



1982

Information Processing of the Cerebral Hemispheres in Schizophrenia and Mania

Aurelio Prifitera
Loyola University Chicago

Follow this and additional works at: https://ecommons.luc.edu/luc_diss



Part of the [Psychology Commons](#)

Recommended Citation

Prifitera, Aurelio, "Information Processing of the Cerebral Hemispheres in Schizophrenia and Mania" (1982). *Dissertations*. 2186.
https://ecommons.luc.edu/luc_diss/2186

This Dissertation is brought to you for free and open access by the Theses and Dissertations at Loyola eCommons. It has been accepted for inclusion in Dissertations by an authorized administrator of Loyola eCommons. For more information, please contact ecommons@luc.edu.



This work is licensed under a [Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 License](#).
Copyright © 1982 Aurelio Prifitera

201
INFORMATION PROCESSING OF THE CEREBRAL HEMISPHERES
IN SCHIZOPHRENIA AND MANIA

by

Aurelio Prifitera

A Dissertation Submitted to the Faculty of the Graduate School
of Loyola University of Chicago in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy

November

1982

ACKNOWLEDGMENTS

Several people helped to bring this work to fruition. Dr. Alan DeWolfe, Dr. Mark Mayzner, Dr. Thomas Petzel, and Dr. Ira Appelman of the Department of Psychology comprised the dissertation committee. Their guidance, advice, and support has been greatly appreciated. Special thanks go to the Psychology Service of North Chicago Veterans Administration Medical Center where the research was carried out; especially to Dr. Joseph Ryan and Dr. Orville Lips for their administrative and material support of the project. Wanda Boffer provided much needed and appreciated secretarial assistance.

Very special thanks go to Loretta Matré for her encouragement and for her aid in compiling the final copy of the manuscript.

Finally, the author wishes to express deepest thanks to his parents, Antonio and Maria Prifitera, whose continual support, encouragement and confidence have been invaluable.

This research was supported in part by a University Dissertation Fellowship from Loyola University of Chicago.

VITA

The author, Aurelio Prifitera, is the son of Antonio and Maria (Musarra) Prifitera. He was born on November 9, 1952, in Patti, Italy.

He obtained his elementary education in the public schools of Union City and North Bergen, New Jersey. He graduated from Notre Dame High School, West Haven, Connecticut, in 1970.

In September, 1970, he entered Syracuse University and in May, 1974, received the degree of Bachelor of Arts, magna cum laude with honors in psychology, and with a major in psychology. He was elected a member of Phi Kappa Phi in 1974 and Phi Beta Kappa in 1975. In August of 1975 he enrolled at the University of Illinois, Champaign-Urbana, where he was granted an assistantship in the psychology department. In January, 1978, he was awarded the Master of Arts in Psychology from the University of Illinois. In September of 1977 he enrolled at the University of Chicago and was awarded a university fellowship. In March of 1979 he was awarded the Master of Arts degree by the Division of the Social Sciences of the University of Chicago.

In September of 1978 he entered the clinical psychology graduate program at Loyola University of Chicago and was granted an assistantship in the psychology department. He completed a clinical clerkship and internship in psychology at the North Chicago Veterans Administration Medical Center during 1979-1980. From May, 1981, to August, 1981, he worked as a psychodiagnostician at the North Chicago Veterans

Administration Medical Center. He was granted a University Dissertation Fellowship from Loyola University for the 1981-1982 academic year.

He is author and co-author of the following articles:

- Prifitera, A. Jungian personality correlates of cerebral hemispheric preference. Journal of Analytical Psychology, 1981, 26, 151-162.
- Prifitera, A., & Ryan, J. J. Validity of the Luria-Nebraska Intellectual Process Scale as a measure of adult intelligence. Journal of Consulting and Clinical Psychology, 1981, 49, 755-756.
- Prifitera, A., & Ryan, J. J. WAIS-R--WAIS comparisons in a clinical sample. Clinical Neuropsychology, 1982, in press.
- Ryan, J. J., Larsen, J., & Prifitera, A. Short form of the Speech-Sounds Perception Test: Further considerations. Clinical Neuropsychology, 1982, in press.
- Ryan, J. J., & Prifitera, A. Concurrent validity of the Luria-Nebraska Memory Scale. Journal of Clinical Psychology, 1982, 38, 378-379.
- Ryan, J. J., Prifitera, A., & Cummins, S. Essential books in clinical neuropsychology. Professional Psychology, 1982, 13, 674-676.
- Ryan, J. J., Prifitera, A., & Powers, L. Scoring reliability on the WAIS-R. Journal of Consulting and Clinical Psychology, 1982, in press.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	ii
VITA	iii
LIST OF TABLES	vii
LIST OF FIGURES	viii
INTRODUCTION AND REVIEW OF LITERATURE	1
Visual Studies	6
Dichotic Listening Studies	13
Neuropsychological, Neurological and Cognitive Studies	19
Psychophysiological Studies	23
Eye Movement Studies	26
METHOD	39
Subjects	39
Materials and Procedures	41
Handedness Questionnaire	41
Visual Tasks	41
Dichotic Tasks	46
Neuropsychological Measure	48
Eye Movement Measure	48
Personality Measure	50
Overview of the Procedures	50
RESULTS	52
Visual Syllable Task	52
Visual Figures Task	57
Dichotic Syllables Task	61
Environmental Sounds Task	63
Right and Left Hemisphere Scales	67
Eye Movements	69
Myers-Briggs Type Indicator	71
DISCUSSION	78

TABLE OF CONTENTS (continued)

	Page
REFERENCE NOTES	92
REFERENCES	93

LIST OF TABLES

Table	Page
1. Summary of Specific Hypotheses	36
2. Handedness Questionnaire	42
3. List of CVC Syllables	43
4. Target and Masking Stimuli Employed for Figural Task	45
5. Eye Movement Questionnaire	49
6. Paired Combinations of the Six Stop Consonants in Terms of the Articulatory Features of Place and Voicing	62
7. Mean Number of Correct Responses on the Environmental Sounds Test by Group and Ear	66
8. Group Means for the Left and Right Hemisphere Scales	68
9. Group Means and Standard Deviations for the Myers-Briggs Scales	72
10. Frequency Distribution of Types by Groups	73
11. Mann-Whitney <u>U</u> Tests for All Possible Combinations of Groups	75
12. Classification of Subjects into Diagnostic Category Based on Discriminant Function	77

LIST OF FIGURES

Figure	Page
1. Mean Number of Correct Syllables by Group in the Left and Right Visual Fields	54
2. Mean Number of Correct Syllables as a Function of Visual Field and ISI	55
3. Mean Number of Correct Syllables as a Function of Group and Syllable Meaningfulness	56
4. Mean Number of Correct Syllables as a Function of Syllable Meaningfulness and ISI	58
5. Percent Correct of Figural Stimuli as a Function of ISI and Figural Type	60
6. Percent of Dichotic Syllables Correct as a Function of Group and Ear	64
7. Percent of Dichotic Syllables Correct as a Function of Ear and Dichotic Contrast	65
8. Group Mean Laterality Scores for Eye Movements	70

INTRODUCTION AND REVIEW OF LITERATURE

A growing body of literature in the neurosciences supports the notion that the human brain is laterally specialized for different cognitive functions (Dimond & Beaumont, 1974; Kinsbourne, 1978; Luria, 1973; Ornstein, 1972). Although many point to Broca's and Wernicke's findings in the 1860's that injury to the left hemisphere was associated with aphasia as the beginning of the notion of cerebral lateralization, Dax's findings which were similar to Broca's preceded him by 30 years (Filskov & Boll, 1981; Springer & Deutsch, 1981).

It has only been within the past 20 years, however, that research in the area of cerebral specialization has begun to flourish. Work with split-brain patients (Bogen, 1969; Sperry, Gazzaniga, & Bogen, 1969) ignited interest in the area of cerebral hemispheric specialization of cognitive functions. These studies investigated patients whose corpus callosum (fibers which connect the two cerebral hemispheres and allow information to be transmitted between the two sides of the brain) had been surgically severed. This enabled investigators to present information exclusively to one or the other hemisphere thus allowing the study of the cognitive capacities and limitations of each hemisphere independently. One of the effects of this research was a rethinking of the concept of cerebral dominance. Since Hughlings Jackson proposed the idea that the left hemisphere was the "leading" hemisphere (Springer & Deutsch, 1981), the left hemisphere had come to be considered the

dominant hemisphere in carrying out all cognitive and motor functions. The right hemisphere became known as the "minor" hemisphere which was not dominant for any cognitive functions and totally subordinate to the dominance of the left hemisphere. Since the split-brain studies this older view of cerebral dominance has given way to the view that each hemisphere is dominant for different functions (Bogen, 1979; Geschwind, 1974). It should be noted that although Jackson's notion of a "leading" hemisphere was the precursor of the older view of cerebral dominance (Springer & Deutsch, 1981), he did not advocate such a position. Rather, he was ahead of his time in proposing the idea that the posterior region of the right hemisphere was important in visual recognition and memory (Benton, 1979). Thus he was the first to have an appreciation for the differential "dominance" of each hemisphere for different cognitive functions, a view which was not to become part of mainstream science for some 70 years after Jackson's work.

While the early work of Dax, Broca, Wernicke, and Jackson as well as much of the contemporary research has studied lateralization of cognitive functions in neurologically impaired patients, studies with neurologically intact individuals have also found similar functional differences between the hemispheres. In general, in right-handed individuals the left hemisphere is specialized for verbal-analytic information-processing tasks while the right hemisphere is superior in visuo-spatial, gestalt type processing (Bogen, 1969; Dimond & Beaumont, 1974; Ornstein, 1972). In other words, the left hemisphere's mode of processing information is sequential and analytical, while the right hemisphere tends to synthesize and treat data in terms of gestalt wholes. There

are even some data which suggest that the differential modes of information processing parallel differential neuronal organization and structure in the hemispheres. Tucker (1981) cites research which found a relatively higher concentration of white matter in the right hemisphere relative to the left. This would seem to indicate a greater degree of neuronal interconnections among cortical areas within the right hemisphere. A more established line of research has found that the human brain is not symmetrical but that the left temporal region is larger than the corresponding region in the right hemisphere (Galabruda, LeMay, Kemper, & Geschwind, 1978). This part of the cerebral cortex is what is known as Wernicke's area, which is known to play an important part in language functions. The same pattern of structural asymmetry has held up for infants as well (Wada, Clarke, & Hamm, 1975; Witelson & Pallie, 1973). This asymmetry is considered to be compatible with the lateralization of linguistic functions to the left hemisphere. These findings in infants suggest that lateralization of function is not a result of learning or ontogenetic development, but rather this inborn asymmetry suggests that the human brain is genetically wired for the lateralization of cognitive functions (at least for linguistic functions).

This neuroanatomical asymmetry may also account for the presence of the lateralization of certain cognitive functions and motor behaviors among neonates. Molfese, Freeman, and Palermo (1975) found that infants (ranging from 1 to 10 months in age) as well as older children and adults had higher amplitude auditory evoked potentials in the left hemisphere compared to the right for verbal stimuli. Nonspeech auditory

stimuli evoked larger amplitude evoked potentials in the right hemisphere. Segalowitz and Chapman (1980) found that speech stimuli affected right limb movements (left hemisphere controlled) among neonates. In a study by Eimas, Siqueland, Jusczyk, and Vigorito (1971), infants as young as 1 to 4 months old were able to discriminate various speech sounds. Entus (1977) carried this line of research a step further and reported a right ear advantage (left hemisphere) for detection of change in the presentation of linguistic material and a left ear advantage (right hemisphere) for detecting changes in nonspeech materials in infants. Saxby and Bryden (Note 4) found a left ear (right hemisphere) superiority for a verbal task in children 5 to 14 years of age. Witelson (1974) reported a left hand (right hemisphere) superiority for identifying tactile stimuli (supposedly a task requiring right hemisphere processing) in children as young as 6 years.

It should be remembered that these functional differences between hemispheres are not universal across individuals. For example, there is substantial evidence that left-handed individuals and females display a different degree and/or direction of lateralization of cognitive functions than right-handed and male individuals (Harris, 1978; Levy & Reid, 1978; McGlone, 1977, 1978, 1980). Differences across individuals have also been found at the neuroanatomical level. Left-handers are less likely to show the usually larger left temporal area and are more likely than right-handed individuals to show a reverse asymmetry of a larger right temporal area (Galaburda et al., 1978). Sex differences were also found, with females being more likely to show reversed asymmetry (Wada

et al. 1975). Hence several factors must be taken into account when mapping cognitive functions along hemispheric lines.

Recently, several studies have related hemispheric dysfunction with psychopathology (e.g., Flor-Henry, 1976b; Gur, 1978; Sandel & Alcorn, 1980). This approach looks at various types of psychopathologies as patterns of cognitive deficits associated with dysfunctional processing of the cerebral hemispheres. Specifically, left hemisphere dysfunction is postulated as characteristic of schizophrenia and right hemisphere dysfunction is characteristic of affective disorders. The rationale is that the right hemisphere is more implicated in emotional states and responsiveness than the left hemisphere (Bear & Fedio, 1977; Sackheim, Gur, & Saucy, 1978; Schwartz, Davidson, & Maer, 1975) so that dysfunction of the right hemisphere is more likely to be associated with affective disorders such as manic-depressive illness. The left hemisphere, which subserves verbal-analytical reasoning, is more likely to be associated with thought disorder, which many have identified as characteristic and definitive of schizophrenia (e.g., Arieti, 1974; Chapman & Chapman, 1973). Hence, the strategy of studying psychopathology from the perspective of cognitive deficits along the lines of cerebral hemispheric specialization has become increasingly common.

Several methods have been used to assess hemispheric function in normal, neurological, and psychopathological groups. These various methodological approaches include tachistoscopic presentation of visual stimuli to the right and left visual fields, dichotic listening, lateral eye movements, psychophysiological measures such as EEG and galvanic skin response, and neurological, neuropsychological, and cognitive

testing. Wexler (1980) pointed out that most studies of hemispheric function typically use only one measure of brain function, which makes the deduction of brain functioning less reliable and valid than had multiple measures been used. Another problem pointed out by Wexler is that each study typically employs a home-grown measure, which hinders reproducibility and continuity across experiments and different investigators. With these caveats in mind, a review of the research literature on hemispheric functioning utilizing the various methodologies is presented below.

Visual Studies

Visual stimuli can be presented unilaterally to one or the other hemisphere by exposure to the contralateral visual field when a subject is fixating at the middle of a visual field. Stimuli presented to the left visual field (LVF) go to the right hemisphere and stimuli displayed in the right visual field (RVF) are transmitted to the left hemisphere. In order to prevent the subject from shifting his or her eyes and focusing on the stimulus, thereby exposing the stimulus to both visual fields and hemispheres, exposure duration must be less than 200 milliseconds (msec), which is the time required to shift eyes to a new fixation (Kimura & Durnford, 1974). Thus presentation to the left and right hemispheres can be performed by exposing stimuli for brief intervals (less than 200 msec). Of course, the other hemisphere in a neurologically intact individual eventually obtains the information received by the receiving hemisphere through callosal transfer of information. For this reason the work with split-brain patients is unique since

commissurotomy prevents callosal transfer of information between hemispheres, allowing the evaluation of the functions of each hemisphere separately.

It was found that in commissurotomy patients the left hemisphere was superior in linguistic tasks (Bogen, 1979). Split-brain patients were unable to identify verbally objects presented to the LVF but had no difficulty with verbal identification of objects presented to the RVF. However, these patients can tactually identify with the left hand (controlled by the right hemisphere) objects presented to the LVF. Tactile identification with the right hand (controlled by the left hemisphere) was poor. When objects are presented simultaneously to both visual fields, the left hand can pick out the object through touch while the right hand cannot. Then when asked to verbally identify what the left hand chose, the patient will name the object seen in the RVF. While the left hemisphere is clearly dominant for linguistic processing, there was evidence of some rudimentary ability to identify letters and words in the right hemisphere (Bogen, 1979). Syntactic and phonetic analysis, however, is extremely limited in the right hemisphere.

The finding of a RVF advantage for processing language in normals has been well documented in several studies. Levy and Reid (1978) found that recognition of 3 letter nonsense syllables was superior in the RVF compared to the LVF. McKeever and Huling (1971) presented two words simultaneously, one to each hemisphere, and found that subjects recognized more of the words presented to the RVF. Kimura (1961, 1966) also found an RVF superiority for words and letters. It should be remembered that in normals, words presented in the LVF are transmitted to the left

hemisphere through the corpus callosum. However, some of this information is likely to decay in the transfer. Presentation of verbal stimuli to the RVF gives the linguistically specialized left hemisphere quicker access to the material and minimizes loss of information due to callosal transfer. The studies with normals, then, agree with the split-brain studies which show a left hemisphere advantage for linguistic tasks.

The RVF superiority for verbal tasks is complemented by a LVF superiority for visuospatial tasks. A LVF superiority for a dot localization task has been reported in several studies with normal subjects (Kimura, 1969; Kimura & Durnford, 1974; Levy & Reid, 1978). A LVF superiority has also been found for a variety of other visuospatial tasks including detection of line slant, facial recognition and tactile perception (Benton, 1979; Kimura & Durnford, 1974).

A series of studies have looked at hemispheric differences in processing emotions and faces. Ley and Bryden (1979) showed subjects cartoon faces tachistoscopically and asked them to match them to a target face for the emotion displayed and facial identification. They reported a LVF advantage for both emotional and facial recognition. A similar LVF advantage for recognition of emotions and faces has been reported by other researchers (e.g., Jaynes, 1976; Safer, 1981; Strauss & Moscovitch, 1981). Employing a somewhat different methodology, Rizzolatti, Umiltà, and Berlucchi (1971) measured manual reaction time in the identification of letters and faces which yielded quicker mean reaction times for faces in the LVF and for letters in the RVF. Sackeim, Gur, and Saucy (1978) created facial composites using either the left or right side of a face. Left-sided composites were judged to express

emotions more intensely than right-sided composites. This was interpreted as supporting the notion of greater right hemisphere involvement in emotional expressiveness since there is greater contralateral hemispheric control of facial expression.

Sex differences in processing emotions were also found in the Safer (1981) study. In that study, Safer concluded that females have greater access to verbal codes for recognizing emotions than males. Males were more apt to use imagery codes. Thus both the left and right hemispheres can process emotional stimuli, but each does so through different strategies, the left using verbal codes and the right using imagery codes. This is consistent with others who have discussed sex differences on visuospatial tasks (Kimura, 1969; Levy & Reid, 1976). The importance of taking into account the particular strategy employed in solving a given task is highlighted by the finding that the usual right hemisphere superiority for facial recognition can be reversed when names are associated with faces (Levy, Trevarthen, & Sperry, 1972; Marzi & Berlucchi, 1977). Buffery (1974) found that difficult-to-verbalize stimuli were more accurately matched than easy-to-verbalize material in the LVF. Performance was better in the RVF for easy-to-verbalize material. Different strategies apparently interact with the cognitive requirements of the task to produce the lateralization findings.

Gur (1978), using a verbal nonsense syllable task and a dot localization task similar to those used by Levy and Reid (1978) with normals, did not find the expected RVF advantage for the verbal task in the schizophrenic groups used (both paranoid and nonparanoid). On the dot localization task the expected LVF superiority was obtained, with

schizophrenics performing more poorly overall than the normal control group. Gur interpreted these findings as supporting the notion of a left hemisphere dysfunction in schizophrenia. Pic'1, Magaro, and Wade (1979) failed to replicate the RVF deficit for letter identification in schizophrenics. Schizophrenics as well as control groups showed a RVF superiority. On a dot enumeration task, no visual field effect was found for any of the groups. Again, as in the Gur study, normals performed better overall than the psychiatric groups on this task. It is important to note that the task stimuli differed in the two studies. Pic'1 et al. used single letters whereas Gur used syllables requiring phonetic analysis. Also, Gur's right hemisphere task required spatial localization of dots whereas Pic'1 et al. required dot enumeration. Also, Gur used a visual mask to interrupt processing of the stimuli whereas Pic'1 et al. used no mask. Nevertheless, the criticisms of Pic'1 et al. concerning Gur's conclusions cannot be dismissed. Gur maintains that her findings indicate a left hemisphere deficit at the initial stages of phonetic analysis in schizophrenics. Since the right hemisphere, as Gur states, is incapable of phonetic analysis, it is difficult to explain how presentation to the LVF is superior to presentation to the RVF since this would require transferring the material from the right hemisphere to the left hemisphere, which is dysfunctional in phonetic analysis in schizophrenics. One would expect deficits when presentation is to either visual field since ultimately the left hemisphere is performing the linguistic analysis. In fact, one would expect worse performance with LVF presentation since some information loss would be expected in callosal transfer. The question of why the left

hemisphere should display less defective phonetic analysis when the syllables are first presented to the right hemisphere remains unanswered. Another problem with Gur's study is that the exposure duration of the stimuli ranged from 55 to 360 msec, which indicates that eye movements could have invalidated the visual field presentation since the upper range exceeds the 200 msec required to shift eyes and redirect attention to a fixation point within the visual field.

