklist is composed of 21 adjectives altering in their degree of positive and negative affect and measures a subject's current feeling state: afraid, calm, desperate, cheerful, fearful, contented, frightened, happy, nervous, joyful, panicky, loving, shaky, pleasant, tense, secure, terrified, steady, upset, thoughtful and worrying. Scores range from 0-21; negative affect words are scored 1 if checked, and positive affect words are scored 1 if not checked.

The Affect Adjective Checklist was presented next with the following instructions:

"The following is a list of adjectives that typically describe varying emotional states. Please check the words that most closely describe your feelings at the present time".

Ekman and Friesen's Judgment of Emotional Expression Task (1975) reliably discriminates at least six different emotions in the human face (surprise, fear, disgust, anger, happiness, sadness), a neutral state, and emotional blends (happiness-surprise, fear-surprise, happiness-contempt, anger-disgust, sadness-fear). Subjects were presented one at a time, twelve static photographs (Appendix L) of varying emotional expressions and required to identify the emotion from a list of 12 choices. The following instructions were given:

"You will be looking at some pictures of people showing different kinds of feelings. Your job is to identify the feeling in each by circling one of the choices for each picture".

Scores range from 0-12.

For these measures, subjects first identify their feeling state at the moment (Affect Adjective Checklist) immediately followed by the Ekman-Friesen Task. Presumably, this task would reflect sequential refocusing of self versus other emotionality, since it is not necessary to coordinate perspectives for this aspect of person/emotional description. The adjective checklist was selected to precede the Ekman-Friesen task to assess if brain damaged subjects' perception of self-emotion would influence subsequent ratings on the Judgement of Emotion Task. Though other investigators (Borod et. al., 1983) have found impairments on the Ekman-Friesen Task with right frontal patients, the mechanism (e.g. sequential refocusing of self vs. other) underlying such impairment has not been studied.

Except where indicated, there were no time limits on any of the measures.

CT Scans

The CAT scans were done with and without enhancement maximizing discrimination of areas of involvement. For all

19 patients, scale drawings of areas of involvement were made by the attending neurosurgeon (Dr. R. Zappulla, Instructor of Neurosurgery at Mount Sinai Hospital) on an atlas of brain for use in computer-assisted tomography (Schoultz, Morrison and Calhoun, 1976). Location, extent and depth of pathology was determined by the same method employed in experiment 1.

Locus of pathology was similarly divided (as in experiment 1) into gross categories for purposes of group comparisons of areas of involvement in the three samples. Figure 1 shows the regions in the atlas which correspond to the location system.

Results

Organization of Data

Results are presented in three sections. Section I presents data which examines subject variables (e.g. age, sex, WAIS Information and Picture Arrangement subtests, Controlled Oral Word Association Test) and summary of extent of lesions with composite drawings for bilateral, left and right pathology groups. Section II contains a comparison of interjudge reliability between current and published findings for selected measures of egocentrism. Section III presents test results which examines evidence for 1) performance decrements of frontal pathology patients generally, 2) a

complete double dissociation of left and right frontal pathology groups along non-social and social measures of decentration respectively, 3) a combined deficit in both spheres for bilateral frontal patients and 4) replication of findings from experiment 1 using simultaneous refocusing tasks.

Section I- Subject Variables

There was no evidence for effects attributable to pre-morbid IQ, sequencing ability (Table 7), age, sex, level of education, extent of pathology, or handedness (Table 8). Left frontal patients scored lower than any other group on the measure of verbal fluency (left vs. right frontal, $t(7)=8.19$, $p<.005$; left vs. bilateral frontal, $t(6)=7.93$, $p<.005$; left frontal vs. post-rolandic, $t(10)=8.76$, $p<.005$).

Figures 5, 6 and 7 show three separate composite drawings of pathology of the bilateral, left and right sided patients respectively.

Section 2- Interjudge Reliability

The Alternate Uses Task (Wallach and Kogan, 1965) determined the subject's level of divergent thinking ability for ideational fluency, spontaneous flexibility and very high

Table 7
 Mean Characteristics of Neurological Sample
 Experiment 2

	Age	Sex	Education	Extent	Hand
FRONTAL					
Bilateral-Frontal					
Mean	55.6	1.3	3.6	2.3	1.6
S.D.	12.3	.6	1.1	.6	1.1
n=3					
Left-Frontal					
Mean	54.0	1.6	4.0	2.4	1.8
S.D.	14.5	.5	1.0	.5	1.1
n=5					
Right-Frontal					
Mean	47.0	1.3	3.0	2.5	1.5
S.D.	20.4	.5	.8	.6	1.0
n=4					
POST-ROLANDIC					
Left Temporal Left Parietal					
Mean	57.0	1.6	2.6	2.8	1.6
S.D.	31.0	.5	1.1	1.4	1.1
n=3					
Right Temporal-Parietal Right Parietal Right Parietal-Occipital					
Mean	44.5	1.7	3.3	2.0	2.0
S.D.	16.9	.5	.5	.8	1.1
n=4					

Table 7 (Cont.)

Mean Characteristics of Neurological Sample
Experiment 2

WAIS			
	Information	Picture Arrangement	COWA
FRONTAL			
Bilateral-Frontal			
Mean	9.3	10.0	37.0
S.D.	.6	1.0	1.0
n=3			
Left-Frontal			
Mean	10.2	10.0	29.8
S.D.	1.3	1.2	1.6
n=5			
Right-Frontal			
Mean	10.3	9.8	37.5
S.D.	.9	.9	1.0
n=4			
POST-ROLANDIC			
Left Temporal			
Left Parietal			
Mean	11.3	9.3	37.0
S.D.	1.5	.6	3.0
n=3			
Right Temporal-Parietal			
Right Parietal			
Right Parietal-Occipital			
Mean	11.0	9.3	38.7
S.D.	1.8	.5	1.5
n=4			

Table 8

Individual Case-By-Case Performance on WAIS and
Controlled Oral Word Association Test (COWA)

		WAIS (age corrected scaled scores)		
Group	S#	Information	Picture Arrangement	COWA
Bi-F	1	9	9	36
	2	10	10	38
	3	9	11	37
L-F	4	12	10	29
	5	9	10	32
	6	11	9	31
	7	10	12	29
	8	9	9	28
R-F	12	11	10	37
	13	9	9	37
	14	11	11	39
	15	10	9	37
L-T	9	13	10	40
	10	10	9	37
L-P	11	11	9	34
R-TP	16	9	9	40
R-P	17	12	9	38
	18	10	9	40
R-PO	19	13	10	37

Bi-F= bilateral frontal
 L-F= left frontal
 L-T= left temporal
 L-P= left parietal
 R-F= right frontal
 R-TP= right temporal-parietal
 R-P= right parietal
 R-PO= right parietal-occipital

Figure 5

**Composite Drawings of Bilateral
Focal Pathology**

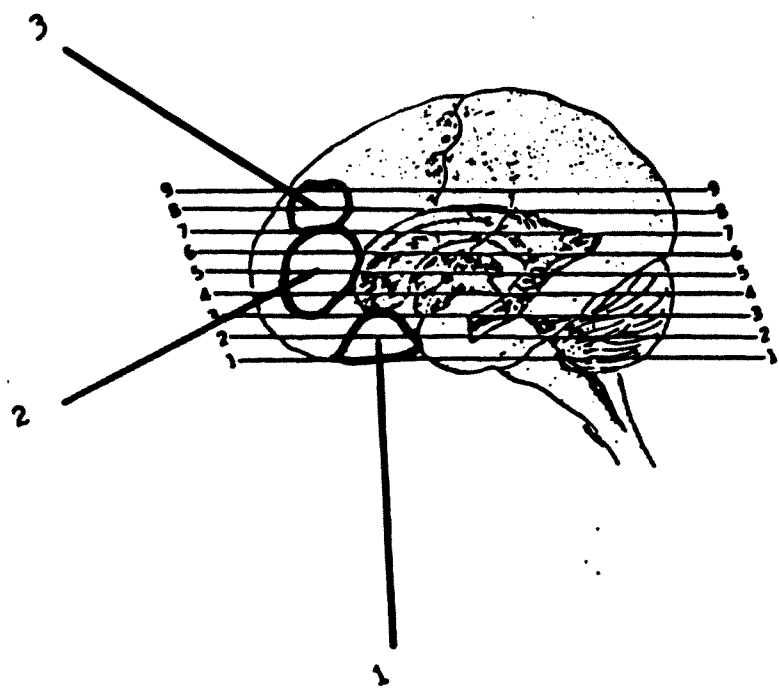


Figure 6

**Composite Drawings of Left-side
Focal Pathology**

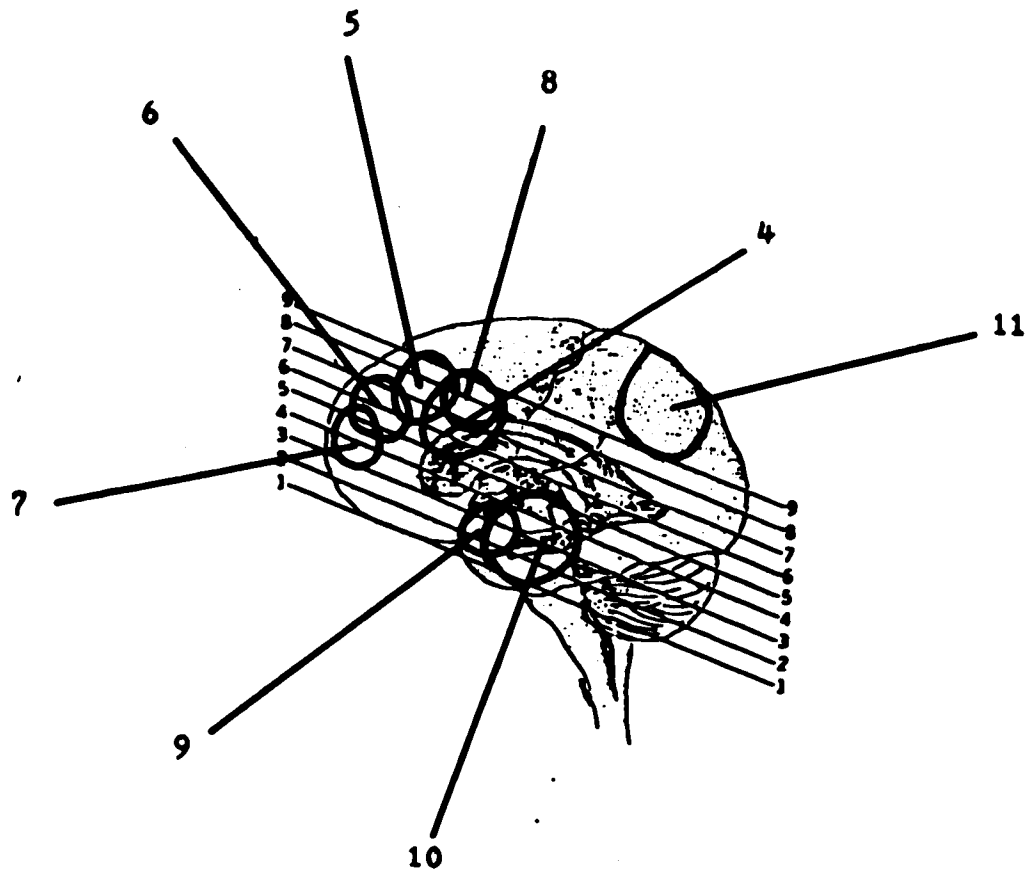
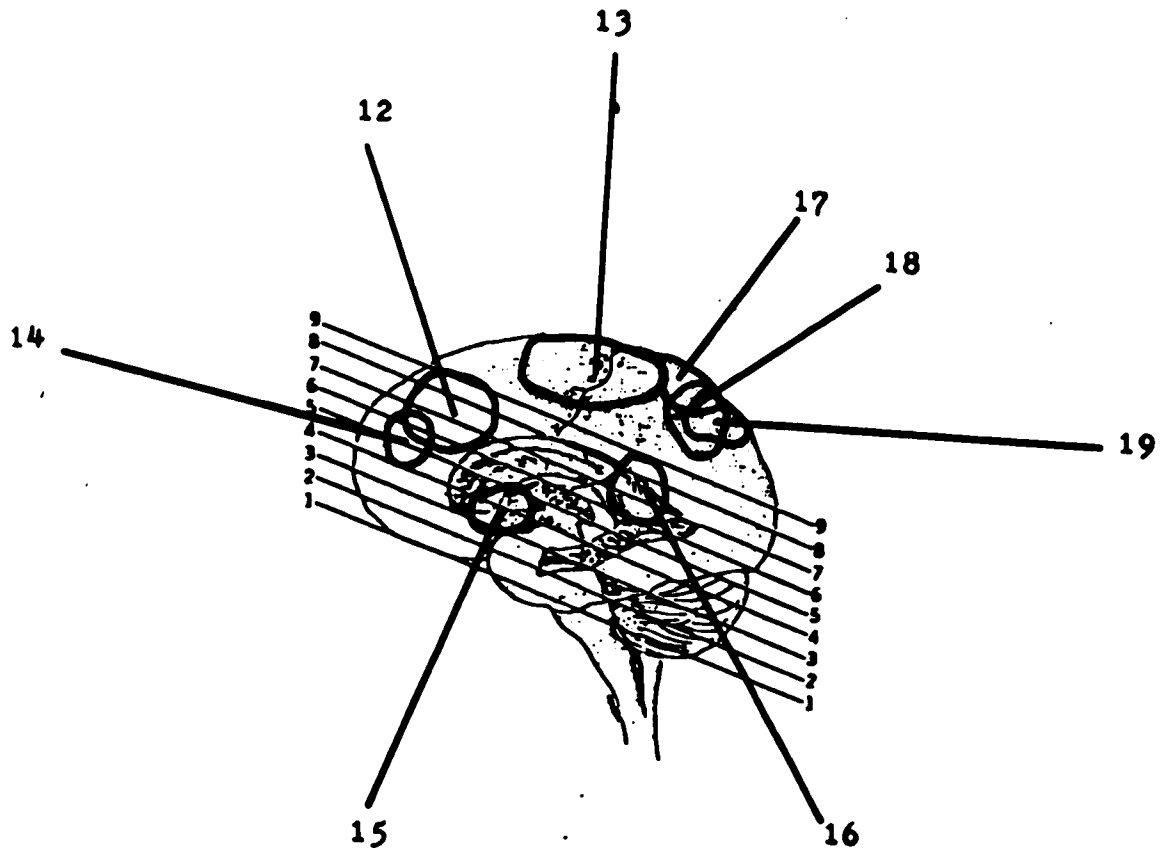


Figure 7

**Composite Drawings of Right-side
Focal Pathology**



quality fluency. The interjudge reliabilities for all protocols for these measures were high (r 's= .93, .94, and .92, respectively). High interjudge reliability is also reported by Leahy (1979) (r 's= .90, .95, and .94, respectively).

The Description of Peers Task (Livesley and Bromley, 1973) determined the subject's level of recursive thinking, central and qualifying statements about spontaneous person descriptions. The interjudge reliabilities for total statements, recursive thought, central and qualifying statements were high (r 's= .94, .84, .92, and .93, respectively), in agreement with published data (r 's= .92, .89, .90, and .93, respectively; Leahy, 1979). Case-by-case coefficients for interjudge reliability on the Alternate Uses Task and Description of Peers task are presented in Appendix N2.

Section 3- Test Results

Focal cortical patients' performance on non-social and social simultaneous and sequential refocusing tasks are summarized in Tables 9 and 10 respectively. Patients are grouped according to side and locus of pathology.

Table 9

Case-By-Case Performance on Non-Social and Social
Decentration Tasks- Simultaneous Refocusing

	<u>Non-Social</u> Goldschmid-Bentler (max= 12)		<u>Social</u> Chandler (max=8)		Leahy (max=20)
S#	Total	Behavior	Explanation		
	(max=6)	(max=6)	(max=6)		
FRONTAL					
Bi-F	1	3	2	1	5
	2	2	2	0	6
	3	3	2	1	6
L-F	4	2	2	0	18
	5	5	3	2	19
	6	4	3	1	18
	7	7	5	2	16
	8	5	3	2	17
R-F	12	12	6	6	5
	13	11	6	5	7
	14	12	6	6	9
	15	11	6	5	7
POST-ROLANDIC					
L-T	9	12	6	6	17
	10	12	6	6	16
L-P	11	12	6	6	18
R-TP	16	12	6	6	18
R-P	17	12	6	6	16
	18	12	6	6	19
R-PO	19	12	6	6	17

Table 10

Case-By-Case Performance on Non-Social Decentration Tasks
Sequential Refocusing: Expected Means in Parentheses

		Alternate Uses			Familiar Figures	
		IF1 (21)	Flex (11)	Fluency (1.6)	Lat	Err(max=24)
FRONTAL						
	S#					
Bi-F	1	10	2	0	17	14
	2	12	2	0	20	18
	3	8	1	0	12	19
L-F	4	10	2	1	15	16
	5	9	3	0	31	15
	6	15	6	1	12	18
	7	15	5	1	19	13
	8	11	3	1	23	20
R-F	12	19	12	5	22	5
	13	16	10	2	34	7
	14	18	11	4	19	4
	15	21	14	3	27	5
POST-ROLANDIC						
L-T	9	18	10	3	17	6
	10	17	10	2	13	5
L-P	11	17	9	2	33	8
R-TP	16	24	13	5	23	5
R-P	17	17	10	3	19	2
	18	19	12	4	17	3
R-PO	19	15	11	3	28	6

Alternate Uses Task: IF1= ideational fluency
Flex= spontaneous flexibility
Fluency= very high quality fluency

Table 10 (cont.)

Case-By-Case Performance on Social Decentration Tasks
Sequential Refocusing: Expected Means in Parentheses

		Description of Peers				ACL	E-F
		RT	Cen	Qual	Ttl	(max=21)	(max=12)
		(1.4)	(2.6)	(.80)	(5.6)		
FRONTAL							
Bi-F	1	0	0	0	3	14	2
	2	0	1	0	5	10	2
	3	0	0	0	5	15	1
L-F	4	2	3	1	13	13	10
	5	2	1	1	11	16	8
	6	2	2	2	14	18	11
	7	2	4	2	12	15	12
	8	2	1	1	11	17	11
R-F	12	1	0	0	17	8	4
	13	0	1	0	15	10	3
	14	1	1	0	14	6	3
	15	0	0	0	19	9	2
POST-ROLANDIC							
L-T	9	2	4	2	16	14	12
	10	2	3	2	13	12	11
L-P	11	2	4	2	13	15	10
R-TP	16	2	5	3	18	11	8
R-P	17	2	4	2	15	12	10
	18	2	5	2	20	14	10
R-PO	19	2	3	1	14	14	9

Description of Peers: RT= recursive thinking
Cen, Qual, Ttl= central, qualifying and
total statements

ACL= Affect Adjective Checklist

E-F= Ekman-Friesen Judgment of Emotional Expressions

All frontal patients demonstrated performance decrements which is dissociated from pre-morbid IQ and sequencing ability. By contrast, all other cortical patients, irrespective of locus and side, performed at or close to ceiling on both social and non-social measures. Most importantly, the predicted side by lesion differences have been supported. Specifically, a complete double dissociation was found.

