





This is to certify that the

thesis entitled Hemispheric Activation as Measured by Conjugate Lateral Eye Movements: The Relationship Between Anxiety and Some Personality Variables To Eye Movement Direction presented by

Melvin Berg

has been accepted towards fulfillment of the requirements for

Doctor of Philosophy degree in Psychology

efter or professor

Date_

O-7639



÷,

-4







HEMISPHERIC ACTIVATION AS MEASURED BY CONJUGATE LATERAL EYE MOVEMENTS: THE RELATIONSHIP BETWEEN ANXIETY AND SOME PERSONALITY VARIABLES TO EYE MOVEMENT DIRECTION

By

Melvin Berg

A DISSERTATION

Submitted to Michigan State University in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology



ABSTRACT

HEMISPHERIC ACTIVATION AS MEASURED BY CONJUGATE LATERAL EYE MOVEMENTS: THE RELATIONSHIP BETWEEN ANXIETY AND SOME PERSONALITY VARIABLES TO EYE MOVEMENT DIRECTION

By

Melvin Berg

The specialization of the left and right cerebral hemispheres for language and spatial processing, respectively, has been found to be reflected by conjugate lateral eye movements in subjects who are asked questions. The first eye movement following presentation of verbal problems tends to be to the right. Following spatial problems the first eye movement tends to be to the left. Theory suggests that during problem solving, activation of a cerebral hemisphere affects the frontal eye fields, stimulating eye movement to the contralateral direction.

These results have been reported when the experimenter sits behind the subject (<u>E</u>-behind-<u>S</u>). When the experimenter faces the subject (<u>E</u>-facing-<u>S</u>), the results are different. Now, subjects tend to look consistently in one lateral direction. The suggested explanation is that individual subjects, irrespective of question type, use a preferred hemisphere and that these preferences are manifested as eye movements in the contralateral direction. Furthermore, an individual's personality is characterized by personality traits reflecting the functional attributes of that preferred hemisphere. For instance, right lookers demonstrate



greater verbal than mathematical aptitude and display an analytical approach to problems.

One suggested resolution of the discrepant results of these two paradigms emphasizes the effects of the experimenter's location on the subject. When the experimenter sits behind the subject, the subject is able to use the appropriate cognitive mode as indicated by the direction of eye movements. However, when the experimenter faces the subject, the subject, made anxious by the interpersonal situation, falls back upon the use of a characteristic cognitive mode, mediated by either the left or the right hemisphere. Consequently, subjects tend to look consistently in one direction. Hypothesis I: The directional consistency of eye movements is a function of anxiety, irrespective of the type of problem being solved. Hypothesis II: Anxiety is related to experimenter location.

Ego strength, defined as the capacity to maintain adaptive functioning under stress, appears to be related to the capacity to use the appropriate cognitive mode under stress. Hypothesis III: The capacity to use the appropriate cognitive mode in problem solving is associated with ego strength.

The personality traits attributed to left movers are considered stereotypically feminine. Hypothesis IV: Left movers describe themselves with more feminine sex stereotyped terms than right movers.

Forty-eight male, right-handed subjects were asked verbal and spatial questions in three conditions -- <u>E</u>-behind-<u>S</u>, <u>E</u>-facing-<u>S</u>, and stress. The stress condition consisted of an <u>E</u>-behind-<u>S</u> arrangement during which the subject was urged to improve his performance, in order to arouse his anxiety.

Contrary to expectations, it was found that verbal problems were followed by eye movements predominantly to the left while spatial items were followed predominantly by eye movements to the right. Spatial problems, furthermore, more frequently elicited staring than verbal problems.

Hypothesis I was not confirmed, since the stress condition did not influence eye movements.

Hypothesis II was not confirmed: Equivalent degrees of anxiety were reported in all conditions.

Hypothesis III received partial confirmation: In the stress condition, ego strength was very modestly correlated to use of the appropriate cognitive mode.

Hypothesis IV was not confirmed: Feminine identification was not associated with a preference for left looking.

The finding that spatial problems elicit stares more frequently than verbal problems agrees with previous research. The finding that verbal problems are followed by eye movements to the left and spatial problems by eye movements to the right is incompatible with previous research. For my parents, friends, and teachers who have helped along the way.

ACKNOWLEDGMENTS

Looking back over the course of my graduate education and the development of this research project I am thankful to the mentors, supervisors, and friends who helped quide me in my growth as a psychologist, clinician, and person. I would like to warmly thank Dr. Joseph Reyher, Co-chairman of my dissertation committee, for sharing his enthusiasm for the science and practice of clinical psychology, and for his continuous support and steadfast friendship. I am grateful to Dr. Lauren Harris, Co-chairman of my dissertation committee, for his profound commitment to this project, his scientific acumen, and his delightful sense of humor. I owe thanks to Dr. Albert I. Rabin for his participation on my committee as well as for years of guidance, sensible advice, and solid teaching which expanded my horizons as a psychologist. I am grateful to Dr. Terrence Allen for his participation on my committee, his statistical expertise, and his suggestions about all aspects of this research. I thank my research assistants, Mark Allen, Dale Buccilli, Paul Koch, Fran Levine, and Sharon Williams, for their generous commitment of time and energy. Finally, I thank Eric Olson for his help in writing the questions used in this study and for his help in administering the pre-test.

iii

TABLE OF CONTENTS

																											F	AGE
LIST	OF	TABL	ES	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	۷
LIST	° OF	FIGU	RES		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	vi
INTR	ODU	CTION	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	1
METH	IOD .	•••	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	11
RESU	ILTS		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	21
DISC	USS	CON .	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	39
LIST	° OF	REFE	REN	ICE	S	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	50
APPE		K																										
	Α.	TEST	F0	RM:	S	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	58
	Β.	QUES	TIO)NN/	AI	RE	0	N	HA	ND	P	RE	FE	RE	NC	E	•	•	•	•	•	•	•	•	•	•	•	70
	С.	BARR	ON	EG	0	ST	RE	NG	iTH	I S	CA	LE	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	73
	D.	BEM	SEX	R	OL	Ε	IN	IVE	ENT	ror	Y	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	77
	Ε.	THE	DEB	BRI	EF	IN	G	•	•	•	•	•	•	•	•		•	•	•	•	•	•			•	•	•	79

LIST OF TABLES

.

TABLE	S	PAGE
1.	Mean Percentage of First Eye Movements to the Right Made by Subjects on Verbal and Spatial Items in the Three Conditions	23
2.	Analysis of Variance for Mean Percentage of First Eye Movements to the Right Made by Subjects, on Verbal and Spatial Items in Three Conditions	24
3.	Mean Percentage of Duration of Right Looking by Subjects, on Verbal and Spatial Items, in the Three Conditions	26
4.	Analysis of Variance for Mean Percentage of Duration of Right Looking by Subjects, on Verbal and Spatial Items, in the Three Conditions	27
5.	Mean Anxiety Reported by Subjects in the Three Conditions	29
6.	Analysis of Variance for Mean Anxiety Reported by Subjects in the Three Conditions	30
7.	Mean Percentage of Verbal and Spatial Items on Which Subjects Made No Eye Movements, for the Three Conditions	32
8.	Analysis of Variance for Mean Percentage of Verbal and Spatial Items on Which Subjects Made No Eye Movements, For the Three Conditions	33
9.	Analysis of Variance for Mean Percentage of Verbal and Spatial Items on Which Subjects Made No Eye Movements For the EBS and EFS Conditions	35
10,	Analysis of Variance for Mean Percentage of Verbal and Spatial Items on Which Subjects Made No Eye Movements, For EFS and Stress Conditions	36
11.	Analysis of Variance for Mean Percentage of Verbal and Spatial Items on Which Subjects Made No Eye Movements, For EBS and Stress Conditions	37

LIST OF FIGURES

FIGURE

PAGE

.

1.	The Mean Percentage of Items on Which Subjects	
	Made No Eye Movements in the EBS and EFS	
	Conditions, for Order I: EBS Followed by	
	EFS and Order II: EFS Followed by EBS	5



INTRODUCTION

In right-handed individuals, the left cerebral hemisphere serves verbal, analytic functions and the right hemisphere serves spatial synthetic functions (Sperry, Gazzaniga and Bogen, 1969). In many lefthanded individuals, the functional specialization of the cerebral hemispheres is less clearly lateralized (Hécaen and de Ajuriaguerra, 1964), and this also appears to be the case for females (Kimura, 1973). Knowledge about the functional specialization of the hemispheres was first established through the study of cognitive deficit in individuals suffering from unilateral cerebral damage (Broca, 1861; Wernicke, 1874; Reitan, 1955; Teuber, 1962; Milner, 1965, Corkin, 1965). The relationship between cognitive modes and the cerebral hemispheres also has been confirmed by research employing a variety of techniques on normal individuals: dichotic listening (Kimura, 1967); average evoked responses (Buchsbaum, 1969); tachistoscopic viewing (Kimura, 1963).

Recently another technique, developed by Kinsbourne (1972), has served to corroborate these earlier findings about the functional specialization of the cerebral hemispheres. This technique involves the monitoring of conjugate lateral eye movements.

Conjugate Lateral Eye Movements as an Indicator of Hemispheric Activation

Kinsbourne (1972) found that when the experimenter, seated behind the subject, presented verbal, spatial and numerical problems, the

subject's lateral direction of eye movement, after question presentation, discriminated between the types of questions. Right-handed subjects tended to make eye movements to the right in response to verbal questions, and eye movements to the left in response to spatial questions, and no consistent directional pattern was found for numerical questions.

Kinsbourne (1973) theorized that the frontal eye fields of each cerebral hemisphere control the direction of eye movements toward the contralateral direction. Extensive comparative studies of humans and lower primates have verified that the frontal eye fields mediate eye movements in the direction contralateral to the activated hemisphere (Crosby, 1953).

Kinsbourne (1973) calls the cerebrum a "highly linked, integrated system with close interconnections," so that neural activation in an area of the cerebrum associated with thought processes, "overflows" into the frontal eye fields stimulating eye movement in the contralateral direction. Thus, as Kinsbourne's (1972) results bear out, concentration on verbal problems, mediated by the left hemisphere, triggers eye movement to the right, and concentration on spatial problems, mediated by the right hemisphere, triggers eye movement to the left. The preponderance of stares, found after presentation of numerical problems, Kinsbourne attributed to the equal activation of both hemispheres required for the solution of these problems.

In left-handed individuals, Kinsbourne (1972) did not find a relationship between problem type and eye movement direction, a result consistent with the known heterogeneous distribution of cerebral functions in sinistrals (Hécean and de Ajuriaguerra, 1967). These different

findings in sinistrals and dextrals provide support for the construct validity of conjugate lateral eye movements as an indicator of hemisphere activation. Unfortunately, Kinsbourne did not take sex of subject into account in his analysis. It is expected that females would show a lack of consistency in eye movement patterns like that found in sinistrals, due to the less completely lateralized cerebral organization in females (Kimura, 1973).

Studies similar to Kinsbourne's (1972) have provided supporting evidence for his theory. Kocel, Galin, Ornstein, & Merrin (1972) found that a combined group of verbal and numerical problems elicited more eye movements to the right than did a group of spatial and musical questions. Likewise, Weiten & Etaugh (1974) showed that eye movement to the right is more likely in response to numerical questions than to music identification problems. Further convergent evidence is provided by Galin & Ornstein (1974), whose subjects made more eye movements to the right on verbal questions than on spatial questions. Galin & Ornstein also found more stares on spatial questions, which they attributed to the bilateral activation of the hemispheres required when a spatial problem is verbally presented, as was the procedure in their as well as in other studies.

Ehrlichman, Weiner, & Baker (1974) performed a series of studies closely modeled upon those of Kinsbourne (1972) and Kocel et al. (1972) and found a consistent though nonsignificant trend for eye movements to the right to occur after the presentation of spatial questions. These findings are inconsistent with Kinsbourne's (1973) theory relating problem type and eye movement direction to the known functional



specialization of the cerebral hemispheres. Ehrlichman et al. (1974) gave no theoretical explanation of their findings.

Consistent with Galin & Ornstein's data, Ehrlichman et al. (1974) found significantly more stares following spatial questions than after verbal questions. The replication of these findings provides some support for Kinsbourne's (1973) theory. This mixture of confirming and disconfirming findings indicates that the use of lateral eye movements as an index of hemispheric activation needs further investigation. The phenomenon may be sensitive, easily influenced by as yet unidentified variables.