Walker, Hoppes, and Emory (1981) also take issue with Gur's interpretation of left hemisphere dysfunction in schizophrenia and offer an alternative explanation based on defective interhemispheric transfer. Studies by Dimond and Beaumont (1974) found that schizophrenics performed worse than normals and psychiatric controls when matching stimuli divided between hemispheres, a task requiring communication between the hemispheres. Other studies using tactile stimuli have also found evidence supporting the hypothesis of defective interhemispheric transfer of information in schizophrenics (Dimond, Scammell, Pryce, Huws, & Gray, 1980; Green, 1978).

Another line of research by Saccuzzo and his colleagues (Braff & Saccuzzo, 1981; Brody, Saccuzzo, & Braff, 1980; Saccuzzo, Braff, & Sprock, 1982; Saccuzzo, Hirt, & Spencer, 1974; Saccuzzo & Miller, 1977; Saccuzzo & Schubert, 1981) has consistently found that schizophrenics are slower than normals and other psychiatric controls (depressives and schizotypal personality type) in processing information. The task used in all of these studies was identification of a target letter, either T or A, presented at various speeds of short duration (in the milliseconds) followed by a visual mask which interrupted processing. Typically

schizophrenics performed worse than controls at comparable interstimulus intervals (ISI), which is the time between the offset of the target stimulus and onset of the interfering mask. These data are viewed by Saccuzzo et al. in terms of an information-processing model (Neisser, 1967) and interpreted as showing that schizophrenics are slower at encoding information from iconic storage to a more permanent memory stage. Saccuzzo's studies, however, have not investigated the effects that presentation to different hemispheres has on the encoding process nor have stimuli other than single letters been used. These studies do support the notion of a generalized cognitive impairment in schizophrenics found in the other visual studies.

There is no disagreement that there is a cognitive deficit in information-processing in schizophrenia. However, the data are divided between the view proposing a lateralized deficit and the position which suggests a deficit in the exchange of information between hemispheres. None of the visual studies addressed the question of right hemisphere dysfunction in the affective disorders. One of the control groups in the Braff and Saccuzzo (1981) study was a group of depressed patients who performed better than the schizophrenic group on a letter identification task, indicating that depressives were not as slow as schizophrenics in processing information. However, this study did not look at laterality deficits. At this point more research is needed to answer the question of lateralized dysfunction in psychiatric patients using the visual field approach.

Dichotic Listening Studies

The use of the dichotic listening technique was first introduced by Broadbent (1954). The procedure consists of presenting two different auditory stimuli simultaneously to each ear. When verbal material (e.g., words or digits) is presented, one finds a right ear advantage (REA) for detection of verbal stimuli and a left ear advantage (LEA) for nonverbal stimuli (e.g., musical melodies, environmental sounds, non-speech vocal sounds such as crying and laughing) (Berlin, 1977; Kimura, 1961, 1967; King & Kimura, 1972). Lateralization for speech and non-speech sounds has also been found in infants and children (Kimura, 1967; Molfese, Freeman, & Palermo, 1975; Segalowitz & Chapman, 1980).

These lateral differences are assumed to reflect an interaction between 1) the greater strength of the contralateral auditory pathways over the ipsilateral auditory pathways which tend to get suppressed during dichotic listening and 2) the greater efficiency of the left hemisphere for processing linguistic material and the greater efficiency of the right hemisphere in processing nonverbal sounds (Kimura, 1964, 1967). The relatively greater strength of the contralateral pathways over ipsilateral ones is substantiated by findings with commissurotomy patients in which the number of words identified by the left ear when presented dichotically is virtually zero (Milner, Taylor, & Sperry, 1968). This is due to the fact that when the corpus callosum is cut, no transmission between hemispheres can take place. If the ipsilateral pathways are suppressed during dichotic listening, then each hemisphere receives only input from the contralateral ear. The right hemisphere with its limited ability to process words cannot identify the word

presented to it from the contralateral ear nor can the word be transferred to the left hemisphere since the corpus callosum has been severed in these patients. Hence the stimuli presented to the left ear would not be identified. That this is not purely an acoustic problem in commissurotomy patients is illustrated by the fact that when verbal stimuli are presented to one ear at a time (which does not result in suppression of ipsilateral pathways), the split-brain patient identifies verbal stimuli to each ear equally well, just as neurologically intact individuals do (Springer & Deutsch, 1981). The dichotic procedure offers an auditory analogue to the visual field studies in which stimuli are presented to each hemisphere separately (Springer, 1977). An REA would indicate left hemisphere superiority and an LEA would indicate a right hemisphere superiority. It should be noted that although researchers employing the dichotic listening paradigm talk as if the suppression of ipsilateral pathways during dichotic listening is a fact, it is an assumption which offers the best explanation for the phenomenon and not at the level of fact. However, it does appear to be the most cogent explanation for accounting for the dichotic phenomenon.

Studies performed with brain-injured adults provide additional support for the REA and left hemisphere specialization for language. Kimura (1961) reported that patients with left temporal lobe lesions performed significantly worse than patients with right temporal lesions when digits were presented dichotically.

In Kimura's dichotic studies both with normals and brain-injured patients, several pairs of syllables or digits were presented on each trial and subjects were asked to recall as many syllables or digits as

possible. Studdert-Kennedy and Shankweiler (1970) and Shankweiler and Studdert-Kennedy (1967) investigated whether lateralization of speech takes place at a far more elementary level than that of words. These two investigators looked at the articulatory features of voicing and place of articulation. They presented consonant-vowel pairs dichotically, which consisted of the voiced stop consonants (b, d, g) and the unvoiced stop consonants (p, t, k) each followed by the vowel "a." Dichotic pairs of steady state vowels were also presented. Results indicated a significant REA for consonants and a nonsignificant LEA for vowels. Further analysis of the data indicated that the left hemisphere is specialized for linguistic feature extraction, specifically for the articulatory features of place and voicing. Place of articulation refers to the place in the mouth involved in the articulation of the sound. Voicing refers to whether or not the vocal cords are vibrated during the sound. Also, unlike most other dichotic studies, Studdert-Kennedy and Shankweiler presented only one syllable to each ear on each trial. Other studies typically presented lists of words which confounded results with short-term memory (Bryden, 1978; Bryden & Allard, 1978). Overall, these studies provide further support for the linguistic specialization of the left hemisphere even at more elementary levels of processing.

Just as a LVF advantage was found in the visual field studies for emotional and nonverbal processing, dichotic studies have paralleled these findings by showing an LEA for processing emotional and nonverbal material. Safer and Leventhal (1977) had college students listen to messages monaurally through either the right or left ears. These

messages contained three levels of emotional tone of voice (neutral, positive, negative) crossed with three levels of verbal content (neutral, positive, negative). A left ear superiority for judgment of emotional tone and a right ear superiority for judgment of content were found. Although this study is not technically a dichotic study, it demonstrates left hemisphere superiority for linguistic analysis and right hemisphere superiority for emotional processing. Carmon and Nachshon (1973) found a significant LEA for identifying nonverbal human sounds such as crying and laughter when presented dichotically. Bryden, Ley, and Sugarman (1982) found an LEA for identifying the emotional quality (positive, neutral, negative) of tonal sequences. Fennel and Mulheira (Note 2) found an LEA for identifying the emotional tone of letters spoken in happy, sad, angry, or indifferent tones using dichotic presentation. It should be noted that although some studies in the literature suggest differential lateralization for positive and negative emotions (Gianotti, 1972; Newlin & Golden, 1981; Tucker, 1981), the Bryden et al. (1982) and Fennell and Mulheira (Note 2) studies failed to find lateralization differences for positive and negative emotions. The Fennell and Mulheira study as well as the King and Kimura (1972) study also failed to find sex differences for the processing of nonverbal sounds.

Dichotic studies of music have also yielded an LEA for the recognition of melodies among nonmusicians. Musicians, curiously, showed an REA advantage for melodies (Bever & Chiarello, 1974). Gordon (1978) found an REA for rhythm cue recognition of melodies, while an LEA was found for dichotic presentation of chords. Gordon noted that these

findings are consistent with the view that the left hemisphere is specialized for analytical, sequential processing (which is the type of processing required for rhythm perception) while the right hemisphere is superior in synthetic, gestalt processing which would be required for processing chords. This study calls attention to the danger of simply labeling the left and right hemispheres as verbal and nonverbal. The type of information processing required by a particular task whether the task be verbal or nonverbal is an important consideration.

Findings in the dichotic listening literature which suggest lateralization of cognitive functions have led to using the procedure for studying lateralization in psychiatric patients. Lerner, Nachson, and Carmon (1977) presented dichotic digits to paranoid and nonparanoid schizophrenics and normal controls. They found a higher overall level of performance in the normal group. However, schizophrenics showed a greater right ear superiority than normals. This is consistent with Gruzelier and Hammond's (1976) findings of greater acuity for auditory thresholds in the right ear for schizophrenics compared with normals. This right ear acuity, however, deteriorated over test sessions. They interpreted this initial right ear acuity which deteriorated over time in terms of a weak inhibitory nervous system in schizophrenics which is more susceptible to fatigue. The fact that this deterioration was true for the right ear but not the left ear would implicate the left hemisphere more than the right in terms of weak inhibitory mechanisms.

Lishman, Toone, Colbourn, McMeekan, and Mance (1978) found that both schizophrenic and manic-depressive groups had higher mean difference scores than normal controls on a dichotic word task showing a large

REA. However, when males and females were looked at separately, only the male schizophrenic group was significantly different from same sex controls. As in other studies the patient groups showed an overall lower level of performance than controls indicating a generalized cognitive deficit in the patient groups. Yozawitz et al. (1979) found that patients with affective disorder showed a pattern of performance similar to patients with right hemisphere lesions on a dichotic click summation task and dichotic word task. This study was able to differentiate affectives from schizophrenic and normal subjects on the basis of the dichotic tasks but did not differentiate schizophrenics from normals on the basis of these tasks. Yozawitz et al. suggest that these results support the notions of a right hemisphere dysfunction in affective disorder.

Green and Kotenko (1980) found that schizophrenics compared to normals and psychiatric controls had significant left ear deficits both in monaural and binaural hearing conditions for recall of stories. This is interpreted by the authors as evidence for defective interhemispheric transfer in schizophrenia which is similar to the Dimond and Beaumont (1974) hypothesis derived from visual studies. Walker, Hoppes, and Emory (1980) have reinterpreted the findings of the Lerner et al. (1977) study as supporting the interhemispheric transfer deficit hypothesis rather than the left hemisphere dysfunction hypothesis advocated by Lerner et al. Here again, as in the tachistoscopic studies, two different hypotheses are advanced to explain cognitive deficits in schizophrenia.

Evidence of differential lateralized deficits in schizophrenia and affective disorder have not been found in several studies. In a study by Gruzelier and Hammond (1980) both schizophrenics and normals showed an equal REA in the recall of dichotic digits. Lishman et al. (1978) found no overall differences between schizophrenics and manic-depressives on dichotic tasks. In the Yozawitz et al. (1979) study no differences were found between the normal and schizophrenic group although the schizophrenic and affective group did differ. The dichotic literature clearly supports the notion that the two cerebral hemispheres are specialized for different cognitive functions. However, whether lateralized dysfunction exists in schizophrenia and affective disorders has only found partial support. A reason for the inconsistent, and at times contradictory, results may be due to the use in several studies of stimuli which require higher level processing and a significant memory component (e.g., recall of several pairs of dichotic words on each trial; short story passages) which can be more easily influenced by attentional and memory capacities (Bryden, 1978; Kinsbourne, 1973).

Neuropsychological, Neurological, and Cognitive Studies

Patients with left-sided cerebral lesions obtain relatively worse scores on the Verbal IQ than on the Performance IQ of the Wechsler intelligence scales (Fitzhugh, Fitzhugh, & Reitan, 1962; Reitan, 1955). The opposite relationship was found for right-sided lesions. Underlying good performance on the Verbal scales of Wechsler's test are verbal-analytic processing while the Performance scales place a premium on visuospatial and visual-motor processing (Lezak, 1976). Aphasias and

other language disturbances are more common with left hemisphere lesions (Heilman & Valenstein, 1979). Patients with right hemisphere lesions show deficits on visuospatial tasks such as judgment of line orientation, facial recognition, drawing, and construction of block designs (Benton, 1979). Poorer performance on musical tasks is also found among individuals with right hemisphere damage. It is not uncommon to find severely aphasic individuals who have suffered left hemisphere strokes who can still sing (Jaynes, 1976).

When sodium amytal (a barbiturate) is injected into the left intracarotid artery which carries blood to the left hemisphere there is temporary loss of speech until the effects of the barbiturate wear off. This technique, known as the Wada test (Wada & Rasmussen, 1960), by temporarily anesthetizing one of the hemispheres is used to assess cerebral dominance for speech in individuals. Through use of this technique it has been established that approximately 95% of right-handers and 70% of left-handers have their speech centers in the left hemisphere. With left carotid artery injection of sodium amytal the person retains the ability to sing while losing speech. With right carotid artery injection, the person can speak but loses the ability to sing (Jaynes, 1976). Kimura (1967) reported an REA for words in a dichotic task for subjects found to have left hemisphere dominance for speech. She found an LEA for those individuals showing right hemisphere dominance for speech on the Wada test. Thus the dichotic listening procedure accurately reflects cerebral dominance as measured by the Wada technique.

Since the right hemisphere is more implicated in emotion (Tucker, 1981), it is not surprising to find a loss of ability to use affective

intonation in speech (Valenstein & Heilman, 1979) and loss of ability to express emotion through body language and action (Ross & Mesulam, 1979) associated with right hemisphere lesions. Wechsler (1973) reported that damage to the right hemisphere resulted in poorer story recall when the story was emotional in content. Flor-Henry (1976a) reported that cases of orgasmic epilepsy had a right hemisphere focus. This is consistent with lateralized EEG slowing in the right hemisphere during sexual orgasm (Cohen, Rosen, & Goldstein, 1976).

With respect to the question of lateralized dysfunction and psychopathology, Tucker's (1981) review of the literature suggests that left temporal lobe dysfunction is more likely to produce schizophrenic-like symptoms and right temporal lobe dysfunction is more likely to produce symptoms characteristic of major affective disorders. Flor-Henry (1969) compared 50 cases of temporal lobe epilepsy for psychotic symptoms. Patients with left temporal lobe epilepsy were more likely to be labeled as schizophrenic and right temporal lobe patients were more common in the affective disorder group. Bear and Fedio (1977) investigated personality differences in interictal behavior patterns between right and left temporal lobe epileptics. Right temporal lobe epileptics were more likely to display emotional tendencies whereas left temporal lobe epileptics were more likely to display ideational traits.

Flor-Henry (1976b) administered a neuropsychological battery to groups diagnosed as schizophrenic and affective disordered (manic, hypomanic, and depressed). The schizophrenic groups displayed a pattern of performance indicative of dysfunction of the left hemisphere in the frontotemporal area. The affective group showed evidence of right

frontotemporal dysfunction. Taylor, Redfield, and Abrams (1981) obtained similar results using a different battery of neuropsychological measures. Gordon, Goldstein, and Sabol (Note 3) reported that 23 of 27 schizophrenics performed relatively better on tests of right hemisphere functioning thus pointing to a left hemisphere deficit. In a study measuring reaction time in identifying pictures, schizophrenics showed evidence of relying on a left hemisphere strategy in solving the task (Gur, 1979). Since, according to Gur, the left hemisphere is dysfunctional in schizophrenia this overreliance on the left hemisphere strategy results in lower performance among schizophrenics. Gur (1977) also cites a greater degree of left-sidedness in schizophrenics, as measured by handedness, footedness, and eye dominance, as evidence for left hemisphere dysfunction. This interpretation of schizophrenia and left-sidedness appears to be contradicted by the Taylor and Fleminger (1981) study which reported that in schizophrenics, hallucinations, hypochondriacal delusions and symptoms were experienced more frequently as spatially located on their left sides. They conclude that the right hemisphere is more involved in the production of symptomatology in schizophrenics.

Studies finding right hemisphere deficits in neuropsychological test performance among depressed individuals report improved performance after electroconvulsive shock treatment (ECT) (Goldstein, Filskov, Weaver, & Ives, 1977; Kronfol, Hamsher, Digre, & Waziri, 1978). Flor-Henry's (1979) review of the ECT literature suggests the relatively greater role of the right hemisphere in affective states. Right unilateral ECT reportedly causes less impairment of verbal memory than

bilateral or left-sided ECT (Fleminger, DelHorne, & Nair, 1970; Fromholt, Christensen, & Stromgren, 1973). These studies support the notion of a right hemisphere dysfunction in affective disorders given the poorer right hemisphere performance prior to ECT. Also, the greater disturbance in verbal memory following left-sided ECT is consistent with the lateralization of linguistic functions in the left hemisphere. ECT appears to have an opposite effect on the two hemispheres: it restores a higher level of functioning in the right hemisphere and disrupts the cognitive functioning of the left hemisphere.

A verbal/spatial dichotomy of the functional differences between the hemispheres is consistent with the data presented above. The hypothesis of left and right hemispheric dysfunction being characteristic of schizophrenia and affective disorder also appears to be supported by the neurological and neuropsychological studies. However, a study by Rosenthal and Bigelow (1972) lends some support to the defective interhemispheric transfer hypothesis. In that study investigators found that the corpus callosum was abnormally thick in schizophrenics and inferred that transcallosal transmission is implicated. No such differences have been reported for the major affective disorders.

Psychophysiological Studies

Galín and Ornstein (1972) demonstrated a link between EEG activity in the cerebral hemispheres and type of task being solved. EEG activity indicated relatively greater involvement of the left hemisphere on a verbal task while there was greater involvement of the right hemisphere on a spatial task. Differences in auditory evoked potentials for

speech and nonspeech sounds were found with larger evoked potentials in the left hemisphere for speech sounds and higher potentials in the right hemisphere for nonspeech sounds (Molfese, Freeman, & Palermo, 1975). A similar relationship holds for visual evoked potentials of verbal and nonverbal stimuli (Buschbaum & Fedio, 1970). In a review of the evidence for the lateralization of cognitive functions based on electrophysiological measures Marsh (1978) concluded that the evidence was quite convincing for asymmetry of cognitive functions.

Measurements of cerebral blood flow have also supported the verbal/spatial distinction between the hemispheres (Knopman, Rubens, Klassen, Meyer, & Niccum, 1980; Risberg, Halsey, Wills, & Wilson, 1975). Verbal tasks result in increased blood flow to the left hemisphere and spatial tasks result in increased blood flow to the right hemisphere. Gur and Reivich (1980) interpreted the blood flow differences as reflecting asymmetrical hemispheric activation as a function of the type of cognitive task (increase in blood flow being indicative of greater activation).

EEG differences between the hemispheres have also been reported in schizophrenic and affective disordered individuals. Flor-Henry (1976b) found that schizophrenics had more activity in the left temporal area compared to the right temporal area. The manic-depressive group in that study had more activity bilaterally, although it was significantly greater in the right hemisphere. Abrams and Taylor (1979) reported that 48% of schizophrenics in their sample showed abnormal EEG patterns. Although the site of abnormality was more frequently the left hemisphere, this difference did not reach statistical significance.

patients with affective disorders tended to show right-sided abnormal EEGs; however, once again this did not reach statistical significance. Roemer, Shagass, Straumanis, and Amadeo (1978) found that schizophrenics showed less stable evoked response potentials in the left hemisphere compared to depressives and normal controls. This instability was interpreted as indicative of left hemisphere dysfunction in schizophrenia. Tucker, Stenslie, Roth, and Shearer (1981), using mood induction with normal subjects, found asymmetrical EEG activation over the frontal lobes during a depressed mood state with relatively greater activity in the right frontal area.

Studies of electrodermal activity have found that schizophrenics have lower skin conductance levels on the left hand than on the right hand (Gruzelier & Venables, 1974; Uherik, 1975). The opposite relationships held for depressives (Gruzelier & Venables, 1974). Since Luria and Homskaya (1970) hypothesized that an absence of electrodermal response occurs on the hand ipsilateral to frontal lobe lesions, Gruzelier and Venables interpreted their findings as supportive of left hemisphere dysfunction in schizophrenia and right hemisphere dysfunction in depression. A study by Myslobodsky and Horesh (1978) produced similar results with endogenously depressed patients. However, these researchers assumed contralateral control of electrodermal activity. Thus the relatively high activity of the left hand in depressives was interpreted as indicative of right hemisphere dysfunction and right hemisphere overactivation in depression.

Measures of cerebral blood flow in schizophrenics report significantly lower blood flow in the frontal areas and higher flows post-centrally in the left hemisphere (Frazen & Ingvar, 1975; Ingvar & Frazen, 1974). However, no measures of the right hemisphere were reported, making it difficult to ascertain whether this abnormality was exclusive to the left hemisphere. No cerebral blood flow studies have been reported with affective groups.

Again, the research using psychophysiological measures points to left hemispheric dysfunction in schizophrenia and right hemispheric dysfunction in depression. It would appear that the dysfunction is related to hyperarousal of the dysfunctional hemisphere.