Inspection of means in Tables 11 and 12 reveal no overlap between left and right frontal groups on both social and non-social measures of simultaneous and sequential refocusing. Left frontal patients performed like other cortical patients on social cognitive simultaneous (Chandler, $\bar{X}=7.8$, S.D.=.44; Leahy, $\bar{X}=17.6$, S.D.=1.1) and sequential refocusing tasks (recursive thinking, central, qualifying and total statements, Ekman-Friesen; \bar{X} 's= 2.0, 2.2, 1.4, 12.2, 10.4; S.D.'s= 0.0, 1.3, .5, 1.3, 1.5, respectively). However, they were impaired in comparison to right frontal patients on non-social simultaneous (Goldschmid-Bentler, $\bar{X}=4.6$, S.D.=1.8; $t(7)=7.34$, $p < .005$) and sequential refocusing tasks (ideational fluency, $t(7)=3.85$, $p < .005$; spontaneous flexibility, $t(7)=7.18$, $p < .005$; very high quality fluency, $t(7)=4.50$, $p < .005$; MFFT, $t(7)=7.50$, $p < .005$; \bar{X} 's= 12.0, 3.8, 0.8, 16.4; S.D.'s= 2.8, 1.6, 0.4, 2.7, respectively).

Table 11

Mean Performance on Non-Social and Social
Decentration Tasks-Simultaneous Refocusing

	Goldschmid-Bentler			Chandler (max=8)	Leahy (max=20)
	Total (max=12)	Behavior (max=6)	Explanation (max=6)		
FRONTAL					
Bilateral-Frontal					
Mean	2.6	2.0	.7	1.0	5.6
S.D.	.6	0	.6	1.0	.6
n=3					
Left-Frontal					
Mean	4.6	3.2	1.4	7.8	17.6
S.D.	1.8	1.0	.8	.4	1.1
n=5					
Right-Frontal					
Mean	11.5	6.0	5.5	1.3	7.0
S.D.	.6	0	.6	.9	1.6
n=4					
POST-ROLANDIC					
Left Temporal Left Parietal					
Mean	12.0	6.0	6.0	7.6	17.0
S.D.	0	0	0	.6	1.0
n=3					
Right Temporal-Parietal Right Parietal Right Parietal-Occipital					
Mean	12.0	6.0	6.0	8.0	17.5
S.D.	0	0	0	0	1.3
n=4					

Table 12

Mean Performance on Non-Social Decentration Tasks
Sequential Refocusing

	Alternate Uses			Familiar Figures	
	IFL	Flex	Fluency	Lat	Err
FRONTAL					
Bilateral-Frontal					
Mean	10.0	1.6	0	16.3	17.0
S.D.	2.0	.6	0	4.0	2.6
n=3					
Left-Frontal					
Mean	12.0	3.8	.8	20.0	16.4
S.D.	2.8	1.6	.4	7.4	2.7
n=5					
Right-Frontal					
Mean	18.5	11.7	3.5	25.5	5.3
S.D.	2.1	1.7	1.3	6.5	1.3
n=4					
POST-ROLANDIC					
Left Temporal Left Parietal					
Mean	17.3	9.6	2.3	21.0	6.3
S.D.	.6	.6	.6	10.5	1.5
n=3					
Right Temporal-Parietal Right Parietal Right Parietal-Occipital					
Mean	18.8	11.5	3.8	21.8	4.0
S.D.	3.8	1.3	.9	4.8	1.8
n=4					

Table 12 (cont.)

Mean Performance on Social Cognitive Tasks
Sequential Refocusing

	Description of Peers				ACL	E-F
	RT	Cen	Qual	Ttl		
FRONTAL						
Bilateral-Frontal						
Mean	0	.3	0	4.3	13.0	1.6
S.D.	0	.6	0	1.1	2.6	.6
n=3						
Left-Frontal						
Mean	2.0	2.2	1.4	12.2	15.8	10.4
S.D.	0	.3	.5	1.3	1.9	1.5
n=5						
Right-Frontal						
Mean	.5	.5	0	16.3	8.3	3.0
S.D.	.5	.5	0	2.2	1.7	.8
n=4						
POST-ROLANDIC						
Left Temporal						
Left Parietal						
Mean	2.0	3.6	2.0	14.0	13.6	11.0
S.D.	0	.5	0	1.7	1.5	1.0
n=3						
Right Temporal-Parietal						
Right Parietal						
Right Parietal-Occipital						
Mean	2.0	4.3	2.0	16.8	12.8	9.3
S.D.	0	.9	.8	2.7	1.5	.9
n=4						

Conversely, right frontal patients were intact on all non-social tasks (Goldschmid-Bentler, ideational fluency, spontaneous flexibility, very high quality fluency, MFFT; \bar{X} 's= 11.5, 18.5, 11.7, 3.5, 5.3; S.D.'s= .57, 2.1, 1.7, 1.3, 1.2, respectively), but uniformly depressed relative to non-frontal and left frontal pathology patients on social cognitive simultaneous (Chandler, \bar{X} =1.3, S.D.=.9, $t(7)$ = 7.86, $p < .005$; Leahy, \bar{X} = 7.0, S.D.= 1.6, $t(7)$ =13.82, $p < .005$) and sequential refocusing tasks (recursive thinking, \bar{X} = .5, S.D.=.5, $t(7)$ =6.81, $p < .005$; central statements, \bar{X} =.5, S.D.=.5, $t(7)$ =6.29, $p < .005$; qualifying statements, \bar{X} =0, S.D.=0, $t(7)$ =5.60, $p < .005$; Ekman-Friesen, \bar{X} =3.0, S.D.=.8, $t(7)$ =10.42, $p < .005$). However, left frontal patients did score significantly lower than right frontal patients on total statements (Description of Peers Task, $t(7)$ =3.53, $p < .005$) despite the former's significantly higher levels of recursive thinking. Compared to left frontal patients and all other non-frontal groups, right frontal patients also scored lowest on the Affect Adjective Checklist (\bar{X} =8.3, S.D.=1.7, $t(7)$ = 6.19, $p < .005$).

Bilateral frontal patients showed consistent deficits in both non-social (Goldschmid-Bentler, \bar{X} =2.6, S.D.=.57) and social cognitive simultaneous refocusing tasks (Chandler, \bar{X} =1.00, S.D.=1.0; Leahy, \bar{X} =5.66, S.D.=.57). Similarly, compared to other frontal patients and all non-frontal

groups, performance deficits for this group (Table 12) were found in most non-social and social sequential refocusing tasks. In terms of non-social sequential refocusing tasks, bilateral frontal patients performed significantly worse than left frontal and other cortical patients on spontaneous flexibility ($\bar{X}=1.6$, S.D.=.6, $t(6)=2.24$, $p < .05$) and very high quality fluency ($\bar{X}=0$, S.D.=0, $t(6)=3.33$, $p < .01$). There was no significant difference between bilateral and left frontal patients on ideational fluency ($\bar{X}=10.0$, S.D.=2.0, $t(6)=1.07$, ns) and the Matching Familiar Figures Test ($\bar{X}=17.0$, S.D.=2.6, $t(6)=.31$, ns).

In terms of social sequential refocusing tasks, bilateral frontal patients did not differ significantly from right frontal patients on recursive thinking, central statements and qualifying statements (see Table 12). Bilateral frontal patients scored significantly lower on Ekman-Friesen Faces ($\bar{X}=1.6$, S.D.=.6, $t(5)=2.54$, $p < .05$) and total statements ($\bar{X}=4.3$, S.D.=1.1, $t(5)=10.36$, $p < .005$) compared to right frontal patients.

Discussion

The following is a review of the major findings in this second experiment. There was no evidence that the present findings were influenced by differences in pre-morbid IQ, sequencing ability, age, sex, level of education, extent of pathology or handedness. All groups were closely matched on these variables, yet significant differences were found on performance of non-social and social cognitive tasks dependent on locus and side of pathology.

As in experiment 1, bilateral frontal patients were impaired in both domains, demonstrating a "floor" effect. Examination of their responses on the Goldschmid-Bentler suggests egocentric responses for both behavior ($\bar{X}=2.0$, S.D.=0) and explanation ($\bar{X}=.6$, S.D.=.57) dimensions. Similarly, responses on the Alternate Uses Task suggest reduced ideational fluency, constricted spontaneous flexibility and no use of very high quality fluency. On the Matching Familiar Figures Test, bilateral frontal patients had the greatest number of errors of all groups. These findings demonstrate that bilateral frontal patients show an egocentric orientation to non-social cognitive tasks, with diminished capacity to attend to various dimensions or perspectives and tendency to respond with an impulsive style.

By contrast, left frontal patients scored slightly higher on most measures of non-social simultaneous and

sequential refocusing. On the Goldschmid-Bentler, they scored significantly better than bilateral frontal patients when judging the relative quantity of two objects (behavior, $\bar{X}=3.2$, S.D.=1.0, $t(6)=2.03$, $p < .05$) but were still compromised by egocentric perceptual explanations and/or describing part of the procedure (explanation, $\bar{X}=1.4$, S.D.=.8, $t(6)=1.32$, ns). Case-by-case transcriptions of Goldschmid-Bentler explanations (Appendix M) qualitatively suggests (for both Experiments 1 and 2) that left frontal patients' responses were due to egocentric reasoning rather than a function of reduced verbal fluency.

Though scoring slightly better than bilateral frontal patients, left frontals were as impaired as bilaterals on the Alternate Uses Task indicating: a) a reduced ideational fluency ($\bar{X}=12.0$, S.D.=2.8, $t(6)=1.07$, ns), b) limited use of categories ($\bar{X}=3.8$, S.D.=1.6, $t(6)=2.24$, $p < .05$) and c) virtually no imaginative and/or original responses ($\bar{X}=.8$, S.D.=.4, $t(6)=3.33$, $p < .01$). Diminished fluency in divergent thinking for left frontal patients could alternately be explained by their tendency to score lower on the Controlled Oral Word Association Test ($\bar{X}=29.8$, S.D.=1.6) compared to other cortically lesioned groups. However, bilateral frontal patients' verbal fluency surpassed left frontals ($\bar{X}=37.0$, S.D.=1.0, $t(6)=7.93$, $p < .005$) and equalled right frontals ($\bar{X}=37.0$, S.D.=3.0, $t(5)=.62$, ns), yet their performance on

the Alternate Uses Task was lowest of all groups. In addition, the Controlled Word Association Test is a timed measure, whereas there were no time limits on the Alternate Uses Task. This possibly could account for diminished fluency by left frontal patients on tasks of rapid linguistic performance. Supporting this inference is the fact that despite fewer total statements ($t(6)=8.77, p<.005$), left frontal patients performed significantly better than right frontal patients on recursive thinking ($t(7)=6.81, p<.005$), number of central statements ($t(7)=6.29, p<.005$) and number of qualifying statements ($t(7)=5.60, p<.005$). The Controlled Word Association Test may thus have been a poor control for verbal fluency in the present investigation.

Right frontal patients performed at or close to ceiling on all measures of non-social simultaneous and sequential refocusing, evidencing knowledge of compensation rules, capacity to attend to various dimensions and respond with a reflective cognitive style.

On the Chandler and Leahy tasks of social cognition, bilateral and right frontal patients' performance suggested egocentric attribution of privileged information and use of an additive principle in arriving at causal attributions. On these measures of social decentration, bilateral and right frontal patients did not differ significantly (Leahy, $t(5)=1.42, ns$; Chandler, $t(5)=.41, ns$). On the Description of

Peers Task, bilateral frontal patients demonstrated a relative paucity in descriptions that did not include the recursive thoughts of others, with little or no psychological descriptions or qualifying statements. On the Affect Adjective Checklist, these patients evidenced an average amount of negative and positive feelings, but were poorest of all groups in identifying the emotional expressions of others (Ekman-Friesen, $\bar{X}=1.6$; S.D.=.6). By contrast, right frontal patients offered many descriptions of peers, but these descriptions made little mention of others thoughts with few central and no qualifying statements. In fact, qualitative examination of their responses suggested a tendency to shift the focus from other description to self-description despite frequent reminders of task instructions. Right frontal patients significantly rated their affect as positive (Affect Adjective Checklist, $\bar{X}=8.3$, S.D.=1.7, $t(7)=6.19$, $p < .005$) compared to left frontal patients and all other groups. Curiously, though their judgment of emotional expressions was only slightly higher than bilateral frontals (Ekman-Friesen, $\bar{X}=3.0$, S.D.=.8, $t(5)=2.54$, $p < .005$), right frontals tended to overrate (incorrectly) many faces as being neutral or positive in affect, suggesting an egocentric intrusion of self versus other emotionality.

Left frontal patients' performance on all social cognitive measures was at or close to ceiling. All other

focal cortical patients performed at ceiling on most measures of non-social and social cognition, a finding expected on the basis of normative data for age and IQ.

Cognitive Regression and Frontal Cortex Pathology

The first experiment examined a model of cognitive regression in adults with focal cortex pathology and demonstrated the importance of the frontal lobes in the mediation of concrete operations (decentration). It further supported current conceptualizations of hemispheric specificity and localization of frontal lobe functions by demonstrating that: 1) left frontal patients showed regression in non-social cognition, 2) right frontal patients, regression in social cognitive tasks and 3) bilateral frontal patients showed regression in both spheres. Consequently, a question was raised that required a closer look at the concept of decentration. That was, if frontal lobe dysfunction results in cognitive regression, can it be specified hierarchically along the decentration dimension.

The first experiment partially addressed this question by use of tasks sensitive to simultaneous refocusing, the highest level of decentration. The second experiment replicated the initial findings and also utilized tasks sensitive to the more primitive aspect of sequential

refocusing. Both experiments demonstrated consistent patterns of deficient decentration in patients with frontal lobe pathology, suggesting regression to egocentric thought. In addition, the side by side lesion differences found in experiment 1 were supported in experiment 2.

The findings support Jackson's (1932) principle that in neurological diseases, the functions last to develop are the first to be lost. Using Piagetian tasks sensitive to concrete operations, frontal patients demonstrated a sequence of regression through levels of operational behavior that is the inverse of developmental progression; that is, the inverse of the sequence found during development in the child.

Hierarchically, along Feffer's (1970) dimensions of decentration, egocentric thought corresponds to Piaget's pre-operational period of cognitive development. At this stage of development, the individual's perceptions are based upon immediate sense impressions, with little understanding of class inclusion and inter-relationships. Resemblances between objects are grouped together by chance contiguity or because of some idiosyncratic meaning. The egocentric thinker assimilates experiences from the world into schemas derived from his own immediate world, seeing everything in relation to himself. The disturbance of logical operations in frontal pathology patients has been identified by Luria

(1980) as impaired "preliminary investigatory activities" that is offset by lapsing into "irrelevant connections". These irrelevant connections may represent an egocentric structuring of a task suggested by frontal patients profound cognitive regression.

Rules of compensation and coordination of perspectives was found to be defective in frontal patients' performance of simultaneous refocusing tasks. Instead of analyzing the situation created by the task presented to them, bilateral and left frontal patients were influenced by immediate sense impressions, reporting quantities were not the same with perceptual explanations. Similarly, right frontal frontal patients were unable to keep separate their knowledge of events and arrived at causal attributions without regard to multi-determinants of behavior. This suggests that individual elements in each task were not compared with one another and no hypotheses were generated on their basis. Instead, "irrelevant connections", dominated by egocentric thought, compromised the selective character of intellectual activity.

The findings of the second experiment further support a relationship between irrelevant connections and egocentric thought. Bilateral and left frontal patients' compromised divergent thinking ability was associated with a decreased probability of attending to various dimensions or

perspectives. The number of different categories and imaginative responses of these patients was highly constricted and perseverative. Similarly, in situations of response uncertainty, bilateral and left frontal patients had the shortest latency to the initial response and could not inhibit their initial response in judging others, nor infer the perspectives of others in order to consider alternative hypotheses. Instead, these patients responded with immediate sense impressions and impulsivity.

Spontaneous person descriptions of bilateral and right frontal patients were relatively free of recursive thought, with few psychological and/or trait descriptions. Instead, these patients focused on overt qualities, such as appearances and possessions and related these qualities to themselves. Similarly, right frontal patients' self-rating of positive affect and subsequent overrating of positive emotional expressions in others suggests egocentric attribution interfering with perspective taking. The "irrelevant connection" hampering logical operations is an intrusion of self-knowledge that cannot be differentiated from other perspectives.

An alternative explanation for frontal patients' egocentric thought follows the Gestalt law of Pragnanz (Heidbreder, 1961). The law of Pragnanz states that experience, whether spatial or temporal, tends to assume the

best possible form, so that forms become more precise and more sharply defined. The "form" of decentration requires simultaneous and/or sequential refocusing on two or more dimensions to establish reasonable connections and hypotheses. As frontal patients cannot adequately compare individual elements of a task and generate hypotheses, the law of Pragnanz predicts a return to simplest form. From a developmental perspective, a simplest form suggests thought that is unidimensional and influenced by immediate sense impressions. From a Jacksonian perspective, a return to simplest form implies cognitive regression.

Dissociation of Function and Hemispheric Specialization

Based on current evidence for localization of function, it was hypothesized that left frontal patients would show regression in non-social cognition, right frontal patients, regression on social cognitive tasks, and bilateral frontal patients, regression in both spheres. The evidence from both experiments supports the above hypothesis. A double dissociation of cognitive function was found to depend on side and locus of pathology.

These findings suggest a model of hemispheric specialization and support Piaget's (1969) "parallel and inseparable" development of social and non-social cognitive

abilities. This view of hemispheric specialization suggests a parallel but independent consciousness of the two hemispheres. The cognitive style of the left hemisphere is suited for an analytic, logical mode, whereas the right hemisphere is a non-verbal analogue for holistic-spatial and affective appreciation. From a Piagetian perspective, the parallel development of decentration in non-social and social spheres appears to represent one aspect of hemispheric specialization under the executive control of the frontal cortex. Inter-hemispheric integration under normal conditions suggests a model of reciprocal inhibition. That is, when one hemisphere is "on", it inhibits the other, thus operating in alternation depending on situational demands. Conversely, when one hemisphere or focal region is "off" (due to pathology), it disinhibits the other, thus maximizing the expression of specialized function. In the present brain damaged sample, left frontal pathology resulted in conservation decrements, but right hemispheric performance on social decentration tasks were intact. The reverse pattern was true of patients with right frontal pathology (e.g. conservation abilities remained intact, with social decentration performance impaired).

Observations of the neurologically intact from EEG studies (Galín and Ornstein, 1972), studies of behavioral interference (Levy, 1969; Miller, 1971) and in lesion

patients (Bogen, 1969) support this model of hemispheric specialization and reciprocal inhibition. The work of Ross (1981) and Heilman et. al. (1975) suggest that hemispheric specialization is accompanied by homologous processes in the left and right hemispheres. These observations lend credence to Piaget's model of parallel cognitive development and support present findings of dissociation of cognitive functions in frontal pathology patients.

Clinical and Research Applications

The history of assessment procedures associated with frontal lobe pathology have often been inappropriate and/or lacking in appropriate control groups. Dissociation of function in right versus left frontal patients has been limited to tests of verbal/non-verbal fluency and spatial-affective appreciation. Many tests have been used to reliably confirm frontal lobe dysfunction (e.g. Wisconsin Card Sorting Test; Porteus Maze Test) but studies of their efficacy were limited to bilateral tumor and/or leukotomy cases.