Conjugate Lateral Eye Movements as a Correlate of Personality Variables

Another line of research on conjugate lateral eye movement has used a different experimental paradigm, in which the experimenter and subject are seated facing each other. The results of these studies are different from the studies reviewed above in which the experimenter sits behind the subject. In the course of doing psychotherapy, Teitlebaum (1954) noticed that his patients characteristically looked in one direction, either left or right while they reflected on a problem. In formal investigations, Day (1964a, 1967a, 1967b) confirmed that in response to problems, people demonstrate consistent eye movement patterns either to the left or the right. The reliability of this individual consistency in the directional preference of eye movement has been established (Duke, 1968; Etaugh & Rose, 1973).

Day (1967a) also found that right movers appeared to have an external locus of attention, are alert and reactive to the external,

visually perceived environment, and identify anxiety as emanating from external events. For example, the right looker might report "It was a dull place, so I went for a walk." Left lookers appeared to have an internal locus of attention, to rely upon subjective experience, and to locate anxiety as emanating from internal, subjective events. For example, the left looker might report, "I was anxious and troubled by disturbing thoughts and feelings and I left hoping to get distracted." Gerdes & Kinsbourne (1974) have provided supporting evidence that right movers describe anxiety states with reference to external cues and events.

In a series of studies, Bakan (1969) showed that left movers are more hypnotizable, more often major in the humanities, have clearer visual imagery, and score higher on the verbal than on the quantitative section of the Scholastic Aptitude Test (SAT). In contrast, right movers were more likely to score higher on the quantitative section of the SAT, prefer to major in the physical sciences, and have less clear visual imagery.

The comparison of left movers and right movers with regard to attention has been studied from several perspectives with convergent results. Bakan & Shotland (1969) found that right movers read faster and demonstrate superior ability to maintain visual attention. The greater reliance upon external attention in right movers was supported by their production of a lower percentage of Alpha on EEG recordings than left movers (Bakan & Svorad, 1969). Employing two self report measures of inner attentiveness and daydreaming, Meskin & Singer (1974) reported that left lookers are more attentive to subjective experience. Gur &

Reyher (1973) showed that left movers score higher on a hypnotic susceptibility scale emphasizing inner experience, while right movers score higher on a scale emphasizing external experience.

Bakan (1969) speculated that the consistency of eye movement is "symptomatic" of easier triggering in the hemisphere contralateral to eye movement. Thus, the personality of the right mover is more likely to reflect the style and dominant cognitive operations of the left hemisphere, whereas the personality of the left looker reflects the style and dominant cognitive operations of the right hemisphere as: prelogical, intuitive, subjective, emotional, global, synthetic, diffuse, and best suited for spatial problems. He characterizes the functioning of the left hemisphere as: objective, analytical, rational, and best suited for verbal problems. The greater reliance upon or easier "triggering" of one of the hemispheres results in a variety of individual personality characteristics related to the mode of cognitive functioning mediated by that particular hemisphere.

The Relevance of Experimenter Location in Research on Lateral Eye Movement

Two apparently inconsistent lines of research regarding lateral eye movements emerge. The studies based upon the experimenter-behindsubject paradigm generally show that the direction of eye movement is a function of the type of question presented (Kinsbourne, 1972; Kocel, Galin, Ornstein, & Merrin, 1972; Galin & Ornstein, 1974), whereas the research using the experimenter-facing-subject paradigm shows that individuals consistently look in one direction and that this tendency is associated with a cluster of internally consistent personality characteristics (Day,

1964, 1967a, 1967b; Gerdes & Kinsbourne, 1974; Bakan & Svorad, 1969; Meskin & Singer, 1974; Gur & Reyher, 1973).

R. E. Gur (1973) attempted to clarify the inconsistency between these two lines of research by using both procedures, the experimenterbehind-subject and the experimenter-facing-subject paradigms on the same group of subjects. She confirmed both the findings of Bakan (1969) and Kinsbourne (1972), suggesting that experimenter location was the critical difference between their procedures. She proposed that when the experimenter faces the subject, the subject is made anxious and is distracted from the nature of the task. The subject then falls back upon the use of a particular cognitive mode, mediated by one of the cerebral hemispheres. She suggested that anxiety is generated by the face-to-face interpersonal situation which poses a threat to self-esteem. Jourard and Friedman (1970) found that subjects disclose more about themselves when the experimenter is absent than when facing the subject. Subjects feel observed in interviews and are made anxious by the possibility of receiving responses threatening to their self-esteem (Argyle, 1969). The determination whether arousal of anxiety is the crucial variable underlying experimenter location will be explored in this study. The following hypotheses will be tested:

<u>Hypothesis I</u>: The directional consistency of eye movements is a function of anxiety, irrespective of the type of problem being solved.

Hypothesis II: Anxiety is a function of experimenter location.

<u>The Examination of Further Personality Characteristics Associated with</u> <u>Directional Preference of Lateral Eye Movement: Ego Strength and Sex</u> <u>Role Identification</u>

Ego Strength. Use of the appropriate mode of cognitive functioning, or the hemisphere best suited to a particular problem, while the individual is under stress, is adaptive, for it should permit optimal problem solving performance. It is expected that the trait of ego strength is reflected in a tendency to use the appropriate hemisphere while under stress.

Ego strength is defined by Fenichel (1945) as the capacity to maintain objective perception and to resist the disturbing influence of affect upon intellectual operations and judgment. In his definition of ego strength, Lazarus (1966) emphasizes the capacity to withstand stress and maintain adaptive forms of coping, so that the appropriate modes of thought are used to suit the demands of the situation. Freedom from the disturbing influence of stress upon adaptive functioning appears to be the common element emphasized by other investigators of ego strength (Ehrenwald, 1966; Karush, Easser, Cooper, & Swerdloff, 1966). In fact, the largest categories of items on the Barron Ego Strength Scale (1953) refer to physiological stability and freedom from disturbance by anxiety. By virtue of the high frequency of its use, the Barron Scale has come to define the trait of ego strength in the empirical literature.

Research has consistently shown that ego strength is associated with physiological stability and the ability to cope with stress (Alexander, Roessler, & Greenfield, 1963; Greenfield, Alexander, & Roessler, 1963). Thus theoretical conceptualization and empirical

studies suggest that a major component of ego strength is the capacity to cope with stress. It is expected that ego strength is associated with the capacity to use the appropriate hemisphere (left hemisphere for verbal problems and the right hemisphere for spatial problems) as indicated by the direction of lateral eye movement during problem solving.

<u>Hypothesis III</u>: The capacity to use the appropriate cognitive mode, in problem solving, as indexed by the direction of eye movement, is associated with ego strength.

Identity. The various personality characteristics associated with left movers and the cognitive style attributed to the right hemisphere appear to have a stereotypic feminine connotation: hypnotizability, preference for the humanities, higher verbal ability than quantitative ability, and an intuitive, subjective approach to problems. Those traits associated with right lookers and the left hemisphere appear to have a stereotypic masculine connotation: preference for the physical sciences, higher quantitative ability than verbal ability, and an objective, analytical approach to problems. Several studies (Fernberger, 1948; Jarrett & Sheriffs, 1953; Rosenkrantz, Bee, & Vogel, 1968) have found that male and female subjects stereotype females as: emotional, sensitive to inner experience, subjective, intuitive, interested in the humanities. Males were stereotyped as: objective, relatively unemotional, preferring the physical sciences, and analytical. In line with these stereotypic patterns, Lopiccolo & Blatt (1972) demonstrated that males with relatively prominent features of feminine identification have

a preference for an intuitive, stereotypic feminine cognitive style. Whether the association of feminine identification and the preference for a stereotypic feminine cognitive style is a result of feminine identification arising from a natural ability in stereotypic feminine interest areas or whether a feminine identification fosters the adoption and development of stereotypical feminine interests and modes of thought is unknown. Nevertheless, it is expected that, on the basis of the relationship between identity and cognitive style found by Lopiccolo & Blatt (1972), males who are left movers should describe themselves with more feminine terms than right movers. It is assumed that attribution of adjectives generally thought of as descriptive of a particular sex indicates identification with that sex.

<u>Hypothesis IV</u>: Left movers describe themselves in relatively more feminine sex stereotyped terms than right movers.

METHOD

Subjects

Forty-eight right-handed males were drawn from introductory psychology classes at Michigan State University. It was decided to use only male subjects since the functional specialization of the cerebral hemispheres appears to be more clearly lateralized for males than females (Kimura, 1973). A 20-item questionnaire (Humphrey, 1951) measuring hand usage in everyday tasks was administered, so as to select subjects with right hand dominance (use of the right hand in 18 of the 20 everyday tasks, including writing and throwing a ball). The use of subjects with right hand dominance increases the probability of left cerebral hemisphere dominance for speech.

Materials

Development and selection of items. An initial item pool consisting of 72 verbal and 72 spatial questions was developed. These problems were written in an attempt to develop verbal items that require a minimum of imagery for solution, and spatial items that necessitate the use of imagery for solution. The verbal questions consisted of 24 of each sub-type: word analogies, finding synonyms, and finding a word to match a definition. The spatial items consisted of questions requiring the description of spatial relationships between familiar objects, the imagined physical transformation of familiar objects, the description of geographic areas on a map, and the description of familiar locales.



Three pretest forms were developed by the random assignment of eight verbal and eight spatial items from each of the three subtypes. Each form consisted of 48 items, 24 spatial, and 24 verbal items. On each form a verbal and a spatial item were paired, forming a block, and within each block the order of the items was randomized. The pretest subjects were 58 men and 40 women drawn from introductory psychology classes. They were instructed to answer each item and rate each on a five point scale for the amount of imagery used in the solution of the problem. The mean imagery rating was determined for each item. On the basis of these ratings, the 60 verbal questions with the lowest imagery ratings and the spatial questions with the highest imagery ratings were selected for use in the experiment. Items were selected on the basis of the ratings by the males, but when items had identical ratings, the ratings by the females were used instead to determine the superior item. Selection of spatial items with the highest mean imagery ratings was presumed to maximize the likelihood that subjects would use a wholistic and synthetic cognitive mode most characteristic of the right hemisphere. Conversely, using verbal items with the lowest mean imagery ratings was presumed to maximize the likelihood that subjects would use an analytical cognitive mode most characteristic of the left hemisphere.

The 120 test questions selected were assigned to one of six equivalent forms, each consisting of 20 items, in the following manner. Ten items from the verbal and spatial categories were randomly assigned to each form of the test. On each form, a verbal and a spatial item were paired, and within each pair the order of the questions was randomized. (These forms appear in Appendix A.) During each of the three

experimental sessions, two forms were administered. The forms were presented in an order counterbalanced across subjects.

<u>Apparatus</u>. Subjects were tested in a 15×9 foot $(4.52 \times 3.04 \text{ m})$ room whose walls were covered with black cloth to assure a homogeneous visual field. The subjects sat in a reclining lounge chair with a high backrest. Two $6 \times 6 \times 3$ in. (15.24 $\times 15.24 \times 7.62$ cm) foam pads were attached to the backrest of the lounger at head level to keep the subject's head in a steady, forward position. A video camera was mounted in the middle of the wall directly facing the subject. The lens of the camera was placed through a 3×3 in. (7.62 $\times 7.62$ cm) hole in the cloth.

Eye movements were observed on a television monitor in another room. A Hewlett Packard digital recorder was used to record the duration of eye position at midline and movements to the left and the right. Three pens on the digital recorder were controlled by different switches for eye movement to the right, midline, and left. These switches were operated by observers. A fourth pen, used to indicate the beginning and end of a problem solution period, was controlled by a switch operated by the experimenter.

The Hand Usage Questionnaire (Humphrey, 1951) was used to assess handedness. (See Appendix B.)

The State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) was used as a measure of anxiety.

The Barron Ego Strength Scale (Barron, 1953) was used to test Hypothesis III: The capacity to use the appropriate hemisphere in problem solving is associated with ego strength (See Appendix C).



The Bem Sex Role Inventory (1974) was used to test Hypothesis IV: Left movers describe themselves in relatively more feminine sex stereotyped terms (see Appendix D).

Procedure

Subjects participated in three conditions: experimenter-facingsubject, experimenter-behind-subject, and the interpersonal stress procedure. Order of the experimenter-facing-subject and experimenterbehind-subject procedures was counterbalanced. All subjects received the stress condition last. All the experimenters were men, and those in the first two conditions were casually dressed undergraduates.