Eye Movement Studies

When an individual is engaged in problem solving and faced by a questioner he/she will typically break eye contact and eye movement to the right or left will take place. Typically, eye movements are elicited by asking subjects to solve verbally presented questions which hypothetically results in differential activation of the hemispheres. In the eye movement literature the lateral direction of eye movement is usually with reference to the subject's right or left. Day (1964) was the first to carry on systematic research on the relationship between lateral eye movement (LEM) and individual differences. Duke (1968) also found individual differences in direction of eye movements and hypothesized a new typology of "left-movers" and "right-movers." A major premise of the eye movement studies is that the direction of LEM indicates

greater activation of the cerebral hemisphere contralateral to the direction of eye movement (Gur & Reivich, 1980).

Robinson (1968) reported research with primates in which he found that stimulating the cortical areas known as the frontal eye fields produced LEMs contralateral to the hemispheric frontal eye field stimulated. He also noted that when two points on opposite sides of the brain are simultaneously stimulated, the resulting LEM is a weighted sum of the two opposing movements evoked by each stimulation. If both right and left frontal fields were stimulated with equal intensity, there would be no movement, the two opposing forces cancelling each other out. However, with differential stimulus intensities there were LEMs contralateral to the more intensely stimulated hemisphere.

In their 1978 review of the eye movement literature, Erlichman and Weinberger concluded that the evidence for interpreting the direction of lateral eye movements as a function of asymmetrical activation of the cerebral hemispheres was inconclusive and weak. However, more recent research has addressed this validity issue. Gur and Reivich (1980) found that the direction of LEMs is associated with volume of blood flow to the hemispheres. Left LEM is associated with greater blood flow to the right hemisphere and right LEM is associated with more blood flow to the left hemisphere. Shevrin, Smokler, and Kooi (1980) reported hemispheric differences in evoked potentials which were related to LEMs. Lefebvre et al. (1977) found a relationship between the direction of the LEMs and accuracy in verbal and nonverbal dichotic listening tasks. Overall, the evidence points to LEM as a valid measure of asymmetrical hemispheric activation.

Following the activation hypothesis, Kinsbourne's (1973) model for explaining the relationship between eye movement and hemispheric activity states that the areas primarily involved in LEMs are the frontal eye fields which are "mutually inhibitory. Thus looking in any given direction is programmed as the vector resultant of the opposing activities of the two frontal eye fields" (p. 241). Kinsbourne claims that when hemispheric activity is balanced, visual gaze is centered straight ahead. Imbalance in activation causes eye movement contralateral to the hemisphere with greater activation.

Although Kinsbourne (1972, 1973) found that people shift their eyes in different directions in response to reflective questions, the direction of eye movement was not a function of individual differences but of the cognitive mode elicited by the type of question asked. People tend to shift their eyes right in response to verbal-analytic questions and left in response to spatial questions. In a later study (Schwartz, Davidson, & Maer, 1975), nonemotional questions elicited the greatest number of right LEMs while emotional questions elicited more leftward movements. This was interpreted as supporting the position implicating a greater role for the right hemisphere in emotional processing. The findings of Kocel, Galin, Ornstein, and Merrin (1972) supported the notion of direction of eye movement as a function of cognitive mode elicited by the type of question. Kinsbourne (1973, 1975) further states that attending to or preparing to attend to verbal stimuli activates the left hemisphere and produces an attentional shift to right hemisphere. The opposite effect takes place with visuospatial material. Thus the hemisphere which is most appropriate for processing

a given type of stimulus is "primed" or readied for action. This line of reasoning is similar to Nebes' (1978) position which states "in the competition for the motor channels, the hemisphere that is most competent for the function involved assumes control over the motor system" (p. 123). Kinsbourne's position on eye movements contradicts several studies which found consistent individual differences in the direction of LEMs (e.g., Bakan, 1969; Bakan & Svorad, 1969; Day, 1964, 1967; Duke, 1968).

Gur (1975) attempted to account for the discrepancies between studies advocating individual differences in eye movement and those attributing the direction of eye movement to attentional shifts as a function of question type. Since results of studies had been confounded by the position of the experimenter who was asking the questions in relationship to the subject (i.e., Bakan, 1969, had used the experimenter-facing-the-subject condition while Kinsbourne, 1972, 1973, had used the experimenter-behind-the-subject condition), Gur (1975) investigated the effects of experimenter position on eye movements. She hypothesized that the experimenter-facing-the-subject position is an anxiety-provoking interpersonal situation. When responding to questions in this condition, the subject reverts to "characteristic modes of response" (Gur, 1975, p. 52), relying on the typically used or preferred hemisphere. In the experimenter-behind-the-subject condition, hemispheric activation is a function of question type. Gur hypothesized that 1) subjects would show individual consistency in the direction of LEMs in the experimenter-facing-the-subject condition and 2) LEM direction would be a function of question type in the experimenter-behind-the-subject

condition. The hypotheses were confirmed. Gur concluded that the discrepancies between studies such as Bakan's (1969) and Kinsbourne's (1973) were attributable to procedure. There are individual differences in eye movements as well as differences due to the cognitive mode elicited by the question.

Several studies have investigated personality differences in relationship to hemispheric asymmetry and LEMs among normal subjects. Bakan and Svorad (1969) found a significant correlation ($r = -.59$) between the number of right LEMs and the percentage of alpha during EEG recordings while subjects were at rest. Day (1967) also found that left-movers have lower frequency and higher amplitude in EEG recordings (more alpha) than right-movers. Since alpha activity is associated with imaginative, intuitive, and imaginal processes, more alpha among left-movers is consistent with the gestalt-holistic cognitive style characteristic of the right hemisphere (Ornstein, 1972).

Several different investigators have found that left-movers are more hypnotically susceptible than right-movers (Bakan, 1969; Bakan & Svorad, 1969; Gur & Reyher, 1973; Morgan, McDonald, & MacDonald, 1971). Sherrod (1972) in a study on persuasion and eye movement hypothesized that left-movers, who are more inner attentive, would react more strongly than right-movers to persuasive arguments because left-movers are "more likely to tap subjective experiences relevant to the message and generate internal stimuli" (p. 355). The hypothesis was confirmed: left-movers' opinions changed significantly more than right-movers' opinions after hearing a persuasive speech. This is consistent with the hypnotic susceptibility literature since the tendency to accept

suggestions (persuasibility) is related to hypnotizability (Fromm & Shor, 1979).

Day (1964, 1967) found that left-movers have an internal focus of attention and right-movers have an external focus. Also, left-movers describe the locus of anxiety as internal whereas right-movers describe the locus as external. These findings corroborate Meskin and Singer's (1974) finding a negative correlation between inner attentiveness (as measured by Byrne's Repression-Sensitization scale) and right LEM. Gur and Gur (1975) reported differences in defensive styles between left-movers and right-movers. Left-movers scored higher on repression and denial scales while right-movers scored higher on projection and turning against other scales of the Defense Mechanism Inventory. These differential defensive styles are consistent with the internal and external focus differences between left-movers and right-movers.

Bakan (1969) found differences in Scholastic Aptitude Test (SAT) scores between left-movers and right-movers with left-movers having higher verbal SAT scores and right-movers having higher math SAT scores. He also found that more of the left-movers were in the humanities while right-movers tended to be in the natural sciences. However, Prifitera (1981) failed to find any relationship between LEM and college major. Also, Galin and Ornstein (1974) found no relationship between LEM and occupation (lawyers and artists). Etaugh (1972) did find a small but significant correlation between left LEM and intelligence. Tucker and Suib (1978) reported that right-movers have higher WAIS Verbal IQs and left-movers have higher Performance IQs.

Harnard (1972), in a study using mathematicians as subjects, found cognitive style differences which were associated with preferred direction of eye movement. He reported that left-movers used more visual imagery in solving problems and had more artistic interests than right-movers. Also, left-movers were rated as more creative by students and peers and scored higher on the Remote Associates Test which is a measure of creativity. He summarized the findings by saying "it is hypothesized that the non-dominant hemisphere has a property by which the activities of that hemisphere are less bound by reality (the data of the senses and reason) than those of the dominant hemisphere" (Harnard, 1972, p. 654). Hines and Martindale (1974) found similar relationships between the Remote Associates Test and eye movement. Bakan (1969) and Morgan et al. (1971) reinforced this idea by suggesting that left-movers are more imaginative than right-movers.

Using a more traditional personality assessment instrument, Etaugh (1972) reported modest correlations between several of the traits measured by Cattell's 16PF and eye movements. None of the correlations were above .25. Specifically, left-movers were less affected by feelings, more assertive, suspicious, and shrewd than right-movers. A later study by Etaugh and Rose (1973) found only one significant correlation between traits and eye movements. Weitan and Etaugh (1973) found no significant correlations between eye movements and the Allport-Vernon Study of Values. Prifitera (1981) postulated that these modest results with personality measures might be due to a mismatch between the personality dimensions measured and the cognitive style of the left and right hemispheres. Erlichman and Weinberger (1978) had suggested that

the lack of consistent findings between LEM and personality may be due to using inappropriate personality measures. Prifitera (1981) postulated that the scales of the Myers-Briggs Type Indicator, which is based on Jung's typology (Jung, 1921), are consistent with the asymmetrical cognitive styles of the cerebral hemispheres. Results showed that for male college students, right LEM was associated with Thinking and Sensation types while left LEM was associated with Intuitive and Feeling types. There was a multiple correlation of .68 between typology and eye movements.

In a study with schizophrenics, Gur (1978) found that schizophrenics had a higher proportion of right LEMs, which she interpreted as indicative of left hemisphere overactivation in schizophrenia. Schweitzer, Becker, and Walsh (1978) and Schweitzer (1979) also reported more right LEM for schizophrenics. More right LEM is also associated with trait anxiety which Tucker, Antes, Stenslie, and Barnhardt (1978) interpret as possibly inducing left hemisphere overactivation and right hemisphere suppression in highly anxious individuals. Smokler and Shevrin (1979) found that right LEM is associated with obsessive-compulsive signs on the Rorschach and left LEM is associated with hysterical signs. These findings with clinical groups are consistent with the thinking/feeling, nonemotional/emotional dichotomies characteristic of hemispheric functioning.

Among depressives, two studies have found greater left LEMs for this group (Myslobodsky & Horesch, 1978; Schweitzer, 1979). Sandel and Alcorn (1981) also found relationships between direction of LEMs and

psychopathology. However, the schizophrenia-right LEM and affective disorder-left LEM relationships were not as clear.

If one views the LEM research in conjunction with the other research reviewed above, it appears that there is considerable evidence for both overactivation and dysfunction of the left hemisphere in schizophrenia and of the right hemisphere in affective disorders. It may also be that schizophrenics and affective disordered patients may overuse the cognitive processing style of the dysfunctional hemisphere. Bogen, DeZure, TenHouten, and Marsh (1972) used the term "hemisphericity" to refer to the proclivity of an individual to use the cognitive processing style of one or the other hemisphere. It may be that extreme left hemisphericity in schizophrenia and extreme right hemisphericity in affective disorder results in use of the inappropriate hemisphere for different tasks. Also, if the left and right hemispheres are dysfunctional in schizophrenic and affective disordered patients, respectively, then there is typical reliance on the dysfunctional hemisphere.

Although several methods have been used to assess hemispheric functioning among psychiatric patients such as the methods discussed above, Wexler (1980) has pointed out that a drawback to these studies is that they typically use different measures and only one measure of hemispheric functioning is used within a study. Also, with the exception of a few studies only one psychiatric group is tested. Pic'1 et al. (1979) have argued that in research with psychiatric patients, other psychiatric groups are more appropriate controls than normals. The present study seeks to test the hypothesis of lateralized hemispheric dysfunction in schizophrenia and affective disorders. By using manic patients,

the study will extend the investigation of lateralized dysfunction to another type of affective disorder since most studies have used depressives. Also, the use of multiple measures of hemispheric functioning on the same individual will provide a stronger case for the validity of lateralized dysfunction. Several of the measures used will be identical to or very similar to measures used in previous studies, thus providing continuity with previous research.

The specific hypotheses which are explicated below are also outlined in Table 1. The hypotheses are:

1. a. Schizophrenics are expected to show poorer performance on verbal material when presented to the left visual field compared to the right visual field.
 - b. The performance of schizophrenics on a nonverbal visual task will show the expected left visual field superiority. These two results (a and b) would be a replication of Gur's (1978) findings.
 - c. Manics will show the expected right visual field superiority on the verbal task.
 - d. The performance of manics will be poorer for nonverbal stimuli when presented to the left visual field compared to the right visual field.
 - e. Normals will show the expected right visual field superiority on the verbal task.
 - f. Normals will show the expected left visual field superiority on the nonverbal task.
2. a. Schizophrenics will not show the expected right ear advantage on the dichotic syllables task.

Table 1
 Summary of Specific Hypotheses

	Schizophrenics	Manics	Normals
1. Performance on visual tasks			
Verbal stimuli	a. LVF > RVF	c. LVF < RVF	e. LVF < RVF
Nonverbal stimuli	b. LVF > RVF	d. LVF < RVF	f. LVF > RVF
2. Performance on auditory tasks			
Syllables	a. LE > RE	c. LE < RE	e. LE < RE
Environmental sounds	b. LE > RE	d. LE < RE	f. LE > RE
3. Eye movements	a. More right LEMs	b. More left LEMs	c. Normal distribution
4. Myers-Briggs Type Indicator	a. Higher T ^a and S scores	b. Higher F and N scores	c. Normal distribution
5. Left (L) and Right (R) scales of the Luria-Nebraska Neuropsychological Battery	a. Higher ^b score on L scale	b. Higher score on R scale	c. No difference

^aT = Thinking; S = Sensation; F = Feeling; N = Intuitive.

^bHigher score indicates poorer performance on these scales.

- b. They will show the expected left ear advantage on the environmental sounds task.
 - c. Manics will show the expected right ear advantage on the dichotic syllables task.
 - d. Manics will not show the expected left ear advantage on the environmental sounds task.
 - e. Normals will show the expected right ear advantage on the dichotic syllables task.
 - f. Normals will show the expected left ear advantage for environmental sounds.
3. a. Schizophrenics will show a left hemisphere preference reflected by more rightward eye movements.
- b. Manics will show a right hemisphere preference reflected by more leftward eye movements.
 - c. Normals will not show any bias as a group towards right or left hemisphericity as reflected by eye movements.
4. a. On the Myers-Briggs Type Indicator (Myers, 1962), schizophrenics will have higher thinking and sensation scores compared to manics.
- b. On the Myers-Briggs, manics will have relatively higher feeling and intuitive scores compared to the schizophrenics.
 - c. Normals will show a normal distribution of scores.
5. a. On the Left and Right scales of the Luria-Nebraska Neuropsychological Battery, schizophrenics will show more deficit on the Left scale.

- b. Manics will show more deficit on the Right scale.
- c. Normals will not show a difference between scales.

METHOD

Subjects

A total of 36 right-handed male subjects ranging in age from 21 to 61 years participated in this study. All subjects were recruited from the North Chicago Veterans Administration Medical Center, North Chicago, Illinois. The two experimental groups consisted of 12 schizophrenics (mean age = 35.5 years, SD = 10.11; mean education = 12.5 years, SD = 1.45) and manic patients (mean age = 41.2 years, SD = 9.79; mean education = 13.3 years, SD = 2.54). The control group consisted of 12 hospital staff members with means for age and education of 35.9 (SD = 13.28) and 13.6 (SD = 3.00) years, respectively. Each subject was paid \$10 for participating.

Diagnosis of patients was based upon interview evaluations by a ward psychologist and psychiatrist. Also, the psychologist was asked to diagnose patients according to DSM-III criteria (American Psychiatric Association, 1980) for the purposes of this study. The researcher reviewed the psychologist's diagnoses and included patients in the study only if he agreed with the psychologist's diagnosis. Each patient's medical chart was also reviewed by the researcher. Patients who had any positive neurological signs based on either a standard neurological exam, EEG, brain scan, or CAT scan were excluded from the study. Patients with abnormal hearing based upon routine audiological examination conducted by the Audiology Service at the hospital were also

excluded. Finally, only patients with normal or corrected-to-normal vision were included. Subjects who satisfied the DSM-III criteria for schizophrenic disorder or bipolar disorder, manic type were included. The normal controls were screened by the researcher for history or neurological, visual, or auditory problems.

All patients in the study were on medication. All the schizophrenics were on major tranquilizers and all the manics were on lithium carbonate. In addition, five of the manic patients were also being administered major tranquilizers. None of the normal controls were taking any form of psychotropic medication. The issue of the effects of medication on performance needs to be taken into account, for it was not controlled in this study. A major reason that medication was not controlled was simply that very few unmedicated patients were available. However, studies have found that phenothiazines either have no effects on task performance related to laterality (Schweitzer et al., 1978) or tend to decrease laterality effects (Gruzelier & Hammond, 1976). Heaton and Crowley (1981) concluded that neuroleptic medications enhance performance in schizophrenics on attentional tasks. They also suggest that impairment due to lithium carbonate is slight if at all present. Thus the effects of medications, while not controlled, can be expected to be minimal and not deleterious to task performance.

Subject selection was restricted to right-handed males for the following reasons: 1) 95% of right-handed individuals have left hemisphere specialization for language and right hemisphere specialization for visuospatial processing. This is true of only 60% of left-handed people (Levy & Reid, 1978). 2) There is also some evidence to suggest

that females are not lateralized in cognitive functioning to the same degree or direction as males (Levy & Reid, 1976; McGlone, 1980; Witelson, 1976). Thus, using only right-handed males offers a homogeneous group of individuals within similar lateralization of cognitive functions. These restrictions on subject selection, however, reduce the generalizability of these results to other groups such as females and left-handers.

Materials and Procedures

Handedness Questionnaire. All subjects were administered the Annett Handedness Scale (Annett, 1970) to assess hand usage for a variety of activities (e.g., writing, throwing, holding scissors). Subjects who classified themselves as right-handed and reported use of the right hand on at least 9 of the 12 activities on the scale were included. Also, if writing was not one of the minimum of nine right-handed activities reported, subjects were excluded. Table 2 contains the questionnaire items.

Visual Tasks. Subjects were asked to identify three-letter nonsense syllables and line figures displayed on a screen. The syllables and figures were displayed on a Radio Shack CRT (cathode-ray tube) driven by a TRS-80 microcomputer.

The verbal stimuli consisted of 80 different consonant-vowel-consonant (CVC) nonsense syllables, which are listed in Table 3. The CVC syllables were taken from Archer (1960) and were selected for rated level of meaningfulness. One-half of the syllables were rated as highly meaningful (75th to 80th percentile) and the other half were rated low

Table 2
Handedness Questionnaire

Please indicate which hand you habitually use for each of the following activities by writing R for right, L for left, or E for either.

Which hand do you use:

1. To write a letter legibly? _____
 2. To throw a ball to hit a target? _____
 3. To hold a racket in tennis, squash, or badminton? _____
 4. To hold a match while striking it? _____
 5. To cut with scissors? _____
 6. To guide a thread through the eye of a needle? _____
 7. At the top of a broom while sweeping? _____
 8. At the top of a shovel while moving sand? _____
 9. To deal playing cards? _____
 10. To hammer a nail into wood? _____
 11. To hold a toothbrush while cleaning your teeth? _____
 12. To unscrew the lid of a jar? _____
-

Table 3
List of CVC Syllables

Meaningfulness	
Low	High
BAV	BEY
BEX	BIF
BIJ	BUK
CEF	CAS
DAX	CAV
FEK	CEN
FUP	DAZ
GEF	DES
JEG	DOB
JEH	FAC
JUV	FAK
KEB	FET
KEZ	FOP
KIG	GAV
KUG	HIZ
KUW	HOK
LEJ	JUS
MAF	KER
MIB	KOG
MUX	KOR
NAX	KUS
NIV	LAN
NIZ	LAR
NUY	LIB
PEF	MAH
QOR	MOS
RIJ	MUR
RUW	NOK
RUX	NUB
TOV	PAV
VEK	PEL
VUC	RAB
VUR	ROP
WUK	TEW
YAD	TIF
YOD	TIZ
ZEC	VAG
ZIB	VAS
ZID	VIS
ZUB	YAW

in meaningfulness (25th to 30th percentile) in the Archer study. Subjects were seated approximately two feet in front of the CRT display and the CVC syllables were presented vertically. Each syllable was positioned 2.51 degrees from center in either the right or left visual field. Subjects were told to fixate at a center point on the screen which was designated by an "X." Immediately after the X was erased from the screen an integer between 1 and 9 was presented for 500 msec. After 100 msec the digit was turned off and a CVC syllable appeared in either the right or left visual field for 60 msec which was followed by a 500 msec visual mask. The time between when the CVC syllable (target stimulus) was turned off and the masking stimulus was turned on was either 20, 40, 60, or 80 msec. The mask consisted of a solid block of light superimposed on the area where the target stimulus had appeared. Subjects were instructed to first report the digit at the center fixation point and then report the CVC syllable. This method of reporting a digit was employed to insure against eye movement away from center fixation before the target stimulus was presented (Levy & Reid, 1978). There were a total of 80 trials for each subject. Level of meaningfulness of the syllables (high or low), interstimulus interval (20, 40, 60, 80 msec), and visual field (left or right) were balanced and order of presentation randomized. Subjects were also given a minimum of eight practice trials to familiarize them with the task.