The present findings provide an avenue for clinical assessment procedures. If social and non-social measures of decentration can significantly assess and dissociate impairments in frontal pathology patients, its use as a screening device may be applicable in clinical settings. The

sensitivity of these measures, however, was limited to patients with tumors and/or AVMs ranging in size from 1-5 cm. Though extent of pathology did not influence differences in performance, it is uncertain whether sensitivity can be generalized to "soft sign" cases (e.g. presence of cognitive deficits with normal EEG and/or CT scan).

Indirect evidence from learning disabled and hyperkinetic children suggests another clinical application. Compared to matched controls, learning disabled children were found to be 2-4 years delayed in their acquisition of conservation and decentration skills (Andersson 1980). In a similar study examining role-taking deficits in learning disabled children, Dickstein (1980) found these children two years behind matched controls. Comparable evidence with hyperkinetic children has not yet been tested, but these children share common features with frontal lobe patients. Hyperkinetic children are generally deficient in attention and impulse control, two deficits similarly identified in frontal lobe patients. To date, there is no known brain damage specific to hyperkinetic children but psychological and neurophysiological evidence does suggest frontal lobe dysfunction (Stamm and Kreder, 1979).

If a delay in decentering abilities exist for hyperkinetic children, one might speculate as to the inferred neural substrate. It has been demonstrated that adult

frontal pathology patients exhibit deficient concrete operations. In addition, some evidence suggests possible frontal lobe dysfunction in hyperkinetic children. Studies with learning disabled children have suggested a developmental lag in the acquisition of decentration. Given the above, hyperkinetic children would seem to display a lag in decentration. Though the evidence is speculative, it appears fruitful to investigate frontal lobe dysfunction as a possible source of childhood hyperkinesis. Moreover, the association of cognitive alterations exhibited by frontally lesioned patients and developmental lags in hyperkinetic children may share a common neural substrate.

Theoretical Links to Schizophrenic Thought Processes

In the Interpretation of Schizophrenia, Arieti (1958) states that schizophrenics use "active concretization" (shift from abstract to concrete thought) in order to ground their extreme levels of anxiety. By keeping their world on a concrete level, schizophrenics reduce their intense anxiety which is hypothesized as the precursor to their dysfunction and break with reality. Arieti proposes a principle of "progressive teleologic regression"; that is, regression in schizophrenia is progressive. The individual reintegrates their functioning at lower levels and by going to lower

levels of integration, utilizes earlier methods of purposeful activity that helped bring about a solution to a problem.

One of these earlier methods or cognitive transformations Arieti calls "teleologic causality". Here the schizophrenic finds a personal motivation or intention as the cause of an event rather than a physical explanation. This transformation seems to parallel Goldstein's (1952) contention that frontal lobe patients use an egocentric, personological problem solving approach to tasks. Consistent with these findings is Arieti's postulation that a functional alteration of the nervous system in schizophrenia likely occurs in the pre-frontal cortex. The cortical alteration, he believes, is responsible for schizophrenic symptomatology. Of particular compromise in the pre-frontal cortex is "seriatum functions"; the organization or synthesis of skilled actions or thoughts into an orderly series. Seriatum functions imply 1) the ability to anticipate a goal and 2) to organize and synthesize acts or thoughts in a given temporal sequence for the purpose of reaching the anticipated goal. This loss or compromise of seriatum functions seem analogous to shifts from decentration to egocentric thinking in problem solving tasks as refocusing on two or more dimensions is required for both reaching a goal or solving a problem. For the schizophrenic, the cognitive transformation of "teleologic causality" might occur in both social and non-

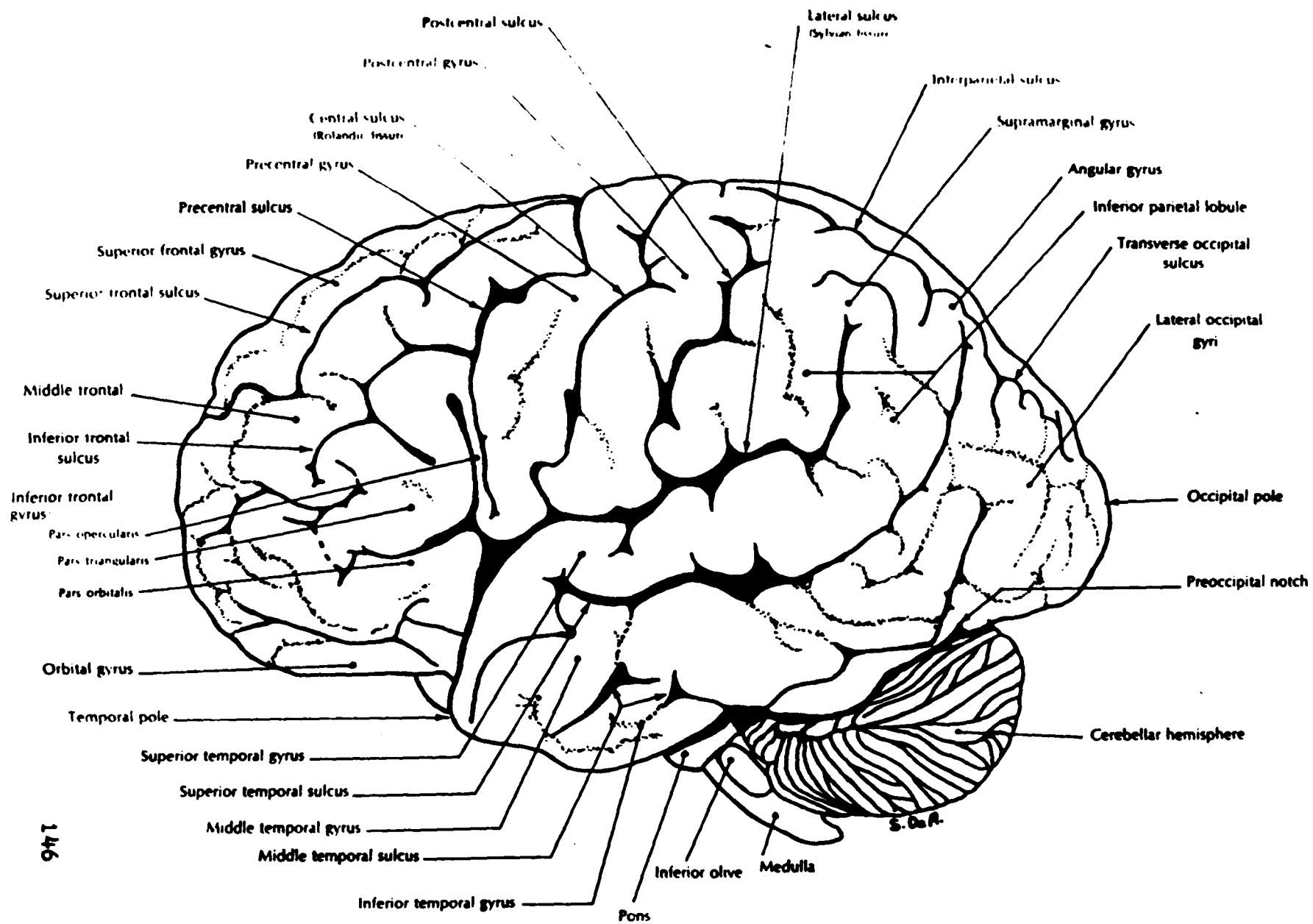
social realms replaced by personological and/or egocentric thought. This would imply non-social and social cognitive regression, paralleling the deficits observed in bilateral frontal patients. In fact, recent evidence has suggested bilateral interhemispheric frontal cortex dysfunction in schizophrenia (Flor-Henry, 1979; Henn, 1982; Ingvar, 1980; Ingvar and Franzen, 1974; Namba, 1982; Weinberger and Wyatt, 1980). Taken together, a prediction that cognitive regression in schizophrenia might parallel that of bilateral frontal patients is offered for future study. Though all frontal patients evaluated in the present study did not exhibit schizophrenic symptomatology, the neural mechanisms associated with schizophrenic functioning and cognitive changes associated with frontal cortex pathology may share a common neural substrate.

Summary

It was shown in experiment 1 that, compared to cortical pathology controls, patients with frontal lobe dysfunction exhibit deficient concrete operations. Moreover, a dissociation of function was evidenced by left and right frontal patients' deficient performance on non-social and social cognitive decentration tasks. Bilateral frontal patients evidenced deficits in both spheres. A model of cognitive regression was offered to account for the findings. It was shown in experiment 2 that the level of deficient decentration performance could be assessed with a second group of frontal pathology patients. The findings corroborated results of experiment 1 and demonstrated that all levels of decentration (e.g. simultaneous and sequential refocusing) were impaired in frontal lobe patients. Dissociation of function dependent on side of pathology was supported as in experiment 1. Extent of pathology did not influence differences in deficient decentration performance. A model of parallel cognitive development and hemispheric specialization was suggested to account for the findings. Finally, clinical, research and theoretical applications were offered for further study.

APPENDIX A

Diagram of Frontal Cortex

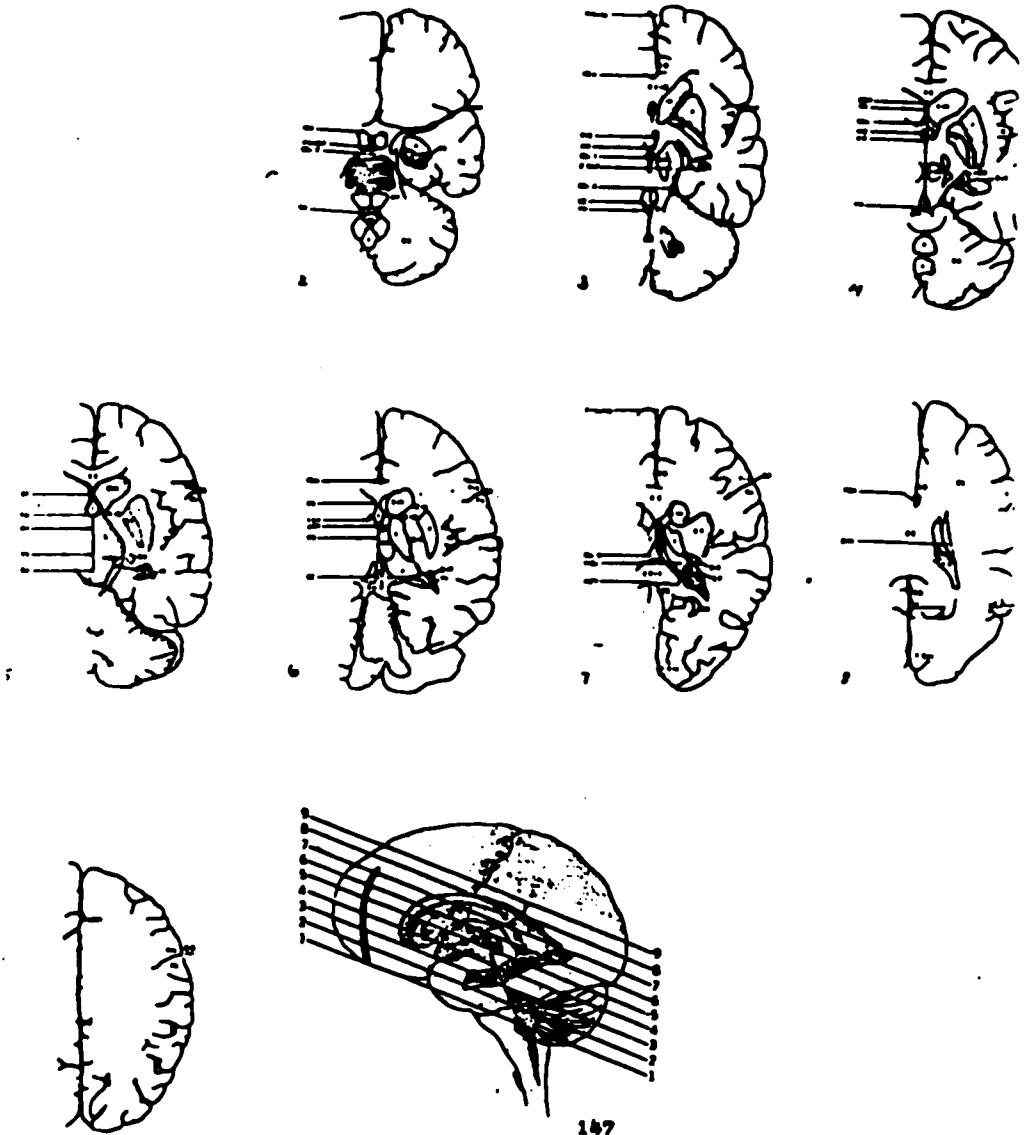


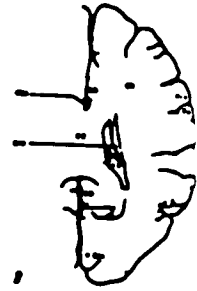
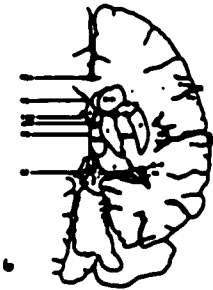
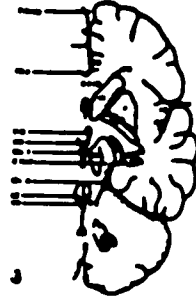
146

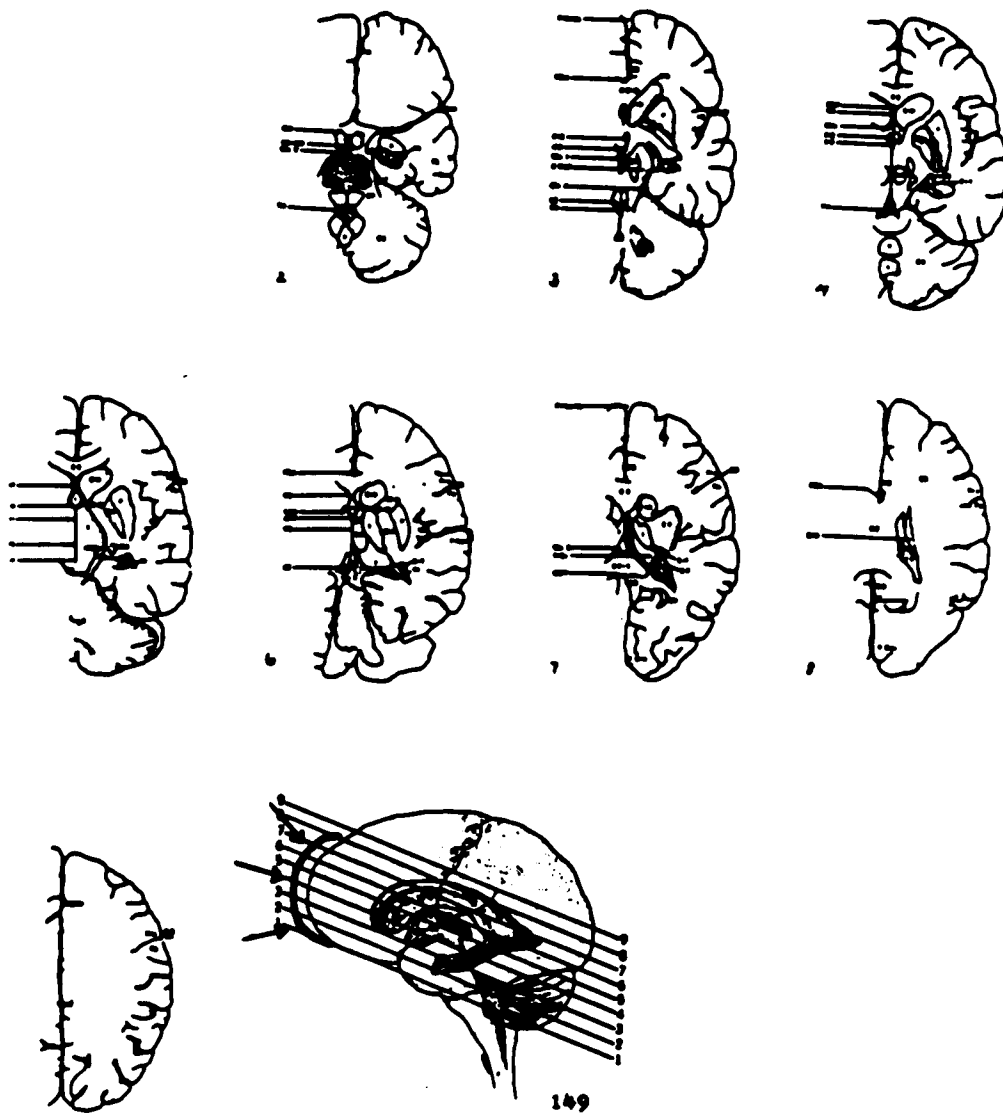
lateral surface of the brain - actual size

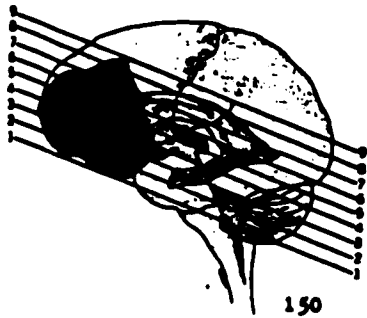
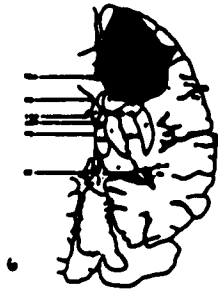
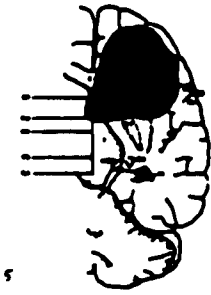
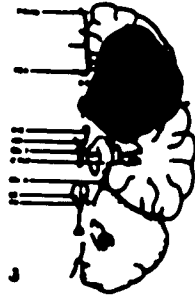
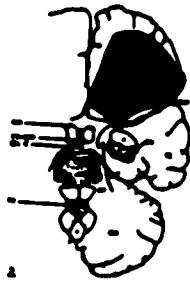
APPENDIX B1

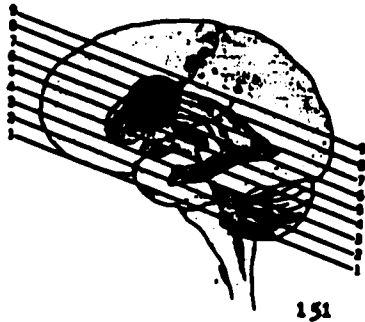
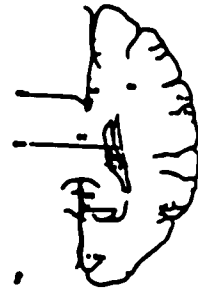
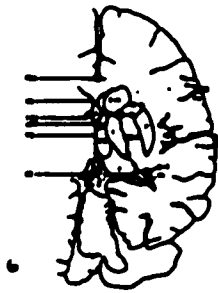
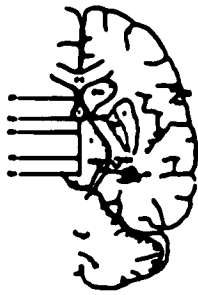
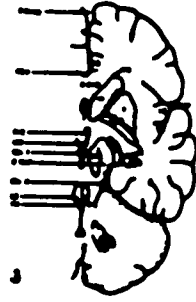
**Reconstructions of Focal Pathology For Each Subject
Experiment 1**