<u>Introduction to the experiment</u>. Upon being seated in the experimental room the subject was instructed as follows:

"Have you ever participated in a psychology experiment before? (The subject is permitted to answer.) In this research we are studying how people answer questions under various circumstances. We are also interested in how actual behavior relates to problem solving and personality. Thus I will be asking you a series of short questions. Secondly, I will ask you to fill out, by yourself, some standard personality questionnaires which require a very brief response. As you see, this is an observation room; however, the windows have been covered. For the purpose of this study we will be monitoring your behavior, just through this camera, but a permanent video recording will not be made.
We are merely interested in seeing how people actually do behave when they answer questions. Please read this consent form, which is a departmental requirement for everybody participating in research. If you agree to the conditions, please sign and we will begin."

<u>Orientation to the apparatus</u>. The subject was asked to sit in the lounge chair and then was further instructed:

"If you have ever worked with a T.V. camera, you know how difficult it is to keep people in focus when they are moving, so I would like you to rest your head between the foam pads, which will hold your head from moving too much. It is your body which we want to be steady, so you may glance around if you wish. Since we need to have you within full view of the camera, I will adjust your chair to the best possible position. Try to get yourself into a comfortable position so that the camera can be set."

<u>Administration of the problems</u>. Depending upon the condition, the experimenter was seated either across the table, directly facing the subject or in a chair five feet (1.52 m) behind the subject. The subject was further instructed as follows:

"I am going to read a series of questions to you. Listen carefully to each question. I will give you 10 seconds to think about the answer after I read the question. Then I will say 'answer' and I would like you to give me the answer then. You will probably find some of the questions easy and some more difficult. If you do not know the answer merely say 'I don't know.' I will be using this switch in order to keep track of the questions. Keep your eyes open while answering and thinking about the questions. Do you have any questions?"

Upon reading the first word of each question the experimenter depressed a button, which controlled a pen on the digital recorder, signifying that a new trial had begun.

Eye movements were scored by one of two trained observers watching the eye movements on a television monitor. The observer was seated in an adjacent room. Upon the first word of the question, the observer began to score by depressing switches for the duration of movements to the right, left or no movement at midline. He continued to score eye movements until the subject gave his response.

After two test forms had been administered, the subject was given the State-Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970), and the experimenter told the subject:

> "Now I would like you to fill out this short questionnaire. During this period your behavior will not be monitored. Listen as I read the instructions. "A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how

you feel right now, that is, at this moment.'

I will leave the room, while you fill this out and return in about four minutes."

The experimenter then left the room and returned in four minutes. When he returned, he instructed the subject:

"Now I would like you to answer some more questions.

I am going to sit over here for this group of questions." Depending upon which condition was being administered, the experimenter was seated in his appropriate chair and administered two more

forms of the test. After answering the questions, the subject was given the anxiety inventory once again, in the manner described above.

<u>Administration of Personality Inventories</u>. After the subject completed the anxiety inventory he was taken to a small room and instructed:

"I would now like you to fill out these brief personality questionnaires. These are commonly used to get a personality description. Please fill them out in the order marked at the top of the questionnaire: 1, 2, 3. Read over the instructions to each one now and I will answer any questions you might have. Here are some pencils and remember to fill them out in the proper order. You will have 45 minutes to complete these. If you finish early, please wait patiently until I return."

The subject was given the following tests to complete in this order: Hand Preference Questionnaire (Humphrey, 1951), Bem Sex Role Inventory (Bem, 1974), and the Ego Strength Scale (Barron, 1953).

Administration of the stress condition. In this condition, another experimenter was used. This experimenter was older and formally dressed in a white shirt, tie, and lab coat in an attempt to give a more intimidating appearance than the other experimenters. After 45 minutes this experimenter entered the room and introduced himself:

> "Hello, I am Dr. _____, the supervisor of this research. Have you completed these questionnaires? I would like you to come to the experimental room with me, where I would like to ask you some more questions."

After entering the experimental room, the experimenter and the subject were seated in two adjacent chairs. While looking at some papers in his folder, the experimenter explained.

"We scored your performance on the tests which you took with my assistant, and we would like you to try harder. Ordinarily undergraduates are able to answer these questions with a high degree of accuracy. Did you find the earlier questions too hard? (The subject is given an opportunity to respond to this and the following questions by the examiner.) How old are you? Do I have your name spelled correctly? What is your major? What is your G.P.A.? Do you expect to get a bachelor's degree? We want to give you some more questions, in order to get a clearer picture of what your performance on these items is really like. Pay very close attention, because each error lowers your score. Try your very best."

The subject was seated in the lounge chair and instructed as follows:

"I am going to read a series of questions to you. Listen carefully. I will give you 10 seconds to think about the answer after I read the question. Then I will say 'answer' and I would like you to give me the answer then. If you do not know the answer, merely say, 'I don't know'. Keep your eyes open while answering and thinking about the questions."

The experimenter was seated in a chair one ft. (.30 m) directly behind the subject. The experimenter responded to the subject's answer to every third item with the following six comments: "Are you sure?; These do seem hard; Close; Hmm; Try your best; Almost." The subject was given an opportunity to respond to these comments, but the experimenter did not respond further. Thus within the first 15 problems six comments were made. After the two forms had been completed, the anxiety inventory was given in the manner described above.

<u>Debriefing</u>. After the experimenter returned to the room, the experimenter and subject were seated in the two adjacent chairs, and the subject was debriefed as follows:

"Now that the experiment is over, I would like to tell you about the purpose of some of the things we have done, and set your mind at ease. First we did not score your performance on the questions, which the first experimenter gave to you. Secondly, although I told you that I would like you to try harder, implying that your performance was in some way not up to par, and though I made some critical comments after some of your responses, this was in no way a reflection upon the quality of your performance. In fact all subjects who participate in this experiment are asked the same questions and told the same things. My instructions to you were designed to help assess the effects of implied negative feedback and stress upon your behavior. I am sorry if any of my statements were in any way disturbing. Let me make clear that my behavior and statements were intended to be stress inducing and did not reflect anything about your performance."

At this point the experimenter encouraged the subject to express any feelings associated with the experiment, permitting him to ventilate feelings of annoyance and concerns over decreased self-esteem. The purpose of the experiment was described, as well as relevant background information. The subject was encouraged to ask questions. See Appendix E for further details about the debriefing.

RESULTS

Reliability of Observers

The reliability of the two observers was determined after approximately 5 hours of practice with pilot subjects. The two observers, making independent ratings, agreed upon the direction of the first movement on 85% of the items. With respect to the rating of all eye movements, when movement was seen simultaneously by both observers, there was agreement upon the direction of the movement in 98% of these cases. Again with respect to the rating of all eye movements, there was agreement that eye movement had occurred in 87% of all eye movements scored.

Anxiety and the Directional Consistency of Eye Movement

Hypothesis I states that the directional consistency of eye movements is a function of anxiety irrespective of the type of problem being solved. It was expected that the mean percentage of right looking would be greater on verbal items than on spatial items in the <u>E-behind S</u> (EBS) condition, but that no such difference would be found in the <u>E-facing-S</u> (EFS) and stress condition. The mean percentages of first eye movements to the right, of items on which there was movement, for the three conditions and two orders of presentation (EBS followed by EFS or EFS followed by EBS) are presented on Table 1. The probabilities of the significance of differences for the main effects and



interactions, as determined by analysis of variance, ranged from p < .13 for Question Type (verbal vs. spatial) to p < .99 for Question Type X Order. A summary of the analysis of variance appears in Table 2. Hypothesis I was not supported. The experimental manipulations failed to influence eye movements. Furthermore, the direction of eye movements failed to distinguish between question type in all three conditions. At most there was a nonsignificant trend for right looking to follow spatial questions and for left looking to follow verbal questions.

Insert Tables 1 and 2 about here

The data next were examined in terms of the total duration of all directional eye movements during the period before the question was answered. For each item, from the total amount of time of directional looking (left or right), the percentage of time looking to the right was computed. Thus the unit of analysis is the percentage of duration of right looking. The means for this analysis are presented in Table 3. The probabilities of the significance of these differences for the main effects and interactions as determined by analysis of variance ranged from p < .04 for Question Type (verbal vs. spatial) to p < .95 for Order. A summary of the analysis of variance appears in Table 4. Again, Hypothesis I failed to be supported. The three conditions did not have different effects on eye movements. Significantly more right looking was found to occur on spatial questions than on verbal questions. Reciprocally, this indicates that significantly more left looking occurred on verbal items. Thus the relationship between question type and direction of eye movement was the reverse of what was expected.



TA	BL	Ξ.	1
----	----	----	---

Mean Percentage of First Eye Movements to the Right Made by Subjects on Verbal and Spatial Items in the Three Conditions

Order of Administration I: EBS Followed by EFS					
Verbal I	tems		Spa t	ial Items:	
Conditions	X	SD		x	SD
EBS	43.50	24.58		46.24	28.15
EFS	46.28	30.87		45.62	31.54
Stress	41.42	30.68		48.20	28.76
Orde	r of Admir	nistration	II: EFS Followed	by EBS	
EBS	45.34	29.96		49.62	28.84
EFS	39.85	29.86		47.18	30.84
Stress	52.41	28.62		49.60	26.67

EBS= experimenter-behind-subject condition. EFS= experimenter-facing-subject condition. Stress= stress condition.



Analysis of Variance for Mean Percentage of First Eye Movements to the Right Made by Subjects, on Verbal and Spatial Items in Three Conditions

Source	df	Ms	F
Order (0) Error	1 46	.03 .35	.09
Conditions (C) Contrast I Error Contrast II Error	1 46 1 46	.00 .05 .05 .05	.00 1.05
C X O (Contrast I) X O Error (Contrast II) X O Error	1 46 1 46	.00 .05 .09 .05	.02 1.93
Question Type (Q) Error	1 46	.06 .03	2.33
Q X O Error	1 46	.00 .03	.00
C X Q (Contrast IV) X Q Error (Contrast V) X Q Error	1 46 1 46	.00 .01 .00 .02	.08 .08
C X Q X O (Contrast IV) X Q X O Error (Contrast V) X Q X O Error	1 46 1 46	.00 .01 .06 .03	.15 2.00
Contrasts I = $C_1 - (C_2 + C_3)/2$ II = $C_2 - (C_1 + C_3)/2$ III = Verbal (V) - IV = $C_1 V - C_1 S - C_2 V_+$ V = $-C_1 V + C_1 S + C_2 V_+$	Spatial (S C ₂ S-C ₃ V ₊ C ₃ S -C ₂ S-C ₃ V+C ₃ S	C ₁ =E C ₂ =E C ₃ =S	BS FS tress

TABLE 2

Insert Tables 3 and 4 about here

Experimenter Location and Anxiety

Hypothesis II states that anxiety is a function of experimenter location. It was expected that the mean self-reported anxiety in the EFS condition would be higher than in the EBS condition. Secondly, it was expected that anxiety in the stress condition would be higher than in the EFS condition. The mean self-reported anxiety ratings are reported in Table 5, for the two orders of presentation. The mean anxiety ratings for Order 1 (EBS followed by EFS) were 44.50 for EBS and 44.42 for EFS and for Order II (EFS followed by EBS) the mean for EBS was 40.63 and 41.46 for EFS. These anxiety ratings are comparable to ratings made by male college students, while taking an intelligence test, for whom the mean rating was 43.01 (Spielberger, Gorsuch & Lushene, 1970). The mean anxiety ratings in the stress condition were 49.71 in Order I and 48.00 in Order II. These anxiety ratings are comparable to those obtained from male college students, after viewing a stressful movie (depicting accidents in a woodworking shop), for whom the mean was 50.03 (Spielberger, Gorsuch & Luthene, 1970).

The range of probabilities of differences for the main effects and interactions is from $p \le .0002$ for Conditions (Stress - $\frac{EBS + EFS}{2}$) to $p \le .72$ for Order x Conditions. The analysis of variance appears in Table 6. The difference between the mean anxiety ratings for the EBS and EFS conditions was nonsignificant by analysis of variance. Hypothesis II was not confirmed, though self-reported anxiety was significantly



Mean Percentage of Duration of Right Looking By Subjects, on Verbal and Spatial Items, in the Three Conditions

Orde	er of Admir	nistration	I: EBS Followed by EFS	
Verbal 2	Items		Spatial Items	
Conditions	x	SD	X	SD
EBS	48.38	22.15	50.70	26.35
EFS	46.59	27.26	49.33	30.76
Stress	46.79	24.86	53.39	27.37
Orde	er of Admir	nistration	II: EFS Followed by EBS	
EBS	46.80	27.72	53.26	27.32
EFS	39.70	28.03	48.71	29.72
Stress	50.91	26.54	53.47	26.73

EBS= experimenter-behind-subject condition. EFS= experimenter-facing-subject condition. Stress= stress condition.

