EYE-HAND PREFERENCE IN MILITARY OFFICERS

By

Hugh Edward Carroll

United States
Naval Postgraduate School

THESIS

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Hugh Edward Carroll, II

Thesis Advisor: J. K. Arima

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Hugh Edward Carroll, II
Lieutenant, United States Navy
B. S., United States Naval Academy, 1964

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ABSTRACT

An experiment was conducted to determine the prevalence of right-left eye preferences and the relationship of eye preference to handedness and task factors. The experimental task was a sighting task. The independent variables were direction of sighting (two levels) and hand used in sighting (right or left). The dependent variable was the eye used in sighting. Handedness was defined as the hand used in writing. Each of 98 Ss underwent 12 sighting trials which replicated the 4 sighting conditions 3 times. 68.3 percent of all Ss gave 12 unilateral eye responses. Using 9 out of 12 unilateral eye responses as a criterion of eye preference, there were 69 right-eyed Ss (67 right-handed, 2 left-handed), 20 left-eyed Ss (15 right-handed, 5 left-handed) and 9 Ss (9 right-handed, 0 left-handed) who showed no eye preference. The phi-coefficient between eye preference and handedness for those showing eye preference was .34. Analysis of the responses of those showing a mixed preference showed a significant task effect.

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I. INTRODUCTION

A. GENERAL

It has long been recognized that most individuals prefer either the right or left hand when performing a task requiring one-handed manipulation. An individual can generally perform the task faster or with greater accuracy or in some generally superior manner if he utilizes his preferred hand rather than his non-preferred hand.

If persons also exhibit such preferredness between another bilateral structure such as the eyes, then in conducting a task requiring eye-hand coordination, individuals might show a preference for some combination of the two and perform less effectively if required to deviate from the preferred combination.

This would imply that perhaps the design of equipment should take into consideration the structure preferences of the operators. In addition, certain problems associated with the training and operating efficiency of any individual involved in a task requiring eye-hand coordination might be alleviated if structure preferences are considered.

In order to determine whether taking such factors into consideration is warranted, the prevalence of eye dominance must first be established. In addition, considerations must be made regarding the relation of eye and hand dominance in a coordinated task and how eye preference is affected by various task factors.

A study of the research of dominance offers some insight into various of these considerations.

B. EYE DOMINANCE RESEARCH

A review of the literature presents a number of theories which relate to eye dominance. These theories can offer a good deal of confusion if one is not careful to determine the type of test associated with the term "dominance."

Early researchers accepted ocular dominance as a human characteristic and the majority of the research was an attempt to establish its origin as hereditary or environmental. These experimenters often used the finger pointing test to determine the dominant eye (Callan, 1881; LeConte, 1884). This test is the simple alignment of a finger to a target object using both eyes.

More sophisticated devices for determining eye dominance were developed by Parson and Lund (Parson, 1924; Lund, 1932). Actually, these devices are merely modifications of the finger pointing test. Each uses a sighting instrument for alignment to a target. The only major difference is that when using Parson's manuscope, the hand used for positioning the sighting instrument is visible while Lund's manoptometer obscures the hand utilized in the task.

Buxton and Crosland (1937) repeated many of the earlier sighting tests conducted with various sighting objects. They concluded that simple tests of eye preference, when repeated in slightly varying ways a relatively large number of times, prove to be statistically reliable. They

contend that a "unitary" trait of eye dominance is not indicated but rather that eye preference can be defined more precisely in terms of the number of activities for which a particular eye is preferred.

Gilinsky (1952) shows a table which summarizes the results of 19 different investigations of the relative frequencies of occurrence of right, left, and ambiocular dominance. She observed that despite a variation in the results, ambiocular individuals constitute a minority and right-eyedness is more frequent than left-eyedness.

The assumption of a close relation between the dominant eye and the eye with the greater visual acuity has been maintained by some experimenters (Woo and Pearson, 1927; Palmer et al., 1947). There is evidence in the literature which sheds doubt on this theory except in cases where the difference in visual acuity between eyes is extremely severe (Coons and Mathias, 1928; Crovitz, 1961; Fink, 1938; Jasper and Raney, 1937).

Cohen (1952) contends that rapid reading precludes the ability of both eyes to fixate at the same place and therefore one eye becomes the dominant eye which is relied on to resolve the double images which result. Clark (1936) contends that there is no correlation between the dominant eye and the leading eye in ocular movements.

Heron (1957) proposes a cognitive scanning process confirmed by Freeburne and Goldman (1969) whereby a subject in effect scans the neural stimulus trace as he habitually reads. Heron implies that this scanning process may be the result of a reading habit process. Braine (1968) conducted an experiment using Israeli subjects, who read from

right to left, and the results indicate that they also tend to organize from left to right.

Experimental evidence indicates that training or practice tends to reduce the tendency of ocular dominance in both sighting and rivalry situations (Coons and Mathias, 1928; Lack, 1969).

Shoen and Wallace (1936) and Ireland (1950) have obtained statistical evidence which indicates that flicker frequency is not a factor to be considered in ocular dominance.

Merrell (1957) contends that his results indicate that heredity plays some role in ocular dominance. The exact genetic mechanism is not known and a single gene hypothesis is not adequate to explain the results.

Contradicting theories regarding some difference in the efficiency of muscular control of a dominant eye have been proposed. Crider (1935) determined that when a muscle imbalance was present in one eye, that eye was rarely depended upon in sighting tasks. Shoen and Scofield (1935), on the other hand, obtained data which indicated a greater muscular efficiency in the non-dominant eye. Walls (1951) presents a theory of ocular dominance which maintains that if a person has a motor dominant eye, an innervation record is kept only for the muscles of that eye and the other eye merely "tracks" as a result of a reflex action.