For the figural stimuli, a similar procedure was followed. Subjects were shown one of six figures (presented in Table 4) followed by a visual mask and asked to identify the figure in a six-alternative multiple choice format. The stimuli were presented either to the left

Table 4
Target and Masking Stimuli Employed
for Figural Task

Plain Parallel Lines	
o o o . .	o . . o .
.	o . . o .
.	o . . o .
o o o . .	. . . . .
.
Shifted Parallel Lines	
o o o . .	. o . . .
. . . . .	. o . . .
. . . . .	. o . . o
. . o o o	. . . . o
. . . . .	. . . . o
Nonparallel Lines	
. . . . .	. . o . .
o o o . .	. . . o .
. . . . o	. . . . o
. . . o .	. . . . .
. . o . .	o o o . .

Target stimuli (o o o) are shown in their positions relative to the masking stimuli (. . .). These figures are similar to those employed by Mayzner and Habinek (1976).

or right visual field whose median point was 3.88 degrees from central fixation. Subjects were instructed to first focus on an "X" presented at central fixation which was followed by a number between 1 and 9 presented for 500 msec which they were asked to report. After 100 msec the digit was turned off and one of six figures appeared in the left or right visual field for 20 msec. The visual mask followed the target stimulus at one of three interstimulus intervals (ISIs) (10, 20, 40 msec). Each of the six figures was presented in each visual field at each ISI three times for a total of 108 trials per subject. All conditions were randomized. Subjects responded by pointing to the correct figure on an answer sheet. A minimum of eight practice trials were given to familiarize subjects with the task.

Dichotic Tasks. All subjects were given 90 trials of dichotic consonant-vowel syllables using the six stop consonants (b, p, d, t, g, k) paired with the vowel "a." The 15 possible different pair combinations were presented six times, alternating which ear received a given syllable in a pair. For example, the dichotic pair ba-pa was presented six times. On three of the trials "ba" was to the left ear and "pa" to the right ear. Ear presentation was reversed for the other three trials. Order of trials was randomized. Subjects were asked to write down the syllable they were most certain of having heard on each trial. A minimum of eight practice trials were given to familiarize subjects with the procedure.

While most studies using dichotic syllables typically instruct students to write down both sounds of the dichotic pair, in this study subjects were instructed to write down only one. The reasons for this

were that first, pretesting indicated that giving both responses was somewhat confusing and stressful for patients which resulted in their becoming annoyed with the task. Also, Bryden (1978) suggests that having subjects report on one stimulus of a dichotic pair reduces the memory component involved in the task, hence there is less confounding of memory factors with lateralization. Also, second responses have been found to be highly inaccurate (Bryden, 1978) and largely "guess work" (Shankweiler & Studdert-Kennedy, 1967). Therefore, to have asked for both members of the dichotic pairs would have resulted in much more noise than relevant information.

The consonant-vowel pairs were similar to those used in previous research by Shankweiler and Studdert-Kennedy (1967). The tape was prepared at the Kresge Hearing Research Laboratory of the South at the Louisiana State University Medical Center. Syllables in the dichotic pairs were presented simultaneously for 300 msec duration. Trials were separated for 6 seconds; however, more time between trials was given if required. Longer time intervals were required on only a few trials for a few subjects. The tape was played on an AIWA 2 channel tape recorder (model TP-1012) and subjects listened to the tape over a pair of Telephonics headphones (model TDH-39P). Sound intensity was calibrated to 60 decibels SPL (reference $.0002 \text{ dynes/cm}^2$).

Subjects were also given the Competing Environmental Sounds Test (Katz, 1979) which consists of 20 pairs of dichotically presented environmental sounds (e.g., running water, a door slamming, telephone dialing). The test consists of 6 practice and 20 test trials in which the subject is instructed to point to pictures of the sounds he hears. The

pictures also contain a verbal description of the sound. The sounds were presented at 50 decibels SPL (reference .0002 dynes/cm²). Subjects heard the tape over the same apparatus used for the syllable task.

Neuropsychological Measure. Subjects were administered the Left and Right scales of the Luria-Nebraska Neuropsychological Battery (Golden, Purish, & Hammeke, 1979). All items were administered in the standardized manner as suggested by Golden et al. (1979). Items consisted of psychomotor and tactile recognition tasks. Scores on these scales reflect left and right hemisphere dysfunction.

Eye Movement Measure. During this procedure, subjects were seated 1 meter directly in front of the experimenter. The subject was asked 20 questions similar to those used by Gur (1978) to elicit eye movements (see Table 5 for the list of questions). The questions consisted of five verbal-nonemotional, five spatial-nonemotional, five verbal-emotional, and five spatial-emotional questions. The experimenter recorded the direction of the subject's first lateral eye movement after the question was asked. Manual recording of eye movements has been found to be as reliable as more technical means such as videotape and EOG (Edwards, Antes, & Adams, 1971). If no eye movement occurred before the subject finished answering a question, the response was scored as no movement. If the subject failed to begin answering a question within 30 seconds after the question was asked or if the subject was unwilling to answer a question, the next question was asked.

The present interest in obtaining individual differences led to running the subjects in the experimenter-facing-the-subject condition only since Gur (1975) found that this condition rather than the

Table 5

Eye Movement Questionnaire

-
1. What is the meaning of the word "repair"?
 2. Imagine a telephone dial, where does the area code appear in relation to the numbers?
 3. What is the basic difference between the meanings of the words "proud" and "boasting"?
 4. Imagine your face, what part of your face most expresses your feelings?
 5. What is a thermometer?
 6. Make up a sentence using the words "happiness" and "joy."
 7. Imagine you are standing in front of a Coke machine, where is the money slot?
 8. If you are crossing a street from west to east, and a car coming from the south smashed into you, which leg would be broken first?
 9. Imagine your father's face, what is the first feeling you have?
 10. What is the meaning of the word "hate"?
 11. Why does land in the city cost more than land in the country?
 12. Imagine Lincoln on a penny, in which direction does he face--to your right or to your left?
 13. Tell me how you feel when you are miserable.
 14. Imagine a public telephone, on which side does the receiver hang?
 15. Explain: A bird in the hand is worth two in the bush.
 16. Picture and describe the most frightening thing that has ever happened to you.
 17. Tell me how you feel when you are uptight.
 18. Why do children go to school?
 19. Imagine George Washington on a quarter, in which direction does he face--to your right or to your left?
 20. Picture and describe the happiest thing that has ever happened to you.
-

experimenter-behind-the-subject condition accentuates individual differences in the direction of eye movements.

Personality Measure. The Myers-Briggs Type Indicator (MBTI) (Myers, 1962) measures personality typology based on Jung's (1921) theory. The measure contains four scales: extraversion-introversion, thinking-feeling, sensation-intuition, and judgmental-perceptive. This measure was chosen because the opposite dimensions on two of the scales, namely, thinking-feeling and sensation-intuition, are in conceptual harmony with the asymmetrical cognitive styles of the hemispheres. The thinking person relies on a logical, analytical style for judgment and decision whereas the feeling type's judgments are based more on feelings and subjective values. The sensation type becomes aware of things in the world directly through the senses in a very tangible and concrete way, while the intuitive type senses the world in a more indirect and symbolic fashion, relying more on hunches and searching for the hidden possibilities in an event. Research by Carlson (1973, 1980) has shown the MBTI to be a useful tool for looking at individual differences in cognitive styles.

Overview of the Procedures. All measures were administered by the same examiner in a randomized order for each subject with the exception of the handedness questionnaire, which was given first to all subjects. Testing required an average of approximately four hours per individual for the patient groups and approximately one hour less for the normal controls. All subjects, except for three normals, completed testing on the same day. Testing for the three normals was spread over three days to accommodate their work schedules. In general, the

patients needed more encouragement to cooperate and finish the tasks. This included taking more breaks from the testing and verbal reinforcements by the examiner. It took more effort to sustain the attention and cooperation of the patient groups than of the control group. However, all subjects who agreed to participate in the study completed all tasks.

RESULTS

A one-way between-subjects analysis of variance (ANOVA) with groups (manic, normal, schizophrenic) as the between-subjects factor was performed on the dependent variables age and years of education. Both analyses yielded nonsignificant results, $F(2, 33) < 1$ for both analyses. Thus no significant differences in age and education levels among the groups were found.

Visual Syllable Task

Using the number correct as the dependent variable, a 3 (manic, normal, schizophrenic group) X 2 (right or left visual fields) X 4 (ISI values of 20, 40, 60, 80 msec) X 2 (low or high meaningfulness of syllables) ANOVA with repeated measures on the last 3 factors was performed on the visual syllables task. The analysis found a significant effect for the groups factor, $F(2, 33) = 4.55$, $p < .05$, with means of 17.58, 34.25, and 20.50 for the manic, normal, and schizophrenic groups, respectively. Planned comparisons¹ among the means indicates that the normal group performed better than the two patient groups ($ps < .05$). The two patient groups did not differ from one another ($p > .05$). A significant visual field effect was also found with the expected RVF superiority for verbal material, $F(1, 33) = 27.06$, $p < .01$. A

¹All planned comparisons were performed using the least significant difference test. All post-hoc analyses of means were performed using the Tukey test (Keppel, 1973).

significant group X visual field effect failed to occur; thus, the hypothesis of relatively poorer performance in the RVF compared to the LVF due to left hemisphere dysfunction in schizophrenia was not confirmed. Figure 1 displays the mean number correct for each group in both visual fields. As can be seen both patient groups display the same pattern as normals across visual fields. Post-hoc analyses indicate that for each group, performance was better for syllables presented to the RVF ($p_s < .05$).

The ISI factor also yielded a significant main effect, $F(3, 99) = 13.00$, $p < .01$, with means of 17.17, 21.92, 16.67, and 16.58 for ISIs of 20, 40, 60, and 80 msec respectively. Planned comparisons of the means indicate that performance at an ISI of 40 msec was significantly better than at each of the other three ISI levels ($p_s < .05$). Performance at ISIs of 20, 60, and 80 msec did not differ significantly from one another ($p_s > .05$). The expected trend of better performance with increasing ISIs did not occur, with the exception of better performance at ISI 40 msec compared to ISI 20 msec ($p < .05$). The significant interaction effect between ISI and visual field, $F(3, 99) = 21.62$, $p < .01$, sheds more light on this unexpected main effect for ISI. Looking at this interaction displayed in Figure 2, one can see that in the RVF there is a trend of better performance at increasing ISI levels. The only exception is ISI of 40 msec, which exceeds all other levels. However, in the LVF, the opposite trend is found with paradoxically better performance at briefer ISI levels.

A significant group X meaningfulness interaction effect was also found, $F(2, 33) = 4.43$, $p < .05$, which is displayed in Figure 3.

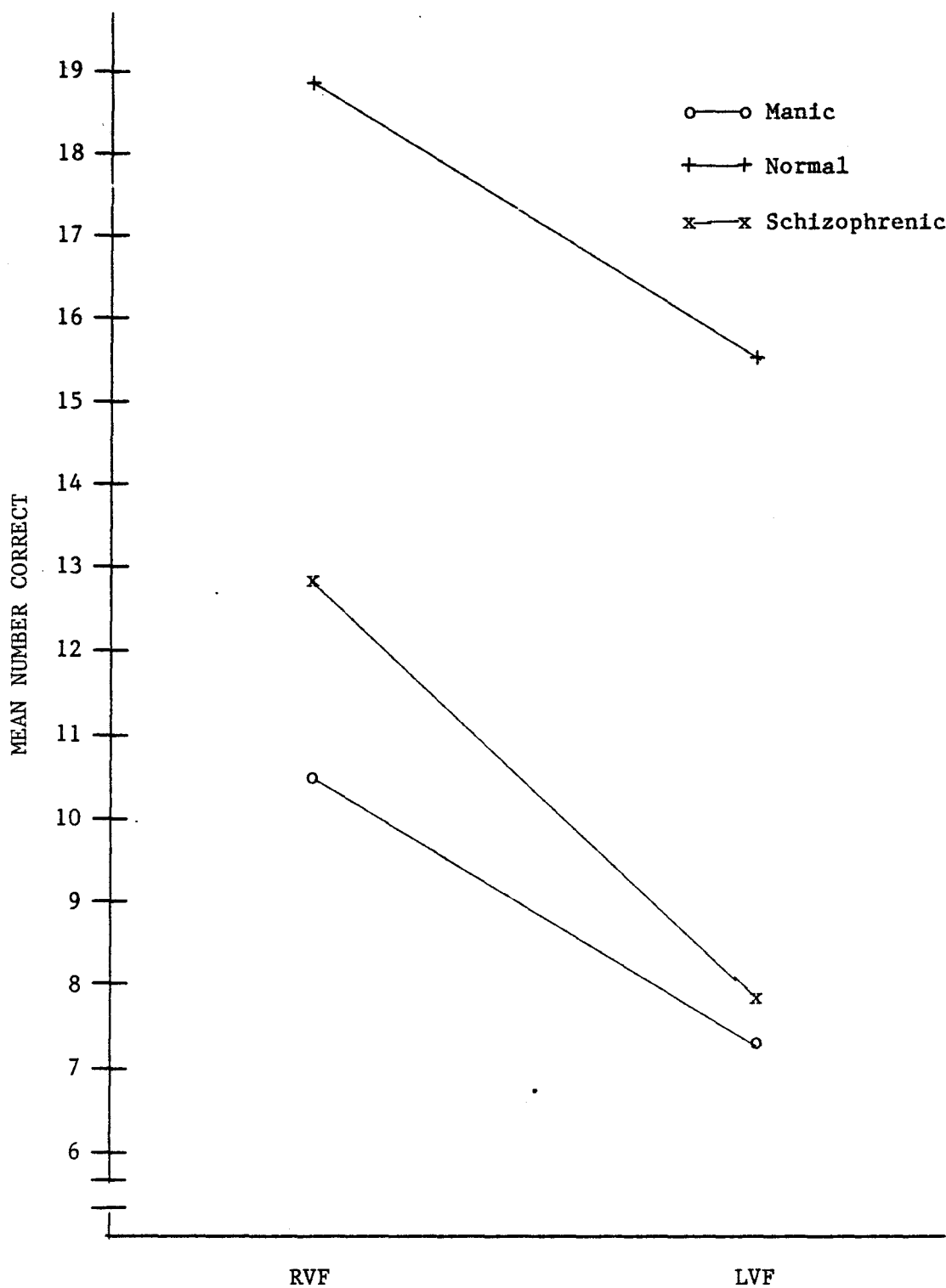


Figure 1. Mean number of correct syllables by group in the left and right visual fields.

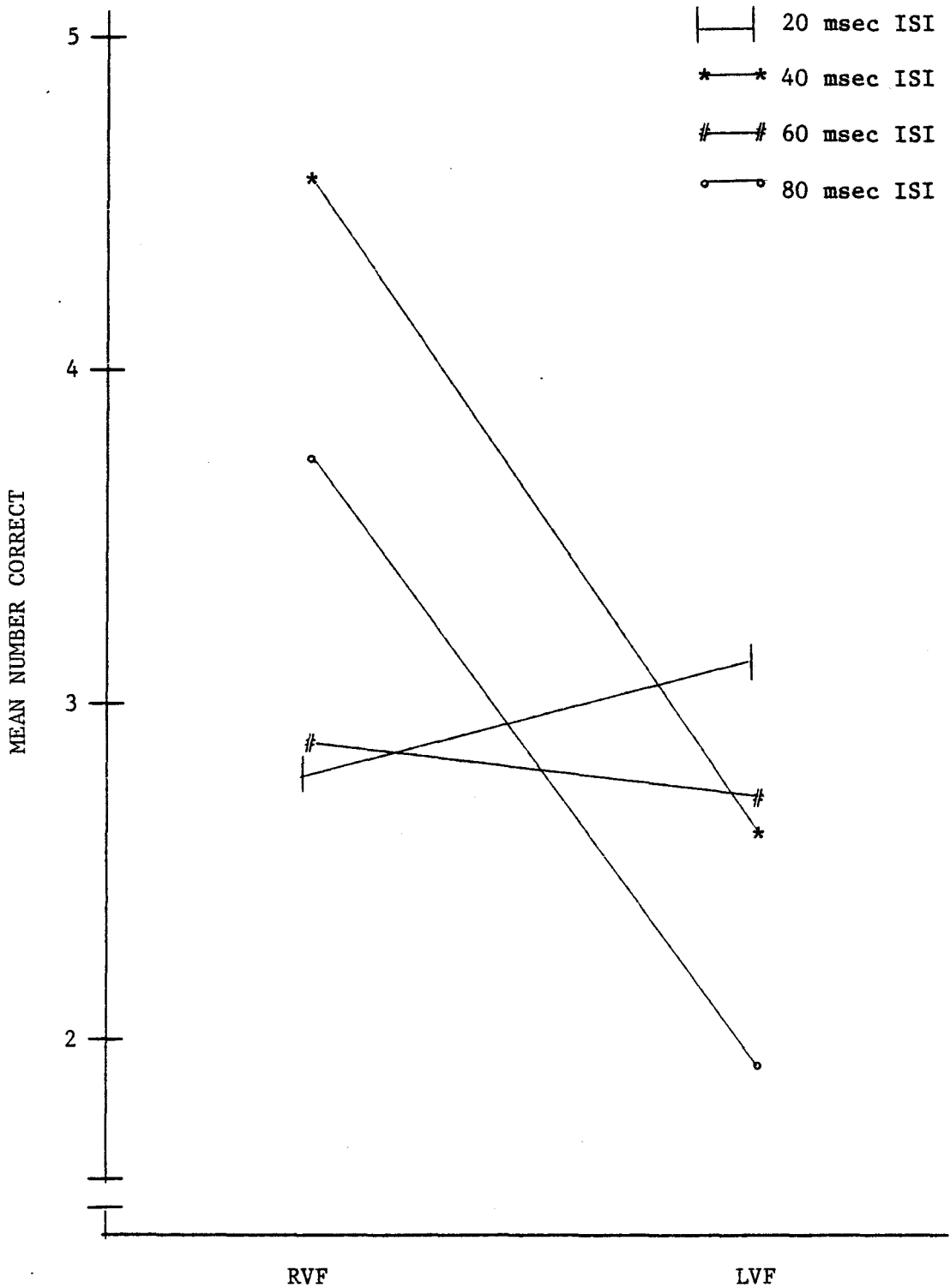


Figure 2. Mean number of correct syllables as a function of visual field and ISI.

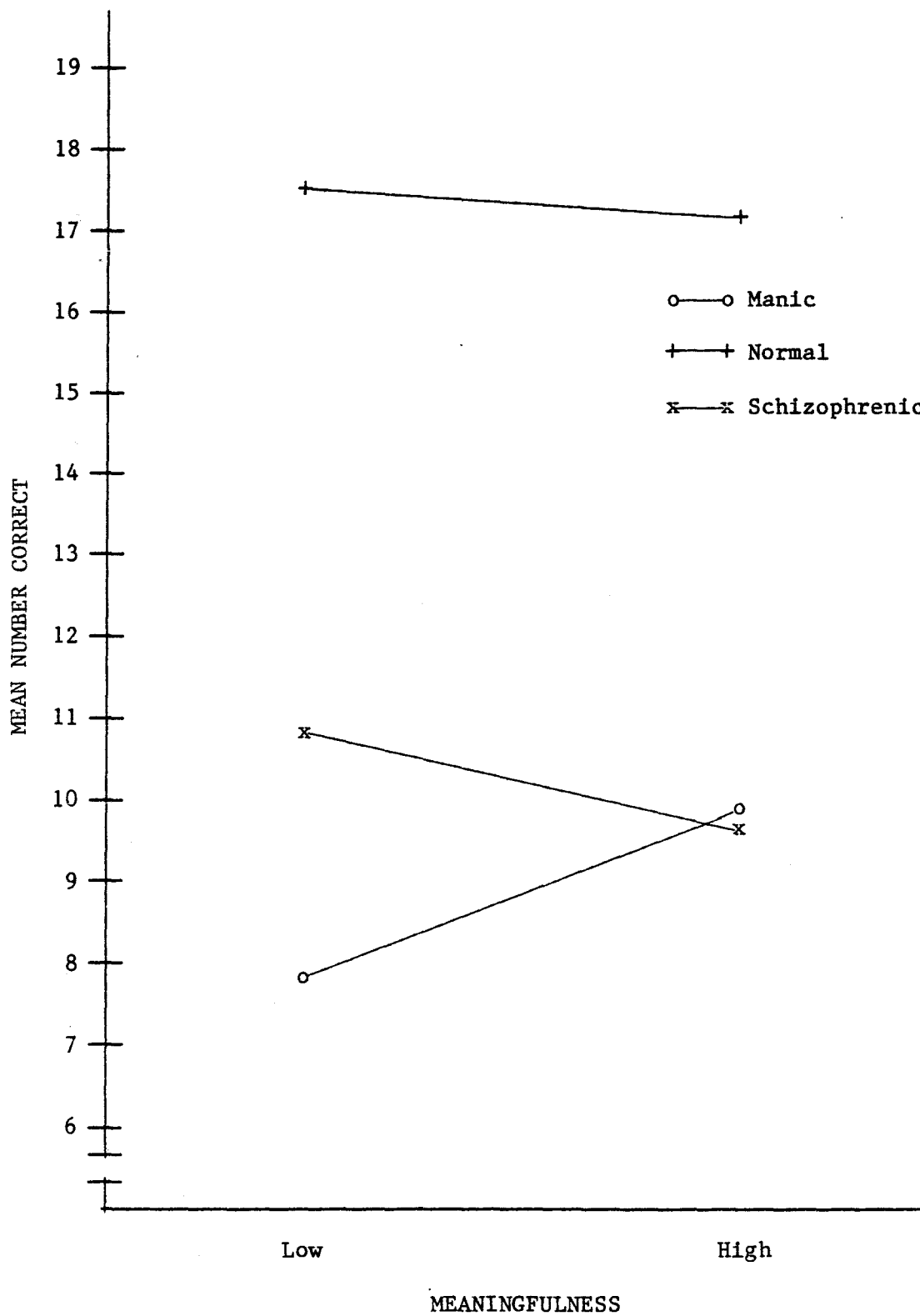


Figure 3. Mean number of correct syllables as a function of group and syllable meaningfulness.