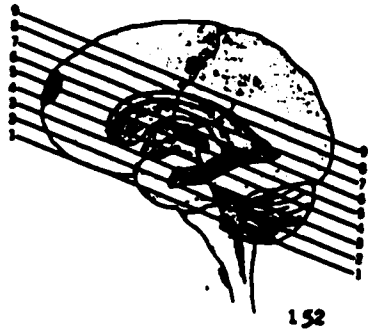
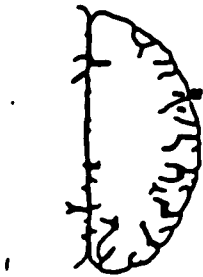
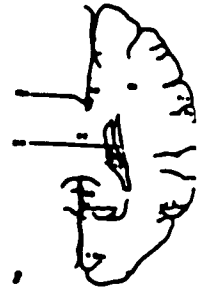
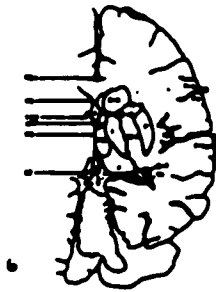
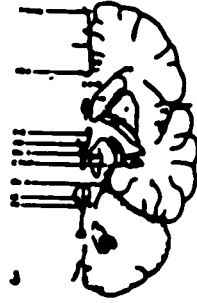


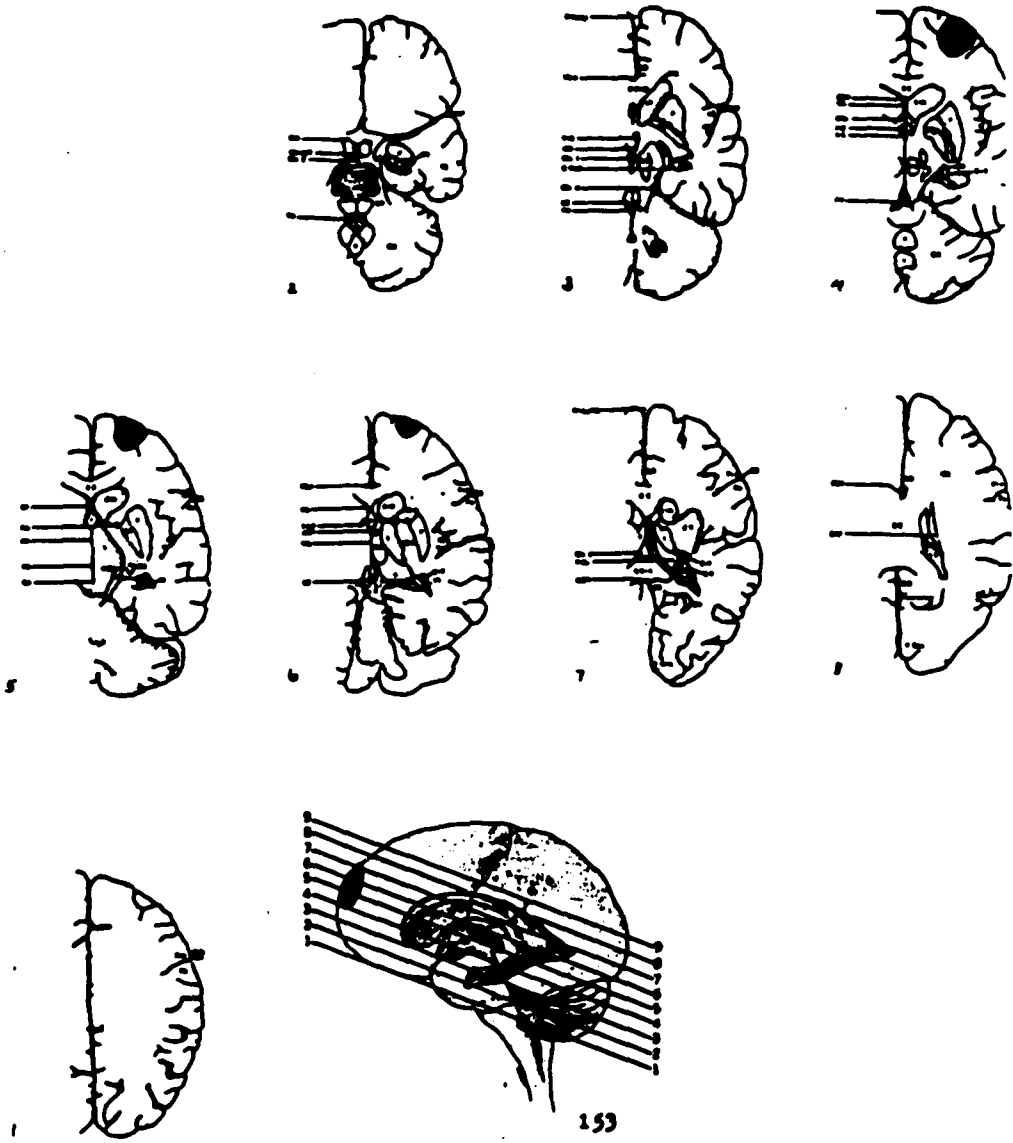


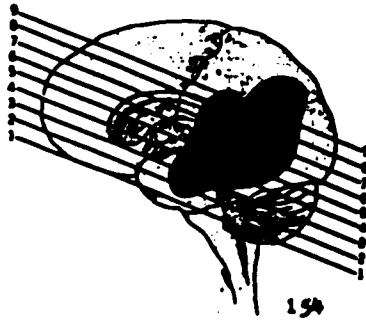
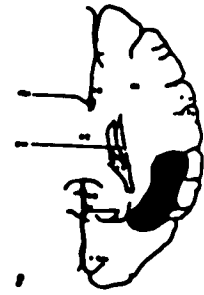
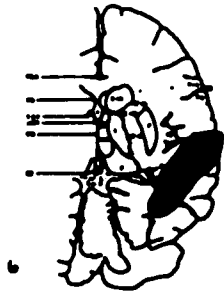
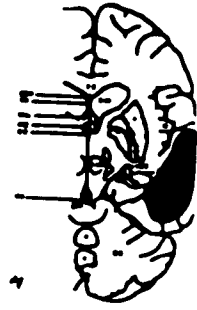
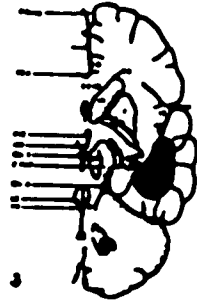
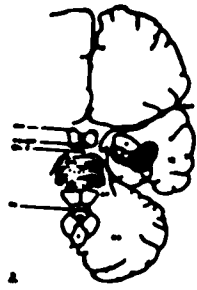


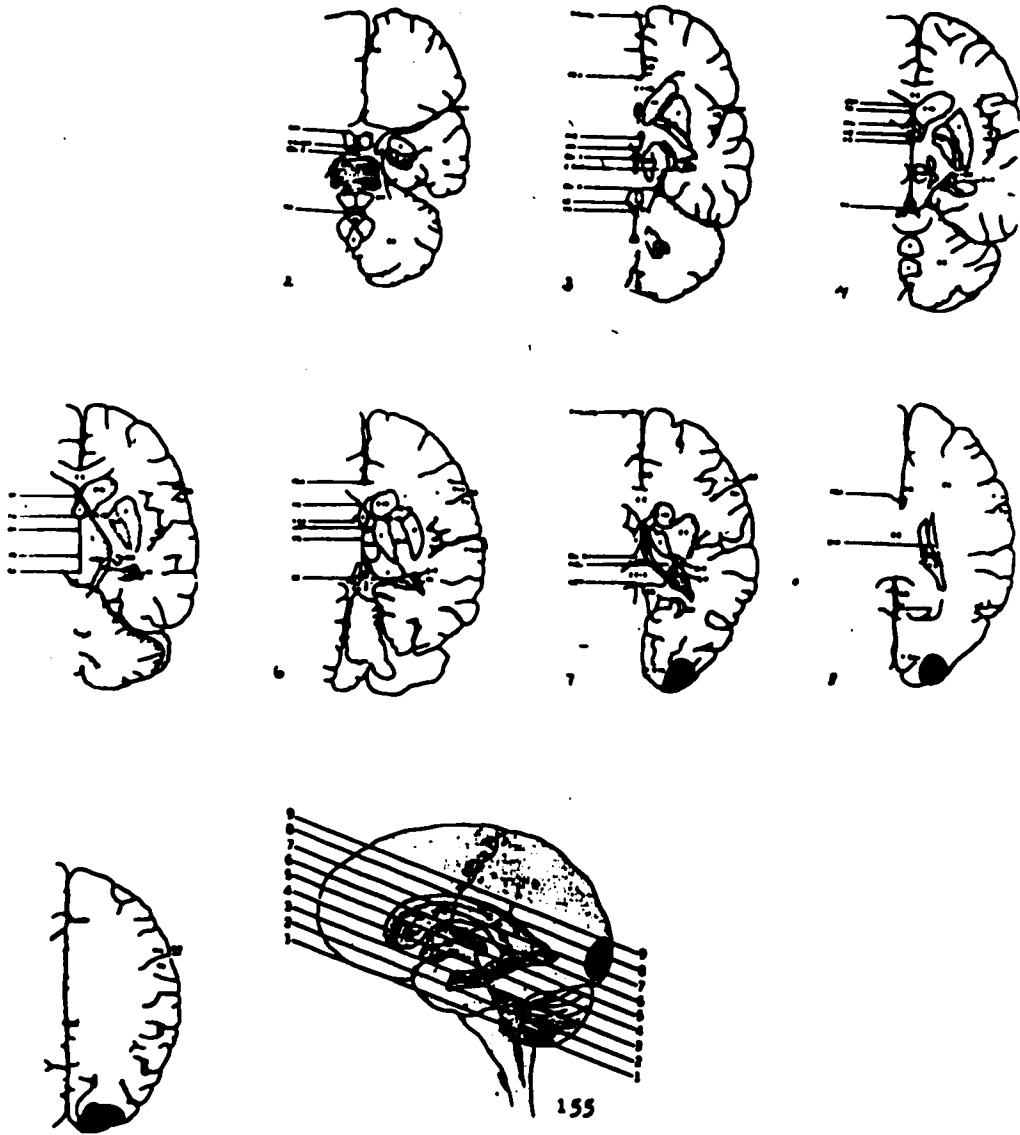


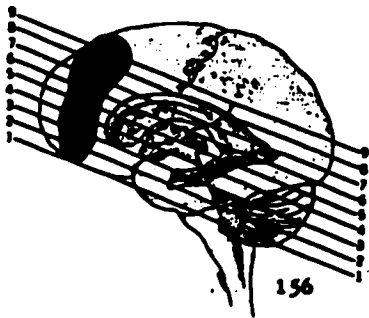
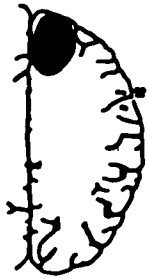
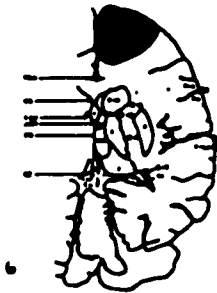
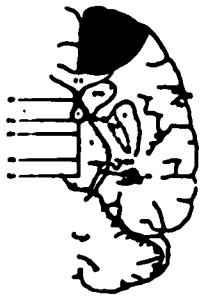
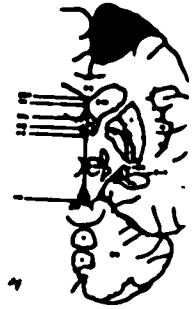
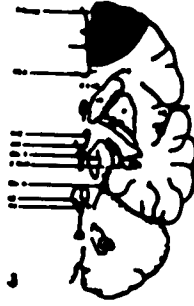


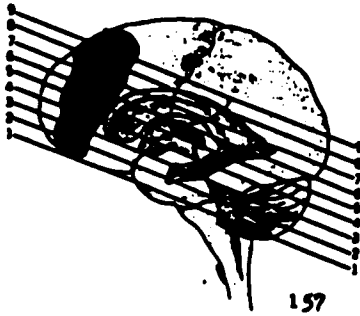
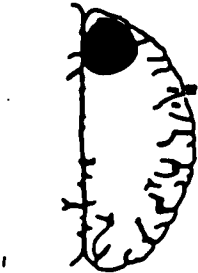
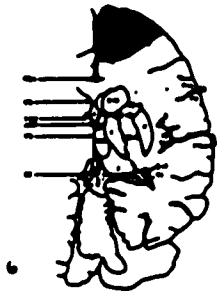
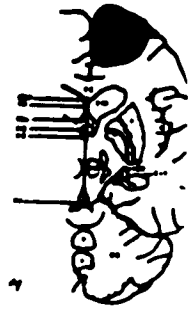
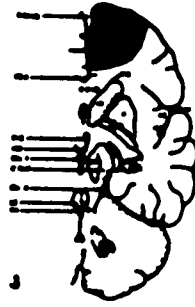


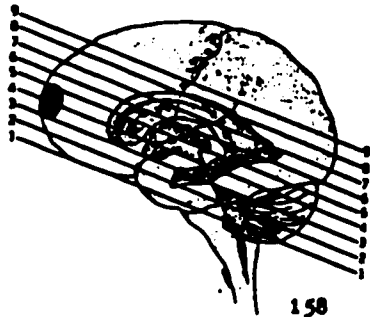
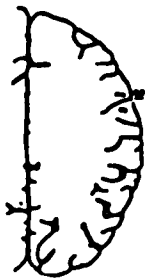
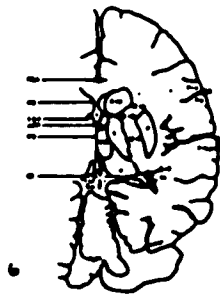
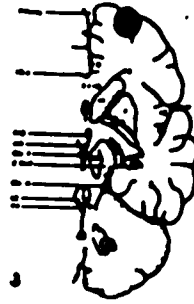


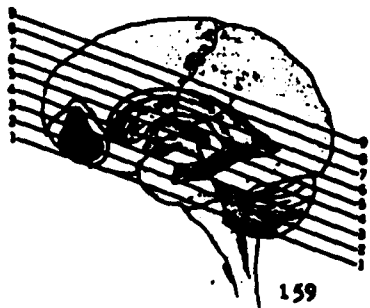
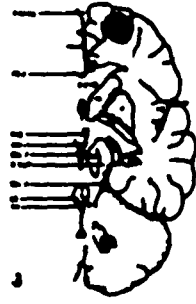
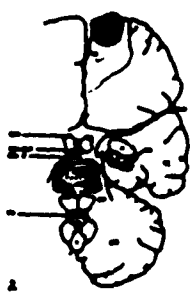


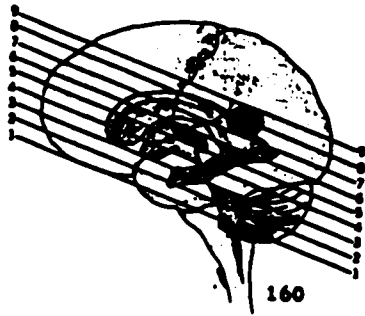
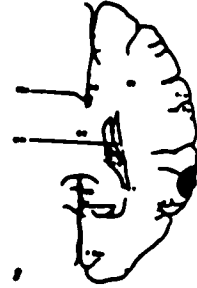
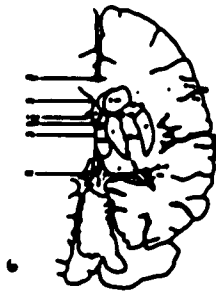
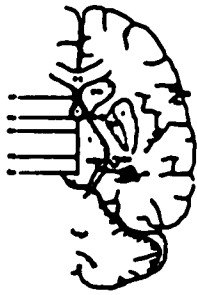
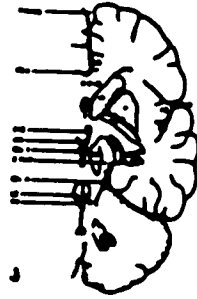


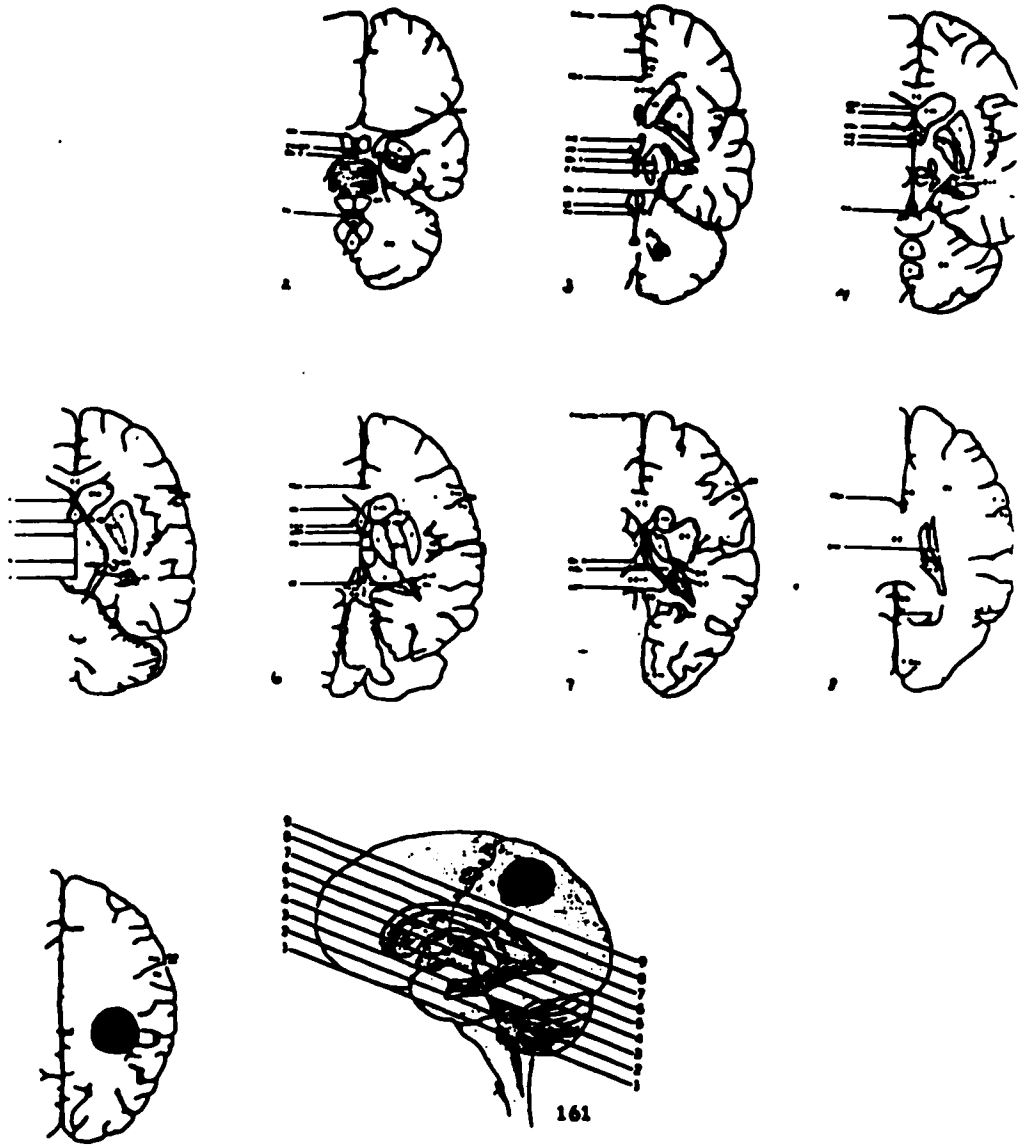


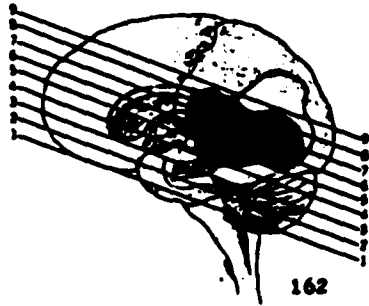
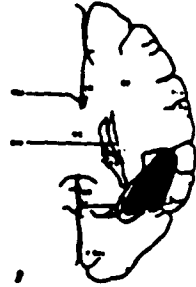
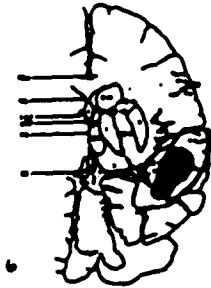
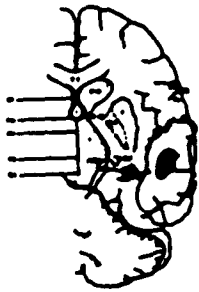
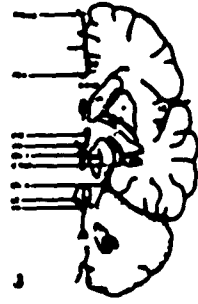