Since the right hemiretina of each eye terminates in the right hemisphere and the left hemiretina terminates in the left hemisphere, interesting and pertinent information can be obtained from the results of

experiments which compare visual field capabilities and limitations. Presentation to the left visual field, for instance, is accomplished by having the subject fixate on a target in the median plane and then presenting a stimulus to the left of the point of fixation but clearly in view of both eyes. This results in the stimulation of the right hemiretina of each eye which traces back through the neural pathways, optic chiasm, optic tract, lateral geniculate body, and terminates in the visual cortex of the right hemisphere.

When visual stimuli are presented tachtiscopically in both left and right visual fields simultaneously, recognition is generally superior in the left visual field. The results of stimulating the visual fields separately vary with the type of stimulation (Bryden, 1960; Bryden and Rainey, 1963).

A general superiority of the right visual field when dealing with verbal data has been attributed to an increased efficiency of the neural pathways leading to and within the left hemisphere and a visual cerebral dominance of the occipital cortex of the left hemisphere (McKinney, 1966; Harris and McKinney, 1967).

A detailed study has been made of the cat's visual system -- one which closely approximates man's. It has been determined that in cats the binocularly driven cortical units are often more effectively activated by a stimulus to one of the eyes than by a stimulus to the other (Hubel and Weisel, 1962). In addition, it is asserted that the projection from the contralateral eye dominates the cat's visual cortex. (Blakemore

and Pettigrew, 1970). One theory with regard to eye dominance contends that when both eyes observe a target and only one may be effectively used, then suppression of vision in the contralateral eye occurs. The method of this suppression is not completely understood but most experimenters hypothesize that nerve fibers from the brain to the retina inhibit the degree of sensitivity of specific areas of the retina (Guyton, 1961; Hochberg, 1961; Tschermak, 1952).

C. HAND DOMINANCE RESEARCH

One of the most popular early theories of dominant handedness is the primitive warfare theory which depicts Darwinian selection. This theory proposes that during war, one hand was required to hold a shield while the other wielded a weapon. Those who held the shield in the left hand protected the heart and were less likely to suffer a fatal wound. Those who held the shield in the right hand were reduced in number over a long period of time as a result of natural selection (Gould, 1908).

An even more widely accepted theory was that the dominant hand is determined by the dominant eye (Callan, 1881; LeConte, 1884). Opinions and evidence contrary to this theory have been presented (Woo and Pearson, 1927; Walls, 1951).

Merrell (1957) agrees with other authors in finding a higher incidence of left handedness among offspring when at least one parent is left-handed. He also presents a modified single gene hypothesis which partially explains the hereditary nature of the trait.

Although many experimenters consider handedness as dichotomously left or right, Annett (1970) proposes that handedness is a continuum of

preference and contends that it is the result of a blending of genetic factors which are subject to developmental influences just as are physical and intellectual growth.

Guyton (1961) states that in more than 9 out of 10 persons, the left hemisphere becomes dominant because of some neural superiority within that hemisphere which is the result of greater usage. This superiority permits a more efficient motor control of the contralateral right hand.

D. RESEARCH OF THE RELATION OF EYE AND HAND DOMINANCE

Much research has been done to determine if a relation exists between the dominant eye and dominant hand. Although Merrell (1957) maintains that his data indicates that there appears to be essentially no relation between the dominant eye and dominant hand, there is sufficient evidence in the literature to shed doubt on this assertion (Coons and Mathias, 1928; Miles, 1930).

Jeeves (1969) investigated the relative efficiency of the various neural pathways related to the coordination of eye and hand. His findings support the theory of unilaterality of dominant eye and hand.

Studies relating to eye-hand coordination generally agree that superior performance is recorded when subjects, without mixed laterality, perform a task with their dominant hand and dominant eye (Freeman and Chapman, 1935; Lund, 1932).

Steinbach (1969) studied the relation between eye and hand in both dynamic and static tracking tasks. In a test of static alignment of the

eye to the non-visible fingertips, whether the experimenter or the subject positioned the fingertips made no difference in the eye's consistency of localization. This, he concluded, indicates that the motor signals to the arm, hand and finger were not supplying the oculomotor system with anymore information about fingertip location than that already present from proprioceptive sources. During dynamic tracking however, Steinbach as well as Angel and Higgins (1970) contend that there appears to be some interoceptive means by which the oculomotor system can use outflow information resulting in a superior tracking performance.

II. STATEMENT OF PROBLEM

Research reveals that most individuals exhibit a preference for either their right or left eye when conducting a specific task requiring the use of the line of sight of only one eye. Although such laterality of function in most cases is presumed to be related to cerebral dominance, the physiological mechanism or neurological basis of eye dominance is not known. Tending to cloud the issue is the fact that each eye has nerve projections to both cerebral hemispheres. This has led to the contention that the particular eye dominating in a specific act cannot be an absolute indication of the dominance of either hemisphere. In addition, eye dominance as related to a sighting task might have components of a motor or a sensory preeminence and only fallible evidence exists as to the role of heredity, relative strengths of the two eyes, learning, scanning preferences, and situation-specific influences in determining eye dominance. Accordingly, on the basis of previous research, the distribution of eye preferences for any particular population cannot be precisely prescribed.

With regard to the relation between the dominant eye and dominant hand, most of the literature is in agreement with the fact that such dominance must be associated with a specific task in order to discuss it objectively. If the preferred hand and preferred eye are task specific, research should attempt to determine the task characteristics that result in a preferred hand and preferred eye combination. Research has,

however, indicated that the use of the preferred eye and hand in a task generally results in superior performance.