Post-hoc analyses indicate that normals and schizophrenics do not differ significantly in number correct at the two levels of meaningfulness. The manic group, however, performed better on the highly meaningful syllables compared to low meaningful syllables ($p < .05$). A significant ISI X meaningfulness interaction, $F(3, 99) = 8.45$, $p < .01$, presented in Figure 4 indicates a tendency for better performance on the highly meaningful syllables at each ISI level except for ISI of 80 msec which shows the opposite tendency. A significant three-way interaction of visual field X ISI X meaningfulness, $F(3, 99) = 8.91$, $p < .01$, and a significant four-way interaction of group X visual field X ISI X meaningfulness, $F(6, 99) = 2.93$, $p < .05$, were also found. These higher-order interactions are simply noted and left uninterpreted since they do not form any consistent or theoretically meaningful pattern and are not directly related to the questions asked in the study.

Visual Figures Task

A similar mixed-design ANOVA was performed on the figure task. Differences are that three ISI levels were used (10, 20, 40 msec) and for the last factor, figure type (parallel, shifted parallel, nonparallel) replaced the meaningfulness factor. A significant main effect was found for groups, $F(2, 33) = 5.50$, $p < .01$. Planned comparisons of the means revealed that normals ($M = 81.08$) had significantly more correct than either the manic ($M = 53.17$) or schizophrenic ($M = 59.83$) groups ($ps < .05$). The two patient groups did not differ significantly ($p > .05$). There were no significant effects found for either the visual field factor or the groups X visual field interaction. Thus this

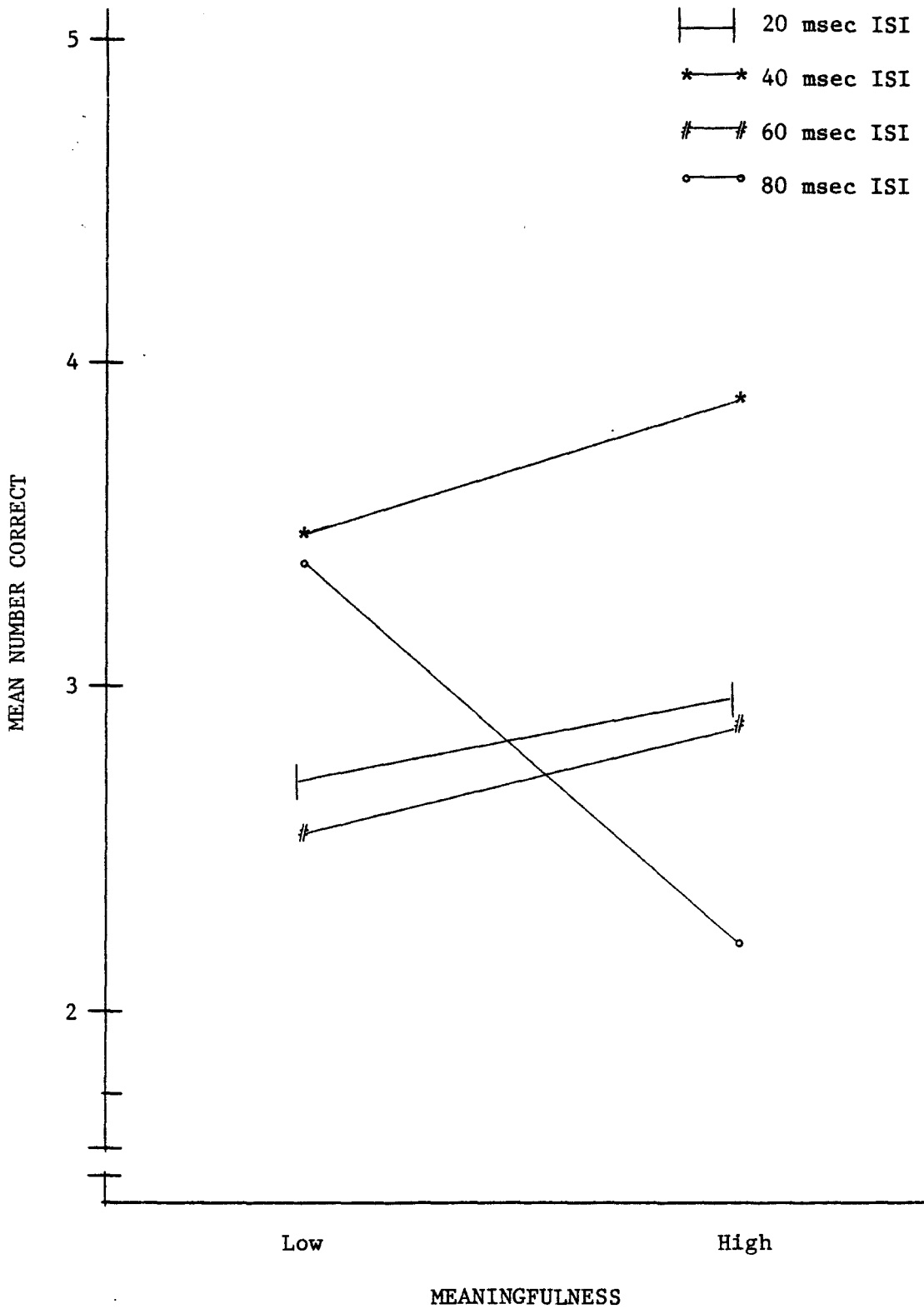


Figure 4. Mean number of correct syllables as a function of syllable meaningfulness and ISI.

test did not show the expected LVF superiority in performance for any of the groups. Therefore it cannot be concluded that this test necessarily taps right hemisphere functions. Nor was the hypothesis of relatively poorer performance of manics in the LVF for this task supported.

Significant main effects for ISI, $F(2, 66) = 32.64$, $p < .01$, and figural type, $F(2, 66) = 47.24$, $p < .01$, did occur in the expected direction. Planned comparisons of the means indicated that performance improved significantly with each increasing ISI level ($ps < .05$). The means for ISIs of 10, 20, and 40 msec were 19.83, 20.97, and 23.89, respectively. Comparing the means on the figural type factor indicated that the nonparallel lines ($M = 28.14$) were easier to perceive than both the parallel ($M = 19.56$) and shifted parallel ($M = 16.99$), $ps < .05$. Also, performance on the parallel lines was significantly better than on the shifted parallel lines ($p < .05$). These findings are consistent with those of Mayzner and Habinek (1976) who found that intersecting features (i.e., nonparallel lines) are extracted before parallel line features by the visual system.

The only other significant finding was for the ISI X figure type interaction, $F(4, 132) = 13.87$, $p < .01$, which is displayed in Figure 5. This effect is accounted for primarily by the fact that the nonparallel lines do not show the sharp increase in performance at 40 msec ISI as do the other two types of figures. This may be due to a ceiling effect since the detection of the nonparallel figures is close to perfect (75%-80%) regardless of ISI.

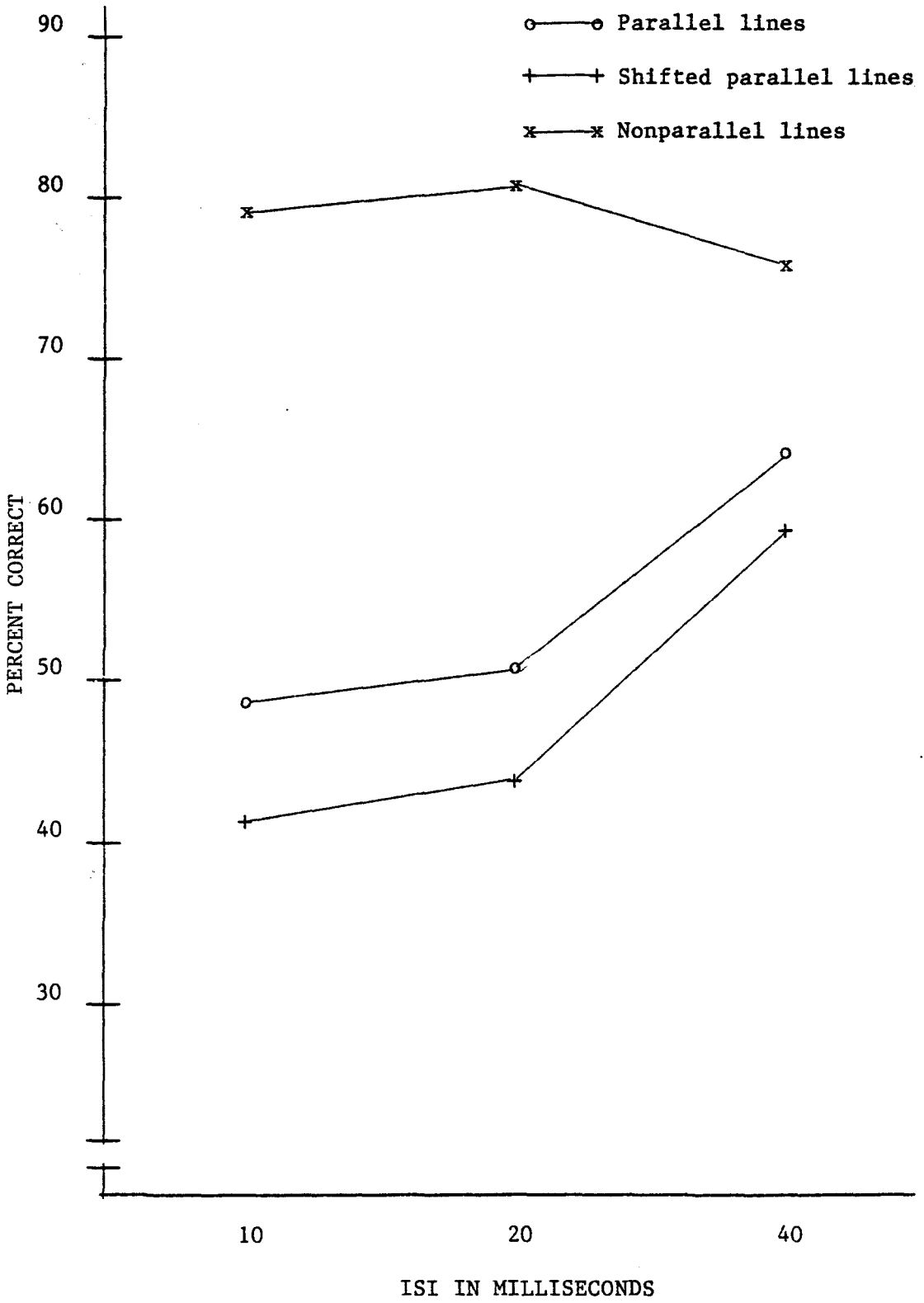


Figure 5. Mean number of correct syllables as a function of syllable meaningfulness and ISI.

Dichotic Syllables Task

The dichotic syllables used in this study (ba, pa, da, ta, ga, ka) can be classified in terms of the articulatory features of the consonants (Studdert-Kennedy & Shankweiler, 1970). The two articulatory features are place of articulation (labial, alveolar, velar) and voicing (voiced or unvoiced). Place of articulation refers to the place in the mouth involved in the articulation of the sound. Voicing refers to whether or not the vocal cords are vibrated during the sound. Since two different syllables were presented on each trial, one to each ear, the syllables could have differed in terms of place alone, voicing alone, or both place and voicing. Table 6 presents the various possible combinations of the stimuli in terms of articulatory features. A 3 (manic, normal, schizophrenic groups) X 2 (right or left ear) X 3 (voicing, place, or voicing and place feature contrast) ANOVA was performed with repeated measures on the last 2 factors. The number of correctly identified syllables served as the dependent measure. A main effect for groups was found, $F(2, 33) = 5.53$, $p < .01$. Planned comparisons of group means, 58.16, 69.67, and 63.33 for the manic, normal, and schizophrenic groups, respectively, indicated that normals performed significantly better than the manics ($p < .05$). The difference between the normals and schizophrenics was only marginally significant ($p < .10$). The performance of the manic and schizophrenic groups was not significantly different. A significant main effect for the ear factor, $F(1, 33) = 17.99$, $p < .01$, found the expected right ear superiority for syllable identification with 41.17% and 29.76% correct for the right and left ears, respectively. The group X ear interaction displayed in

Table 6
 Paired Combinations of the Six Stop Consonants in
 Terms of the Articulatory Features of Place and Voicing

Place of Articulation			
Voicing	Labial	Alveolar	Velar
Voiced	b	d	g
Unvoiced	p	t	k
Dichotic Pairs Differing in			
Voicing	Place	Voicing and Place	
b-p	b-d	b-t	
d-t	b-g	b-k	
g-k	p-t	p-d	
	p-k	p-g	
	d-g	d-k	
	t-k	t-g	

Figure 6 was not significant; thus, the hypothesized left hemisphere deficit for schizophrenics was not found. All groups showed the same pattern of better performance in the right compared to the left ear.

A significant main effect was found for the feature contrast factor, $F(2, 66) = 63.67$, $p < .01$. Planned comparisons revealed that pairs differing in place alone ($M = 38\%$) or voicing alone ($M = 40\%$) were not significantly different ($p > .05$). There were fewer correct detections for dichotic pairs differing in terms of both features of place and voicing ($M = 30\%$) than on either of the two other contrasts ($ps < .05$). A significant ear X feature contrast interaction effect is displayed in Figure 7, $F(2, 66) = 4.45$, $p < .05$. This interaction effect is primarily due to detection's being significantly worse for pairs differing in voicing compared to those differing in place in the left ear whereas in the right ear they do not differ. The lack of a significant group X feature contrast effect, or a group X ear X feature contrast effect indicates that there is no evidence for differential processing due to feature contrast among the groups. In other words, the pattern of performance is similar across groups, the only difference being that normals tend to perform better overall.

Environmental Sounds Task

A 3 (manic, normal, schizophrenic groups) X 2 (right or left ear) ANOVA with repeated measures on the last factor was performed with number correct as the dependent variable. Table 7 contains the group X ear cell and marginal means for the environmental sounds. The main effects for group, $F(2, 33) = 2.86$, $p < .07$, and ear, $F(1, 33) = 3.60$, $p < .07$,

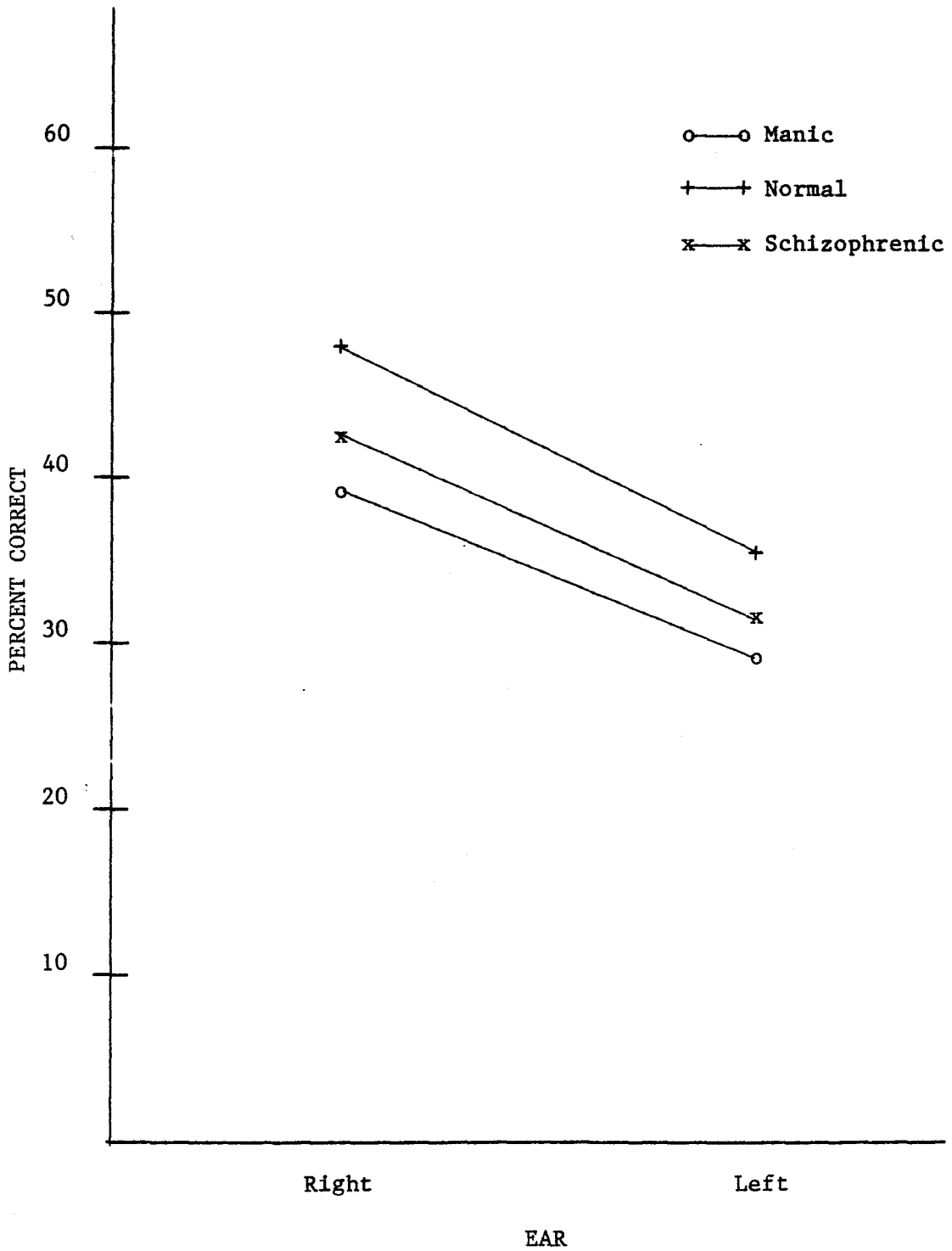


Figure 6. Percent of dichotic syllables correct as a function of group and ear.

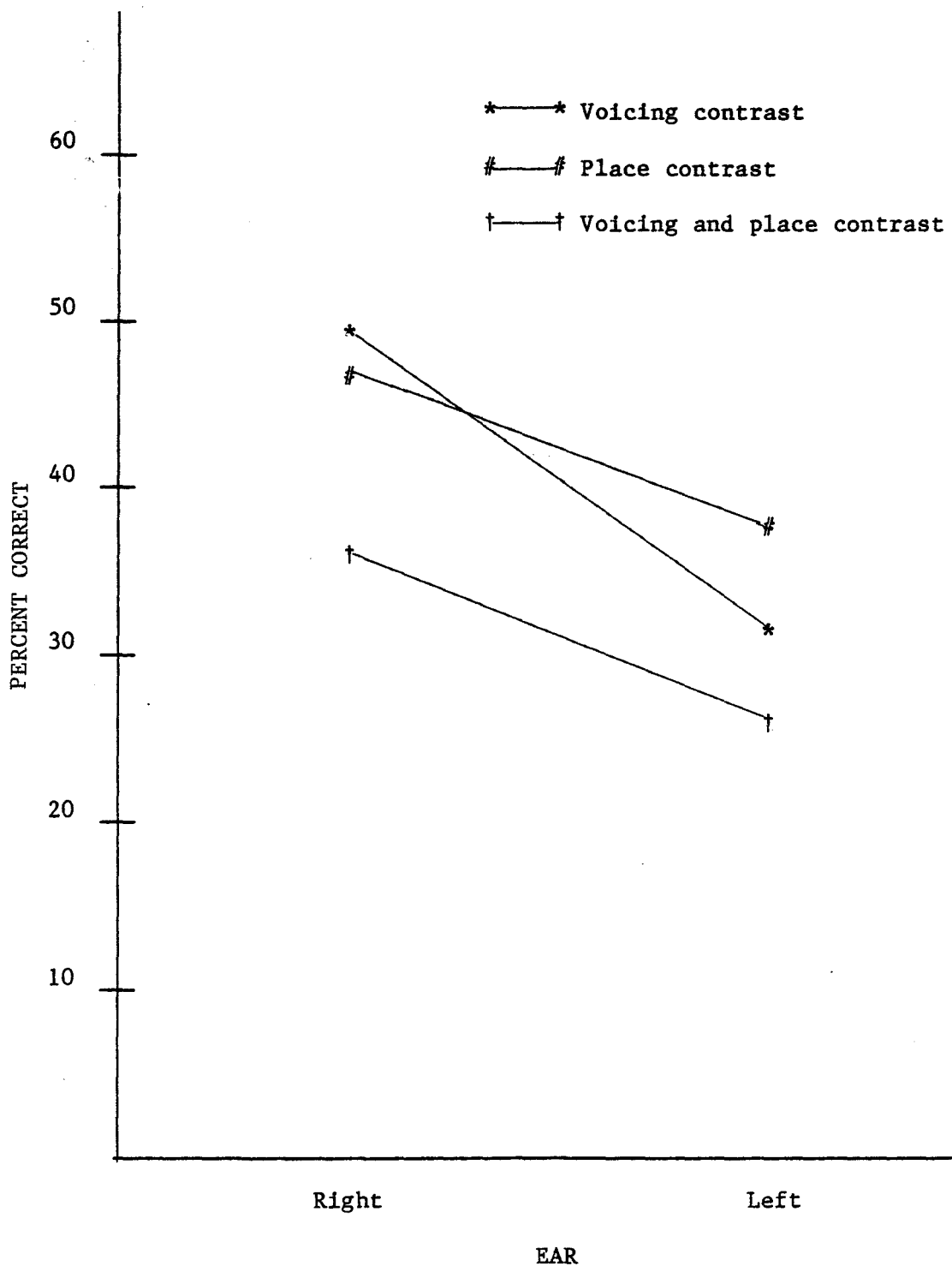


Figure 7. Percent of dichotic syllables correct as a function of ear and dichotic contrast.