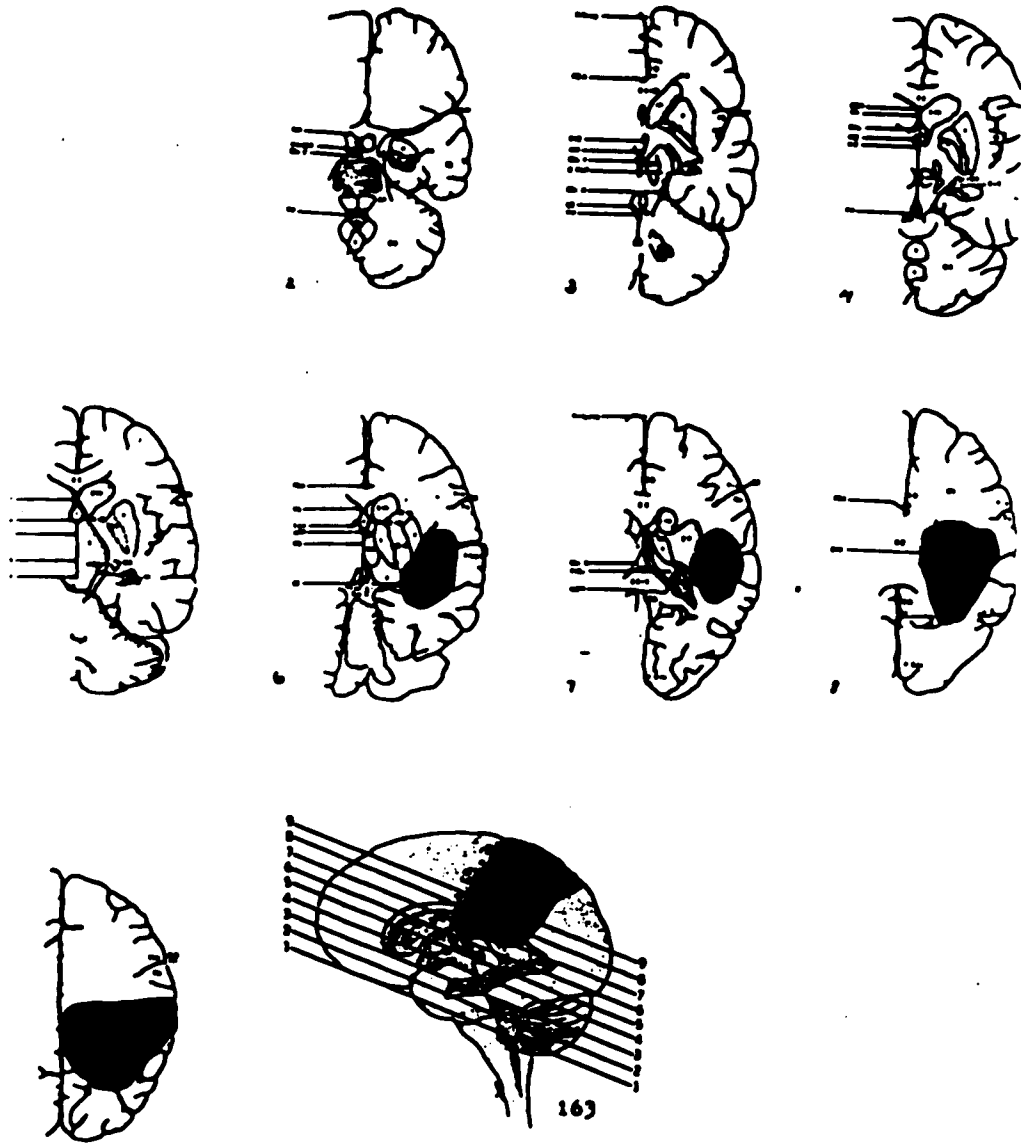


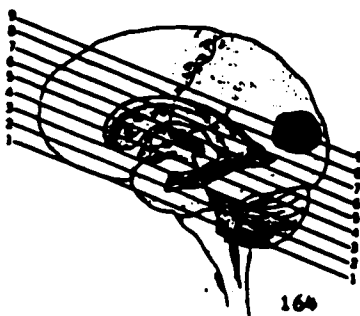
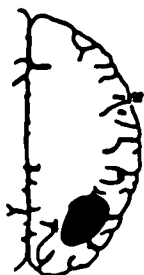
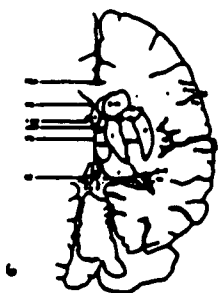
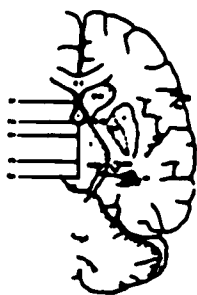
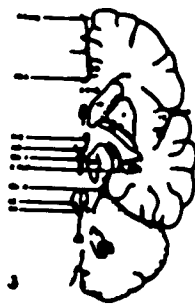






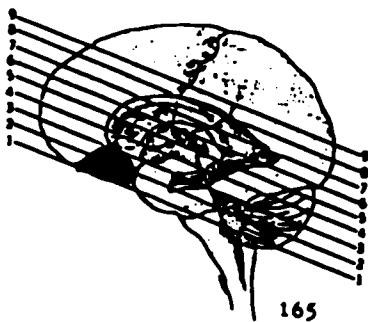
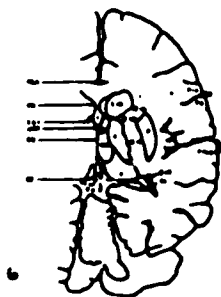
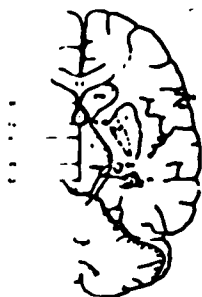
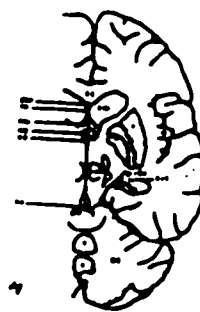
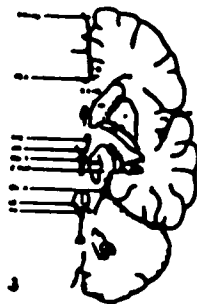
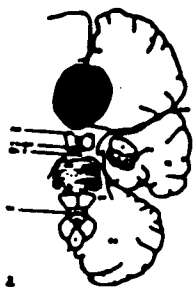


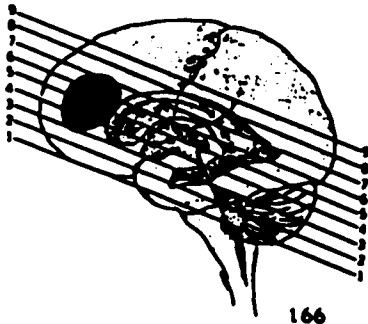
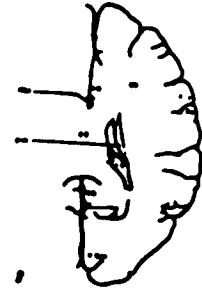
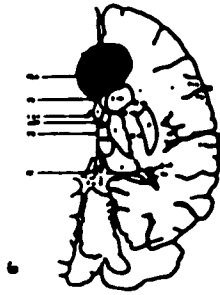
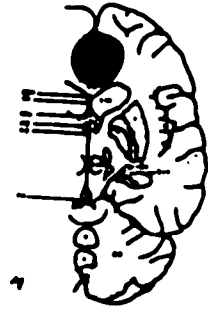
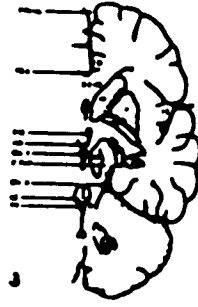


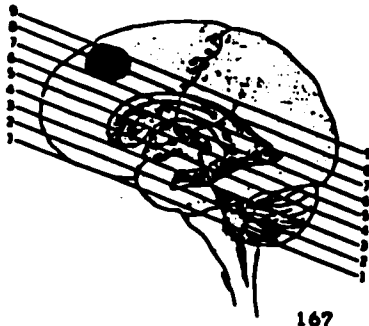
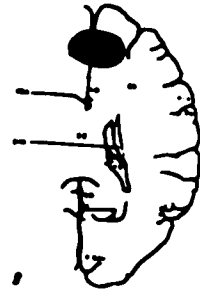
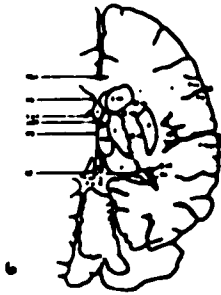
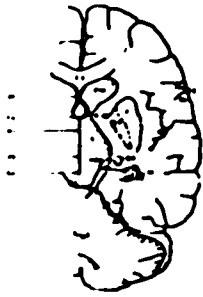
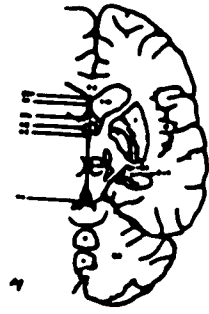
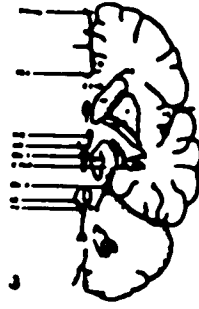
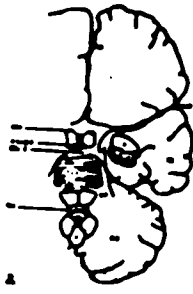


APPENDIX B2

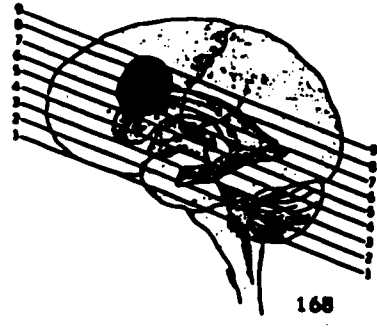
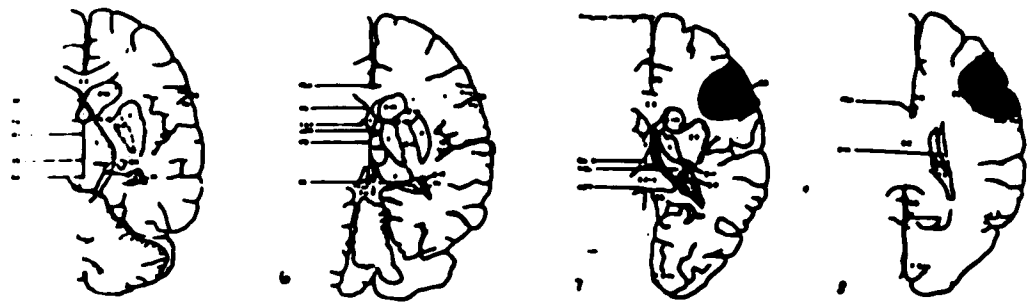
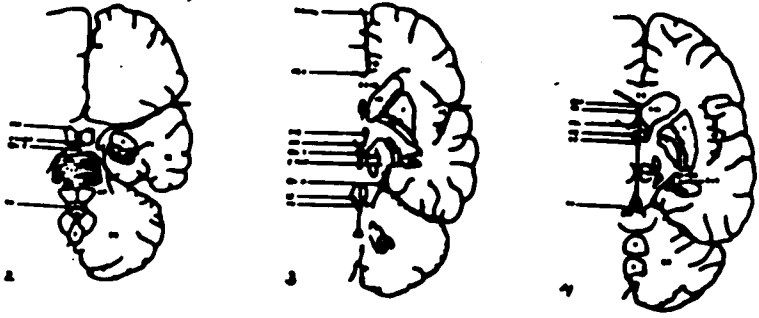
**Reconstructions of Focal Pathology For Each Subject
Experiment 2**

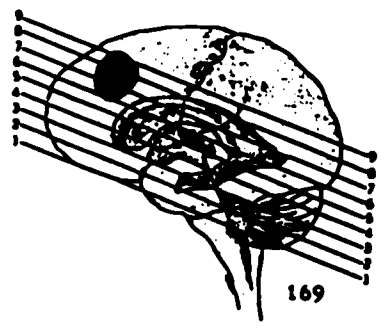
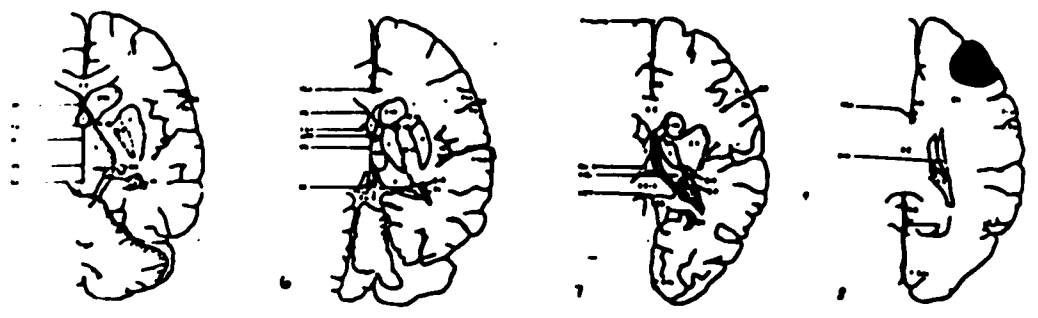
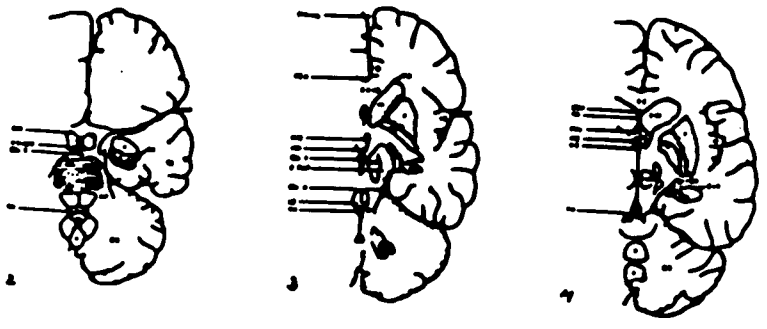


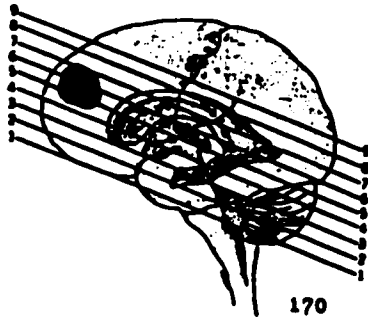
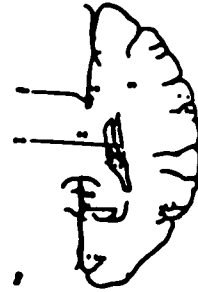
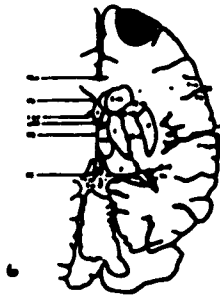
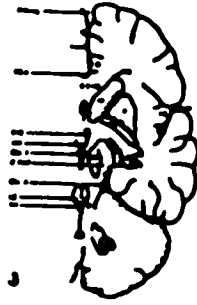
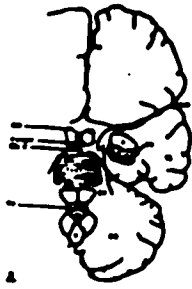


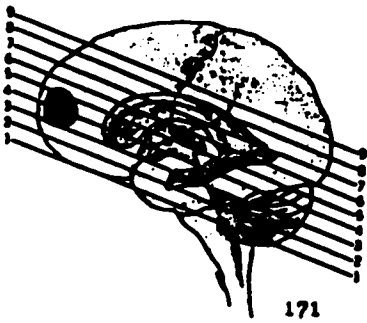
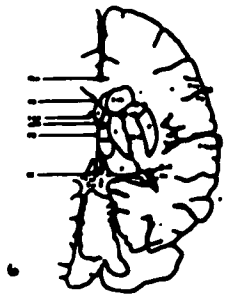
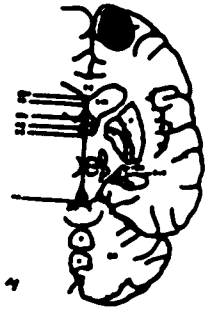
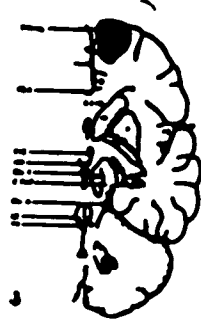
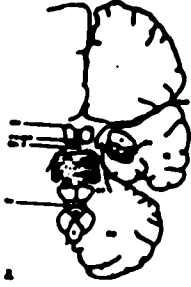