In spite of the knowledge of the existence of eye-hand preferences, the fact has been too seldom used by designers of systems requiring the use of the eyes. For instance, only recently have design engineers implemented dual observing lenses on microscopes and telescopes to prevent undue stress on the dominant eye. The present installation of the mil grid in the left tube of a pair of binoculars may be convenient for some users but irritating to others. Training and operating procedures as well as the design of a system requiring the coordinated use of eyes and hands should perhaps vary depending upon the preferred eye and hand of the trainee or operator. Even the method of training a recruit to fire a rifle in the manner instructed in the Army's pamphlet "Quick Fire" requires knowledge of the trainee's dominant eye.

It is obvious that for vast improvement in the design of devices which require coordinated hand and eye control, the design engineer would require more reliable information regarding the relationship between eye and hand preferences, task characteristics, and performance efficiency with the user population. Accordingly, this experiment was devised to examine the prevalence of eye and hand dominance and the relationship between eye and hand preference in a sample of military officers. Moreover, a dynamic sighting situation was used which permitted the assessment of the role of two situational factors -- sighting direction and hand used for sighting.

III. EXPERIMENTAL PROCEDURE

A. DESIGN

The experiment was a 2 x 2 factorial design with individual subjects serving in all conditions. The two independent variables were hand used in sighting (right or left) and the direction of sighting (right or left). The dependent variable was the eye used in sighting. In addition to the main variables, several control variables were created as a consequence of the procedures used (see below). One of these was termed "phase" and referred to the order in which the subjects performed the two roles of experimenter and experimental subject. Another variable, "sequence," referred to the two orders in which the experimental tasks were presented. Finally, since the experiment was replicated using entire academic classes, there was a variable called "groups" referring to the four academic sections used. Group 1 consisted of Sections 1 and 2, both of which completed the experiment approximately 6 months prior to Group 2, which consisted of Sections 3 and 4.

B. SUBJECTS

The subjects of the experiment were male, career, military officers in the Army, Navy, and Marine Corps, who were attending the U.S. Naval Postgraduate School, Monterey, California. Their ages ranged from 25-35 years and they averaged 6 years of military service. The experiment was

conducted using four sections consisting of 22, 23, 29, and 24 students enrolled in the Operations Analysis curriculum. The organization is as presented in Table 1.

Table 1.

Organization and Number of Subjects for the Experiment

GROUP	1		2	
SECTION	1	2	3	4
Number of subjects	22	23	29	24

C. SETTING

Experiments were conducted in an academic classroom with lighting, noise level, and room arrangement being similar on all occasions.

D. EQUIPMENT

A white, plastic, cone-shaped cup served as a sighting apparatus. Cup dimensions were $3\frac{1}{2}$ inches across the top and $1\frac{1}{2}$ inches across the bottom. A sighting hole 3/4 inch was cut in the bottom of the cup. Instructions and data sheets were supplied to the subjects.

E. INSTRUCTIONS

Subjects were instructed prior to attending the experiment to wear or bring glasses and contact lenses if they normally wore them. The experiment was performed with all subjects having corrected vision.

Prior to the experiment, all subjects received a verbal briefing on procedures and received written instructions. Subjects were asked not to move or tilt their heads when sighting, to avoid squinting or attempts to close their eyes, not to experiment with their vision between trials, to sit erect and to forget any preconceived ideas concerning eye dominance as related to themselves. Subjects were asked to record information in the data sheet regarding handedness and whether or not glasses were worn.

F. PROCEDURE

Subjects were seated in pairs squarely facing each other at intervals of two arms length. One subject, the "experimenter" of each pair, administered the test on the first phase, then the roles were reversed for the second phase. Subjects underwent four practice trials enabling them to understand the procedures and to determine an adequate exposure-duration time when sighting.

At the start of each trial, a class monitor alerted the subjects with the command of "Ready"; he designated one of the experimenter's eyes as a target eye upon which the subject was to focus his gaze with both eyes open. The monitor also designated in which hand the subject was to hold the cup so that when he raised it for alignment, he sighted through the hole with the bottom of the cup facing the subject. On the monitor's command "Now," the subject raised the cup to his eye level at a comfortable arm's distance away from his body and aligned the cup's hole with one of the experimenter's eyes which had been designated as the

target for the trial. The subject held this position until the experimenter's command "O.K.," and the subject was then free to lower the cup and relax until the next trial. At the time the subject had the cup aligned with the designated eye of the experimenter, the experimenter viewed the eye whose line of sight was being utilized and recorded the response on the data sheet. If the experimenter had difficulty in ascertaining which eye was being utilized or the subject had difficulty in aligning the cup, the trial was repeated. The experimenter did not allow the subject to observe the results during the experiment.

1. Tasks and Sequences

The experiment consisted of four different tasks each used three times. One of the tasks was to focus on the experimenter's right eye using the subject's right hand to hold the cup. The three other tasks were right eye-left hand, left eye-right hand, and left eye-left hand. The order of the trials during the experiment was arranged randomly into two different task sequences with the restriction that each task appear three times in a sequence and that no task follow itself in the sequence (except for the last trial). Task sequence one was LL, RL, LL, RR, RL, LL, LR, RR, RL, RR, LR and LR. Task sequence two was LL, LR, RL, LR, RR, LR, RR, RL, RR, LL, RL, and LL. To further randomize the procedures, Sections 1 and 3 conducted task sequence one first and Sections 2 and 4 conducted task sequence two first.

IV. RESULTS

A. SUMMARY OF RESULTS

A summary of the results of the experiment by group, section and phase is presented in Table 2. This table shows the number of subjects in each category responding with the indicated number of right-eye responses on the twelve experimental tasks. A histogram of the frequency of subjects responding with the indicated number of right-eye responses is displayed in Figure 1. This figure shows a distribution radically skewed to the right indicating a tendency toward right-eye uniocularity.