.



Source	df	Ms	F
Order (0) Error	1 46	.00 .31	.00
Conditions (C) Contrast I Error Contrast II Error	1 46 1 46	.01 .04 .12 .04	.23 3.00
C X O (Contrast I) X O Error (Contrast II) X O Error	1 46 1 46	.00 .04 .04 .04	.07 1.04
Question Type (Q) Error	1 46	.18 .04	4.67*
Q X O Error	1 46	.00 .04	. 21
C X Q (Contrast IV) X Q Error (Contrast V) X Q Error	1 46 1 46	.00 .01 .00 .01	.12 .22
C X Q X O (Contrast IV) X Q X O Error (Contrast V) X Q X O Error	1 46 1 46	.00 .01 .03 .01	.41 3.00
* $p \sim .05$ Contrasts I = $C_1 - (C_2 + C_3)/2$ II = $C_2 - (C_1 + C_3)/2$ III = Verbal (\forall)-Spatial IV = $C_1 V - C_1 S - C_2 V + C_2 S - C_3$ V = $-C_1 V + C_1 S + C_2 V - C_2 S - C_3$	(S) V+C ₃ S C ₃ V+C ₃ S	C ₁ =EBS C2=EFS C ₃ =Stre	25 5

Analysis of Variance for Mean Percentage of Duration of Right Looking by Subjects, on Verbal and Spatial Items, in the Three Conditions



higher in the stress condition than in the other two conditions as was predicted.

Insert Tables	5 and 6 about	here	

Ego Strength and the Use of the Cerebral Hemispheres

Hypothesis III states that the capacity to use the appropriate cognitive mode as indexed by the direction of eye movements during problem solving is associated with ego strength. Within the three conditions, the correlation of ego strength and the total number of first eye movements in the appropriate direction (right on verbal questions and left on spatial questions) was determined. Pearson correlations were: r = -.10(p < .25) for the EBS condition, r = .25 (p < .04) for the stress condition, and r = .20 (p < .45) for the EFS condition. Thus Hypothesis III received only weak support.

Sex Role Identity and Left Looking

Hypothesis IV states that left movers describe themselves in relatively more feminine sex stereotyped terms than right movers. The hypothesis received no support. Pearson correlation of the scores on the Bem Sex Role Inventory (BSRI) with the percentage of items for which the subject's first eye movement was to the left was $r \leq .09$. The correlation of the BSRI with the percentage of time looking to the left, or the total amount of time spent looking in either direction was $r \leq .01$.

As a third test of the hypothesis, subjects were identified as either left movers or right movers if 70% or more of their first eye movements were to the left or the right, the criteria used in previous research (Gur, 1973). By this criterion 11 subjects were classified



Mean Anxiety Reported by Subjects in the Three Conditions

Order I: EBS Fol	lowed by EFS	
Conditions	x	SD
EBS	44.50	7.56
EFS	44.42	8.53
Stress	49.71	10.52
Order II: EFS Follo	owed by EBS	
EBS	40.63	7.97
EFS	41.46	7.74
Stress	48.00	11.34

EBS= experimenter-behind-subject condition. EFS= experimenter-facing-subject condition. Stress= stress condition.



TAB	LE	6
-----	----	---

Analysis of Variance for Mean Anxiety Reported by Subjects in the Three Conditions

Source	df	Ms	F
Order (0)	1	291.84	1.95
Error	46	149.60	
Conditions (C)			
Contrast I	1	1192.34	17.49*
Error	46	68.18	
Contrast II	1	3.38	.12
Error	46	29.19	
охс			
(Contrast I) X O	1	23.35	.34
Error	46	68.17	
(Contrast II) X O	1	5.04	.17
Error	46	29.19	

* p ∠.001 Contrasts

I= Stress-(EFS-EBS)/2 II= EFS-EBS



as right movers and 13 as left movers with the remaining 24 subjects being, by definition, 'ambilateral' lookers. The hypothesis received no support. The mean score on the BSRI for right movers was -1.52 and for left movers -1.08 (t $\angle 1.0$).

Additional Findings: Staring

The amount of staring (no lateral eye movement occurred) for verbal and spatial items within the three conditions was examined. The mean percentages of verbal and spatial items on which there is no eye movement is reported in Table 7. The probabilities for the significance of differences in the main effects and interactions range from $p \ge .0097$ for Question Type (verbal vs. spatial) to $p \le .75$ for Conditions x Question Type x Order, by analysis of variance. The analysis of variance appears in Table 8. Thus there is strong evidence that more staring occurs on spatial questions than on verbal questions.

Insert Tables 7 and 8 about here

The Conditions by Order (C x 0) interaction for Contrast I was significant (p < .05). Contrast I consists of EBS - (EFS + Stress)/2. To better understand this interaction, analyses of variance were done comparing each condition with one other condition in all possible pairs. These analyses of variance appear in Tables 9, 10, and 11. The C x 0 interaction was significant at p < .05 only for the experimenter-behindsubject and experimenter-facing-subject conditions as shown in Table 9.



.

Mean Percentage of Verbal and Spatial Items on Which Subjects Made No Eye Movements, for the Three Conditions

	Order of	Administra	tion I:	EBS Followed by	EFS
Verbal	Items			Spatial Item	S
Conditions	X	SD		X	SD
EBS	8.54	15.78		14.79	19.14
EFS	13.96	20.85		17.29	19.84
Stress	13.12	15.66		17.71	18.30
	Order of	Administra	tion II:	EFS Followed by	EBS
EBS	11.87	12.84		15.21	18.79
EFS	8.33	9.40		10.21	10.16
Stress	12.08	15.60		11.04	14.22

EBS= experimenter-behind-subject condition. EFS= experimenter-facing-subject condition. Stress= stress condition.

Source	df	Ms	F
Order (O) Error	1 46	22.22 41.07	. 54
Conditions (C) (Contrast I) Error (Contrast II) Error	1 46 1 46	.34 6.67 2.08 5.81	.05 .36
C X O (Contrast I) X O Error (Contrast II) X O Error	1 46 1 46	31.17 6.67 3.00 5.81	4.67* .52
Question Type (Q) Error	1 46	26.89 3.68	7.30**
Q X O Error	1 46	8.00 3.68	2.17
C X O (Contrast IV) X Q Error (Contrast V) X Q Error	1 46 1 46	4.34 2.69 .33 3.63	1.61 .09
C X Q X O (Contrast IV) X Q X O Error (Contrast V) X Q X O Error	1 46 1 46	.06 2.69 2.08 3.63	.02 .57
* $p \geq .05$ ** $p \geq .01$ Contrasts I = $C_1 - (C_2 + C_3)/2$ II = $C_2 - (C_1 + C_3)/2$ III = Verbal (V)-Spatial IV = $C_1 V - C_1 S - C_2 V + C_2 S - C_3 V$ V = $-C_1 V + C_1 S + C_2 V - C_2 S - C_3 V$	(S) +C ₃ S V+C ₃ S	$C_1 = EBS$ $C_2 = EFS$ $C_3 = S tress$	

Analysis of Variance for Mean Percentage of Verbal and Spatial Items on which Subjects Made No Eye Movements, for the Three Conditions

TABLE 8

.

This interaction is plotted in Figure 1, and shows that staring is lowest in the first condition presented to the subjects irrespective of condition.