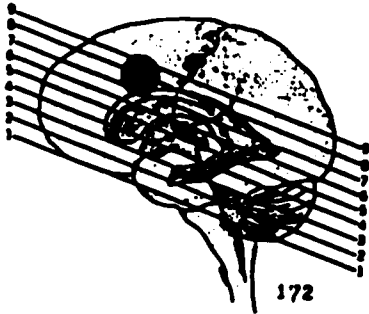
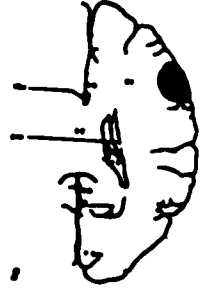
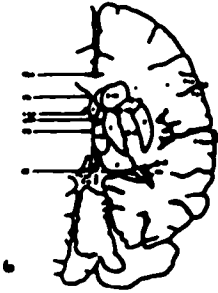
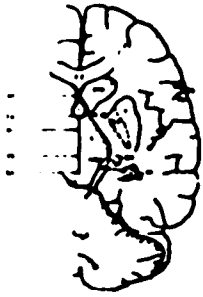
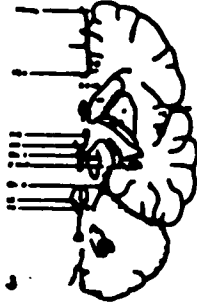
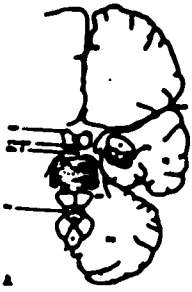
SCM

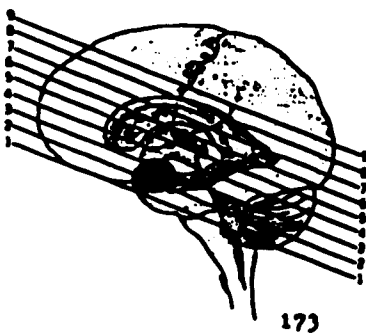
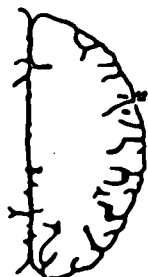
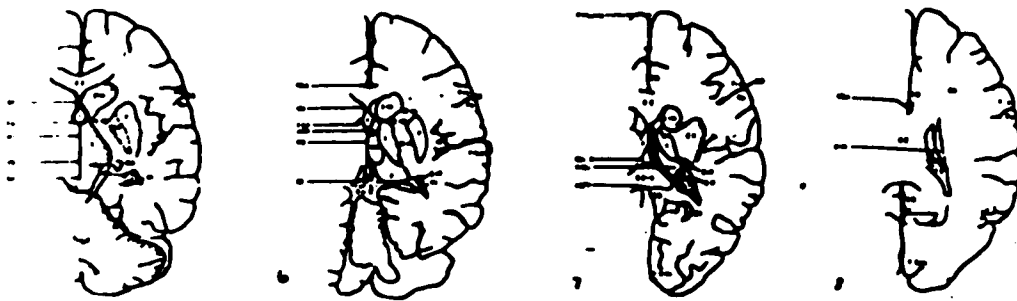
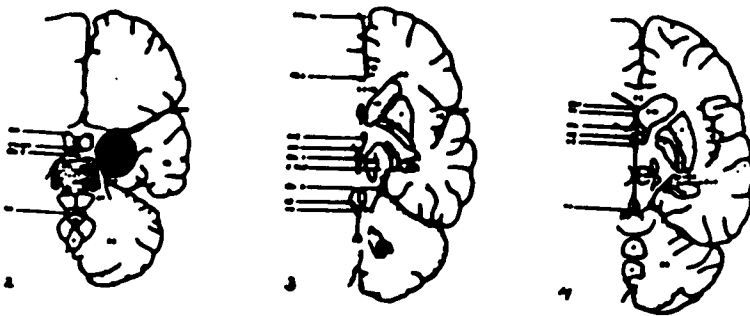


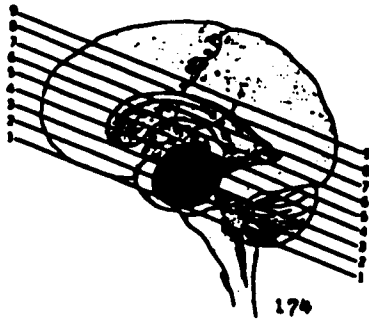
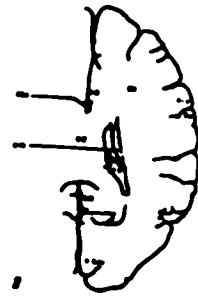
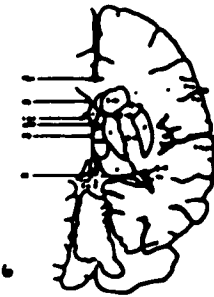
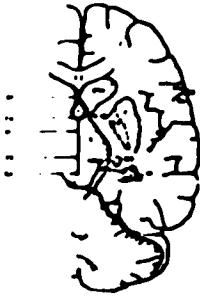
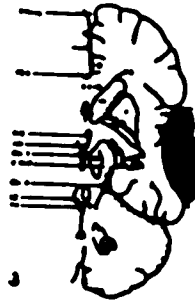
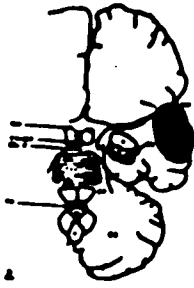


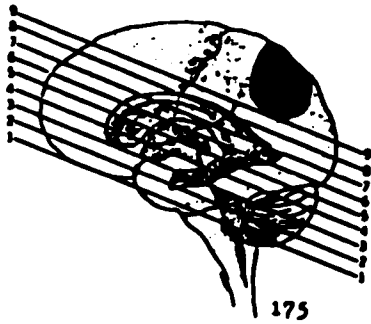
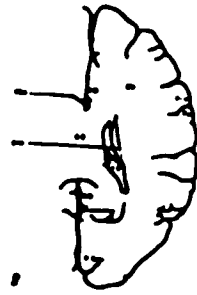
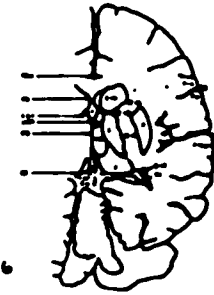
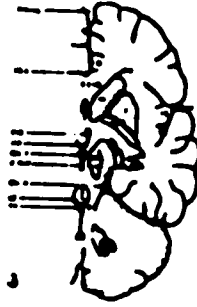
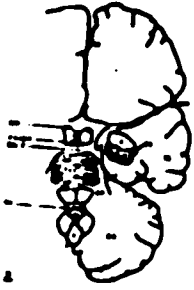


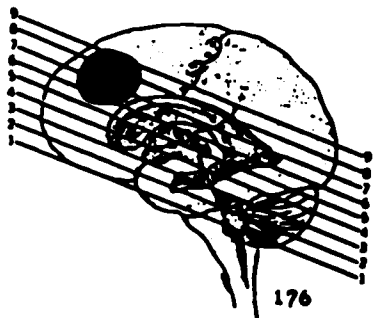
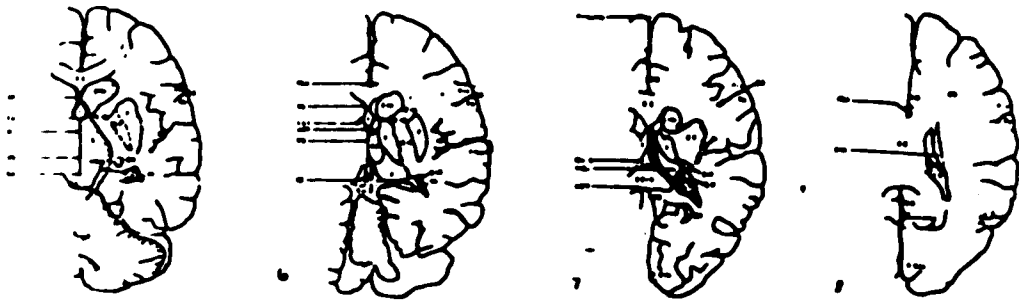
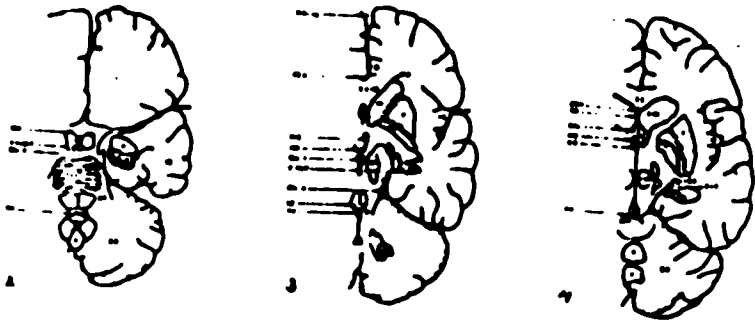


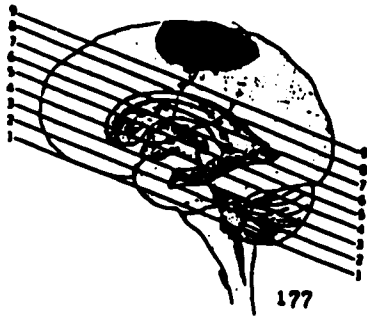
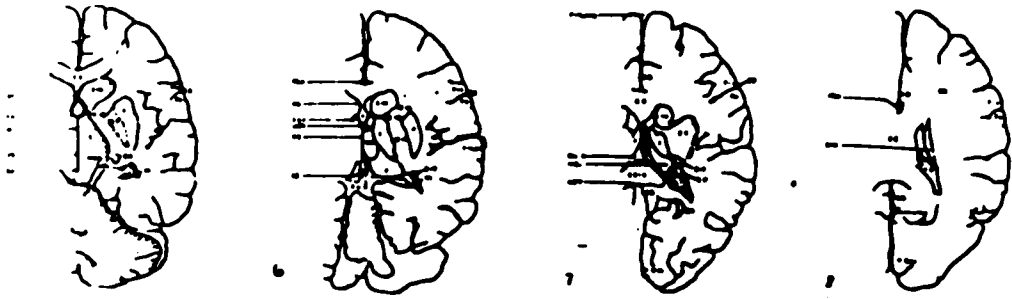
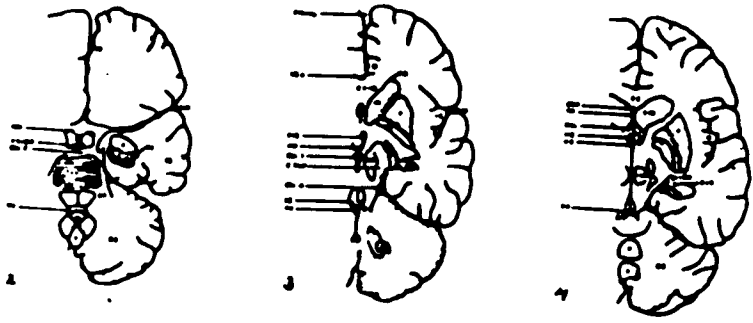


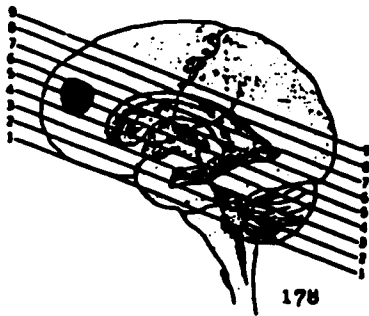
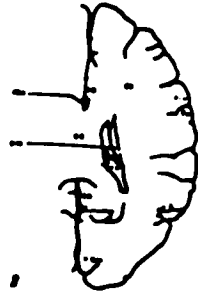
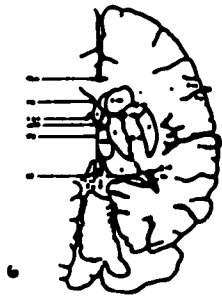
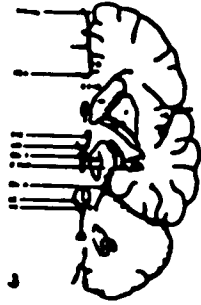
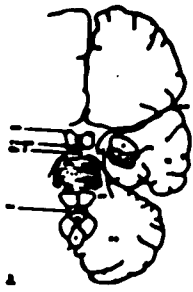


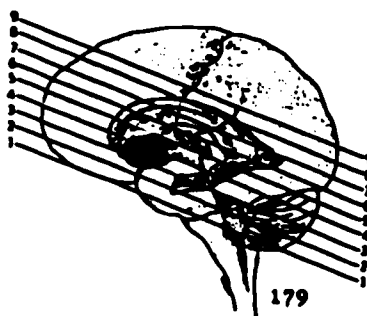
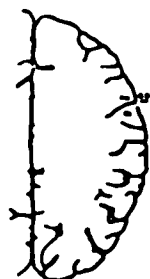
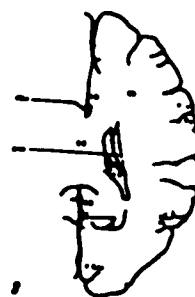
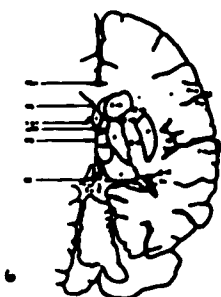
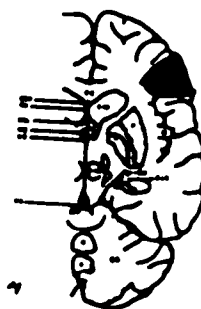
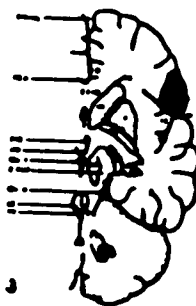
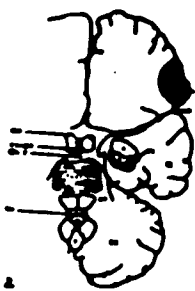


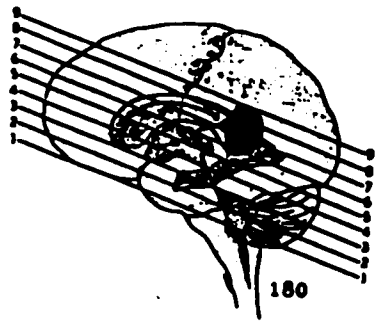
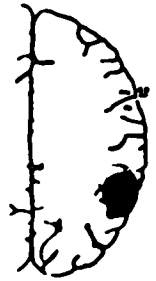
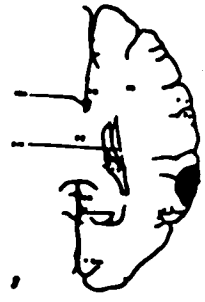
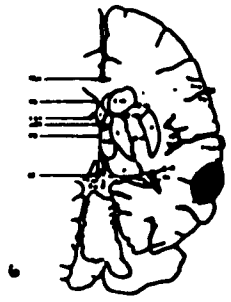
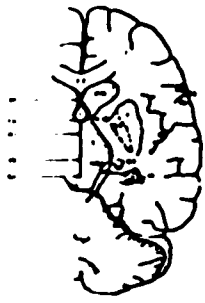
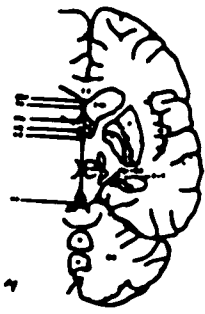
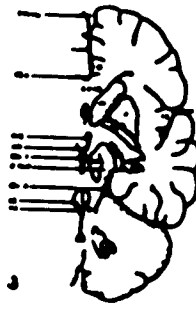
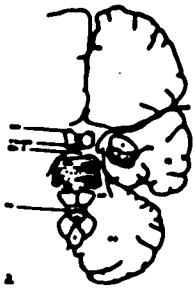


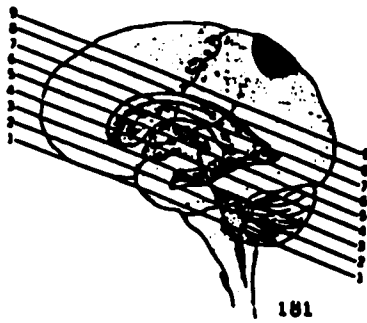
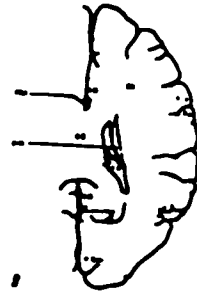
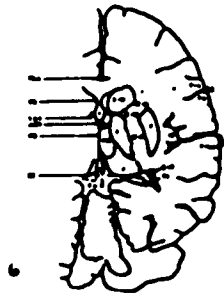
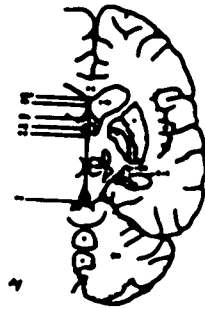
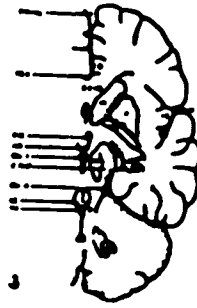
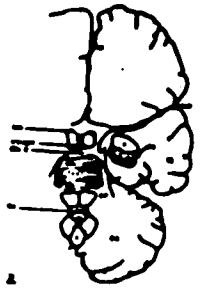


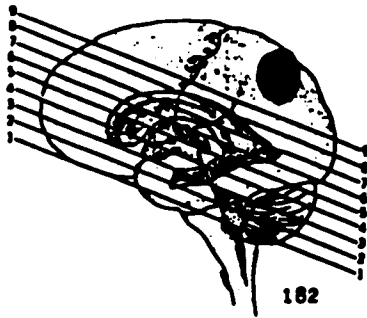
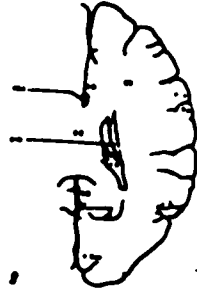
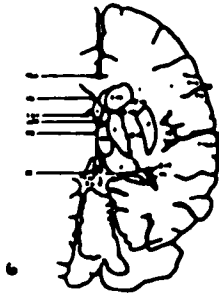
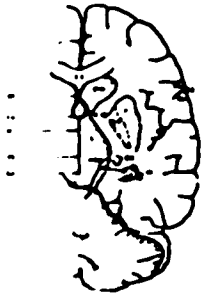
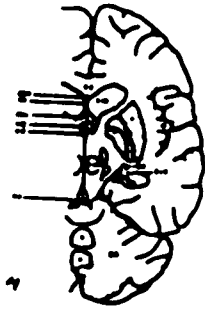
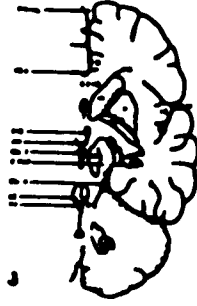
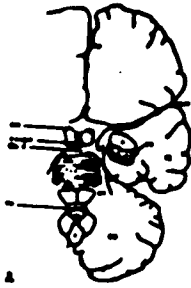


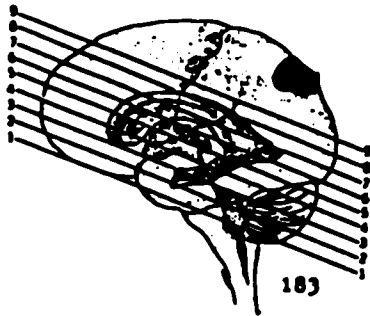
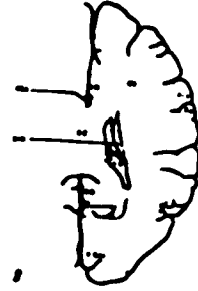
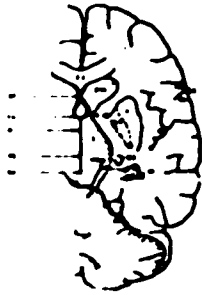
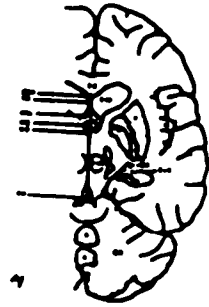
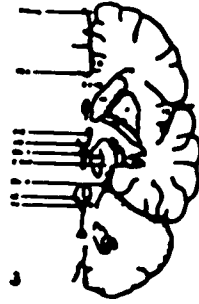