FIGURE 1. Frequency of Subjects Showing Designated Number of Right-Eye Responses

Table 2. Frequency of Subjects Showing Designated Number of Right-Eye Responses by Group, Section, and Phase

GROUP	SECTION	PHASE	NUMBER OF RIGHT-EYE RESPONSES													TOTAL
			12	11	10	9	8	7	6	5	4	3	2	1	0	
1	1	1	3	1	0	2	0	0	2	0	0	0	0	1	3	12
		2	5	1	1	0	0	1	0	0	0	0	0	1	1	10
	2	1	11	0	0	0	0	0	0	0	0	0	0	1	0	12
		2	10	0	0	0	0	0	0	1	0	0	0	0	0	11
2	3	1	7	0	0	4	0	0	0	1	0	0	0	1	2	15
		2	10	1	0	0	0	0	1	0	0	1	0	0	1	14
	4	1	4	2	0	1	0	0	1	0	0	0	1	0	3	12
		2	6	0	0	0	1	0	1	0	0	0	1	2	1	12
TOTAL			56	5	1	7	1	1	5	2	0	1	2	6	11	98

A summary of the findings of the experiment with respect to handedness of subjects and whether glasses were worn is represented in Table 3.

Table 3. Summary of Experimental Findings Concerning Characteristics of Subjects

GROUP	1		2		TOTAL
SECTION	1	2	3	4	
NUMBER OF SUBJECTS	22	23	29	24	98
RIGHT-HANDED SUBJECTS	18	22	28	23	91
LEFT-HANDED SUBJECTS	4	1	1	1	7
NUMBER OF SUBJECTS WEARING GLASSES	8	6	11	9	34

Table 4 is a further breakdown of the data indicating frequency of subjects showing a designated number of right or left-eye responses by handedness.

Table 4. Frequency of Subjects Showing Designated Number of Right or Left-Eye Responses by Handedness

NUMBER OF LIKE RESPONSES	RIGHT-HANDED		LEFT-HANDED		TOTAL		
	RIGHT EYE	LEFT EYE	RIGHT EYE	LEFT EYE	RIGHT EYE	LEFT EYE	BOTH EYES
12	54	9	2	2	56	11	67
11	5	4	0	2	5	6	11
10	1	2	0	0	1	2	3
9	7	0	0	1	7	1	8
8	1	0	0	0	1	0	1
7	1	2	0	0	1	2	3
TOTAL	69	17	2	5	71	22	93

Five right-handed and no left-handed subjects had an equal number of right and left responses.

A histogram of the frequency of total number of subjects responding with the indicated number of like-eye responses is presented in Figure 2. This figure displays a distribution which indicates a strong tendency for uniocularity of response over all tasks.

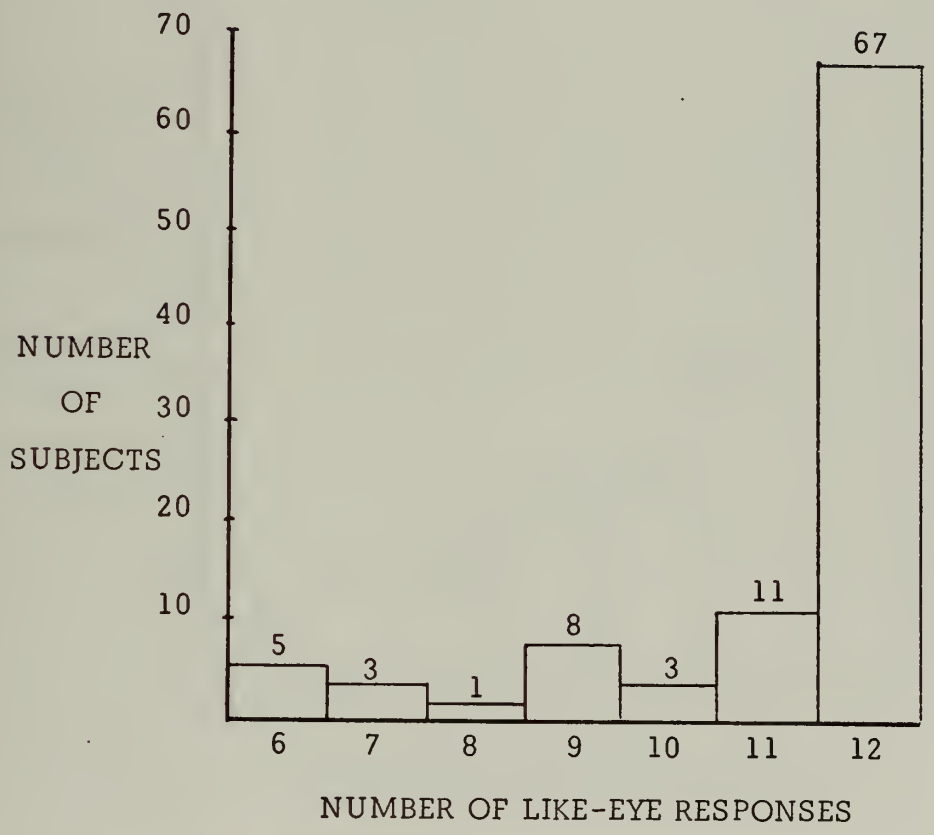


FIGURE 2. Frequency of Subjects Showing the Indicated Number of Like-Eye Responses

The cumulative frequency of subjects showing the indicated number of like responses is shown in Figure 3.