Table 7

Mean Number of Correct Responses on the
Environmental Sounds Test by Group and Ear

Group	Ear		Total
	Left	Right	
Manic	18.92	17.92	18.42
Normal	19.58	19.50	19.54
Schizophrenic	18.58	18.33	18.46
Total	19.03	18.58	18.81

Note. Maximum number correct for each ear = 20.

did not quite reach significance at the .05 level. The group X ear interaction failed to even approach significance, $F(2, 33) = 1.45$, $p < .25$. Thus the hypothesis of poorer left ear performance among manics was not substantiated. Since there was an overall accuracy rate of about 90%, it could be that the test was too easy and a ceiling effect occurred which did not allow laterality differences to be more pronounced.

Although the F s were not significant, the trend was towards better performance in the normal group than for the two patient groups-- this being consistent with the results on other performance measures. Also, there was a tendency for the left ear to be more accurate than the right, which is in the expected direction for this task.

Right and Left Hemisphere Scales

The standard scores of the Right and Left scales of the Luria-Nebraska Neuropsychological Battery and a difference score (Left minus Right scale) were the dependent variables in three separate one-way ANOVAs with groups as the main effect. Table 8 presents the means for the three groups on the three variables. A significant effect was found for both the Left scale, $F(2, 33) = 5.85$, $p < .01$, and Right scale, $F(2, 33) = 4.88$, $p < .01$. Planned comparisons of means revealed that for both variables, normals had significantly lower scores (indicating better performance) than the two patient groups (p s $< .05$). The patient groups did not differ from each other ($p > .05$). On the Left-Right index there were no differences among groups (p s $> .05$). The hypotheses of greater right hemisphere impairment for the manics and left

Table 8

Group Means for the Left and Right Hemisphere Scales

Group	Scale		
	Left	Right	Left-Right
Manic	48.08	46.92	1.17
Normal	41.08	39.00	2.08
Schizophrenic	52.00	48.75	3.25

hemisphere impairment for the schizophrenics were not confirmed. It should also be noted that none of the group means on either of the scales were in the pathological range as specified by Golden et al. (1979). Thus there was no evidence of significant hemisphere pathology for any of the groups in either hemisphere.

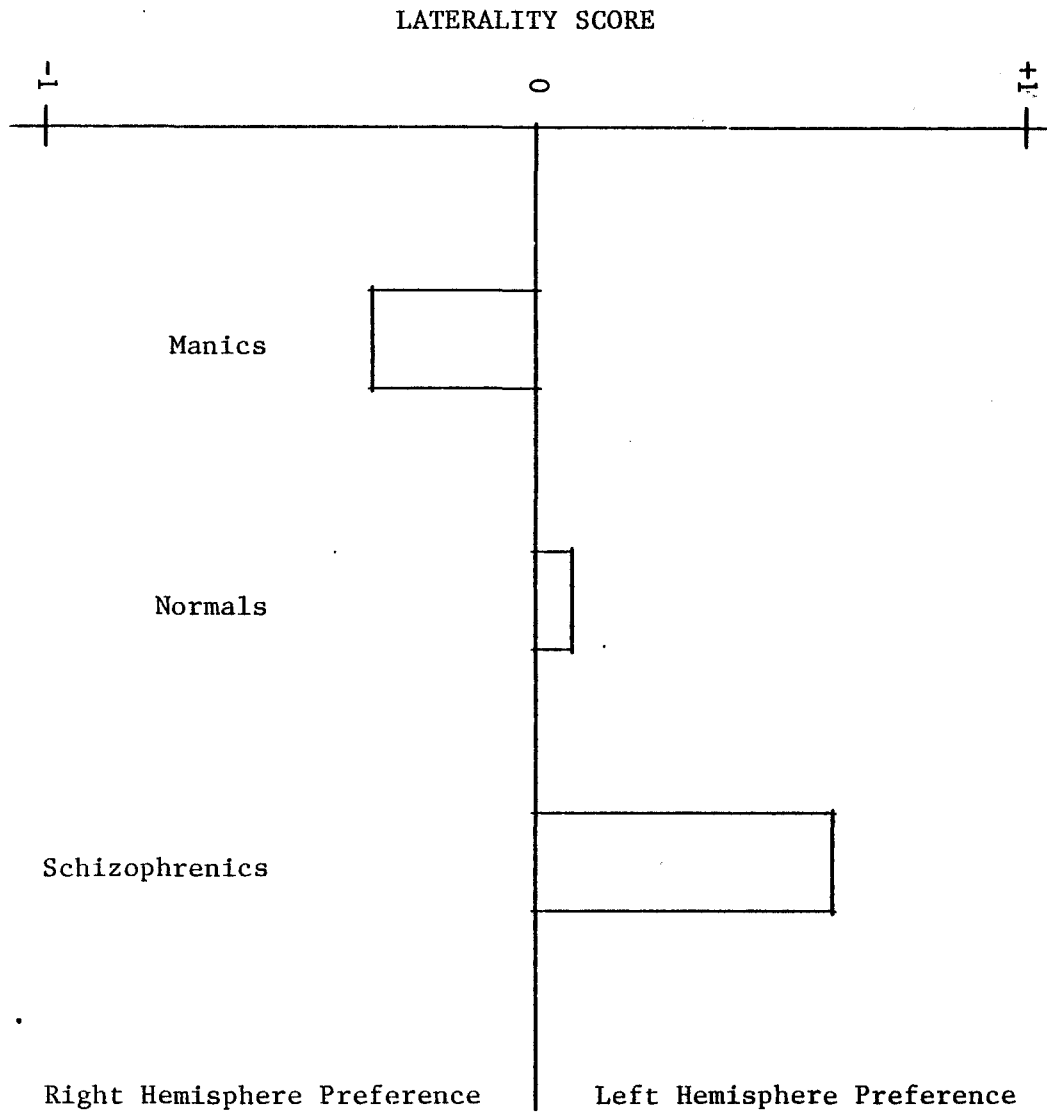
Eye Movements

A laterality score was computed as the dependent measure in this analysis. The formula for the laterality score \underline{L} is as follows:

$$\underline{L} = \frac{(\text{number of right LEMs} - \text{number of left LEMs})}{(\text{number of right LEMs} + \text{number of left LEMs})}$$

This is a ratio of the difference in the number of right and left LEMs over the total number of LEMs. Scores could range from +1.0, which would indicate all right LEMs, to -1.0, which would indicate all left LEMs. A score of 0.0 indicates an equal number of left and right LEMs. The laterality score \underline{L} was analyzed in a 3 (manic, normal, schizophrenic groups) X 2 (verbal or spatial type question) X 2 (emotional or non-emotional question) ANOVA with repeated measures on the last two factors. The analysis revealed a significant main effect for group, $F(2, 33) = 6.99, p < .01$. The means for the manic, normal, and schizophrenic groups of -.26, .06, and .54, respectively, are displayed in Figure 8. Since preferential direction of LEM is related to hemisphericity or hemispheric preference, it can be seen that manics show a right hemisphere preference and schizophrenics show a left hemisphere preference while normals as a group show no preference. Thus the hypotheses of right hemisphere preference in affective disorder and left

Figure 8. Group mean laterality scores for eye movements.



hemisphere preference in schizophrenia were confirmed. No other main or interaction effects reached significance.

Myers-Briggs Type Indicator

The extraversion-introversion (E-I), sensation-intuition (S-N), and thinking-feeling (T-F) scales of the Myers-Briggs were the dependent variables analyzed in three separate one-way between-subjects ANOVAs with groups (manic, normal, schizophrenic) as the between-subjects variable. Table 9 contains the means and standard deviations of the three scales for each group. A score of 100 is the midpoint of each scale, so scores greater than 100 categorized individuals as introverted on the E-I scale, intuitive on the S-N scale, and feeling on the T-F scale. Scores lower than 100 place individuals on the extraverted, sensation, and thinking ends of the corresponding scales. On the E-I scale, schizophrenics scored more towards the introverted end of the scale than the manics and normals. However, the ANOVA was not significant, $F(2, 33) = 1.32, p > .05$. On the S-N scale, schizophrenics scored more towards the sensation end of the scale than manics and normals, but again the ANOVA was not significant, $F(2, 33) = .15, p > .05$. Both normals and schizophrenics scored more towards the thinking end of the T-F than did the manics, whose group mean was toward the feeling end. The ANOVA was significant, $F(2, 33) = 3.71, p < .05$. Post-hoc analyses revealed that both normals and schizophrenics differed significantly from the manics on the T-F scale ($ps < .05$). Normals and schizophrenics did not differ significantly ($p > .05$). Table 10 contains the distribution of types for each group.

Table 9
Group Means and Standard Deviations for Myers-Briggs Scales

Group	Scale ^a		
	E-I	S-N	T-F
Manic	101.50 (28.42) ^b	90.67 (25.71)	100.67 (22.45)
Normal	102.00 (28.18)	87.67 (26.44)	78.83 (17.24)
Schizophrenic	116.50 (19.32)	85.17 (20.79)	83.00 (22.47)

^aE-I = extraversion-introversion scale; S-N = sensation-intuition scale; T-F = thinking-feeling scale.

^bNumbers in parentheses are standard deviations.

Table 10
Frequency Distribution of Types by Groups

Group	Introverted				Extraverted			
	T-S	T-N	F-S	F-N	T-S	T-N	F-S	F-N
Manic	1	2	2	1	1	1	2	2
Normal	4	3	0	0	3	1	1	0
Schizophrenic	8	1	1	0	2	0	0	0

The nonparametric Mann-Whitney U test was computed for each of the scales in comparing the ranks of the normal, manic, and schizophrenic groups on these scales. All possible pairs of groups were compared. This was done to look at the relative standing of groups with one another since the distributions of scores were skewed. Table 11 contains the mean rankings for each group contrast on the Mann-Whitney test and associated probability levels. These findings indicate that the mean rankings of the schizophrenic group compared to the manic group are more towards the introverted, sensation, and thinking ends of the scales. Normals and schizophrenics did not differ significantly on the scales although there was a nonsignificant trend towards the introverted end for schizophrenics compared to normals ($p < .10$). Normals differed from manics on the T-F scale, scoring more towards the thinking end than manics. The lack of consistent differences between the normal and patient groups is not unexpected since the Myers-Briggs is not meant to separate normal from pathological groups. Rather, it is meant to describe typology which normals and pathological groups may or may not have in common. The main interest in this test was to look for different typologies between schizophrenic and manic patients, which was found. Overall, these results support the hypothesis of a sensation-thinking typology for schizophrenics and an intuitive-feeling typology for manics. In addition, schizophrenics tend to be introverted, while manics tend towards extraversion.

Since previous research has related Jungian typology to hemispheric preference (Prifitera, 1981; Rossi, 1977) and this study hypothesized left hemisphere preference for schizophrenics and right

Table 11
Mann-Whitney U Tests for All Possible Combinations of Groups

Variable	Mean Rankings		<u>U</u>	<u>p</u>
	Manic	Schizophrenic		
E-I	10.0	15.0	42.0	.04
S-N	14.2	10.8	52.0	.12
T-F	15.3	9.7	38.0	.03
Variable	Manic	Normal	<u>U</u>	<u>p</u>
	Normal	Schizophrenic		
E-I	12.0	13.0	66.5	.38
S-N	13.0	12.0	65.5	.36
T-F	16.0	9.0	29.5	.01
Variable	Normal	Schizophrenic	<u>U</u>	<u>p</u>
	Schizophrenic	Normal		
E-I	10.7	14.3	50.0	.10
S-N	12.0	13.0	65.5	.36
T-F	11.8	13.3	63.0	.30

hemisphere preference for manics, a discriminant function analysis on the two patient groups was performed using the eye movement laterality score and the T-F and S-N scales from the Myers-Briggs. This analysis yielded a discriminant function consisting of the two variables T-F and eye movement laterality. The S-N variable dropped out of the equation because it did not contribute significantly to group discrimination. The standardized discriminant function coefficients were $-.3803$ for the T-F variable and $.9129$ for the eye movement laterality score, indicating that the latter variable is making a relatively greater contribution to the discriminant function score. This function can be viewed as a cognitive style factor with left hemisphere analytical style defining one pole and right hemisphere emotional style defining the other pole. Tatsuoka's (1970) formula for discriminatory power yielded a value of $.47$ for the discriminant function. This value is analogous to the squared correlation coefficient and thus offers an index of the amount of variance attributable to group differences. Classification of subjects according to the discriminant function, presented in Table 12, yielded 88% correct classification. Of course, cross-validation of this function with other groups of patients is needed to obtain a better estimate of the classificatory power of this function. Since results indicated that patient groups differed on the E-I scale, another discriminant function analysis was performed which included this as a fourth dependent variable although previous research did not find a relationship between E-I and laterality (Prifitera, 1981). The E-I variable did not contribute significantly to group discrimination and dropped out of the discriminant function equation as did the S-N factor.

Table 12
Classification of Subjects into Diagnostic Category
Based on Discriminant Function

Actual Group	Predicted Group Membership	
	Manic	Schizophrenic
Manic	11	1
Schizophrenic	2	10

DISCUSSION

The hypotheses of left hemisphere dysfunction in schizophrenia and right hemisphere dysfunction in mania were not supported on the visual, auditory, and neuropsychological measures. Both patient groups performed poorer than normals; however, the patterns of performance across hemispheres were remarkably similar to those of the normal controls. The hypotheses of left hemisphere preference in schizophrenics, as measured by eye movements, and right hemisphere preference in manics were confirmed: schizophrenics had more right LEMs and manics had more left LEMs. Also, the personality differences between the groups on the Myers-Briggs Type Indicator scales were in the expected direction. Schizophrenics tended to score more toward the thinking, sensation, and introverted end of the scale, whereas manics scored towards the feeling, intuitive, and extraverted ends.

With respect to the visual syllable task, poorer performance in the RVF for schizophrenics as reported by Gur (1978) was not found in this study. Also, manics failed to show abnormal hemispheric differences on this task. Both patient groups showed the same RVF superiority found in normals. The only difference was that normals performed better than both patient groups. Since there is a left hemisphere advantage in this task, one would expect schizophrenics to perform much worse overall if a left hemisphere dysfunction were present and performance would be particularly poor for RVF presentation. Since this was not the case, it

argues against the presence of left hemisphere dysfunction in schizophrenia. In fact, it appears that both schizophrenics and manics process verbal material in the two hemispheres in much the same way as normals. If anything, the schizophrenics showed a LVF deficit since the difference in the number of syllables correct in the LVF compared to the RVF was greater for the schizophrenics than for the normal or manic group (see Figure 1), although the difference was not statistically significant. There were also differences in levels of performance for each group across ISI levels, indicating that the interference of the mask had a similar effect across groups. The manic group showed better performance on the highly meaningful syllables compared to the low meaningful syllables while the other two groups did not differ significantly as a function of syllable meaningfulness. It may be that the lack of associational value or semantic familiarity makes it more difficult for the manics to process and identify the syllables. This fits with what Prentky (1979) refers to as the A type of cognitive style, which is characteristic of manics. This type of processing involves many associations in the thought process. The low meaningful words, which have much less probability of generating associations, are less likely to fit in with the A type of cognitive style.

An unexpected finding was the significant interaction effect between ISI and visual field. In the RVF, identification of syllables was better with increasing ISIs, which is in the expected direction. The only exception is at 40 msec ISI in which performance is higher than at longer ISIs. Apparently some factor extraneous to the questions asked in this study made the syllables presented at 40 msec ISI easier to

perceive. Solso (1979) reports studies in which various contextual effects influenced identification of letters such as the specific letters in a group of letters. An effect such as this may account for the level of performance at ISI 40 msec. In other words, some factor unique to those syllables presented in the RVF at 40 msec made them easier to detect. Nevertheless, the trend of better performance with increasing ISI levels is present. One would expect this trend since a longer ISI would give the subject more time to encode the target stimulus before the mask interfered with the processing. However, in the LVF the exact opposite trend occurs. There is better performance at briefer ISIs. This paradoxical effect has not been previously reported in the literature. Researchers using a masking paradigm in letter and word identification tasks have rarely looked at the differences between visual fields. There is no ready explanation for the difference in trend between visual fields and more research will be required to validate and understand this effect. However, it is evident from the research in hemispheric functioning that the two hemispheres do process information differently, which may account for the difference in trends. The right hemisphere processes information in wholes, gestalt configurations, and instantaneously, whereas the left hemisphere processes information sequentially and analytically. Magaro (1980) has pointed out the similarities between the left and right hemispheric styles of information processing and Schneider and Shiffrin's (1977) model of automatic and controlled processing. In automatic processing there is an automatic, almost instantaneous, response to the stimulus which does not require active control or attention by the individual. It is, in Neisser's

(1967) terms, "pre-attentive" and is much quicker than controlled processing or Neisser's "focal attention" which is serial in nature and capacity limited compared to automatic processing. It would seem that simple pattern recognition would require simple automatic processing whereas phonetic analysis would require controlled processing in the case of syllable identification. It may be that with presentation to the right hemisphere, which does possess some rudimentary ability to identify words (Bogen, 1979; Nebes, 1978), the individual may use an automatic processing strategy and retain the icon as icon at the quicker ISIs. With increased ISI a controlled processing strategy may take over which results in poorer performance. This decrease in performance may be a result of either the right hemisphere attempting a phonetic analysis for which it is poorly equipped or in transferring the information to the left hemisphere in an attempt to let the left hemisphere perform the phonetic analysis for which it is appropriately equipped. In this case there is a greater probability of information being lost in callosal transfer. While all this is highly speculative and requires further investigation, it should be remembered that whatever the mechanism involved, the patterns of performance of the patient groups were similar to those of the normal controls, indicating that the patient groups processed the information in a manner analogous to normals.

On the visual figures task no visual field effect was found, indicating that there was no hemispheric advantage evident on this task. No group X visual field interaction was found either, thus the hypothesis of right hemisphere deficit on this task for manics was not supported. Also, if a right hemisphere deficit had been present in manics,

one would have expected worse performance in the LVF, which was not the case. However, since this task did not prove to have a right hemisphere advantage, the fact that manics performed equally across visual fields cannot be taken as clear evidence for the lack of a right hemisphere deficit.

A significant main effect for the ISI factor found that performance improved with increasing ISIs, which is in the expected direction. Unlike the syllable task, the trend was identical in both visual fields. Also, the results indicate that detection was best for the nonparallel lines compared to the parallel and shifted parallel lines. This is consistent with Mayzner and Habinek (1976), who concluded that intersecting features (characteristic of the nonparallel lines) are extracted before parallel features by the visual system. The fact that patient groups performed in a manner analogous to the normals indicates that the mechanism for this type of feature extraction does not deviate from the norm in schizophrenics and manics. There was a difference in the groups in terms of overall level of performance, with normals having more correct detections than either of the patient groups. This finding is consistent with the visual syllable task finding, suggesting a generalized cognitive impairment among the psychiatric groups.

On the dichotic syllables task, normals performed significantly better than manics, but the difference between normals and schizophrenics was only marginally significant ($p < .10$). The two patient groups did not differ significantly. Better performance by normals is consistent with generalized cognitive impairment in the patient groups. The expected right ear advantage was found in all groups. There was no

significant group X ear effect, which argues against a left hemisphere impairment in schizophrenia. In fact, the finding that schizophrenics and normals did not differ significantly (at the .05 level) on this task is even a stronger argument against left hemisphere dysfunction in schizophrenia. Again, the pattern of performance across ears is similar in the three groups, suggesting similar information processing mechanisms for this task in the two hemispheres across groups. The findings in the present study are consistent with other studies which have failed to find a left hemisphere deficit in schizophrenia on dichotic verbal tasks (Fennell et al., Note 1; Lishman et al., 1978). Also, these findings do not support the defective transcallosal transfer hypothesis since the pattern of performance for both patient groups was in the expected direction.