Insert Tables 9, 10, and 11 about here

~~~~

Insert Figure 1 about here

\_\_\_\_\_ \_\_\_\_\_  HOC .



| TA | BL | E | 9 |
|----|----|---|---|
|----|----|---|---|

# Analysis of Variance for Mean Percentage of Verbal and Spatial Items on which Subjects Made No Eye Movements, for the EBS and EFS Conditions

| Source            | df | Ms     | F      |
|-------------------|----|--------|--------|
| Order (0)         | 1  | 38.52  | .31    |
| Error             | 46 | 121.58 |        |
| Conditions (C)    | 1  | .19    | .01    |
| Error             | 46 | 25.67  |        |
| C X O             | 1  | 130.02 | 5.07*  |
| Error             | 46 | 25.67  |        |
| Question Type (Q) | 1  | 105.02 | 7.68** |
| Error             | 46 | 13.67  |        |
| Q X O             | 1  | 9.19   | .67    |
| Error             | 46 | 13.67  |        |
| C X Q             | 1  | 9.18   | .81    |
| Error             | 46 | 11.32  |        |
| C X Q X O         | 1  | 1.02   | .09    |
| Error             | 46 | 11.32  |        |

\* p ∠ .05 \*\* p ∠ .01

| IABLE IC |
|----------|
|----------|

# Analysis of Variance for Mean Percentage of Verbal and Spatial Items on which Subjects Made No Eye Movements, for EFS and Stress Conditions

| Source            | df | Ms     | F    |
|-------------------|----|--------|------|
| Order (O)         | 1  | 200.08 | 1.76 |
| Error             | 46 | 113.46 |      |
| Conditions (C)    | 1  | 8.33   | .36  |
| Error             | 46 | 23.25  |      |
| C X O             | 1  | 12.00  | .52  |
| Error             | 46 | 23.25  |      |
| Question Type (Q) | 1  | 36.75  | 2.97 |
| Error             | 46 | 12.37  |      |
| Q X O             | 1  | 24.08  | 1.95 |
| Error             | 46 | 12.37  |      |
| C X Q             | 1  | 1.33   | .09  |
| Error             | 46 | 14.53  |      |
| C X Q X O         | 1  | 8.33   | . 57 |
| Error             | 46 | 14.53  |      |



# Analysis of Variance for Mean Percentage of Verbal and Spatial Items on which Subjects Made No Eye Movements, for EBS and Stress Conditions

| Source            | df | Ms     | F     |
|-------------------|----|--------|-------|
| Order (O)         | 1  | 7.52   | .06   |
| Error             | 46 | 118.53 |       |
| Conditions (C)    | 1  | 6.02   | .23   |
| Error             | 46 | 26.00  |       |
| C X O             | 1  | 63.02  | 2.42  |
| Error             | 46 | 26.00  |       |
| Question Type (Q) | 1  | 82.69  | 5.15* |
| Error             | 46 | 16.07  |       |
| Q X O             | 1  | 35.02  | 2.18  |
| Error             | 46 | 16.07  |       |
| C X Q             | 1  | 17.52  | 1.45  |
| Error             | 46 | 12.09  |       |
| C X Q X O         | 1  | 3.52   | .29   |
| Error             | 46 | 12.09  |       |

\* p ∠ .05




Figure 1. The Mean Percentage of Items on Which Subjects Made No Eye Movements in the EBS and EFS Conditions, for Order I: EBS Followed by EFS and Order II: EFS Followed by EBS.



#### DISCUSSION

# Lateral Eye Movement as an Index of Hemispheric Activation

The current results showing that spatial questions tend to elicit right looking and verbal questions tend to elicit left looking are the reverse of earlier experiments (Kinsbourne, 1972; Kocel et al., 1972; Gur, 1973; Weiten & Etaugh, 1974; Galin & Ornstein, 1974). The current findings agree with those of Ehrlichman et al. (1974), who found in a series of three experiments a nonsignificant trend for spatial questions to elicit more initial eye movements to the right than verbal questions. There is no obvious explanation for these findings, which are contrary to the current understanding of the lateral eye movement phenomenon and its relation to the activation of the cerebral hemispheres. The proposal (Bakan, 1969; Kinsbourne, 1972) that eye movement reflects activation of the contralateral cerebral hemisphere in the course of cognitive activity must be tested further. Within the confines of this theory the current results, as well as those of Ehrlichman et al. (1974), are difficult to explain, especially since special care was taken to select spatial and verbal items likely to require, respectively, a high and a low degree of imagery for solution.

The discrepancies among the findings of the various studies suggest that lateral eye movement is a fragile phenomenon and that all of the significant task, subject, and environmental variables have not been

identified and brought under control. One possible source of uncontrolled variance may be the different sets of questions used in the investigations. Most of the studies used verbal and spatial questions to elicit right and left hemisphere activation. However, both categories of questions have been loosely defined. Verbal questions include word definitions, explanation of proverbs, and word analogies. Spatial items here included a variety of problems requiring the construction of a visual image in order to achieve a solution. Examples of spatial questions include: (a) "Which states border on California?" (b) "Which direction does the front of your house face?" (c) "If you hold the letter P in front of a mirror upside down, what letter would you see in the mirror?" (d) "Describe the route by which you came to the experiment today." Both of these groups of questions are heterogeneous and consist of problems which may tap different cognitive processes. The use of a standardized set of problems in various experiments would introduce a higher degree of control into this research.

These problems can often be solved by either a verbal or a spatial approach. For example, when a subject is asked "Describe the route by which you came to the experiment today," he may indeed visualize the route or if he is highly familiar with the route he may not need to call upon imagistic cues to answer the question. The degree to which individuals use a verbal or spatial approach to solve problems probably is related to individual abilities and propensities.

In future studies it would be valuable to perform an item analysis examining the responses of the subjects to individual problems. Such an item analysis could examine the difficulty of the problem, the percentage



of right and left looking, the content of the item, and the relationships among these variables. It also would be worthwhile to relate these item variables to individual differences such as verbal and spatial ability.

A new method of measuring lateral eye movements was employed and consisted of measuring the duration of all eye movements from presentation of the question to subject response. It was assumed that the solution of problems extends over a duration and that the eye movements during this period are an index of continuous hemispheric activation in the service of problem solution. Thus the measurement of the duration of total eye movements may be a more valid reflection of hemispheric activation than the first eye movement as was used by Gur (1973). While the rating of first eye movements indicated a trend for spatial questions to elicit eye movements to the right with a greater frequency than verbal questions, this trend was significant only when the duration of total eye movement was employed as the measure. It would be appropriate for future research to use both measures of eye movements and to further clarify the relationship between the two.

#### Eye Movement, Experimenter Location, and Anxiety

The results of this study did not confirm Gur's (1973) finding that experimenter location affects lateral eye movement, such that in the experimenter-facing-subject situation subjects tend to look predominantly in one direction while eye movements in the experimenter-behindsubject condition are to the left or the right depending upon question type. The current findings suggest that the directional consistency



of eye movements is unrelated to experimenter location. This failure to confirm Gur's (1973) results is difficult to explain, since the experimental procedures were very similar in both experiments. Since anxiety was not related to the directional consistency of eye movement in this study, it may be that other variables contributed to the differences that Gur (1973) found between the experimenter-facing-subject and experimenter-behind-subject conditions.

Gur (1973) suggested that the effect of experimenter location upon eye movement is mediated by anxiety. She concluded that the anxiety aroused by the interpersonal situation in the experimenter-facingsubject paradigm distracts the subject from the salient aspects of the problem, making him fall back on a mode of cognitive processing (and by implication of a hemispheric) characteristic of that subject. The results of the current study indicate that anxiety is not related to eye movement behavior, since no differences were found between the stress condition and the experimenter-behind-subject condition. Indeed, there were no differences among any of the three conditions. Thus the directional consistency of eye movements does not appear to be related to anxiety as Gur (1973) suggested.

The hypothesis that anxiety is related to experimenter location was not supported. Subjects reported an equivalent degree of anxiety in the experimenter-behind-subject and experimenter-facing-subject situations. A high degree of anxiety, however, was observed by experimenters and reported by many of the subjects during the debriefing (see



Appendix E). This already high level of anxiety may have prohibited a further increment of anxiety by such a subtle manipulation as the experimenter-facing-subject situation. It is possible that at this already elevated level of anxiety, a more potent threat to self-esteem, such as the stress condition, may have been necessary to arouse further anxiety.

It may be important that both the experimenters and subjects in the current study were male, whereas Gur's (1973) male subjects were tested by women. Whether men would experience significantly more anxiety in an experimenter-facing-subject situation with a woman is uncertain. Sarason and Winkel (1966) found that male subjects rated male experimenters as more friendly, relaxed, and casual than female experimenters in the course of administering tasks. This more favorable view of male experimenters by male subjects could result in a lower anxiety level, and less of a threat to self-esteem. Men's self-esteem may be more vulnerable when confronted by a female experimenter, in circumstances where intellectual competence is apparently being examined. This could have made the experimenter-facing-subject situation more anxiety-arousing in Gur's (1973) study.

 $\mathcal{F}_{\mathbf{x}}^{\mathbf{x}}$ 

# Ego Strength and Hemispheric Activation

The hypothesis that the capacity to use the appropriate hemisphere in problem solving is associated with ego strength received very weak support. A marginally significant low correlation between these factors was found in the stress condition although not in the other two conditions. Since ego strength can be thought of as an individual's capacity to maintain adaptive means of coping in the face of stress, perhaps it might be



expected that this trait influences behavior, or discriminates among individuals' behavior in stressful situations only.

A different measure of ego strength may be needed to adequately examine the current hypothesis, which may be referring to only one component of the trait as measured by the Barron Scale (1953). Factor analysis of the Ego Strength Scale (Stein & Chu, 1967) reveals the following factors: freedom from disabling anxiety or depression, freedom from disabling primary process thought, freedom from physical complaints, a religious attitude of nonbelief, seeking heterosexual stimulation. These factors may not be closely enough related to the capacity for efficient problem solving and use of the appropriate cerebral hemisphere. Furthermore, the Ego Strength Scale (Barron, 1953) has proven to be most effective in discriminating normal and psychiatric groups and also in differentiating among psychiatric groups (Frank, 1967). The instrument may lack sufficient sensitivity to discriminate within a normal population where the range of ego strength by definition is relatively narrow. Nevertheless, the current findings do suggest that further examination of the relationship between ego strength and the lateral eye movement phenomenon is warranted.

## Lateral Eye Movement and Identity

The hypothesis that left movers describe themselves in relatively more feminine sex stereotyped terms was not confirmed. There are several possible explanations. This hypothesis presupposes a relationship between lateral eye movements and hemispheric activation which the current findings call into question. Secondly, from another perspective



the functional capacities of the cerebral hemispheres and of individuals characterized as left movers and right movers may not fit the dichotomous categorization of masculine and feminine as was believed at the outset of the study. Although the functions attributed to each cerebral hemisphere as well as the personality characteristics of unidirectional left and right movers appear to correspond to broad sex role stereotypes, there are major exceptions. For example, it has been shown repeatedly that males demonstrate superior ability in spatial tasks, a function of the right hemisphere which in this study was thought of as mediating functions stereotyped as feminine. Secondly, the superiority of females in certain limited aspects of verbal ability, a predominantly left hemisphere function, has also been demonstrated (Harris, in press). Thus the current finding suggests that there is no relationship between sex role identification and the use of a preferred cerebral hemisphere as measured by the preferred direction of lateral eye movement.

# Additional Findings: Staring

The greater incidence of staring on spatial questions confirmed similar findings by Kinsbourne (1972), Galin and Ornstein (1974), and Ehrlichman et al. (1974). In all these studies, staring was interpreted as a manifestation of simultaneous and equal activation of both hemispheres. It is reasonable that staring most often occured on spatial problems. Since these problems were verbally presented, left hemisphere activation would have been necessary to process the verbal communications, and right hemisphere functioning was necessary for their solution.



Another explanation of the higher frequency of stares on spatial items is possible. Meskin and Singer (1974) proposed, in their cognitive processing model of lateral eye movement, that concentration upon imagined visual images may require reduction of external stimulation in the visual system. Continuous staring at a fixed point may provide the most redundant and least compelling external visual field. Thus during spatial problem solving, staring may reduce the interference from the external field with the internally generated image. A test of the two competing models, bilateral hemispheric activation and cognitive processing, could be made by presenting spatial and verbal problems to subjects with their eyes closed. Eye movements could be measured electrophysiologically. The lack of external visual stimulation would preclude the influence of peripheral factors upon eye movement behavior.