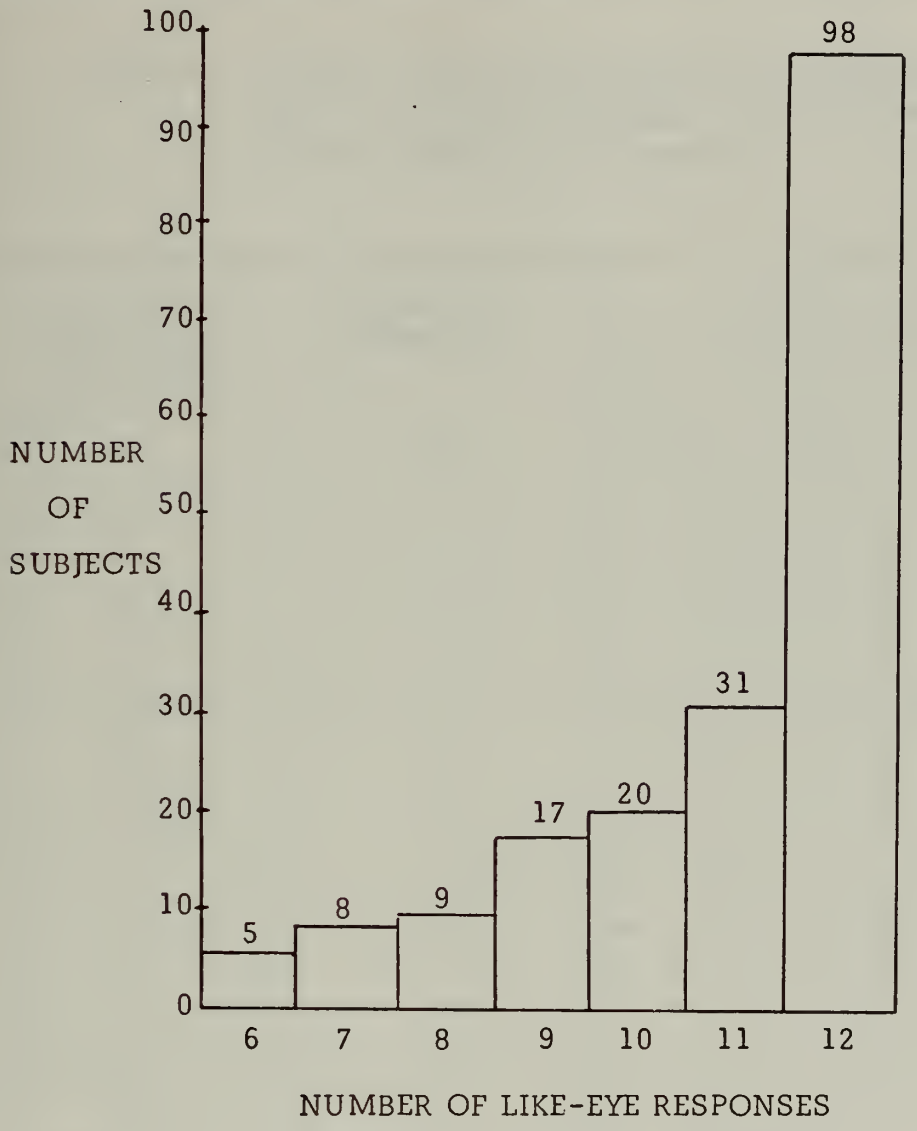


FIGURE 3. Cumulative Frequency of Subjects Showing 6 to 12 Like-Eye Responses

A breakdown of the number of right-eye responses to each of the four experimental tasks classified according to the subjects with the indicated number of right-eye responses is presented in Table 5. It is interesting to note that 168 of the right-eye responses to each of the

test tasks were a result of the subjects who exhibited right-eye uniocularity during the experiment over all 12 experimental tasks.

Table 5. Number of Right-Eye Responses in Experimental Tasks Classified According to Subjects with Number of Right-Eye Responses

NUMBER OF RIGHT-EYE RESPONSES	NUMBER OF SUBJECTS	TEST TASK*			
		RR	RL	LR	LL
12	56	168	168	168	168
11	5	12	13	15	15
10	1	3	3	3	1
9	7	11	16	16	20
8	1	1	1	3	3
7	1	2	0	3	2
6	5	3	8	8	11
5	2	3	5	0	2
4	0	0	0	0	0
3	1	0	2	0	1
2	2	0	0	4	0
1	6	0	0	4	2
0	11	0	0	0	0
TOTAL	98	203	216	224	225

* The first letter designates the target eye; the second, the hand used in sighting.

The foregoing data was initially examined to determine what effect experimental procedure and chacteristics of subjects had on the results. The data was then analyzed to determine to what extent a tendency for eye dominance existed in this sighting situation and to what degree it was related to declared handedness. Finally, the data was examined to determine what effect the experimental tasks had on eye preference. Since the distribution of subjects' scores departed radically from the normal (Figure 1), distribution-free statistics were used to analyze most of the data.

B. RESULTS OF EXPERIMENTAL PROCEDURE AND CHARACTERISTICS OF SUBJECTS

The first test was conducted to determine if the six month difference between Group 1 and Group 2 testing or some other factor caused significantly different results to occur between the groups. A median test using the number of right-eye responses indicated no significant difference between the two groups.

An extended median test was then conducted to determine if the four sections within the groups had been drawn from populations with the same median. This test resulted in a significant difference among sections at the .001 level. The sections within each group were then tested and it was found that Sections 1 and 2 showed significant difference at the .001 level, while Sections 3 and 4 showed no significant difference. Sections between groups were tested in a pairwise manner and it was found that Sections 2 and 4 showed a significant difference at the

.001 level and Sections 2 and 3 showed a significant difference at the .02 level.