APPENDIX C

Tables of Frequencies of Subject Variables
and Clinical Characteristics of
Brain-damaged Samples
Experiment 1

Table A

Distribution of Ages in Bilateral, Left- and Right-side Focal Pathology Patients

Age	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
17-30	1	33.3	4	67.0	5	55.0
31-40	-	0	-	0	-	0
41-50	1	33.3	-	0	1	11.0
51-60	-	0	2	33.0	1	11.0
61-69	1	33.4	-	0	2	23.0

Table B

Distribution of Sex in Bilateral, Left- and Right-side Focal Pathology Patients

Sex	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Male	3	100	4	67.0	3	33.0
Female	-	0	2	33.0	6	67.0

Table C

Distribution of Type of Pathology in Bilateral,
Left- and Right-side Focal Pathology Patients

Type	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Menin	1	33.0	4	67.0	2	22.0
Glio	-	0	-	0	5	56.0
AVM	-	0	2	33.0	1	11.0
Other	2	67.0	-	0	1	11.0

Table D

Distribution of Indexes of Handedness
in Bilateral, Left- and Right-side
Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Right Handed	2	67.0	3	50.0	8	89.0
Positive Fam. Hx	1	33.0	3	50.0	1	11.0

Table E

Distribution of Locus of Pathology Using Gross Categories
in Bilateral, Left- and Right-side
Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Anterior	3	100	4	68.0	4	44.0
Posterior	-	0	1	16.0	4	44.0
Lateral	-	0	1	16.0	1	12.0

Table F

Distribution of Extent of Pathology in Bilateral,
Left- and Right-side Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Small	-	0	1	17.0	-	0
Medium	-	0	1	17.0	3	33.0
Large	1	33.0	2	33.0	2	22.0
Very Large	2	67.0	2	33.0	4	45.0

Table G

Distribution of Education in Bilateral,
Left- and Right-side Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Elementary	-	0	1	17.0	1	11.0
Some H.S.	1	34.0	-	0	-	0
H.S. Grad	1	33.0	2	33.0	4	44.0
Some College	-	0	2	33.0	2	23.0
College Grad	1	33.0	1	17.0	1	11.0
Grad/Professl	-	0	-	0	1	11.0

APPENDIX D

Annett Scale and Subject Questionnaire

Data Form

Name _____ Unit # _____ Date _____
Education _____ Age _____ Sex _____ Occupation _____

Preferred Hand For: (1) Writing _____ (2) Brush Teeth _____ (3) Scissors _____
(4) Throw Ball _____ (5) Hammer _____ (6) Sew/er Sew _____
(Claimed Handedness: _____)

Family Handedness Hx:

(1) Either Parent LH? _____ M _____ F _____
(2) Any sibling LH? _____
(3) Any Uncles, Aunts or Cousins LH? _____

Dx Data:

Locus _____
Type _____
Pre-Op _____ Post-Op _____ Anytal-Lang _____

Documentation:

(1) CAT _____ (2) ANGIO _____ (3) EKG _____ (4) Other _____

(5) Clinical Findings (note side and/or type)

A. Motor:	B. Sensory:	C. Visual:
1. Hemiplegia _____	1. Hemiparesis _____	1. Field Cut _____
2. Graphomotor _____	2. Agraphesthesia _____	2. Inattention _____
3. Apraxia _____	3. Extinction _____	3. Blindness _____
4. Ataxia _____		
D. Aphasia _____	E. Prev. Neurologic Insults _____	

APPENDIX E

**Wechsler Adult Intelligence Scale Subtests
Information and Picture Arrangement**

PLEASE NOTE:

Copyrighted materials in this document have not been filmed at the request of the author. They are available for consultation, however, in the author's university library.

These consist of pages:

<u>E.</u>	<u>189-193</u>
<u>F.</u>	<u>194-197</u>
<u>G.</u>	<u>198-200</u>
<u>H.</u>	<u>201</u>
<u>K.</u>	<u>207-211</u>
<u>M.</u>	<u>213-249</u>

**University
Microfilms
International**

300 N. ZEEB RD., ANN ARBOR, MI 48106 (313) 761-4700

APPENDIX F

Goldschmid-Bentler Test

APPENDIX G

Chandler Cartoons

APPENDIX H

Leahy Pro-Social Behavior Task

Appendix I

**Tables of Frequencies of Subject Variables and
Clinical Characteristics of Brain-Damaged Samples**

Experiment 2

Table A

Distribution of Ages in Bilateral, Left- and Right-side Focal Pathology Patients

Age	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
25-40	-	0	2	25.0	4	50.0
41-50	1	33.3	1	12.5	-	0
51-60	1	33.3	2	25.0	2	25.0
61-70	1	33.3	2	25.0	1	12.5
71-87	-	0	1	12.5	1	12.5

Table B

Distribution of Sex in Bilateral, Left- and Right-side Focal Pathology Patients

Sex	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Male	2	67.0	3	38.0	4	50.0
Female	1	33.0	5	62.0	4	50.0

Table C

Distributions of Type of Pathology in Bilateral,
Left- and Right-side Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Menin	1	33.0	5	63.0	6	75.0
Glio	2	67.0	2	25.0	2	25.0
AVM	-	0	1	12.0	-	0

Table D

Distribution of Indexes of Handedness
in Bilateral, Left- and Right-side Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Pure Rt. handed	2	67.0	5	63.0	5	63.0
Positive Fam. Hx	1	33.0	3	37.0	3	37.0

Table E

Distribution of Locus of Pathology Using Gross Categories
in Bilateral, Left- and Right-side Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Anterior	3	100	5	63.0	4	50.0
Posterior	-	0	2	25.0	3	37.0
Lateral	-	0	1	12.0	1	13.0

Table F

Distribution of Extent of Pathology in Bilateral,
Left- and Right-side Focal Pathology Patients

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Small	-	0	1	12.5	1	12.5
Medium	2	67.0	3	37.5	4	50.0
Large	1	33.0	3	37.5	3	37.5
Very Large	-	0	1	12.5	-	0

Table G
**Distribution of Education in Bilateral, Left and-
 Right-side Focal Pathology Patients**

	Bilateral BD		Left BD		Right BD	
	#Ss	%	#Ss	%	#Ss	%
Elementary	-	0	-	0	-	0
Some H.S.	-	0	2	25.0	1	12.0
H.S. Grad	2	67.0	2	25.0	5	63.0
Some Coll	-	0	2	25.0	2	25.0
Coll Grad	1	33.0	2	25.0	-	0
Grad/Prof	-	0	-	0	-	0

APPENDIX J

Controlled Oral Word Association Test

Name _____ Case NO. _____ Date _____

Age _____ Educ. _____ Handed Sex _____

Record Sheet

	C	F	L
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
13	_____	_____	_____
14	_____	_____	_____
15	_____	_____	_____
16	_____	_____	_____
17	_____	_____	_____
18	_____	_____	_____
19	_____	_____	_____
20	_____	_____	_____
21	_____	_____	_____
22	_____	_____	_____

Sum C _____

Sum F _____

Sum L _____

TOTAL _____ • Correction

_____ 206 _____

• _____ Percentile

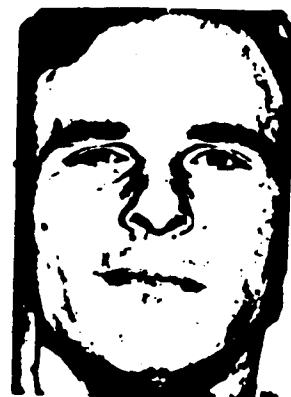
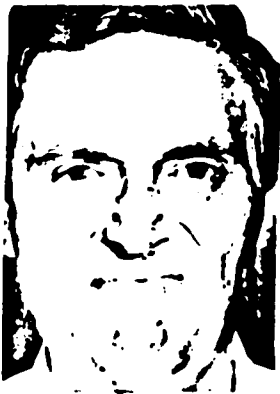
3

APPENDIX K

**Matching Familiar Figures Test
Instructions and Sample Items**

APPENDIX L

Ekman-Friesen Photographs



APPENDIX M

**Goldschmid-Bentler Explanation Responses
Experiments 1 and 2**

APPENDIX N1

Case-By-Case Coefficients of Interjudge Reliability
Experiment 1

Goldschmid-BentlerChandler

Subject #	Explanation	I	II
1	.95	.93	.91
2	.92	.89	.92
3	.94	.90	.89
4	.94	.92	.90
5	.96	.94	.92
6	.91	.94	.90
7	.93	.91	.90
8	.89	.92	.91
9	.93	.93	.89
10	.92	.90	.90
11	.92	.93	.90
12	.95	.91	.91
13	.94	.90	.90
14	.93	.94	.91
15	.92	.89	.90
16	.96	.92	.89
17	.92	.91	.91
18	.93	.93	.90
Overall r=	.94	.92	.90

APPENDIX N2

Case-By-Case Coefficients of Interjudge Reliability
Experiment 2

Alternate Uses Task

S#	Ideational Fluency	Spontaneous Flexibility	High Fluent
1	.94	.96	.90
2	.92	.92	.95
3	.95	.95	.93
4	.93	.93	.94
5	.93	.92	.91
6	.94	.95	.93
7	.95	.94	.91
8	.90	.95	.91
9	.92	.93	.92
10	.94	.92	.93
11	.94	.94	.94
12	.93	.95	.90
13	.92	.96	.91
14	.94	.94	.93
15	.93	.95	.93
16	.95	.97	.90
17	.91	.92	.91
18	.93	.95	.94
19	.94	.95	.93
overall r=	.93	.94	.92

Description of Peers Task

S#	Total Statements	Recursive Thought	Central	Qualifying
1	.96	.90	.93	.94
2	.94	.86	.92	.94
3	.93	.87	.90	.96
4	.97	.81	.91	.93
5	.92	.82	.92	.94
6	.93	.80	.94	.96
7	.91	.83	.90	.91
8	.93	.86	.91	.93
9	.95	.84	.93	.92
10	.98	.82	.90	.91
11	.96	.81	.90	.90
12	.95	.80	.91	.92
13	.92	.83	.92	.91
14	.89	.85	.93	.93
15	.92	.86	.90	.94
16	.94	.85	.90	.90
17	.93	.83	.93	.95
18	.95	.84	.94	.93
19	.94	.86	.92	.94
overall	.94	.84	.92	.93

BIBLIOGRAPHY

- Achenbach, T. (1974). Developmental Psychopathology. New York: John Wiley and Sons.
- Ackerly, S.S. (1935). Instinctive, emotional and mental changes following prefrontal extirpation. American Journal of Psychiatry, 92, 717-729.
- Ajuriaguerra, J.de, & Tissot, R. (1968). Some aspects of psychoneurologic disintegration in senile dementia. C. Muller and L. Ciompi (Eds.), Senile Dementia (pp. 69-79). Huber, Switzerland.
- Altman, J. (1978). Three levels of mentation and the hierarchic organization of the human brain. In J. Altman (Ed.), Psychology and Biology of Language and Thought. Academic Press.
- Andersson, K. (1980). Piagetian task performance of learning disabled children. Journal of Learning Disabilities, 13, 37-41.
- Annett, M. (1970). A classification of hand preference by association analysis. British Journal of Psychiatry, 61, 303-321.
- Ariel, R. & Golden, C. (1983). Regional blood flow in schizophrenics. Archives of General Psychiatry, 40, 258-263.
- Arieti, S. (1974). Interpretation of Schizophrenia. Basic Books: New York.
- Babinski, J. (1914). Contribution a l'etude des troubles mentaux dans l'hemiplegie cerebrale (anosognosie). Revue Neurologie, 27, 845-847.
- Barenboim, C. (1978). Development of recursive and non-recursive thinking about persons. Developmental Psychology, 74, 419-420.
- Barstis, S., & Ford, L. (1977). Reflection-impulsivity, conservation and the development of ability to control cognitive tempo. Child Development, 48, 955-959.
- Battersby, W.S., Krieger, H.P., & Bender, M.B. (1955). Visual

- and tactile discriminative learning in patients with cerebral tumors. Amer. J. Psychol, 68, 562-574.
- Benton, A.L., & Hamsher, K. (1977). Multilingual Aphasia Examination. University of Iowa, Iowa City.
- Berg, E.A. (1948). A simple objective technique for measuring flexibility in thinking. Journal of Genetic Psychology, 39, 15-22.
- Blumer, D., & Benson, D.F. (1975). Personality changes with frontal and temporal lobe lesions. In D.F. Benson & D. Blumer (Eds.), Psychiatric Aspects of Neurologic Disease(pp.151-169). New York: Grune & Stratton.
- Bogen, J.E. (1969). The other side of the brain II: An oppositional mind. Bulletin Los Angeles Neurological Society, 34, 135-162.
- Borod, J., Koff, E. Perlman, M. and Nicholas, M. (1983). Appreciation and expression of focal emotion in brain damaged patients. Paper presented at the meeting of the International Neuropsychological Society, Mexico City.
- Brain, L. and Walton, J.N. (1969). Brain's Diseases of the Nervous System. Oxford University Press.
- Brickner, R.M. (1934). An interpretation of frontal lobe function based upon the study of a case of partial bilateral frontal lobectomy. Res Publ assoc Res ner ment Dis
- Brickner, R.M. (1936). The Intellectual Functions of the Frontal Lobes, Macmillan; New York.
- Brickner, R.M. (1939) Bilateral frontal lobectomy: Follow-up report of a case. Archives of Neurology and Psychiatry, 41, 580-585.
- Brickner, R.M. (1952). Brain of patient "A" after bilateral frontal lobectomy; statue of frontal lobe problem. Arch. Neurol. Psychiat., 68, 293-313.
- Brickner, J. (1956). A Study of Thinking. Wiley: New York City.
- Canavan, A.G.M. (1983). Stylus-Maze performance in patients with frontal lobe lesions: Effects of signal valency and relationship to verbal and spatial abilities. Neuropsychologia, 21, 375-382.

- Chandler, M. (1973) Egocentrism and anti-social behavior: The assessment and training of social perspective skills. Developmental Psychology, 9, 326-332.
- Chandler, M.J., Greenspan, S. and Barenboim, C. (1974). Assessment and training of role-taking and referential communication skills in institutionalized emotionally disturbed children. Devel. Psych., 10, 546-553.
- Cicone, M., Wapner, W. and Gardener, H. (1980). Sensitivity to emotional expressions and situations in organic patients. Cortex, 16, 145-158.
- Constantinidis, J. (1978). Is Alzheimer's disease a major form a senile dementia? Clinical, anatomical and genetic data. In Alzheimer's Disease: Senile Dementia and Related Disorders. R. Katzman, R.D. Terry, and K.L. Bick (Eds.) Raven Press: New York.
- Damasio, A.R. and Van Hosen, G.W. (1983) Emotional disturbances associated with focal lesions of the limbic frontal lobe. In Neuropsychology of Human Emotion. K.M. Heilman and P. Satz (Eds.), Guilford Press: New York, 85-110.
- Denny-Brown, D. (1951) The frontal lobes and their functions. In Modern Trends in Neurology. H. Feilung (Ed.), Modern Trends in Neurology, Butterworth: London.
- Dewing , K., and Battye, G. (1971). Attention deployment and nonverbal fluency. Journal of Personality and Social Psychology, 17, 214-218.
- Dickstein, E. (1980). Role-taking deficits in learning disabled children. Journal of Learning Disabilities, 13, 33-37.
- Divitto, B., and McArthur, L.Z. (1978). Developmental differences in the use of distinctiveness consensus and consistency information for making causal attributions. Developmental Psychology, 14, 474-482.
- Drewe, E.A. (1975). An experimental investigation of Luria's theory of the effects of frontal lobe lesions in man. Neuropsychologia, 13, 421-429.
- Ekman, P., and Friesen, W. (1975). Unmasking the Face. Prentice Hall, New Jersey.
- Fefer, M. (1970). Development analysis of interpersonal

- behavior. Psychological Review, 77, 197-214.
- Feffer, M. and Gourevitch, V. (1960). Cognitive aspects of role taking in children. Journal of Personality, 28, 383-396.
- Feldman, M.J. and Drasgow, J. (1960). The Visual-Verbal Test Manual. Beverly Hill: Western Psychological Service.
- Finset, A. (1983). Depressive behavior outbursts of crying emotional indifference in left hemiplegics. Paper presented to Second Annual Symposium on Models and Techniques of Cognitive Rehabilitation, Indianapolis.
- Flavell, J.H. (1963). The Developmental Psychology of Jean Piaget. Princeton, New Jersey: Van Nostrand.
- Flor-Henry, P. (1979). On certain aspects of the localization of the cerebral systems regulating and determining emotion. Biological Psychiatry, 14, 677-698.
- Ford, M.E. (1985). Two perspectives on the validation of developmental constructs: psychometric and theoretical limitations in research on egocentrism. Psychological Bulletin, 97, 497-501.
- Freedman, A.M., Kaplan, H.I. and Sadock, B.J. (1976). Modern Synopsis of Psychiatry II, 2nd edition. Williams and Wilkins Co. Baltimore.
- Freud, S. (1900). On Schizophrenia to regression to narcissism. Collected Papers, vol. 4, 30-59.
- Gadzhiev, S.G. (1966). Disturbance of optical intellectual activity in frontal lobe lesions. In The Frontal Lobes and Regulation of Psychological Processes. A.R. Luria and E.B. Khomshaya (Eds.) Moscow University Press.
- Gainotti, G. (1969). Reactions catastrophiques et manifestations d'indifference au cours des atteintes cerebrales. Neuropsychologia, 7, 195-204.
- Gainotti, G. (1972). Emotional behavior and hemisphere side of lesion. Cortex, 8, 41-55.
- Galin, D. and Ornstein, R. (1972). Lateral specialization of cognitive mode: An EEG study. Psychophysiology, 9, 412-418.
- Gardner, H., Ling, P.K., Flamm, L. and Silverman, J. (1975).