A main effect was found for the feature contrast factor of the dichotic syllables. Dichotic pairs differing in both features of place and voicing had lower accuracy rates than those pairs contrasting in only one feature. This is consistent with the findings of Shankweiler and Studdert-Kennedy (1967) and Studdert-Kennedy and Shankweiler (1970). A significant contrast X ear interaction was also found. Accuracy for the right ear on pairs differing in voicing and differing in place are not significantly different. They do differ with respect to accuracy in the left ear. The fact that there is a greater right ear advantage for pairs differing in voicing than for pairs differing in place suggests greater lateralization for the voicing feature. Again, the most important aspect of these findings is that all groups display the same pattern of lateralization for articulatory features. Patient groups tend

to process articulatory features in the same manner as normals. If schizophrenics did have a left hemisphere dysfunction, one would not expect such a pattern of performance for them.

Results of the Environmental Sounds Test revealed a nonsignificant trend for normals to perform better than both patient groups. This trend is consistent with generalized cognitive impairment in the patient groups. Performance was also better for sounds presented to the left ear, but this effect was only marginally significant ($p < .07$). This, however, is in the expected direction, suggesting a right hemisphere advantage for this task. It should be remembered that the high overall accuracy rate for this task indicates that it was fairly easy for all subjects. This may have diminished the laterality effect as well as group differences for the type of processing required for this task. There was no group X ear interaction effect, which argues against a right hemisphere deficit in manics. In fact, manics show the largest left ear superiority of the three groups although this was not statistically significant. These findings also argue against defective inter-hemispheric transfer in psychiatric groups since the patterns were similar across groups.

On the Right and Left Hemisphere scales, normals performed better than both patient groups. The patient groups did not differ from one another. The hypotheses of left and right hemisphere dysfunction for the schizophrenic and manic groups, respectively, were not confirmed. This is consistent with findings on the other performance measures. It should be noted that none of the group means were in the pathological range, indicating that hemispheric functioning was in the normal range

for all groups. These scales have also been found to be effective in discriminating normal from neurological patients (Golden et al., 1979). The fact that both patient groups performed within the normal range on these two scales argues against the presence of significant neurological impairment in these samples.

In the perceptual tasks discussed thus far, normals typically perform better than both patient groups. The patterns of performance, however, are remarkably similar across groups, even at the level of feature detection of lines and articulatory features of speech. There is little in these results to support the notion of lateralized dysfunction in either patient group. Nor can one support the interhemispheric transfer hypothesis.

Saccuzzo and his associates (1974, 1977, 1978, 1981, 1982) propose that schizophrenics are slower in processing information. The findings in this study are consistent with such a viewpoint. Also, this study finds that a similar process is present in mania. Just as thought disorder is not specific to schizophrenia (Harrow and Quinlin, 1977), so, too, slowness of information processing is not particular to schizophrenia but may be a feature of psychotic disorders.

Another factor probably contributing to the poorer performance of the patient groups, which was not directly measured in the study, is patients' behavior during the testing. In many instances of testing with the psychiatric subjects, the experimenter often had to focus the patient's attention and redirect interest to the task at hand. Also, patients were less cooperative than normals, which may have detracted from optimal performance. At times hallucination and impaired thought

processes (e.g., flight of ideas, delusion thoughts) halted the testing until the patients were stable again. Motivational levels of the patients were lower than those of normals, indicated by frequent complaining that the tasks were too difficult or boring and they did not want to try. In other words, testing was not nearly as smooth with the patient groups as with the normals. Of course, this is not unexpected when testing psychiatric patients. However, it could have been that these factors contributed to a high level of distractability which lowered performance. It may be that distractability rather than or in addition to slower information processing contributes to poorer performance. It would be beneficial to systematically examine and control for these factors in future studies.

Results on the eye movement measure confirmed the hypotheses of left hemisphere preference in schizophrenia and right hemisphere preference in mania. This is consistent with findings by other researchers (Gur, 1978; Schweitzer, 1979). Since direction of eye movements is an index of hemispheric activation (Gur & Reivich, 1980; Hassett, 1978), the notion of overactivation of the left and right hemisphere in schizophrenia and affective disorder, respectively (Gur, 1978; Flor-Henry, 1976b; Tucker et al., 1981), is supported. It must be remembered that while hemispheric preference may be characteristic of different psychopathologies, it is not a pathognomic sign since normals also display hemispheric preferences. While hemispheric preference may help in differential diagnosis among a group of psychotic patients, it is not useful in differentiating normal from pathological individuals. Also, hemispheric preference apparently is not related to performance on

various information processing tasks since group differences on the perceptual tasks were not found between the two patient groups who displayed different hemispheric preferences.

The hemispheric preference factor, when looked at in conjunction with associated personality characteristics, can be viewed as a cognitive style factor. The present study found that manics tended to score towards the extraverted, intuitive, and feeling ends of the Myers-Briggs scales compared to the schizophrenics who scored towards the introverted, sensation and feeling ends. Again it must be remembered that these typology differences may be characteristic of the psychiatric groups tested, but they are not pathognomic since normals also can show these typologies.

Jung (1921) had postulated that manic-depressives were more likely to be extraverts and schizophrenics were more likely to be introverts. This is supported in the present study. Jung, however, made no statements concerning the other two personality dimensions. The left hemisphere-analytic and right hemisphere-emotional typology suggested by the present findings is consistent with Smokler and Shevrin (1979), who found that obsessive-compulsive types were more likely to show a left hemisphere preference and hysterical personality types showed a right hemisphere preference. This cognitive style dichotomy is also similar to Prentky's (1979) dichotomy of extracognitive and introcognitive processing, which he relates to left and right hemispheric styles of cognitive processing. He also postulates that the extracognitive style is characteristic of manics who possess a strong inhibitory nervous system while the introcognitive style is characteristic of schizophrenics with

a weak inhibitory nervous system. The use of the inhibitory construct based on Pavlov's classic work also resembles Eysenck's (1967) explanation of personality differences, although Pavlov and Eysenck did not consider hemispheric differences.

It may be that schizophrenics use a left hemisphere-analytic cognitive style to such a degree that it becomes maladaptive and dysfunctional and digresses into a caricature of a left hemisphere-analytic cognitive style. The same may be true for manics with respect to a right hemisphere-emotional style. Overreliance on one or the other hemisphere may prevent effective integration of the two hemispheres and undermines their complementarity which is needed for constructive adaptation to the environment (Kinsbourne, 1982).

Gur (1978) speculated that since schizophrenics in her study showed a left hemisphere dysfunction, psychological interventions which concentrated on ameliorating the left hemisphere dysfunction might be useful in treating schizophrenics. The present study, however, found no such lateralized cognitive deficits. Thus, based upon the current study, there is no basis for taking into account lateralized deficits when planning interventions. The patient groups in the present study processed information across hemispheres much like normals, except at a less efficient rate. Since left hemisphere dysfunction in schizophrenia has not been found consistently, additional research is needed before intervention strategies based upon amelioration or remediation of a dysfunctional hemisphere can be prescribed.

Differences in cognitive styles and hemispheric preference between manics and schizophrenics suggested by the present findings do

provoke speculations about implications for therapeutic approaches in treating these disorders. The differences in typology found between manics and schizophrenics may be a fruitful area of research in terms of implications for therapy. Different typologies differ in the type of information attended to and remembered (Carlson, 1980). This may affect the way in which manics and schizophrenics perceive past and current events in their lives, thereby affecting self-perception and perception of others (including the therapist) in ways which may be predictable and lawful as a function of typology. Also, a patient with a given typology may interact differently with a therapist as a function of the therapist's typology. This may affect the types of transference issues which emerge. Research into these areas would be fruitful for understanding the therapeutic process with manics and schizophrenics.

Another perspective from which to view the effects of cognitive styles upon therapy is by looking at the relationship between hemispheric preference and defense mechanisms. Hemispheric preference has been found to be associated with different defensive styles (Gur & Gur, 1975). Differences in defense mechanisms are likely to affect the types of issues that emerge in therapy such as the client-therapist relationship and transference issues. Of course, to say that manics and schizophrenics employ different defense mechanisms is not say anything new. However, to look at these differences in terms of cognitive style gives the problem a different vantage point than those of traditional approaches such as psychoanalysis. It is this vantage point which allows one to select from a new set of therapeutic strategies which take into account cognitive and information-processing strategies of

patients. For example, Tucker and Newman (1981) reported that a verbal-analytic cognitive strategy was more effective in suppressing emotional arousal than a global-imaginative strategy. These strategies are reminiscent of left and right hemispheric styles. The present findings which suggest that schizophrenics overemploy a left hemisphere-analytic style may account for the schizoid qualities and blunted affect in these individuals. Likewise, the emotional lability and flights of ideas characteristic of manics may be due to the overuse of a right hemisphere cognitive style. Taking these different cognitive styles into account may be important when planning therapeutic interventions. For example, using a verbal-analytic therapeutic modality such as psychoanalysis with schizophrenics may actually be encouraging the use of a dysfunction cognitive style. Research with manics and schizophrenics on the effects of treatments which increase reliance on left or right hemispheric cognitive styles is needed to assess whether the cognitive style dimension is an important factor to consider in therapy. Such considerations may also be relevant in the treatment of neurotic disorders since hemispheric cognitive style differences have been found between obsessive-compulsive and hysterical personalities (Smokler & Shevrin, 1979).

Polar distinctions between the concepts of "left" and "right" have been made in a variety of cultures throughout history (Needham, 1973; Tomkins, 1964). Bruner (1962) eloquently discusses the difference between two modes of knowing which are based on the symbolism of left and right:

Since childhood, I have been enchanted by the fact and the symbolism of the right and the left--the one the doer, the other the dreamer. The right is order and lawfulness, le droit. Its beauties are those

of geometry and taut implication. Reaching for knowledge with the right hand is science. Yet to say only that much of science is to overlook one of its excitements, for the greatest hypotheses of science are gifts carried in the left (pp. 2-3).

Modern neuroscience appears to be catching up with man has known about the qualities of "left" and "right" throughout the ages. Science is finding empirical justifications for the hunches and beliefs men have had about the symbolism of "left" and "right." Or at the very least the qualities attributed to "left" and "right" are uncanny in their analogous nature to the cognitive attributes of the two sides of the brain. Ornstein (1972) implies that a lack of integration between the two polar cognitive styles leads to maladaptive behavior. Restoring a balance between the two cognitive styles may be an important step towards healing in schizophrenic and manic disorders.

REFERENCE NOTES

1. Fennell, E. B., Moskowitz, R., & Barkus, D. Dichotic listening in schizophrenic and depressed patients. Paper presented at the meeting of the International Neuropsychological Society, Pittsburgh, February 1982.
2. Fennell, E. B., & Mulheira, M. Lateralized differences in recall of dichotic words and emotional tones. Paper presented at the meeting of the International Neuropsychological Society, Pittsburgh, February 1982.
3. Gordon, H. W., Goldstein, G., & Sabol, W. Hemispheric asymmetries in chronic schizophrenia. Paper presented at the meeting of the International Neuropsychological Society, Pittsburg, February 1982.
4. Saxby, L. N., & Bryden, M. P. Left-ear superiority in children for processing auditory emotional material. Paper presented at the meeting of the International Neuropsychological Society, Pittsburgh, February 1982.

REFERENCES

- Abrams, R. & Taylor, M. A. Differential EEG patterns in affective disorder and schizophrenia. Archives of General Psychiatry, 1979, 36, 1355-1358.
- Alford, R., & Alford, K. F. Sex differences in asymmetry in the facial expression of emotion. Neuropsychologia, 1981, 19, 605-608.
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders (3rd ed.). Washington, D.C.: 1980.
- Annett, M. A classification of hand preference by association analysis. British Journal of Psychology, 1970, 61, 303-321.
- Archer, E. J. A re-evaluation of the meaningfulness of all possible CVC trigrams. Psychological Monographs: General and Applied, 1960, 74, 1-23.
- Arieti, S. Interpretation of schizophrenia (2nd ed.). New York: Basic Books, 1974.
- Bakan, P. Hypnotizability, laterality of eye movements and functional brain asymmetry. Perceptual and Motor Skills, 1969, 28, 927-932.
- Bakan, P., & Svorad, D. Resting EEG alpha and asymmetry of reflective eye movements. Nature, 1969, 223, 975-976.
- Bear, D. M., & Fedio, P. Quantitative analysis of interictal behavior in temporal lobe epilepsy. Archives of Neurology, 1977, 34, 454-467.
- Benton, A. Visuo-perceptive, visuospatial, and visuoconstructive disorders. In K. M. Heilman & E. Valenstein (Eds.), Clinical Neuropsychology. New York: Oxford University Press, 1979.
- Berlin, C. Hemispheric asymmetry in auditory tasks. In S. Harnard, R. W. Doty, L. Goldstein, J. Jaynes, & G. Drauthamer (Eds.), Lateralization in the nervous system. New York: Academic Press, 1977.
- Bever, T. G., & Chiarello, R. J. Cerebral dominance in musicians and nonmusicians. Science, 1974, 185, 537-539.
- Bogen, J. E. The other side of the brain II: An appositional mind. Bulletin of the Los Angeles Neurological Society, 1969, 34, 73-105.

- Bogen, J. E. The callosal syndrome. In K. M. Heilman & E. Valenstein (Eds.), Clinical neuropsychology. Oxford: Oxford University Press, 1979.
- Bogen, J. E., DeZure, R., Tenhouten, W. D., & Marsh, J. F. The other side of the brain VI: The A/P ratio. Bulletin of the Los Angeles Neurological Society, 1972, 37, 49-61.
- Braff, D. L., & Saccuzzo, D. P. Information processing dysfunction in paranoid schizophrenia: A two-factor deficit. American Journal of Psychiatry, 1981, 138, 1051-1056.
- Broadbent, D. E. The role of auditory localization in attention and memory span. Journal of Experimental Psychology, 1954, 47, 191-196.
- Brody, D., Saccuzzo, D. P., & Braff, D. L. Information processing for masked and unmasked stimuli in schizophrenia and old age. Journal of Abnormal Psychology, 1980, 89, 617-622.
- Bruner, J. S. On knowing: Essays for the left hand. Cambridge, Mass.: Harvard University Press, 1962.
- Bryden, M. P. Strategy effects in the assessment of hemispheric asymmetry. In G. Underwood (Ed.), Strategies of information processing. London: Academic Press, 1978.
- Bryden, M. P., & Allard, F. Dichotic listening and the development of linguistic processes. In M. Kinsbourne (Ed.), Asymmetrical function of the brain. Cambridge, England: Cambridge University Press, 1978.
- Bryden, M. P., Ley, R. G., & Sugarman, J. H. A left-ear advantage for identifying the emotional quality of tonal sequences. Neuropsychologia, 1982, 20, 83-87.
- Buffery, A. W. H. Asymmetrical lateralisation of cerebral functions and the effects of unilateral brain surgery in epileptic patients. In S. J. Dimond & J. G. Beaumont (Eds.), Hemisphere function in the human brain. London: Elek Science, 1974.
- Buschbaum, M., & Fedio, P. Hemispheric differences in evoked potentials to verbal and nonverbal stimuli on the left and right visual fields. Physiology and Behavior, 1970, 5, 207-210.
- Carlson, R. Studies of Jungian typology II: Representations of the personal world. Journal of Personality and Social Psychology, 1980, 5, 801-810.
- Carlson, R., & Levy, N. Studies of Jungian typology I: Memory, social perception, and social action. Journal of Personality, 1973, 41, 559-576.

- Carmon, A., & Nachshon, I. Ear asymmetry in perception of emotional non-verbal stimuli. Acta Psychologica, 1973, 37, 351-357.
- Chapman, L. J., & Chapman, J. P. Disordered thought in schizophrenia. Englewood Cliffs, N.J.: Prentice Hall, 1973.
- Cohen, H. D., Rosen, R. C., & Goldstein, L. Electroencephalographic laterality changes during human sexual orgasm. Archives of Sexual Behavior, 1976, 5, 189.
- Corballis, M. C., & Beale, I. L. The psychology of left and right. Hinsdale, N.J.: Lawrence Erlbaum Associates, 1976.
- Day, M. E. An eye movement phenomenon relating to attention, thought and anxiety. Perceptual and Motor Skills, 1964, 19, 443-446.
- Day, M. E. An eye movement indicator of individual differences in the physiological organization of attentional processes and anxiety. Journal of Psychology, 1967, 66, 51-62.
- Dimond, S. J., & Beaumont, J. G. (Eds.). Hemisphere function in the human brain. London: Elek Science, 1974.
- Dimond, S. J., Scammell, R., Pryce, I. J., Huws, D., & Gray, C. Some failures of intermanual and cross-lateral transfer in chronic schizophrenia. Journal of Abnormal Psychology, 1980, 89, 505-509.
- Duke, J. D. Lateral eye movement behavior. Journal of General Psychology, 1968, 78, 189-195.
- Edwards, D., Antes, J., & Adams, R. Comparisons of first eye movement detection methods. Perceptual and Motor Skills, 1971, 32, 435-441.
- Ehrlichman, H., & Weinberger, A. Lateral eye movements and hemispheric asymmetry: A critical review. Psychological Bulletin, 1978, 85, 1080-1101.
- Eimas, P. D., Siqueland, E. R., Jusczyk, P., & Vigorito, J. Speech perception in infants. Science, 1971, 171, 303-306.
- Entus, A. K. Hemispheric asymmetry in processing dichotically presented speech and nonspeech stimuli by infants. In S. J. Segalowitz & F. Gruber (Eds.), Language development and neurological theory. New York: Academic Press, 1977.
- Etaugh, C. F. Personality correlates of lateral eye movements and handedness. Perceptual and Motor Skills, 1972, 34, 751-754.
- Etaugh, C. F., & Rose, M. Lateral eye movement: Elusive personality correlates and moderate stability estimates. Perceptual and Motor Skills, 1973, 37, 211-217.

- Eysenck, H. J. The biological basis of personality. Springfield, Ill.: Charles C. Thomas, 1967.
- Filskov, S. B., & Boll, T. J. (Eds.). Handbook of clinical neuropsychology. New York: Wiley, 1981.
- Fitzhugh, K., Fitzhugh, L., & Reitan, R. M. Wechsler-Bellevue comparisons in groups with chronic and current lateralized and diffuse brain lesions. Journal of Consulting Psychology, 1962, 26, 306-310.
- Fleminger, J. J., Del Horne, D. J., & Nair, N. P. V. Differential effects of unilateral and bilateral ECT. American Journal of Psychiatry, 1970, 127, 430-436.
- Flor-Henry, P. Schizophrenic-like reactions and affective psychoses associated with temporal lobe epilepsy: Etiological factors. American Journal of Psychiatry, 1969, 126, 148-162.
- Flor-Henry, P. Epilepsy and psychopathology. In K. Granville-Grossman (Ed.), Recent advantages in clinical psychiatry (2nd ed.). Edinburgh, Scotland: Churchill, Livingstone, 1976. (a)
- Flor-Henry, P. Lateralized temporal-limbic dysfunction and psychopathology. Annals of the New York Academy of Sciences, 1976, 280, 777-795. (b)
- Flor-Henry, P. On certain aspects of the localization of the cerebral systems regulating and determining emotion. Biological Psychiatry, 1979, 14, 677-698.
- Franzen, G., & Ingvar, D. H. Abnormal distribution of cerebral activity in chronic schizophrenia. Journal of Psychiatric Research, 1975, 12, 199-214.
- Fromholt, P., Christensen, A. L., & Stromgren, L. The effects of unilateral and bilateral electroconvulsive therapy on memory. Acta Psychiatrica Scandinavica, 1973, 49, 466-478.
- Fromm, E., & Shor, R. E. (Eds.). Hypnosis: Developments in research and new perspectives (2nd ed.). New York: Aldine, 1979.
- Gainotti, G. Emotional behavior and hemispheric side of the lesion. Cortex, 1972, 8, 41-55.
- Galaburda, A. M., LeMay, M., Kemper, T. L., & Geschwind, N. Right-left asymmetries in the brain. Science, 1978, 199, 852-856.
- Galin, D., & Ornstein, R. Lateral specialization of cognitive mode: An EEC study. Psychophysiology, 1972, 9, 412-418.