It is obvious that a significant difference occurred in every instance in which Section 2 was compared to any other section. This difference was attributed to the high consistency of right-eyed responses. Of the 23 subjects in Section 2, 21 subjects responded using the right eye on all 12 trials and only two subjects showed any mixed responses.

There appeared to be no indication as to what might have caused Section 2 to respond so consistently. Since these analyses did not indicate any specific biases in the data, consistency of Section 2 was accepted as a chance phenomenon and the various sections were considered as drawn from one population for the purpose of subsequent analyses.

Median tests also showed no significance for the wearing of glasses (Table 3), phases, or task sequences (Table 2).

The criterion for a dominant hand in this experiment was merely to record the hand preferred for writing as the dominant hand. In so doing, the population contains seven left-handed subjects out of 98 subjects (Table 3). This differs from the expected 10 left-handed persons per 100 only slightly and a chi-square test showed no significant difference. With reference to handedness, this data was used with confidence that it was fairly representative of the population in general.

C. EYE DOMINANCE

The data in Table 4 shows that 67 subjects of the 98 who were tested used one eye consistently on all twelve trials. Fifty-six subjects

were consistently right-eyed and eleven were consistently left-eyed. It was also interesting to note that neither phase within any section had fewer than 50% of its subjects consistently utilize one eye on all tests. Obviously, a strong trend for eye preference was present.

D. EYE-HAND RELATION

In order to investigate a possible relation between handedness and eyedness, it was necessary to establish some test score as a criterion for classifying subjects with regard to eyedness. In order to view this possible correlation objectively, scores of 12 like responses, 11 or more, 10 or more, and 9 or more like responses were investigated. Since the left-handed population was small, Fisher's exact probability test was used to determine the probability of the distribution that occurred and the probability that an even more extreme distribution occurred with the same marginal totals. In each case, H_0 was that left-handed subjects and right-handed subjects show equal proportions in their preference for an eye to be used in this sighting task. H_1 was that a greater proportion of right-handed subjects preferred the right eye than did the left-handed subjects.

Utilizing the first criterion of twelve like responses, it was found, using the data in Table 4, that the probability of such a distribution was .11050. This did not appear significant. However, when Tocher's modification to Fisher's test was used, it was found that the probability of a more extreme distribution was .01248 which resulted in a Tocher ratio of .339 with a α of .05. A probability of .339 of rejecting H_0 resulted.

For the case in which eleven or more like responses was utilized as indicating eye dominance, Fisher's exact probability test yielded a probability of .01845 that the distribution observed and those more extreme would occur.

Utilizing ten or more like responses as the criterion for eye dominance, a probability of .02488 was determined for the observed distribution and those more extreme.

Finally, when nine or more like responses was the criterion for eye dominance, Fisher's test yielded a probability of .00566 for the observed distribution and those more extreme.

Thus, when the criterion of 9, 10, or 11 like responses is used, the results show a highly significant association of handedness and eyedness. A phi-coefficient was then computed for the above criteria with the resultant phi values ranging from .28 to .34.

E. EXPERIMENTAL TASKS AND EYE PREFERENCE

To investigate the effects of the four experimental tasks as shown in Table 5, a chi-square one sample test was conducted and revealed no significant difference among tasks when the entire population of 98 subjects was considered.

A small difference in these four tasks was concealed by the large number of subjects responding with one eye to all trials in the task sequence. The 67 subjects responding consistently with one eye were removed from the data sample and it was possible to make observations specifically regarding those subjects who gave mixed responses to the experiment.

Considering only the subjects with mixed responses, a chi-square one sample test was again conducted to determine if a difference existed between tasks. A significant difference occurred between the .1 and .05 levels.

Although this was not an extremely significant difference, it did indicate that further differences between tasks should be investigated.

Using the same population, chi-square one sample tests were conducted which examined differences resulting when using the two choices of target eye and the two choices of hand used for sighting. Although differences related to the hand used for sighting proved insignificant, differences resulting from the two choices of target eye were significant at the .05 level. A chi-square test revealed that the effects of interaction between hand used for sighting and target eye were insignificant.

When the subjects who responded consistently with one eye were excluded and in addition, the data of those subjects who scored precisely six like responses was eliminated, the remainder of the subjects could be divided into two groups -- those who preferred the left eye on a majority of the tasks but not all and those who preferred the right eye on a majority of the tasks but not all. The investigation of this population was conducted to determine if some insight might be gained concerning the reason that these subjects varied their responses during the experiment while the majority of subjects remained consistent.

Using the above criterion, Table 6 was constructed. This table indicates the number of contralateral eye responses to the four

experimental tasks classified according to the preferred eye of the subjects. A chi-square test of the distribution of contralateral eye responses on the preferred eye with respect to the hand holding the cup showed no significance, however, when the target eye was the task variable considered, a significance at the .05 level resulted.

Table 6. Number of Contralateral Eye Responses in Experimental Tasks Classified According to Preferred Eye of Subjects. (Excludes Subjects Responding with 12 and 6 Like Responses.)

PREFERRED EYE	NUMBER OF SUBJECTS	TEST TASK*				TOTAL
		RR	RL	LR	LL	
RIGHT	15	16	12	5	4	37
LEFT	11	3	7	8	5	23
TOTAL	26	19	19	13	9	60

* The first letter designates the target eye; the second, the hand used in sighting.

These analyses suggest that there was a tendency for subjects who preferred the right eye to use the left eye when looking to the left and for subjects who preferred the left to use the right eye when looking to the right.