- Comprehension and appreciation of humorous material following brain damage. Brain, 98, 399-412.
- Gasparri, W.G., Satz, P., Heilman, K. and Coolidge, F.L. (1978). Hemispheric asymmetries of affective processing as determined by the Minnesota Multiphasic Personality Inventory. Journal of Neurology, Neurosurgery and Psychiatry, 41, 470-473.
- Ginsburg, H. and Oppen, S. (1979). Piaget's Theory of Intellectual Development. Englewood Cliffs, NJ; Prentice-Hall.
- Glenwick, D. and Burka, A. (1975). Cognitive impulsivity and role taking skills in elementary school children. Perceptual and Motor Skills, 41, 547-552.
- Goldman-Rakic, P.S. (1984). The frontal lobes: Uncharted provinces of the brain. Trends In Neurosciences, November, 425-429.
- Goldschmid, M.L. and Bentler, P.M. (1968). The dimensions and measurement of conservation. Child Development, 39, 787-802.
- Goldstein, K. (1936). The significance of the frontal lobes for mental performances. J. Neurology and Psychopathology, 17.
- Goldstein, K. (1939). The Organism. New York: American Book.
- Goldstein, K. (1943). The significance of psychological research in schizophrenia. Journal of Nervous and Mental Disease, 97, 261-279.
- Goldstein, K. (1944). The mental changes due to frontal lobe damage. J. Psychol., 17.
- Goldstein, K. (1952). The effect of brain damage on personality. Psychiatry, 15, 245-260.
- Goldstein, K. and Katz, S.E. (1937). The psychopathology of Pick's disease. Archives of Neurology and Psychiatry, 38, 473-490.
- Goldstein, K. and Scheerer, M. (1941). Abstract and concrete behavior: An experimental study with special tests. Psychological Monographs, J3, No. 2, Evanston, Ill. APA.
- Gray, J.A. (1970). The psychophysiological basis of introver-

- sion-extroversion. Behavior Research Therapy, 8, 249-266.
- Greenblatt, M. and Solomon, H.C. (1953). Frontal Lobes and Schizophrenia. New York: Springer Publishing.
- Guilford, J.P. (1967). The Nature of Human Intelligence. McGraw-Hill, New York.
- Halstead, W.C. (1940). Preliminary analysis of grouping behavior in patients with cerebral injury by the method of equivalent and non-equivalent stimuli. American Journal of Psychiatry, 96, 1263-1294.
- Halstead, W.C. (1947). Brain and Intelligence: A Quantitative Study of the Frontal Lobes. Chicago: University of Chicago Press.
- Halstead, W.C. (1948). Specialization of behavioral functions and the frontal lobes. In The Frontal Lobes, Proceedings from the Association For Research in Nervous and Mental Disease, Vol. 27.
- Harlow, H.F. and Settlage, P.H. (1948). Effect of extirpation of frontal areas upon learning performance in monkeys. Research Publication - Association for Research in Nervous and Mental Disease, 27, 446-459.
- Harlow, J.M. (1868). Recovery from the passage of an iron bar through the head. Publication of the Massachusetts Medical Society, 2, 327-346.
- Hebb, D.O. (1939). Intelligence in man after large removals of cerebral tissue: report of four left frontal lobe cases. Journal of General Psychology, 21, 73-87.
- Hebb, D.O. (1945). Man's frontal lobes: A critical review. Archives of Neurology and Psychiatry, 54, 10-24.
- Hebb, D.O. (1942). The effect of early and late brain injury upon test scores. Proc. Am. Phil. Soc., 85.
- Hebb, D.O. and Penfield, W. (1940). Human behavior after extensive bilateral removal from the frontal lobes. Archives of Neurology and Psychiatry, 44, 421-438.
- Hecaen, H., Ajuriaguerra, J.D. and Massonet, J. (1951). Les troubles visuo-constructifs par lésions pariéto-occipitales droites. L'Encephale, 1, 122-179.

- Hacaen, H. and Albert, M.L. (1975). Disorders of mental functioning related to frontal lobe pathology. In D.F. Benson and Blumer (Eds.). Psychiatric Aspects of Neurologic Disease, Grune and Stratten.
- Heibreder, E. (1961) Seven Psychologies. Prentice-Hall Hall Inc. New Jersey.
- Heilman, K.M., Scholes, R., and Watson, R.T. (1975). Auditory affective agnosia: Disturbed comprehension of affective speech. Journal of Neurology, Neurosurgery and Psychiatry, 38, 69-72.
- Henn, F.A. and Nasrallah, H.A. (1982). Schizophrenia as a Brain Disease, New York: Oxford University Press.
- Hudson, L.M. (1978). On the coherence of role-taking abilities: An alternative to correlational analysis. Child Development, 49, 223-227.
- Hunt, J. McV. (1961). Intelligence and Experience. New York: Ronald Press.
- Huttonlocher, J., & Presson, C.C. (1973). Mental rotation and the perspective problem. Cognitive Psychology, 4, 227-299.
- Huttonlocher, J., & Presson, C.C. (1979). The coding and transformation of spatial information. Cognitive Psychology, 11, 375-394.
- Inguar, D.H. (1980). Abnormal distribution of cerebral activity in chronic schizophrenia: A neurophysiological interpretation. In C. Baxter and T. Melnechuk. Perspectives in Schizophrenia Research. New York: Raven Press.
- Inguar, D.H. and Franzen, G. (1974). Abnormalities of cerebral blood flow distribution in patients with chronic schizophrenia. Acta Psychiatr. Scand., 50, 425-462.
- Jackson, J.H. (1932). Selected Writings, (J. Jackson, Ed.). London: Hodder and Stoughton.
- Jefferson, G. (1930). Removal of right or left frontal lobes in man. British Medical Journal, 2, 199-206.
- Jones-Gotman, M. and Milner, B. (1977). Design Fluency: The Invention of nonsense drawings after focal cortical lesions. Neuropsychologia, 15, 653-674.

- Kagan, J., Rosman, B.L., Day, D. Albert, J. and Philips, W. (1964). Information processing in the child: Significance of analytic and reflective attitudes. Psychological Monographs, 78 (1, whole no. 578).
- Karniol, R. and Ross, M. (1976). The development of causal attributions. Journal of Personality and Social Psychology, 34, 455-464.
- Kasanin, J.S. (1944). The disturbance of conceptual thinking in schizophrenia. In J.S. Kasanin (Ed), Language and Thought in Schizophrenia. W.W. Norton and Company, Inc.
- Kelley, H.H. (1967). Attribution theory in social psychology. In D. Levine (Ed)., Nebraska Symposium on Motivation (Vol. 15). Lincoln: Univeristy of Nebraska Press.
- Kelley, H.H. (1972). Causal Schemata and the Attribution Process. Morristown, NJ: General Learning Press.
- Klages, W. (1954). Frontale und diencephale antriebsschwache. Archives Psychiatry U Neurol. 191.
- Kohlberg, L. (1964). Development of moral character and moral ideology. In M.L. Hoffman and L.W. Hoffman (Eds), Review of Child Development Research. New York: Russel Sage.
- Kohlberg, L. (1969). The cogniitive-developmental approach to socialization. In D. Goslin (Ed.), Handbook of Socialization: Theory and Research, Chicago: Rand McNally.
- Kolb, B. and Taylor, L. (1981). Affective behavior in patients with lateralized cortical excisions: role of lesion site and side. Science, 214, 89-91.
- Kolb, B. and Whishaw, I.O. (1980). Fundamentals of Human Neuropsychology, San Francisco: Freeman.
- Kurdek, L.A. (1977). Structural components and intellectual correlates of cognitive perspective taking in first-through fourth-grade children. Developmental Psychology, 11, 643-650.
- Leahy, R.L. (1979). Social cognition, divergent thinking and reflection-impulsivity in children. Paper presented at American Psychological Association - National Meeting.
- Leahy, R.L. (1979). Child's conception of mens rea: Informa-

- tion mitigating punishment judgements, Journal of Genetic Psychology, 134, 71-78.
- Levy, J. (1969). Possible basis for the evolution of lateral specialization of the human brain. Nature, 224, 614-615.
- Lishman, W.A. Organic Psychiatry, Oxford: Blackwell, 1978.
- Livesley, W. and Bromley, D. (1973). Person Perception and Adolescence. London: Wiley.
- Luria, A.R. (1973). The Working Brain. New York: Basic Books.
- Luria, A.R. (1980). Higher Cortical Functions in Man, 2nd ed. Basic Books, Inc. New York.
- Luria, A.R. and Homskaya, E.D. (1964). Disturbance in the reg-
lative role of speech with frontal lobe lesions. In J.M.
Warren, and K. Akert (Eds.), The Frontal Granular Cortex and
Behavior, 353-371. New York: McGraw Hill.
- Malmo, R.B. (1948). Psychological aspects of frontal gyrectomy
and frontal lobectomy in mental patients. Research Publi-
cations - Association for Research in Nervous and Mental
Disease, 27, 537-564.
- McFie, J. & Thompson, J.A. (1972). Picture arrangement: a meas-
ure of frontal lobe function. British Journal of Psych-
iatry, 121, 564.
- Mettler, F.A. (Ed.) (1949). Columbia - Greystone Associates:
Selective partial ablation of the frontal cortex: A correla-
tive study of its effects on human psychotic subjects.
New York: Holber.
- Mettler, F.A. (By the Columbia-Greystone Associates second
group). (1952). Psychological Problems. New York;
McGraw Hill.
- Miller, E. (1971). Handedness and the pattern of human ability.
British Journal of Psychology, 62, 111-112.
- Milner, B. (1963). Effects of different brain lesions on card
sorting. Archives of Neurology, 9, 90-100.
- Milner, B. (1964). Some effects of frontal lobectomy in man.
In J.M. Warren and K. Akert (Eds.), The Frontal Granular
Cortex and Behavior, 313-334, New York: McGraw Hill.
- Milner, B. (1982). Some cognitive effects of frontal lobe

- lesions in man. In D.E. Broadbent and L. Weiskrantz (Eds.), The Neuropsychology of Cognitive Function, 211-226. London: The Royal Society.
- Mishkin, M. (1964). Preservation of central sets after frontal lesion in monkeys. In J.M. Warren and K.A. Akert (Eds.), The Frontal Granular Cortex and Behavior, 219-241. New York: McGraw Hill.
- Namba, M. (1982). Evidence for the fronto-nigral pathway in the human brain. In M. Namba (Ed.), Psychobiology of Schizophrenia. Oxford: Pergamon Press.
- Newcombe, F. (1969). Missile Wounds of the Brain. London: Oxford University Press.
- Newell, A., Shaw, J.C. and Simon, H.A. (1958). Elements of a theory of human problem solving. Psychological Review, 65, 151-166.
- Partridge, M. (1950). Pre-frontal Leukotomy, Springfield, IL. Charles C. Thomas Publisher.
- Penfield, W. and Evans, J. (1935). The frontal lobe in man: A clinical study of maximal removal. Brain, 58, 115-133.
- Petrie, A. (1949). Preliminary report of changes after pre-frontal leucotomy. Journal of Mental Sciences, 95, 449-455.
- Petrie, A. (1952). Personality and the Frontal Lobes. London, Routledge and Kegan Paul Ltd.
- Piaget, J. (1926). Judgment and Reasoning in the Child. Trans. M. Warden, New York, Harcourt, Brace and World, Inc.
- _____. (1946). Le Developpement de la Notion de Temps Chez l'Enfant. Paris: Presses Universitaires de France.
- _____. (1950). The Psychology of Intelligence. Trans. M. Percy & D.E. Berlyne, London: Routledge and Kegan Paul LTD.
- _____. (1952). The Origins of Intelligence in Children. New York: International Universities Press.
- _____. (1954). The Construction of Reality in the Child. New York: Basic Books.
- _____. (1971). Genetic Epistemology. W.W. Norton, Inc.

- Piaget, J., & Inhelder, B. (1941). Le Developpement des Quantities chez l'Enfant. Paris: Delachaux & Niestle.
- _____. (1969). The Psychology of the Child. Basic Books, Inc.
- Piaget, J., Inhelder, B., & Szeminska, A. (1960). The Child's Conception of Geometry. Basic Books, Inc.
- Pollack, M. (1955). Effect of brain tumor on perception of hidden figures, sorting behavior, and problem-solving performance. Dissertation Abstracts International, 20, #8.
- Porteus, S.D. (1950). The Porteus Maze Test and Intelligence. Palo Alto, CA: Pacific Press.
- Porteus, S.D., & Kepner, R.D. (1944). Mental changes after bilateral prefrontal lobotomy. Genetic Psychology Monographs, 29, 3-115.
- Porteus, S.D., & Peters, H.N. (1947). Psychosurgery and test validity. Journal of Abnormal and Social Psychology, 42, 473-475.
- Pribram, K.H. (1971). Languages of the Brain: Experimental Paradoxes and Principles in Neuropsychology. Englewood Cliffs, N.J: Prentice-Hall.
- Pribram, K.H., Ahumada, A., Hartog, J., & Ross, L. (1964). A progress report on the neurological processes disturbed by frontal lesions in primates. In J.M. Warren, & K. Akert (Eds.), The Frontal Granular Cortex and Behavior. New York: McGraw Hill.
- Ross, E.D. (1981). The aprosodias. Archives of Neurology, 38, 561-569.
- Ross, E.D. & Mesulam, M.M. (1979). Dominant language functions of the right hemisphere? Prosody and emotional gesturing. Archives of Neurology, 36, 144-148.
- Ross, E.D. & Rush, A.J. (1981). Diagnosis and neuroanatomical correlates of depression in brain damaged patients. Archives of General Psychiatry, 38, 1344-1354.
- Rosvold, H.E. & Mishkin, M. (1950). Evaluation of the effects

- of prefrontal lobotomy on intelligence. Canadian Journal of Psychology, 4, 122-126.
- Rubin, K.H. (1973). Egocentrism in childhood: A unitary construct? Child Development, 44, 102-110.
- Rylander, G. (1939). Personality changes after operations on the frontal lobes: a clinical study of 32 cases. Acta Psychiat. Neurol., Copenhagen, Suppl. 20.
- _____. (1943). Mental changes after excision of cerebral tissue. A clinical study of 16 cases of resections of parietal, temporal, and occipital lobes. Acta Psychiat. Neurol., Copenhagen, Suppl. 25.
- _____. (1948). Personality analysis before and after frontal lobotomy. Res. Publ. ass. nerv. ment. Dis., 27, 691-705.
- Schliefer, M. & Douglas, V. (1973). Moral judgments, behavior and cognitive style in young children. Canadian Journal of Behavior Sciences, 5, 133-144.
- Schultz, T.W., Morrison, J.R., & Calhoun, J.D. (1976). Atlas of the human brain for use in the diagnosis by computer assisted tomography. Surgical Neurology, 5, 255-266.
- Selman, R. (1976). Social-cognitive understanding: A guide to educational and clinical practice. In T. Likona (Ed.), Moral Development and Behavior. New York: Holt, Rinehart, and Winston.
- Selman, R. and Byrne, D. (1974). A structural-developmental analysis of levels of role taking in middle childhood. Child Development, 45, 803-806.
- Shallice, T. (1982). Specific impairments of planning. In D.E. Broadbent, and L. Weiskrants (Eds.). The Neuropsychology of Cognitive Function, 199-209. London: The Royal Soc.
- Shantz, C.U. (1975). The Development of Social Cognition. Chicago: University of Chicago Press.
- Smythies, J.R. (1966). The Neurological Foundations of Psychiatry, Oxford.
- Spielberger, C.D. (1967). State-trait anxiety inventory. In E. Levitt (Ed.), The Psychology of Anxiety. Bobbs-Merrill Co. Inc., New York.
- Stamm, J. and Kreder, S. (1979). Minimal brain dysfunction:

- Psychological and Neuropsychological disorders in hyperkinetic children. In M. Gazzaniga (Ed.), Handbook of Behavioral Neurobiology 2: Neuropsychology, New York.
- Stuss, D.T. and Benson, D.F. (1984). Neuropsychological studies of the frontal lobes. Psychological Bulletin, 95, No.1, 3-28.
- Stuss, D.T., Benson, D.F., Kaplan, E.F., Weir, W.S., Naeser, M.A., Lieberman, I. and Ferril, D. (1983). The involvement of orbitofrontal cerebrum in cognitive tasks. Neuropsychologia, 21, 235-248.
- Stuss, D.T. Kaplan, E.F. and Benson, D.F. (1982). Long term effects of prefrontal leucotomy: cognitive functions. In R.N. Malatesia, and L.C. Hartlage (Eds.), Neuropsychology and Cognition, 2, 252-271.
- Stuss D.T. Kaplan, E.F., Benson, D.F., Weir, W.S., Naeser, M.A. and Levine, H. (1981). Long-term effects of prefrontal leukotomy: An overview of neuropsychological residuals. Journal of Clinical Neuropsychology, 3, 13-32.
- Taylor, L.B. (1979). Psychological assessment of neurosurgical patients. In T. Rasmussen and R. Marino (Eds.) Functional Neurosurgery. Raven Press, New York.
- Teuber, H.L. (1959). Some alteration in behavior after cerebral lesions in man. In A.D. Boss (Ed.). Evolution of Nervous Control from Primitive Organisms to Man. Am. Assoc. Adv. Sci. 157 -194. Washington D.C.
- Teuber, H.L. (1964). The riddle of frontal lobe function in man. In J.M. Warren and K. Abert (Eds.), The Frontal Granular Cortex and Behavior. New York: McGraw-Hill.
- Teuber, H.L., Batterby, W.S. and Bender, M B. (1951). Performance of complex visual tasks after cerebral lesions. J. Nerv. and Ment. Dis., 114, 413-429.
- Teuber, H.L. and Mishkin, M. (1954). Judgement of visual and postural vertical after brain injury. J. Psychology, 38, 161-175.
- Tucker, D.M., Watson, R.T. and Heilman, K.M. (1977). Discrimination and evocation of affectively intoned speech with right parietal disease. Neurology, 27, 947-950.
- Tuddenham, R.D. (1966). Jean Piaget and the world of the child.

- American Psychologist, 21, 207-217.
- Tizard, B. (1959). The psychological effects of frontal lesion. Acta Psychiat. et Neurol. Scand., 33.
- Urberg, K.A. and Docherty, E.M. (1976). Development of role-taking skills in young children. Developmental Psychology, 12, 198-203.
- Voyat, G. and Shakelford, M. (1982). A Piagetian analysis of thinking in severely disturbed children. Advances in Child Behavioral Analysis and Therapy, 2, 257-285.
- Vygotski, L.S. (1956). Selected Psychological Investigations. Acad. Ped. Sci. Press: Moscow.
- Wallach, M. and Kogan, N. (1965). Modes of Thinking in Young Children. New York: Holt, Rinehart and Winston.
- Walsh, K.W. (1977). Neuropsychological aspects of modified leucotomy. In W.H. Sweet, S. Obrador and JLG. Martin-Rodriguez (Eds.), Neurosurgical Treatment in Psychiatry, Pain and Epilepsy, 163-174. Baltimore, MD; University Park Press.
- Wapner, W., Hamby, S. and Gardner, H. (1981). The role of the right hemisphere in the apprehension of complex linguistic materials. Brain and Language, 49, 15-33.
- Ward, W. (1960). Creativity and environment cues in nursery school children. Developmental Psychology, 1, 543-547.
- Waters, H.S., and Tinsley, V.S. (1985). Evaluating the discriminant and convergent validity of developmental constructs: Another look at the concept of egocentrism. Psychological Bulletin, 97, 483-496.
- Wechsler, A.F. (1973). The effect of organic brain disease on recall of emotionally charged versus neutral narrative texts. Neurology, 23, 130-135.
- Wechsler, D. (1955). Manual For The Wechsler Adult Intelligence Scale. New York: Psychological Corporation.
- Weinberger, D.R. and Wyatt, R.J. (1980). Structural brain abnormalities in chronic schizophrenia: computed tomography findings. In C. Baxter and T. Melnechuk (Eds.). Perspectives in Schizophrenia Research. New York: Raven Press.

Winner, E. and Gardner, H. (1977). The comprehension of metaphor in brain-damaged patients. Brain, 100, 717-729.