- Galin, D., & Ornstein, R. Individual differences in cognitive style I: Reflective eye movements. Neuropsychologia, 1974, 12, 367-376.
- Geschwind, N. The anatomical basis of hemispheric differentiation. In S. J. Dimond & J. G. Beaumont (Eds.), Hemisphere function in the human brain. London: Elek Science, 1974.
- Golden, C. J., Purisch, A. D., & Hammeke, J. A. The Luria-Nebraska Neuropsychological Battery. Lincoln, Neb.: University of Nebraska Press, 1979.
- Goldstein, S. G., Filskov, S. B., Weaver, L. A., & Ives, J. Neuro-psychological effects of electroconvulsive therapy. Journal of Clinical Psychology, 1977, 33, 798-806.
- Gordon, H. W. Left hemisphere dominance for rhythmic elements in dichotically-presented melodies. Cortex, 1978, 14, 58-70.
- Green, P. Defective interhemispheric transfer in schizophrenia. Journal of Abnormal Psychology, 1978, 87, 476-480.
- Green, P., & Kotenko, V. Superior speech comprehension in schizophrenics under monaural versus binaural listening conditions. Journal of Abnormal Psychology, 1980, 89, 399-408.
- Gruzelier, J., & VENABLES, P. Bimodality and lateral asymmetry of skin conductance orienting activity in schizophrenics: Replication and evidence of lateral asymmetry in patients with depression and disorders of personality. Biological Psychiatry, 1974, 8, 55-73.
- Gruzelier, J. H., & Hammond, N. V. Schizophrenia: A dominant temporal-limbic disorder. Research Communication in Psychology, Psychiatry, and Behavior, 1976, 1, 33-72.
- Gruzelier, J. H., & Hammond, N. V. Lateralized deficits and drug influences on the dichotic listening of schizophrenic patients. Biological Psychiatry, 1980, 15, 759-779.
- Gur, R. C., & Reivich, M. Cognitive task effects on hemispheric blood flow in humans: Evidence for individual differences in hemispheric activation. Brain and Language, 1980, 9, 78-92.
- Gur, R. E. Conjugate lateral eye movements as an index of hemispheric activation. Journal of Personality and Social Psychology, 1975, 31, 751-757.
- Gur, R. E. Motoric laterality imbalance in schizophrenia. Archives of General Psychiatry, 1977, 34, 33-37.

- Gur, R. E. Left hemisphere dysfunction and left hemisphere over-activation in schizophrenia. Journal of Abnormal Psychology, 1978, 87, 226-238.
- Gur, R. E. Cognitive concomitants of hemispheric dysfunction in schizophrenia. Archives of General Psychiatry, 1979, 36, 269-274.
- Gur, R. E., & Gur, R. C. Relationship between style of hypnotic induction and direction of lateral eye movements. Journal of Abnormal Psychology, 1973, 82, 499-505.
- Gur, R. E. & Gur, R. C. Defense mechanisms, psychosomatic symptomatology and conjugate lateral eye movements. Journal of Consulting and Clinical Psychology, 1975, 43, 416-420.
- Harnard, S. R. Creativity, lateral saccades and the non-dominant hemisphere. Perceptual and Motor Skills, 1972, 34, 653-654.
- Harris, L. J. Sex differences in spatial ability: Possible environmental, genetic, and neurological factors. In M. Kinsbourne (Ed.), Asymmetrical function of the brain. Cambridge, England: Cambridge University Press, 1978.
- Harrow, M., & Quinlan, D. Is disordered thinking unique to schizophrenia? Archives of General Psychiatry, 1977, 34, 15-21.
- Hassett, J. A primer of psychophysiology. San Francisco: Freeman, 1978.
- Heaton, S. R., & Crowley, T. J. Effects of psychiatric disorders and their somatic treatments on neuropsychological test results. In S. B. Filskov & T. J. Boll (Eds.), Handbook of Clinical Neuropsychology. New York: Wiley, 1981.
- Heilman, K. M., & Valenstein, E. (Eds). Clinical neuropsychology. New York: Oxford University Press, 1979.
- Hines, D., & Martindale, C. Induced lateral eye movements and creative and intellectual performance. Perceptual and Motor Skills, 1974, 39, 153-154.
- Ingvar, D. H., & Franzen, G. Abnormalities of cerebral blood flow distribution in patients with chronic schizophrenia. Acta Psychiatrica Scandinavica, 1974, 50, 425-462.
- Jaynes, J. The origin of consciousness in the breakdown of the bicameral mind. Boston: Houghton Mifflin, 1976.

- Jung, C. G. Psychological types. In H. Read, M. Fordam, G. Adler, & W. McGuire (Eds.), The collected works of C. G. Jung (Vol. 6). Princeton: Princeton University Press, 1971. (Originally published, 1921).
- Katz, J. Competing environmental sounds test. St. Louis: Auditec of St. Louis, 1979.
- Keppel, G. Design and analysis: A researcher's handbook. Englewood Cliffs, N.J.: Prentice Hall, 1973.
- Kimura, D. Cerebral dominance and the perception of verbal stimuli. Canadian Journal of Psychology, 1961, 1, 166-171.
- Kimura, D. Left-right differences in the perception of melodies. Quarterly Journal of Experimental Psychology, 1964, 16, 355-358.
- Kimura, D. Dual function asymmetry of the brain in visual perception. Neuropsychologia, 1966, 4, 275-285.
- Kimura, D. Functional asymmetry of the brain in dichotic listening. Cortex, 1967, 3, 163-178.
- Kimura, D. Spatial localization in left and right visual fields. Canadian Journal of Psychology, 1969, 23, 445-458.
- Kimura, D., & Durnford, M. Normal studies on the function of the right hemisphere in vision. In S. J. Dimond & J. G. Beaumont (Eds.), Hemisphere function in the human brain. London: Elek Science, 1974.
- King, F. L., & Kimura, D. Left-ear superiority in dichotic perception of vocal nonverbal sounds. Canadian Journal of Psychology, 1972, 26, 111-116.
- Kinsbourne, M. Eye and head turning indicates cerebral lateralization. Science, 1972, 176, 539-541.
- Kinsbourne, M. The control of attention by interaction between cerebral hemispheres. In S. Kornblum (Ed.), Attention and Performance. New York: Academic Press, 1973.
- Kinsbourne, M. The mechanism of hemispheric control of the lateral gradient of attention. In P. M. A. Rabbitt & S. Dornic (Eds.), Attention and performance (Vol. V). New York: Academic Press, 1975.
- Kinsbourne, M. (Ed.). Asymmetrical function of the brain. Cambridge, England: Cambridge University Press, 1978.
- Kinsbourne, M. Hemispheric specialization and the growth of human understanding. American Psychologist, 1982, 37, 411-420.

- Knopman, D. S., Rubens, A. B., Klassen, A. C., Meyer, M. W., & Niccum, N. Regional cerebral blood flow patterns during verbal and nonverbal auditory activity. Brain and Language, 1980, 9, 93-112.
- Knox, C., & Kimura, D. Cerebral processing of nonverbal sounds in boys and girls. Neuropsychologia, 1970, 8, 227-237.
- Kocel, K., Galin, D., Ornstein, R., & Merrin, E. L. Lateral eye movements and cognitive modes. Psychonomic Science, 1972, 27, 223-224.
- Kronfol, A., Hamsher, K., Digre, K., & Waiziri, R. Depression and hemispheric functions: Change associated with unilateral ECT. British Journal of Psychiatry, 1978, 132, 560-567.
- Lefevre, E., Starck, R., Lambert, E. E., & Genesee, F. Lateral eye movements during verbal and nonverbal dichotic listening. Perceptual and Motor Skills, 1977, 44, 1115-1122.
- Lerner, J., Nachson, I., & Carmon, A. Responses of paranoid and non-paranoid schizophrenics in a dichotic listening task. Journal of Nervous and Mental Disease, 1977, 164, 247-252.
- Levy, J., Trevarthen, C., & Sperry, R. W. Perception of bilateral chimeric figures following hemispheric disconnection. Brain, 1972, 95, 61-78.
- Levy, J., & Reid, M. Variations in cerebral organization as a function of handedness, hand posture in writing, and sex. Journal of Experimental Psychology: General, 1978, 107, 119-144.
- Ley, R. G., & Bryden, M. P. Hemispheric differences in processing emotions and faces. Brain and Language, 1979, 7, 127-138.
- Lezak, M. D. Neuropsychological assessment. New York: Oxford University Press, 1976.
- Lishman, W. A., Toone, B. K., Colburn, C. J., McMeekan, E. R. L., & Mance, R. M. Dichotic listening in psychiatric patients. British Journal of Psychiatry, 1978, 132, 333-341.
- Luria, A. R. The working brain. New York: Basic Books, 1973.
- Luria, A. R., & Homskaya, E. D. Frontal lobes and the regulation of activation processes. In D. Mostofsky (Ed.), Attention: Contemporary theory and analysis. New York: Appleton, Century, Crofts, 1970.
- Magaro, P. A. Cognition in schizophrenia and paranoia: The integration of cognitive processes. Hillsdale, N.J.: Lawrence Erlbaum, 1980.

- Marsh, G. R. Asymmetry of electrophysiological phenomena and its relation to behavior in humans. In M. Kinsbourne (Ed.), Asymmetrical function of the brain. Cambridge, England: Cambridge University Press, 1978.
- Marzi, C. A., & Berlucchi, G. Right visual field superiority for accuracy of recognition of famous faces in normals. Neuropsychologia, 1977, 15, 751-756.
- Mayzner, M. S., & Habinek, J. K. Visual recognition processing of simple and parallel line patterns. Bulletin of the Psychonomic Society, 1976, 8, 256.
- McGlone, J. Sex differences in the cerebral organization of verbal functions in patients with unilateral brain lesions. Brain, 1977, 100, 775-793.
- McGlone, J. Sex differences in functional brain asymmetry. Cortex, 1978, 14, 122-128.
- McGlone, J. Sex differences in human brain asymmetry: A critical survey. Behavioral and Brain Sciences, 1980, 3, 215-263.
- McKeever, W. F., & Huling, M. D. Lateral dominance in tachistoscopic word recognition performance obtained with simultaneous bilateral input. Neuropsychologia, 1971, 9, 15-20.
- Meskin, B. B., & Singer, J. L. Daydreaming, reflective thought and laterality of eye movements. Journal of Personality and Social Psychology, 1974, 30, 64-71.
- Milner, B., Taylor, L., & Sperry, R. W. Lateralized suppression of dichotically presented digits after commissural section in man. Science, 1968, 161, 184-186.
- Molfese, D. L., Freeman, R. B., & Palermo, D. S. The ontogeny of brain lateralization for speech and non-speech stimuli. Brain and Language, 1975, 2, 356-368.
- Morgan, A. H., McDonald, P. J., & MacDonald, H. Differences in bilateral alpha activity as a function of experimental task, with a note on lateral eye movements and hypnotizability. Neuropsychologia, 1971, 9, 459-469.
- Myers, I. Manual: The Myers-Briggs type indicator. Princeton: Princeton University Press, 1962.
- Myslobodsky, M. S., & Horesh, N. Bilateral electrodermal activity in depressive patients. Biological Psychology, 1978, 6, 111-120.

- Nebes, R. D. Direct examination of cognitive function in the right and left hemispheres. In M. Kinsbourne (Ed.), Asymmetrical function of the brain. Cambridge, England: Cambridge University Press, 1978.
- Needham, R. Right and left: Essays on dual symbolic classification. Chicago: University of Chicago Press, 1973.
- Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.
- Newlin, D. B., & Golden, C. J. Hemispheric asymmetries in manic-depressive patients: Relationship to hemispheric processing of affect. Clinical Neuropsychology, 1981, 2, 163-169.
- Ornstein, R. The nature of consciousness. San Francisco: Freeman, 1972.
- Pic'1, A. K., Magaro, P. A., & Wade, E. A. Hemispheric functioning in paranoid and nonparanoid schizophrenia. Biological Psychiatry, 1979, 14, 891-903.
- Prentky, R. A. Creativity and psychopathology: A neurocognitive perspective. In Progress in experimental personality research (Vol. 9). New York: Academic Press, 1979.
- Prifitera, A. Jungian personality correlates of cerebral hemispheric preference. Journal of Analytical Psychology, 1981, 26, 151-162.
- Reitan, R. M. Certain differential effects of left and right cerebral lesions in human adults. Journal of Comparative and Physiological Psychology, 1955, 48, 474-477.
- Risberg, J., Halsey, J. H., Wills, E. L., & Wilson, E. M. Hemispheric specialization in normal man studied by bilateral measurements of the regional cerebral blood flow: A study with the 133 Xe inhalation technique. Brain, 1975, 98, 511-524.
- Rizzolatti, G., Umiltà, C., & Berlucchi, G. Opposite superiorities of the right and left cerebral hemispheres in discriminative reaction time to physiognomical and alphabetical material. Brain, 1971, 94, 431-432.
- Robinson, D. A. Eye movement control in primates. Science, 1968, 161, 1219-1224.
- Roemer, R. A., Shagass, C., Straumanis, J. J., & Amadeo, M. Pattern evoked potential measurements suggesting lateralized hemispheric dysfunction in chronic schizophrenics. Biological Psychiatry, 1978, 13, 185-202.

- Rosenthal, R., & Bigelow, L. B. Quantitative brain measurements in chronic schizophrenia. British Journal of Psychiatry, 1972, 121, 259-264.
- Ross, E. D., & Mesulam, M. M. Dominant language functions of the right hemisphere?: Prosody and emotional gesturing. Neurology, 1979, 36, 144-148.
- Rossi, E. The cerebral hemispheres in analytic psychology. Journal of Analytical Psychology, 1977, 22, 132-151.
- Sackeim, H. A., Gur, R. C., & Saucy, M. C. Emotions are expressed more intensely of the left side of the face. Science, 1978, 202, 434-436.
- Saccuzzo, D. P., Braff, D. L., & Sprock, J. The effect of mental retardation and schizophrenia on information processing. The Journal of Nervous and Mental Disease, 1982, 170, 102-106.
- Saccuzzo, D. P., Hirt, M., & Spencer, J. J. Backward masking as a measure of attention on schizophrenia. Journal of Abnormal Psychology, 1974, 83, 512-522.
- Saccuzzo, D. P., & Miller, S. Critical interstimulus interval in delusional schizophrenics-and normals. Journal of Abnormal Psychology, 1977, 86, 261-266.
- Saccuzzo, D. P., & Schubert, D. L. Backward masking as a measure of slow processing in schizophrenia spectrum disorders. Journal of Abnormal Psychology, 1981, 90, 305-312.
- Safer, M. A. Sex and hemispheric differences in access to codes for processing emotional expressions and faces. Journal of Experimental Psychology: General, 1981, 110, 86-100.
- Safer, M.A., & Leventhal, H. Ear differences in evaluating emotional tones of voice and verbal content. Journal of Experimental Psychology: Human Perception and Performance, 1977, 3, 75-82.
- Sandel, A., & Alcorn, J. D. Individual hemisphericity and maladaptive behaviors. Journal of Abnormal Psychology, 1980, 89, 514-517.
- Schneider, W., & Shiffrin, R. M. Controlled and automatic human information processing I: Detection, search and attention. Psychological Review, 1977, 84, 1-60.
- Schwartz, G. E., Davidson, R. J., & Maer, F. Right hemisphere lateralization for emotion in the human brain: Interactions with cognition. Science, 1975, 190, 286-288.

- Schweitzer, L. Differences of cerebral lateralization among schizophrenic and depressed patients. Biological Psychiatry, 1979, 14, 721-733.
- Schweitzer, L., Becker, E., & Welsh, H. Abnormalities of cerebral lateralization in schizophrenic patients. Archives of General Psychiatry, 1978, 35, 982-985.
- Segalowitz, S. J., & Chapman, J. S. Cerebral asymmetry for speech in neonates: A behavioral measure. Brain and Language, 1980, 9, 281-288.
- Shankweiler, D., & Studdert-Kennedy, M. Identification of consonants and vowels presented to left and right ears. Quarterly Journal of Experimental Psychology, 1967, 19, 59-63.
- Sherrod, D. R. Lateral eye movement and reaction to persuasion. Perceptual and Motor Skills, 1972, 35, 355-358.
- Shevrin, H., Smokler, I., & Kooi, K. A. An empirical link between lateral eye movements and lateralized event-related brain potentials. Biological Psychiatry, 1980, 15, 691-697.
- Smokler, A., & Shevrin, H. Cerebral lateralization and personality style. Archives of General Psychiatry, 1979, 30, 949-954.
- Solso, R. L. Cognitive psychology. New York: Harcourt Brace Jovanovich, 1979.
- Sperry, R. W., Gazzaniga, M. S., & Bogen, J. E. Interhemispheric relationships: The neocortical commissures; syndromes of hemispheric disconnection. In P. J. Vinken & G. E. Bruyn (Eds.), Handbook of clinical neurology (Vol. 4). Amsterdam: North-Holland, 1969.
- Springer, S. P. Tachistoscopic and dichotic-listening investigations of laterality in normal human subjects. In S. Harnard, R. W. Doty, L. Golstein, J. Jaynes, & G. Drauthamer (Eds.). Lateralization in the nervous system. New York: Academic Press, 1977.
- Springer, S. P., & Deutsch, G. Left brain, right brain. San Francisco: Freeman, 1981.
- Strauss, E., & Moscovitch, M. Perception of facial expressions. Brain and Language, 1981, 13, 308-332.
- Studdert-Kennedy, M., & Shankweiler, D. J. Hemispheric specialization for speech. Journal of the Acoustical Society of America, 1970, 48, 579-594.
- Tatsuoka, M. M. Discriminant analysis: The study of group differences. Champaign, Ill.: Institute for Personality and Ability Testing, 1970.

- Taylor, M. A., Redfield, J., & Abrams, R. Neuropsychological dysfunction in schizophrenia and affective disease. Biological Psychiatry, 1981, 16, 467-478.
- Taylor, P., & Fleming, J. J. The lateralization of symptoms in schizophrenia. British Journal of Medical Psychology, 1981, 54, 59-65.
- Tomkins, S. Left and right: A basic dimension in personality and ideology. In R. W. White (Ed.), The study of lives. New York: Atherton, 1964.
- Tucker, D. M. Lateral brain function, emotion and conceptualization. Psychological Bulletin, 1981, 89, 19-46.
- Tucker, D. M., Antes, J. R., Stenslie, C. E., & Barnhardt, T. N. Anxiety and lateral cerebral function. Journal of Abnormal Psychology, 1978, 3, 380-383.
- Tucker, D. M., Stenslie, C. E., Roth, R. S., & Shearer, S. L. Right frontal lobe activation and right hemisphere performance. Archives of General Psychiatry, 1981, 38, 169-174.
- Tucker, D. M., & Newman, J. P. Lateral brain function and the cognitive inhibition of emotional arousal. Cognitive Therapy and Research, 1981, 52, 197-202.
- Tucker, G. H., & Suib, M. D. Conjugate lateral eye movement (CLEM) direction and its relationship to performance on verbal and visuo-spatial tasks. Neuropsychologia, 1978, 16, 251-254.
- Uherik, A. Interpretation of bilateral asymmetry of bioelectrical skin reactivity in schizophrenics. Studia Psychologica, 1975, 17, 51-60.
- Valenstein, E., & Heilman, K. M. Emotional disorders resulting from lesions of the central nervous system. In K. M. Heilman & E. Valenstein (Eds.), Clinical neuropsychology. New York: Oxford University Press, 1979.
- Wada, J. A., Clarke, R., & Hamm, A. Cerebral hemispheric asymmetry in humans. Archives of Neurology, 1975, 32, 239-246.
- Wada, J. A., & Rasmussen, T. Intracarotid injection of sodium amytal for the lateralization of cerebral speech dominance: Experimental and clinical observations. Journal of Neurosurgery, 1960, 17, 266-282.
- Walker, E., Hoppes, E., & Emory, E. A reinterpretation of findings on hemispheric dysfunction in schizophrenia. The Journal of Nervous and Mental Disease, 1981, 169, 378-380.

- Wechsler, A. R. The effect of organic brain disease on recall of emotionally charged versus neutral narrative text. Neurology, 1973, 23, 130-135.
- Wexler, B. Cerebral laterality and psychiatry: A review of the literature. American Journal of Psychiatry, 1980, 137, 279-291.
- Weitan, W., & Etaugh, C. Lateral eye movement as related to verbal and perceptual-motor skills and values. Perceptual and Motor Skills, 1973, 36, 423-428.
- Witelson, S. F. Hemispheric specialization for linguistic and non-linguistic tactual perception using a dichotomous stimulation technique. Cortex, 1974, 10, 3-17.
- Witelson, S. F. Sex and the single hemisphere: Specialization of the right hemisphere for spatial processing. Science, 1976, 193, 425-427.
- Witelson, S. F., & Pallie, W. Left hemisphere specialization for language in the newborn. Brain, 1973, 96, 641-646.
- Yozawitz, A., Bruder, G., Sutton, S., Sharpe, L., Gurland, B., Fleiss, J., & Costa, L. Dichotic perception: Evidence for right hemisphere dysfunction in affective psychosis. British Journal of Psychiatry, 1979, 135, 224-237.

APPROVAL SHEET

The dissertation submitted by Aurelio Prifitera has been read and approved by the following committee:

Dr. Alan DeWolfe, Director
Professor of Psychology, Loyola

Dr. Mark Mayzner
Professor of Psychology, Loyola

Dr. Thomas Petzel
Professor of Psychology, Loyola

Dr. Ira Appelman
Assistant Professor of Psychology, Loyola

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Date

12/4/82

Director's Signature