V. DISCUSSION

The most striking finding of this experiment was that 68.36 percent of the subjects used one eye for all 12 tasks. The probability of a subject responding in this manner, if subjects tended to use both visual lines impartially, is .04 percent. This is extremely strong support for eye dominance. It indicates that, regardless of the various situational factors involved, over two-thirds of the subjects were absolutely one-eye dominant. Buxton and Crosland (1937) found that the reliability coefficient between four sighting tests varied from .44 to .71 whereas the split-half reliability of this experiment was .87, which for a test twice as long is .93 using the Spearman-Brown formula.

With reference to the 31 subjects who did not respond with 12 like responses, the question remains as to the criterion to be used to categorize those subjects as to eye dominance or ambiocularity. The data was examined to determine if the frequency of subjects falling into the various categories with respect to like responses would indicate some logical separation between eye dominance and ambiocularity. Figure 2 indicates a negative slope from 6 to 8 like responses and thereafter a generally increasing slope. The cumulative frequency of like responses (Figure 3) likewise indicates an inflection point at 9 like responses. For these reasons, 9 or more like responses were considered as indicating eye dominance.

This criterion resulted in classifying 70.4 percent of the subjects right-eye dominant, 20.4 percent left-eye dominant and 9.2 percent ambiocular.

The results of findings of 7 researchers showing percentage of right, left and ambiocular dominance are presented in Table 7.

Table 7. Summary of Findings Showing Percentage of Right, Left and Ambiocular Dominance

RESEARCHER	NUMBER OF SUBJECTS	PERCENTAGE RIGHT-EYED	PERCENTAGE LEFT-EYED	PERCENTAGE AMBI-OCULAR
Coons & Mathias (1928)	112	68.9	12.4	18.7
Crider (1935)	717	54.0	25.0	21.0
Fink (1938)	125	61.5	34.5	4.0
Fink (1938)	125	49.5	30.5	20.0
Lund (1932)	526	69.8	25.5	4.6
Miles (1930)	203	66.0	31.5	2.5
Palmer (1947)	1671	54.7	36.6	9.7
Parson (1924)	877	69.3	29.3	1.4

(Adapted from Gilinsky, 1952)

Considering the variability among the various studies, the results of the present study are consistent with the general trend shown.

Using the above criterion for eye dominance, the number of individuals whose hand preference and sighting preferences coincided was 73.5 percent. This compares favorably with 73.5 percent found by Parson (1924) and 63.4 percent found by Miles (1930).

The distribution of eyedness appears to be less differentiating than that of handedness. Whereas our data indicates 7.2 percent of the subjects are left handed, 20.4 percent were classified as left-eyed.

No significant difference was evident between the four types of tasks when the total population was considered. This implies that eye preference overrides the effects of situational tasks and therefore, is not task specific. With the reduced population of those subjects showing a mixed response however, it was shown that the inconsistent responses were most common when sighting at a target across the median plane from their preferred eye.

The results of this experiment must be evaluated in light of the experimental population which consisted of all-male military officers whose average visual acuity is probably well above that which might be expected from a random sample. In addition, most engage in activities which require an above average use of their eyes in tasks requiring visual skills and the ages of subjects ranged from 25-35 years. All of the above factors have been contended as affecting eye dominance (Palmer et al., 1947; Coons and Mathias, 1928; Lack, 1969; Kimura, 1969).

In this study, these factors appear to have a combined effect which makes the sample of military officers somewhat more right-eye dominant.

The results of the experiment must also be evaluated in light of the procedures used. That is, a second person observed directly the eye being used by the subject, whereas the other sighting tasks used have

relied upon the self-report of the subject. The corrected split-half reliability of .93 seems to be considerably higher than the reliability reported for the measurement procedures used in other studies.

The question as to why people are eye dominant remains a mystery. Most researchers have attempted to relate eye dominance to some type of physiological efficiency. If this were the case however, an important question which must be answered is why so many individuals exhibit mixed laterality. Studies relating eye dominance to tasks of eye and hand coordination suggest that the combination of eye dominance and hand dominance is a more important consideration than eye dominance alone. Unilaterality of hand and eye dominance has been shown to lead to greater efficiency in hand and eye coordinated tasks.

The results of this experiment indicate that system designers should, in general, continue to design for the individual preferring the right eye and right hand. This ensures that the equipment design will be compatible with the largest categorical population.

Although experimental results have shown that eye preference is not very task specific, a tendency for inconsistency of the preferred eye exists under certain experimental conditions. The significance of this inconsistency may be recognized by system designers, instructors, or operating personnel as indicative of some other critical factor such as parallax which affects efficiency, accuracy, or safety in the operation of an integrated system. In view of this, the optimum design of a system in which the cost of errors is very high may require the system designer

to minimize the maximum error rather than design for the convenience of the majority population. The selection of a system design, in this instance, should be based upon results of experimental tests of the various proposed designs by a population of subjects representative of the user population with respect to hand and eye preference.

As exhibited in this experiment, even when tasks appear almost identical, a difference, which may be attributed to psychological or physiological factors, can exist which will affect the results. System designers must therefore carefully select the experiment to duplicate as closely as possible the actual task under consideration.

Appendix A

EXPERIMENTER'S INSTRUCTIONS

This is an experiment on eye dominance. You are informed of this fact so that you will not try to outguess the experimenter as you undergo the experimental trials. You may have your own ideas about eye dominance, especially with respect to yourself. But you are asked to forget these ideas and play your part as you are told to without trying to think about what you are doing. Actually, the facts have not been clearly established regarding eye dominance. And the accuracy of typical, simple tests of eye dominance is not well known. You will help to clarify these issues if you perform according to instructions.