The results of the current study showed that staring occurred least frequently in the first condition administered, whether it was the EBS or EFS condition. This suggests that staring is related to a time dependent variable involving accommodation to the experimental situation. It does not appear to be activation, since no differences were found in the anxiety scores. Future research should examine this effect in order to clarify the significance and function of staring.

# Conclusion and Suggestions for Future Research

The current results raise further questions about the lateral eye movement phenomenon. In agreement with previous empirical investigations and neuropsychological theory, it was found that spatial problems

elicit more staring than verbal items. Secondly, support, though weak, was found for the hypothesis that ego strength is associated with the use of the appropriate hemisphere in solving problems as indicated by the direction of lateral eye movements.

It was unexpectedly found, however, that verbal problems predominantly elicited eye movements to the left and spatial problems predominantly elicited eye movements to the right. While these results confirm an earlier report of a nonsignificant trend for spatial problems to elicit eye movements to the right (Ehrlichman et al., 1974), they do not agree with most other earlier reports or with the theory associating the direction of lateral eye movement with hemispheric activation. These discrepancies are difficult to explain.

It is possible that the lateral eye movement phenomenon may be influenced by variables which have not been identified and controlled. It would be helpful if a series of experiments employed the same set of problems and if the sex of the experimenter is held constant. Sex and handedness of subjects should be controlled.

Furthermore, unlike all other studies, neither the current study nor Gur's (1973) study separated verbal and spatial items into homogeneous blocks for consecutive presentation of one type of problems; all of the other studies did follow this procedure. Though the effect of blocking items has not been empirically examined, it may be that blocking enables the subject to develop a cognitive set toward the problems. This set could encourage the subjects to use the appropriate cognitive approach and the appropriate hemisphere. Also, the

introduction of each block of problems, wherein the subjects are primed as to the nature of the problems which follow and the most suitable cognitive approach for their solution can also be employed. Kinsbourne's (1973) attentional model for laterality effects in cognition has bearing on this point. Kinsbourne suggests that a preparatory state in a cerebral hemisphere makes that hemisphere more ready to employ the mode of cognitive processing characteristic of that hemisphere. A preparatory state could be induced by blocking and priming according to Kinsbourne's model. The resulting attentional orientation could enhance the readiness of the cerebral hemisphere to become activated by the appropriate material and could enhance the readiness to stimulate eye movements in the contralateral direction. Kimura's (1967) model for laterality effects in cognition does not take into account attention and hemispheric readiness so that a prediction concerning blocking and priming could not be made on the basis of her model. It is suspected that both the use of blocking and priming should emphasize the salient characteristics of the problems and heighten the lateral eye movement effect as reported by Kinsbourne (1972), Gur (1973), and others.

The use of electrophysiological measures of eye movement, permitting the subject's eyes to remain closed, would also introduce a methodological improvement in this research. The measurement of eye movements with the eyes closed would prohibit the influence of external visual stimuli upon eye movement and control all variables on the visual periphery.

The current results indicate that experimenter location and anxiety do not influence lateral eye movement in any detectable way. Perhaps a more rigorous and simpler investigation of the influence of anxiety upon lateral eye movement can be performed. One possibility is the use of two independent groups who are both asked to solve problems, with eyes closed, in the experimenter-behind-subject situation. One group can be subjected to stressful conditions similar to those used in the present study, whereas the other group can be administered a "relaxation condition" in which an active attempt is made to reduce the anxiety of the subject. Such an experiment would provide further control of anxiety and would clarify the influence of this variable upon lateral eye movement.

LIST OF REFERENCES

•



#### LIST OF REFERENCES

- Alexander, A., Roessler, R., & Greenfield, N. Ego strength and physiological responsivity. <u>A.M.A. Archives of General Psy-</u> chiatry, 1963, 9, 142-146.
- Argyle, M. Social interaction. Chicago: Aldine-Atherton, 1969.
- Bakan, P. Hypnotizability, laterality of eye movements and functional brain asymmetry. <u>Perceptual and Motor Skills</u>, 1969, 28, 927-932.
- Bakan, P. The eyes have it. Psychology Today, 1971, 71, 64-68.
- Bakan, P., & Shotland, L. Lateral eye movement, reading speed, and visual attention. <u>Psychonomic Science</u>, 1969, <u>15</u>, 93-94.
- Bakan, P. & Svorad, D. Resting EEG alpha and asymmetry of reflective eye movements. Nature, 1969, 223, 975-976.
- Barron, F. An ego-strength scale which predicts response to psychotherapy. Journal of Consulting Psychology, 1953, 17, 327-333.
- Barton, M., Goodglass, H., & Shai, A. Differential recognition of tachistoscopically presented English and Hebrew words in right and left visual fields. <u>Perceptual and Motor Skills</u>, 1965, 21, 431-437.
- Bem, S. L. The measurement of psychological androgyny. <u>Journal</u> of Consulting and Clinical Psychology, 1974, 42, 165-172.
- Bogen, J. The other side of the brain: II an oppositional mind. Bulletin of the Los Angeles Neurological Society, 1969, 34, 135-162.
- Branch, C., Milner, B., & Rasmussen, T. Intracarotid Sodium Amytal for the lateralization of cerebral speech dominance. Journal of Neurosurgery, 1964, 21, 399-406.
- Broca, P. Remarques sur le siege de la faculte du langage articule, suives d'une observation d'aphemie. <u>Bull. Soc. Anat. Paris, 1861, 6, 330-337. Cited by O. Zangwill, Cerebral dominance</u> <u>and its relation to psychological function</u>. Springfield: Charles Thomas, 1960, p. 49.



- Bryden, M. Left-Right differences in tachistoscopic recognition: Directional scanning or cerebral dominance. <u>Perceptual and</u> <u>Motor Skills</u>, 1966, <u>23</u>, 1127-1134.
- Bryden, M. Binaural competition and division of attention as determinants of the laterality effect in dichotic listening. <u>Canadian Journal of Psychology</u>, 1969, <u>23</u>, 101-113.
- Buchsbaum, M. F. Visual information and evoked responses from the left and right hemispheres. <u>Electroencephalography and</u> <u>Clinical Neurophysiology</u>, 1969, 26, 266-272.
- Carmon, A., & Benton, A. Tactile perception of direction and number in patients with unilateral cerebral disease. <u>Neurology</u> (Minneapolis), 1969, 19, 525-532.
- Corkin, S. Tactually guided maze learning in Man: Effects of unilateral cortical excisions and bilateral hippocampal lesions. <u>Neuropsychologia</u>, 1965, <u>3</u>, 339-351.
- Crosby, E. Relations of brain centers to normal and abnormal eye movements in the horizontal plane. <u>Journal of Comparative</u> <u>Neurology</u>, 1953, 99, 437-479.
- Day, M. An eye movement phenomenon relating to attention and anxiety. Perceptual and Motor Skills, 1964, 19, 443-446.
- Day, M. An eye movement indicator of individual differences in the physiological organization of attentional processes and anxiety. Journal of Psychology, 1967, 66, 51-62 (a).
- Day, M. An eye movement indicator of type and level of anxiety: some clinical observations. <u>Journal of Clinical Psychology</u>, 1967, 23, 438-441 (b).
- De Renzi, E., Faglioni, P., & Scotti, G. Judgment of spatial orientation in patients with focal brain damage. <u>Journal of</u> Neurology, 1971, 34, 389-495.
- Duke, J. Lateral eye movement behavior. <u>Journal of General Psy-</u> chology, 1968, 78, 189-195.
- Durnford, M., & Kimura, D. Right hemisphere specialization for depth perception reflected in visual field differences. <u>Nature</u>, 1971, <u>231</u>, 394-395.
- Ehrenwald, J. The visual distortion test. <u>Psychiatric Quarterly</u>, 1966, <u>40</u>, 429-448.



- Ehrlichman, H., Weiner, S. L., & Baker, A. Effects of verbal and spatial questions on initial gaze shifts. <u>Neuropsychologia</u>, 1974, <u>12</u>, 265, 277.
- Etaugh, C., & Rose, M. Lateral eye movement: elusive personality correlates and moderate stability estimates. <u>Perceptual and</u> <u>Motor Skills</u>, 1973, 37, 211-217.
- Ettlinger, G., Jackson, C., & Zangwill, O. Cerebral dominance in sinistrals. <u>Brain</u>, 1954, <u>77</u>, 521-548.
- Fenichel, O. <u>The psychoanalytic theory of the neuroses</u>. New York: Norton, 1945.
- Fernberger, S. Persistence of stereotypes concerning sex differences. <u>Journal of Abnormal and Social Psychology</u>, 1948, <u>43</u>, 97-101.
- Frank, G. A review of research with measures of ego strength derived from the MMPI and the Rorschach. <u>Journal of General</u> <u>Psychology</u>, 1967, <u>77</u>, 183-206.
- Galin, D., & Ornstein, R. Lateral specialization of cognitive mode: An EEG study. <u>Psychophysiology</u>, 1972, <u>9</u>, 412-418.
- Galin, D., & Ornstein, R. Individual differences in cognitive style. I. Reflective eye movements. <u>Neuropsychologia</u>, 1974, 12, 367-376.
- Gerdes, E., & Kinsbourne, M. Lateral eye movements and state anxiety. <u>Catalog of Selected Documents in Psychology</u>, 1974, 4, 118-119.
- Geschwind, N. The organization of language and the brain. Science, 1970, 170, 940-945.
- Geschwind, N. Cerebral dominance and anatomic asymmetry. <u>The</u> <u>New England Journal of Medicine</u>, 1972, <u>287</u>, 194-195.
- Geschwind, N. The anatomical basis of hemispheric differentiation. In S. J. Dimond and J. G. Beaumont (Eds.), <u>Hemispheric function</u> <u>in the human brain</u>. New York: Wiley, 1974.
- Geschwind, N., & Levitsky, N. The human brain: left-right asymmetries in temporal speech region. <u>Science</u>, 1968, <u>161</u>, 186-187.
- Goodglass, H., & Quadfasel, F. Language laterality in left handed aphasics. <u>Brain</u>, 1954, <u>77</u>, 521-541.



- Greenfield, N., Alexander, A., & Roessler, R. Ego strength and physiological responsivity. <u>A.M.A. Archives of General</u> <u>Psychiatry</u>, 1963, <u>9</u>, 129=146.
- Gur, R. C., & Reyher, J. Relationship between style of hypnotic induction and direction of lateral eye movements. Journal of Abnormal\_psychology, 1973, 82, 499-505.
- Gur, R. C., Sackheim, H.A., & Gur, R. E. Classroom seating and psychopathology. <u>Journal of Abnormal Psychology</u>, 1976, <u>85</u>, 122-124.
- Gur, R. E. Experimental validation and personality correlates of conjugate lateral eye movements as an index of contralateral hemispheric activation. Unpublished Ph.D. Dissertation, Michigan State University, 1973.
- Gur, R. E. Conjugate lateral eye movement as an index of hemispheric activation. <u>Journal of Personality and Social</u> <u>Psychology</u>, 1975, 31, 451-457.
- Gur, R. E., Gur, R. C., & Harris, L. J. Cerebral activation as measured by subjects' lateral eye movement is influenced by experimenter location. Neuropsychologia, 1975, <u>13</u>, 35-44.
- Harris, L. J. Sex differences in spatial ability: possible environmental, genetic and neurological factors. In M. Kinsbourne (Ed.), <u>Hemispheric asymmetries of function</u>. Cambridge, England: Cambridge University Press, in press.
- Harris, L. J. Sex differences in the growth and use of language. In E. Donelson and J. Gullahorn, (Eds.), <u>Women: a psychological</u> <u>perspective</u>. New York: Wiley, 1977, 79-94.
- Hathaway, S. R., & McKinley, J. <u>The Minnesota Multiphasic Per-</u> sonality Inventory. New York: Psychological Corporation, 1951.
- Hécaen, H., & Ajuriaguerra, J. <u>Left handedness</u>. New York: Grune and Stratton, 1964.
- Humphrey, M. Consistency of hand usage: a preliminary inquiry. British Journal of Educational Psychology, 1951, 21, 214-255.
- Jackson, A. On the nature of duality of the brain. <u>Brain</u>, 1915, <u>38</u>, 96-103. (Originally published: <u>Medical Press and Circular</u>, 1874, <u>1</u>, 63-70).
- Janett, R., & Sherriffs, A. Sex differences in attitudes about sex differences. <u>Journal of Psychology</u>, 1953, <u>19</u>, 161-168.

- Jourard, S. & Friedman, R. Experimenter subject "distance" and self disclosure. Journal of Personality and Social Psychology, 1970, 15, 278-282.
- Karush, A., Easser, R., Cooper, A., & Swerdloff, B. The evaluation of ego strength. I: a profile of adaptive behavior. Journal of Nervous and Mental Disease, 1964, 139, 332-350.
- Kimura, D. Right temporal lobe damage. <u>Archives of Neurology</u>, 1963, 8, 264-273.
- Kimura, D. Dual functional asymmetry of the brain in visual perception. <u>Neuropsychologia</u>, 1966, 4, 275-285.
- Kimura, D. Functional asymmetry of the brain in dichotic listening. <u>Cortex</u>, 1967, <u>3</u>, 163-173.
- Kimura, D. Spatial localization in left and right visual fields. Canadian Journal of Psychology, 1969, 23, 445-460.
- Kimura, D. The asymmetry of the brain. <u>Scientific American</u>, 1973, <u>228</u>, 70-77.
- Kinsbourne, M. Eye and head turning indicates cerebral dominance. <u>Science</u>, 1972, <u>176</u>, 539-541.
- Kinsbourne, M. The control of attention by interaction between the cerebral hemispheres. In S. Kornblum (Ed.), <u>Attention and</u> Performance, IV. New York: Academic Press, 1973.
- Kinsbourne, M. Note: Direction of gaze and distribution of cerebral thought processes. <u>Neuropsychologia</u>, 1974, 12, 279-281.
- Knox, A., & Boone, D. Auditory laterality and tested handedness. Cortex, 1970, 6, 163-170.
- Kocel, K., Galin, D., Ornstein, R., & Merrin, E. Lateral eye movement and cognitive mode. <u>Psychonomic Science</u>, 1972, <u>27</u>, 223-224.
- Landsdell, A. The effect of neurosurgery on a test of proverbs. American Psychologist, 1961, 16, 448.
- Lansdell, A. The use of factor scores from the Wechsler-Bellevue Scale of Intelligence in assessing patients with temporal lobe removals. <u>Cortex</u>, 1968, <u>4</u>, 257-267.
- Lazarus, R. <u>Psychological stress and the coping process</u>. New York: McGraw-Hill, 1966.



- Levy, J. Possible basis for the evolution of lateral specialization of the human brain. <u>Nature</u>, 1969, <u>224</u>, 614-615.
- Levy, J. Trevarthen, C., & Sperry, R. Perception of bilateral chimeric figures following hemispheric disconnection. <u>Brain</u>, 1972, <u>95</u>, 61-78.
- Lopiccolo, J., & Blatt, S. Cognitive style and sexual identity. Journal of Clinical Psychology 1972, 28, 148-151.
- Matsumya, Y., Tagliasco, V., Lombroso, C., & Goodglass, H. Auditory evoked response, meaningfulness of stimuli and interhemispheric asymmetry. Science, 1972, 175, 790-792.
- McAdam, D., & Whitaker, M. Language production: electroencephalographic localization in the normal human brain. <u>Science</u>, 1971, <u>172</u>, 449-502.
- McClone, J., & Davidson, W. The relation between cerebral speech laterality and spatial ability. <u>Neuropsychologia</u>, 1973, <u>11</u>, 105-113.
- McClone, J., & Kertesz, J. Sex differences in cerebral processing of visuospatial tasks. <u>Cortex</u>, 1973, <u>9</u>, 313-320.
- McKee, H., Humphrey, B., & McAdam, D. Scaled lateralization of alpha activity during linguistic and musical tasks. <u>Psycho-</u> physiology, 1973, <u>10</u>, 441-443.
- McKeever, N., & Huling, M. Left cerebral hemisphere superiority in tachistoscopic word recognition performance. <u>Perceptual</u> and <u>Motor Skills</u>, 1970, 30, 763-766.
- McRae, D., Branch, C., & Milner, B. The occipital horns and cerebral dominance. <u>Neurology</u> 1968, <u>18</u>, 95-98.
- Meskin, B., & Singer, J. Daydreaming, reflective thought and laterality of eye movement. <u>Journal of Personality and Social</u> <u>Psychology</u>, 1974, <u>30</u>, 64-71.
- Milner, B. The effects of different brain lesions on card sorting: the role of the frontal lobes. <u>Archives of Neurology</u>, 1963, <u>9</u>, 90-100.
- Milner, B. Visually guided maze learning in men: effects of bilateral hippocampal, bilateral frontal, and unilateral cerebral lesions. <u>Neuropsychologia</u>, 1965, 3, 317-338.
- Milner, B., Taylor, L., & Sperry, R. Dichotic listening. <u>Science</u>, 1968, <u>161</u>, 184-190.



- Morell, L., & Salamy, J. Hemispheric asymmetry of electrocortical responses to speech stimuli. <u>Science</u>, 1971, <u>174</u>, 164-166.
- Penfield, W., & Roberts, L. <u>Speech and brain mechanisms</u>. New Jersey: Princeton University Press, 1959.
- Reitan, R. Certain differential effects of left and right cerebral lesions in human adults. <u>Journal of Comparative and Physiological</u> Psychology, 1955, 48, 474-481.
- Roessler, R., Alexander, A., & Greenfield, N. Ego strength and physiological response. <u>Archives of Psychiatry</u>, 1963, <u>8</u>, 142-154.
- Rosenkrantz, P., Bee, H., Vogel, S., Broverman, I., & Boverman, D. Sex role stereotypes and self concepts in college students. Journal of Consulting and Clinical Psychology, 1968, 32, 287-295.
- Sarason, I. G. & Winkel, C. H. Individual differences among subjects and experimenters and subjects' self-descriptions. <u>Journal of</u> <u>Personality and Social Psychology</u>, 1966, 3, 448-457.
- Shafer, R. <u>Psychoanalytic interpretation in Rorschach testing</u>. New York: Grune & Stratton, 1954.
- Shankweiler, D. Dichotic listening. <u>Journal of Comparative and</u> Physiological Psychology, 1966, 62, 115-120.
- Sperry, R., Gazzaniga, M., & Bogen, J. Interhemispheric relationships: the neocortical commissures; syndromes of hemispheric disconnection. In P. Vinken and G. Bruyn (Eds.), <u>Handbook of Clinical Neurology</u>. Amsterdam: North Holland Publishing, 1969.
- Spielberger, C., Gorsuch, R., & Lushene, R. <u>State-Trait anxiety</u> <u>inventory</u>. Palo Alto: Consulting Psychologists Press, 1970.
- Spreen, O., Spellacy, F., & Reid, J. The effect of inter stimulus interval and intensity on ear asymmetry for nonverbal stimuli in dichotic listening. <u>Neuropsychologia</u>, 1970, <u>8</u>, 245-250.
- Stein, K., & Chu, C. Dimensionality of Barron's ego strength scale. Journal of Consulting Psychology, 1967, 31, 153-161.
- Teitlebaum, H. Spontaneous rhythmic ocular movements: their possible relationship to mental activity. <u>Neurology</u>, 1954, <u>4</u>, 350-354.



- Teuber, H. L. Effects of brain wounds implicating right or left hemisphere in man: hemispheric differences and hemispheric interaction in vision, audition and somesthesis. In V. Mountcastle (Ed.), <u>Interhemispheric relations and cerebral dominance</u>. Baltimore: Johns Hopkins Press, 1962.
- Von Bonim, G. Anatomical asymmetries of the cerebral hemispheres. In V. Mountcastle (Ed.), <u>Interhemispheric relations and cerebral</u> dominance. Baltimore: Johns Hopkins Press, 1962.
- Wada, J., Clark, R., & Hamm, A. Asymmetry of temporal and frontal zones in 100 adult and 100 infant brains. <u>A.M.A. Archives of</u> <u>Neurology</u>, 1975, 32, 239-246.
- Wada, J. & Rasmussen, T. Intracarotid injection of sodium amytal for the lateralization of cerebral speech dominance. <u>Journal</u> of Neurosurgery, 1960, 17, 266-282.
- Weiten, W., & Etaugh, C. Lateral eye movement as a function of cognitive mode, question sequence and sex of subject. <u>Perceptual</u> <u>and Motor Skills</u>, 1974, <u>38</u>, 439-444 (a).
- Weiten, W. & Etaugh, C. Lateral eye movement consistency is related to academic aptitude. <u>Perceptual and Motor Skills</u>, <u>38</u>, 1203-1206 (b).
- Wernicke, K. <u>Der aphasische symptomoncomplex</u>. Breslau: Cohn und Weigert, 1874. Cited by O. W. Zangwill, <u>Cerebral dominance</u> and its relation to psychological function. London: Oliver and Boyd, 1960.
- Witelson, S., & Pallie, W. Left hemisphere specialization for language in the newborn: Neuroanatomical evidence of asymmetry. Brain, 1973, 96, 641-646.


APPENDICES



APPENDIX A



# APPENDIX A

# Test Forms

# Form I

| 1.  | Name a word beginning with "C" meaning to utter loudly or clearly.   |  |  |  |
|-----|----------------------------------------------------------------------|--|--|--|
| 2.  | On the typewriter, where is the letter "R" relative to "B"?          |  |  |  |
| 3.  | Which states border the Great Lakes?                                 |  |  |  |
| 4.  | Name a word beginning with "I" meaning "to copy or emulate."         |  |  |  |
| 5.  | 5. Name a word, beginning with "F" meaning "new to one's experience, |  |  |  |
|     | novel, original."                                                    |  |  |  |
| 6.  | On the map of the United States, which is farther south, San         |  |  |  |
|     | Francisco or Atlanta?                                                |  |  |  |
| 7.  | Imagine a telephone. On which side is the cord to the receiver?      |  |  |  |
| 8.  | Complete the analogy. Sporadic:Constant :: Infrequent:               |  |  |  |
| 9.  | Complete the analogy. Enraged:Annoyed :: Ecstatic:                   |  |  |  |
| 10. | You leave Jacobson's Department store on Grand River and walk toward |  |  |  |
|     | the Student Book Store. Name one store that you will pass on         |  |  |  |
|     | the way.                                                             |  |  |  |
| 11. | Imagine a car from the passenger side, moving forward. In what       |  |  |  |
|     | direction do the wheels turn?                                        |  |  |  |
| 12. | Complete the analogy. Zip:Letter :: Area:                            |  |  |  |



- 13. Complete the analogy. Shirt:Wear :: Bloody Mary:
- 14. Imagine a circle rotating around its diameter. What shape do you get?
- 15. Which states border on Ohio?
- 16. Name a word beginning with "H" meaning "to desire with some confidence of fulfillment."
- 17. Imagine the capital letter "P" upside down and held before a mirror. What letter do you get?
- 18. Name a synonym for exaggeration.
- 19. Name a synonym for perseverance.
- 20. You are sitting in front of a telephone. Where is the metal part which stops the finger, relative to the telephone number?

#### Form II

- 1. Complete the analogy. Infection:Epidemic :: One:
- 2. On the map of the United States, where is Chicago relative to Minneapolis?
- 3. Name a synonym for cause.
- 4. You are traveling from Denver to Minneapolis. Which states do you pass through?
- 5. Name the word beginning with "E" meaning "the applied use of physical or mental energy."
- 6. Imagine Lincoln on a penny. In which direction does he face?
- 7. Complete the analogy. Never:Always :: Zero:
- 8. Imagine a square. In your imagination, draw a line from the upper left corner to the lower right corner. Now draw line from the upper right corner to the lower left corner. What shape does this produce?
- 9. Name the word beginning with "E" meaning "something brought about by a cause or agent."
- 10. Imagine the campus as a clock where the Men's IM is the center and the Administration Building is 12 o'clock. In what hour approximately will the Union Building be?
- 11. Name a synonym for impatience.
- 12. You are standing in front of an ice cream vending machine. On which side is the money slot?



- 13. On the cartoon page of the State News, where does "Peanuts" appear relative to Doonesbury"?
- 14. Name a synonym for instantaneous.
- 15. Imagine the pedals of an automobile. Where is the brake in relation to the accelerator?
- 16. Name a synonym for infiltrate.
- 17. Imagine the lion's head in the MGM movies. To which side is it tilted after it stops moving?
- 18. Name a word beginning with "G" meaning "to predict with insufficient information."
- 19. Complete the analogy. Time:Space :: Schedule:
- 20. If you look at the lower case letter "b" in the mirror, what letter do you see?

#### Form III

- 1. Complete the analogy. Number:Gender :: Singular:
- 2. Imagine the campus as a clock where the library building is the center and Beaumont Tower is 12 o'clock. In what hour approximately will the Administration Building be?
- 3. Name a synonym for impulsive.
- 4. Imagine Thomas Jefferson on a nickel. Which direction does he face?
- 5. Name a word beginning with "N" meaning to "confer with another or others in order to come to terms.
- 6. If the Administration building were tipped over onto its west side, in which direction would the bottom of the building face?
- 7. Complete the analogy. Barrier:Impede :: Elevator:
- 8. Which is farther east, Cincinnati or Toledo?
- 9. If you hold the number "9" up to a mirror, and turned it upside down what letter does this resemble?
- 10. Name a word beginning with "L" meaning "deficiency or absence."
- 11. Complete the analogy. Day:Year :: Second:
- 12. On the back of a nickel, where does the phrase "E Pluribus Unum" appear?
- 13. Complete the analogy. I:You :: Shall:
- 14. Visualize your social security card. Where is your number on it relative to your name?
- 15. Name a synonym for middle.
- 16. On your M.S.U. I.D. card, where is your signature relative to your photograph?

- 17. Name a synonym for regularity.
- 18. If you are facing the driver's side of a car, on which side are the hinges of the driver's door?
- 19. Imagine a square rotating 360 degrees around its axis. What shape would you get?
- 20. Name a synonym for general.

#### Form IV

- Name a word that begins with "G" that means to "talk of rumors and sensational facts."
- 2. You are sitting before a typewriter. Where is the letter "D" in relation to "O"?
- 3. Recall the portrait of Whistler's Mother." To which side of the viewer does she face?
- 4. Name a word beginning with "I" meaning "power to sway a person or course of events."
- 5. Name a synonym for similarity.
- 6. You are traveling from South Dakota to Oklahoma. Which states do you pass through?
- 7. Name a word beginning with "O" meaning, "someone who always expects the best possible outcome."
- 8. You are traveling from Las Vegas to Dallas. Which states do you pass through?
- 9. Complete the analogy. Dislike:Hate :: Respect:
- 10. Imagine your driver's license. Where is the date of expiration on it relative to your picture?
- 11. Name a synonym for extraneous.
- 12. Imagine the campus as a clock where the stadium is the center and the Administration Building is the hour 12. On what hour approximately is the auditorium?
- 13. Which states border on Lake Superior?

- 14. Name a synonym for dimension.
- 15. Imagine two parallel lines. Upon these superimpose two vertical parallel lines, the same distance apart. What shape do you get?
- 16. Name a word beginning with "B," meaning "to carry, to support."
- 17. Name a synonym for destruction.
- 18. In what direction does George Washington face on a dollar bill?
- 19. Recall the photograph of the U.S. Marines raising the flag at Iwo Jima. In which direction is the flag pole pointing?
- 20. Name a synonym for assemblage.

#### Form V

- 1. Name a synonym for redeem.
- 2. Imagine the Miss Liberty Statue in the Columbia movies. In which direction does it face?
- 3. You are sitting in front of a typewriter. Where is the letter "J" in relation to "C"?
- 4. Name a word beginning with "S" meaning "to prick painfully?
- 5. Imagine two right triangles of equal size. If you join them along their longest side, what figure do you have?
- Name a word beginning with "G" meaning "to control, guide, direct."
- 7. Name a word beginning with "C" that means "to begin."
- 8. Imagine walking toward the setting sun. What happens to your shadow as time passes?
- 9. Name a word beginning with "A" that means "wide awake and watchful."
- 10. Imagine turning a bulb into a socket. In which direction must you turn it?
- 11. Imagine the campus as a clock where the Administration Building is the center and the Union Building is the hour 12. On what hour approximately is the Student Services Building?
- 12. Complete the analogy. Mongrel:Purebred :: Alloy:
- 14. On the front page of the State News, where is the sketch of Beaumont Tower relative to the State News masthead?

- 15. Name a word beginning with "O" meaning "a view or judgment about a particular matter."
- 16. You are on the corner of Abbott and Grand River and you start walking toward M.A.C. Name one store you will pass on your way.
- 17. On the map of the United States, which states border on California?
- 18. Name a synonym for change.
- 19. Name a synonym for increase.
- 20. On Your M. S. U. Library card where is the green stripe in relation to your student number?

### Form VI

- 1. On a pay telephone, where is the slot for the dime?
- 2. Name a synonym for exclusion.
- 3. Complete the analogy. Person:Reincarnation :: Battery:
- 4. You are driving a car and approaching an intersection with a traffic light. Where is the red light relative to the green light?
- 5. Name a word beginning with "R" meaning "to keep in mind."
- 6. On the station dial of a radio, where do the stations with the higher frequency numbers appear?
- 7. Name a word beginning with "D" meaning "to decide, establish, or ascertain conclusively."
- 8. You are sitting in front of a typewriter. Where is the letter "L" in relation to "K"?
- 9. Name a synonym for absolve.
- 10. Imagine a long rectangular block whose width and height are equal and whose length is twice its width. If you cut the block into two equal lengths what figures do you have?
- 11. Complete the analogy. Silent:Taciturn :: Mute:
- 12. Is Mexico City east or west of St. Louis?
- 13. Name a synonym for abstract.
- 14. When you wish to back up in a car, and go to your left, which way do you turn the steering wheel?
- 15. You are standing in front of a coffee vending machine. On which side is the money slot?

- 16. Name a word beginning with "S" that means "to strike with amazement because unexpected."
- 17. Name the word beginning with "C" meaning "quiet or serene."
- You are coming out of the Campus Theater on Grand River. You turn left. Name two stores you will pass.
- 19. Name a word beginning with "I" meaning "not suited to the given circumstances."
- 20. What states border on Texas?

APPENDIX B

### APPENDIX B

### Questionnaire on Hand Preference

First, state whether you regard yourself as right-handed (R), lefthanded (L), or ambidextrous (A)

GENERAL INSTRUCTIONS: The main body of the questionnaire falls into two parts:

PART A is designed to find out which hand you habitually use, or would prefer to use, for certain acts requiring the use of one hand only. It is expected that habitual tendency and preference will, for the most part, coincide, but if there is any case where they differ, you are asked to add a note to that effect.

PART B is designed to find out which hand plays the leading role in certain acts requiring the use of both hands. Indicate in the column provided, R, if you use your right hand, L, if you use your left hand, or E, if you are aware of **no** special preference in either direction, i.e., if you are just as likely to use one hand as the other. When in doubt, you should try to settle the issue by experimenting, for example, by going through the motions or by trying to visualize yourself performing the action.

| Α.  |                                                                    |
|-----|--------------------------------------------------------------------|
| 1.  | With which hand do you throw?                                      |
| 2.  | With which hand do you write?                                      |
| 3.  | With which hand do you draw?                                       |
| 4.  | With which hand do you play games such as tennis, squash, and bad- |
|     | minton, and paddle ball?                                           |
| 5.  | With which hand do you use a pair of scissors (e.g., for cutting   |
|     | paper)?                                                            |
| 6.  | With which hand do you use a razor? (state type of razor)          |
| 7.  | With which hand do you use a comb? (state side on which you part   |
|     | your hair)                                                         |
| 8.  | With which hand do you use a toothbrush?                           |
| 9.  | With which hand do you use a knife for purposes other than eating? |
|     | (e.g., cutting string, sharpening a pencil)                        |
| 10. | With which hand do you use a spoon for eating?                     |
| 11. | With which hand do you use a hammer?                               |
| 12. | With which hand do you use a screw-driver?                         |
| 13. | With which hand do you use a knife for cutting, in conjunction     |
|     | with a fork?                                                       |
| 14. | On which side of your body do you swing a baseball bat?            |
| 15. | On which hand do you hold the top of a broom when sweeping?        |
| 16. | With which hand do you unscrew the lid of a jar?                   |
| 17. | With which hand do you hold the top of a rake when raking?         |
| 18. | With which hand do you strike a match?                             |

19. With which hand do you deal cards?\_\_\_\_\_

| 20. | With which | hand do you  | guide the   | thread through  | n the eye | ofa |
|-----|------------|--------------|-------------|-----------------|-----------|-----|
|     | needle, or | the needle c | onto the th | nread, as the d | ase may b | be? |

APPENDIX C

### APPENDIX C

## Barron Ego Strength Scale

**INSTRUCTIONS:** 

Read each statement and decide whether it is true as applied to you or false as applied to you.

You are to mark your answers on the computer answer sheet. If your response to the statement is <u>TRUE</u> blacken the space for alternative <u>1</u> for the appropriate item on the answer sheet. If your response to the statement is <u>FALSE</u> or <u>NOT USUALLY TRUE</u> blacken the space for alternative <u>2</u> for the appropriate item on the answer sheet.

Remember to give YOUR OWN opinion of yourself. Do not leave any items unanswered.

Remember: TRUE - 1 FALSE - 2

1. I believe my sins are unpardonable.

2. Christ performed miracles such as changing water into wine.

3. Often I cross the street in order not to meet someone I see.

4. At times I have fits of laughing and crying that I cannot control.

5. I brood a great deal.

6. I am attracted by members of the opposite sex.

7. One or more members of my family is very nervous.

- 8. I am afraid of finding myself in a closet or small closed place.
- 9. I like to cook.
- My plans have frequently seemed so full of difficulties that I have had to give them up.
- 11. I have often been frightened in the middle of the night.
- 12. I feel sympathetic towards people who tend to hang on to their griefs and troubles.
- 13. I am not afraid of fire.
- 14. I have had no difficulty in keeping my balance in walking.
- 15. I feel unable to tell anyone all about myself.
- 16. I have never had a fainting spell.
- 17. I pray several times every week.
- 18. I have had blank spells in which my activities were interrupted and I did not know what was going on around me.
- 19. I frequently find myself worrying about something.
- 20. I do not like to see women smoke.
- 21. I find it hard to keep my mind on a task or job.
- 22. I have a cough most of the time.
- 23. I like science.
- 24. My hands have not become clumsy or awkward.
- 25. I have had some very unusual religious experiences.
- 26. I would certainly enjoy beating a crook at his own game.
- 27. I feel tired a good deal of the time.
- 28. When I am with people, I am bothered by hearing very queer things.
- 29. Everything is turning out just like the prophets of the Bible said it would.

- 30. When I get bored, I like to stir up some excitement.
- 31. I feel weak all over much of the time.
- 32. I have a good appetite.
- 33. I am in just as good physical health as most of my friends.
- 34. I like to talk about sex.
- 35. I dream frequently about things that are best kept to myself.
- 36. I have diarrhea once a month or more.
- 37. I have met problems so full of possibilities that I have been unable to make up my mind about them.
- 38. I have strange and peculiar thoughts.
- 39. Parts of my body often have feelings like burning, tingling, crawling, or like "going to sleep."
- 40. I am made nervous by certain animals.
- 41. I like to flirt.
- 42. My skin seems to be unusually sensitive to touch.
- 43. I do many things which I regret afterwards (I regret things more or more often than others seem to).
- 44. At times I hear so well it bothers me.
- 45. The man who had most to do with me when I was a child (such as my father, stepfather, etc.) was very strict with me.
- 46. I sometimes feel that I am about to go to pieces.
- 47. I never attend a sexy show if I can avoid it.
- 48. I like collecting flowers or growing house plants.
- 49. My way of doing things is apt to be misunderstood by others.
- 50. I very much like horseback riding.

- 76
- 51. If I were an artist, I would like to draw flowers.
- 52. During the past few years I have been well most of the time.
- 53. Dirt frightens or disgusts me.
- 54. I seldom worry about my health.
- 55. I have had very peculiar and strange experiences.
- 56. Sometimes some unimportant thought will run through my mind and bother me for days.
- 57. I can be friendly with people who do things which I consider wrong.
- 58. I get mad easily and then get over it soon.
- 59. When I leave home, I do not worry about whether the door is locked and the windows closed.
- 60. I am easily downed in an argument.
- 61. I think Lincoln was greater than Washington.
- 62. When someone says silly or ignorant things about something I know, I try to set him right.

APPENDIX D

# APPENDIX D

# Bem Sex Role Inventory

Please indicate on a 7-point scale how well each of the characteristics describes you. Write the number appropriate for your answer beside each item number.

| <u> </u>                        | . 2 . 3 .           | 4  | •   | <u>5</u> . | 6         | <u>    7     .</u>                         |
|---------------------------------|---------------------|----|-----|------------|-----------|--------------------------------------------|
| Never or<br>almost n<br>true of | ever<br>me          |    |     |            |           | Always or al-<br>most always<br>true of me |
| 1.                              | Self-reliant        | -  | 16. | Strong     | persona   | lity                                       |
| 2.                              | Yielding            | -  | 17. | Loya1      |           |                                            |
| 3.                              | Helpful             | -  | 18. | Unpredi    | ic tabl e |                                            |
| 4.                              | Defends own beliefs | -  | 19. | Forcefu    | 1         |                                            |
| 5.                              | Cheerful            | -  | 20. | Feminir    | ne        |                                            |
| 6.                              | Moody               | -  | 21. | Reliabl    | е         |                                            |
| 7.                              | Independent         | -  | 22. | Analyti    | cal       |                                            |
| 8.                              | Shy                 | _  | 23. | Sympath    | netic     |                                            |
| 9.                              | Conscientious       | -  | 24. | Jealous    | 5         |                                            |
| 10.                             | Athletic            | -  | 25. | Has lea    | dership   | abilities                                  |
| 11.                             | Affectionate        | -  | 26. | Sensiti    | ive to o  | thers' needs                               |
| 12.                             | Thea trica l        | -  | 27. | Truthfu    | 1         |                                            |
| 13.                             | Assertive           | _  | 28. | Willing    | j to tak  | e risks                                    |
| 14.                             | Flatterable         | _  | 29. | Underst    | anding:   |                                            |
| 15.                             | Нарру               |    | 30. | Secreti    | ve        |                                            |
|                                 |                     | 77 |     |            |           |                                            |

| 31. Makes decisions easily   | 46. Aggressive             |
|------------------------------|----------------------------|
| 32. Compassionate            | 47. Gullible               |
| 33. Sincere                  | 48. Inefficient            |
| 34. Self-sufficient          | 49. Acts as a leader       |
| 35. Eager to soothe feelings | 50. Childlike              |
| 36. Conceited                | 51. Adaptable              |
| 37. Dominant                 | 52. Individualistic        |
| 38. Soft spoken              | 53. Not use harsh language |
| 39. Likeable                 | 54. Unsystematic           |
| 40. Masculine                | 55. Competitive            |
| 41. Warm                     | 56. Loves children         |
| 42. Solemn                   | 57. Tactful                |
| 43. Willing to take a stand  | 58. Ambitious              |
| 44. Tender                   | 59. Gentle                 |
| 45. Friendly                 | 60. Conventional           |

APPENDIX E

## APPENDIX E

#### The Debriefing

The debriefing provided an informal manner of investigating the impact of the experiment upon the experience of the subjects. The primary aim of debriefing was the clarification of the intent of the experiment, especially with respect to the induction of stress. Secondly, the exploration of the subject's feelings helped alleviate anxiety and a potential sense of failure engendered by the stress condition. Thirdly, the discussion of the subject's experience served to monitor and evaluate the effectiveness of the experimental manipulations and the presence of confounding variables.

The subjects experienced a range of reactions to the stress condition. One subject reported extreme anger, "I felt like tearing the place apart." The intensity of his reaction warranted continuing the debriefing for an extra hour later in the day. The subject returned and initially expressed his anger at the experimenter for having received negative feedback. He began to talk of the frustration he had been experiencing with his academic work and how this frustration had been aggravated by his experience in the experiment. His anger subsided significantly and he appreciated this opportunity to explore his frustrations. He left the debriefing session feeling that his experience

had been a positive and useful one in learning about himself.

One other subject experienced intense distress warranting an extended debriefing. This subject reported feeling quite anxious, disappointed, and angry with himself over what he still considered to be his inadequate performance. Since this subject appeared to be directing his anger toward himself, he was helped to express his anger toward the examiner. After having directed his anger toward the experimenter the subject left the debriefing feeling considerably relieved.

Most of the subjects reported feeling more anxious in the stress condition, and this was a result of their reported attempts to concentrate harder on the problems in this condition. Additionally, some subjects attributed their higher anxiety to the apparently higher status and authority of the experimenter in the stress condition.

Three subjects reported that they believed that the experimenter's comments were designed to raise their anxiety and that they were not affected by it. Two of these subjects, however, reported, on the anxiety inventory, experiencing greater anxiety in the stress condition than in the other two conditions on the anxiety inventory. It is not possible to determine whether this discrepancy between verbally reported anxiety and scores on the anxiety inventory is attributable to the demand characteristics of the experiment. It is possible that these subjects reported higher anxiety on the inventory because of a desire to support the hypothesis of the experiment as they perceived them. An alternative possibility suggests that at least some of these subjects

attempted to minimize the impact of the experimenter's comments in the stress condition by denying the significance of these comments. In line with this explanation one subject commented paradoxically, "I wanted to leave...but I didn't take it seriously."

Two subjects spontaneously reported feeling tense throughout the experiment as a result of the constraint imposed upon them by the foam rubber head guides. It is impossible to assess the effect these head guides had on the entire subject sample, but these head guides may have raised the anxiety of other subjects who did not choose to spontaneously report it.

The debriefing session was apparently experienced as being helpful by providing an opportunity to ventilate anxiety aroused by the experiment. Secondly, this discussion of their experience and the purpose of the experiment seemed to enrich the personal and educational rewards of their participation.