You will be given 12 test trials after four practice trials. You are to sit facing me squarely and two arms lengths away. At the beginning of a trial, I will alert you by saying, "Ready?" Then I will designate one of my eyes which you are to focus your gaze on by saying "Right Eye" or "Left Eye." Look at the designated eye using both of your eyes and without moving your head.

Next, I will tell you which hand to hold the cone in by saying "Right Hand" or "Left Hand." Hold the cone gently in the designated hand with the small end facing you. When I say "Now!" raise the cone to eye level and a comfortable arm's length away. Adjust the position of the cone so that you can see my eye that you are looking at in the middle of the opening. Hold it in that position until I say "OK." When I say "OK" the trial is over.

Do not squint or close one eye. Do not turn or tilt your head. The temptation may be great to do so, but don't. And please don't experiment with your vision between trials. Also, try to get the cone to the position where you see my eye without a lot of shifting around. Ideally, your gaze should be so fixed on my eye that you should be able to lift the cone and place the opening in your line of sight in one quick movement. And remember, once my eye appears in the opening, hold the cone there until I say "OK."

Do you have any questions? Let's run four practice trials.
RR, RL, LL, LR.

(DON'T LET THE SUBJECT SEE YOUR SCORING OF HIS RESPONSES!)

Appendix B

SAMPLE DATA SHEET

SECTION: 1 2 PHASE: 1 2

EXPERIMENTER _____

SUBJECT _____ HANDEDNESS: L R

TRIAL NUMBER	TASK SEQUENCE 1	TASK SEQUENCE 2	RESPONSE (EYE USED)	
1	LL	LL	R	L
2	RL	LR	R	L
3	LL	RL	R	L
4	RR	LR	R	L
5	RL	RR	R	L
6	LL	LR	R	L
7	LR	RR	R	L
8	RR	RL	R	L
9	RL	RR	R	L
10	RR	LL	R	L
11	LR	RL	R	L
12	LR	LL	R	L

GLASSES

Appendix C

DATA ANALYSIS
TABLE 1

GROUP 1 SECTION 1 PHASE 1 TASK SEQUENCE 1

			TRIAL												
SUBJECT	GLASSES	HANDED	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	N	R	R	L	R	R	L	R	R	R	L	R	R	R	9
2	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
3	N	L	L	L	L	L	L	L	L	L	L	L	L	L	0
4	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
5	N	R	R	R	R	R	L	R	R	R	R	R	R	R	11
6	N	R	L	L	L	L	L	L	L	L	L	L	L	L	0
7	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	R	R	R	R	L	R	R	L	R	R	R	L	R	9
9	N	R	R	R	R	L	R	R	L	L	R	L	L	L	6
10	Y	R	L	L	R	L	L	L	L	L	L	L	L	L	1
11	Y	R	L	L	L	R	L	L	R	R	L	R	R	R	6
12	Y	R	L	L	L	L	L	L	L	L	L	L	L	L	0

GROUP 1 SECTION 1 PHASE 1 TASK SEQUENCE 2

			TRIAL												
SUBJECT	GLASSES	HANDED	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	N	L	L	R	L	L	L	L	L	L	L	L	L	L	1
2	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
3	N	R	L	R	R	R	R	R	R	R	R	R	R	L	10
4	Y	R	R	R	L	R	R	R	R	L	L	R	L	L	7
5	N	L	L	L	L	L	L	L	L	L	L	L	L	L	0
6	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
7	Y	L	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
9	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
10	Y	R	R	R	R	R	L	R	R	R	R	R	R	R	11

TABLE 1 (continued)

GROUP 1 SECTION 2 PHASE 1 TASK SEQUENCE 2

			TRIAL												
SUBJECT	GLASSES	HANDED	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
2	N	L	L	L	L	L	L	R	L	L	L	L	L	L	1
3	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
4	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
5	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
6	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
7	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
9	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
10	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
11	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
12	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12

GROUP 1 SECTION 2 PHASE 2 TASK SEQUENCE 1

			TRIAL												
SUBJECT	GLASSES	HANDED	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
2	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
3	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
4	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
5	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
6	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
7	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
9	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
10	N	R	L	L	L	R	R	L	L	R	R	R	L	L	5
11	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12

TABLE 1 (continued)

GROUP 2 SECTION 3 PHASE 1 TASK SEQUENCE 1

SUBJECT	GLASSES	HANDED	TRIAL 1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	N	R	L	L	L	L	L	L	L	L	L	L	L	L	0
2	Y	R	L	R	R	L	R	R	L	L	R	L	L	L	5
3	N	L	L	L	R	L	R	R	R	R	R	R	R	R	9
4	Y	R	R	L	L	L	L	L	L	L	L	L	L	L	1
5	N	R	L	L	L	L	L	L	L	L	L	L	L	L	0
6	N	R	R	R	R	L	L	R	R	R	R	L	R	R	9
7	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
9	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
10	N	R	R	R	R	L	R	R	R	L	R	L	R	R	9
11	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
12	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
13	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
14	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
15	Y	R	R	R	R	L	R	R	R	L	R	L	R	R	9

GROUP 2 SECTION 3 PHASE 2 TASK SEQUENCE 2

SUBJECT	GLASSES	HANDED	TRIAL 1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
2	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
3	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
4	N	R	R	L	R	L	L	L	L	R	L	R	R	R	6
5	N	R	R	R	R	R	R	R	R	R	R	R	L	R	11
6	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
7	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	L	R	L	R	L	L	L	L	L	L	L	R	L	3
9	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
10	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
11	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
12	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
13	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
14	N	R	L	L	L	L	L	L	L	L	L	L	L	L	0

TABLE 1 (continued)

GROUP 2 SECTION 4 PHASE 1 TASK SEQUENCE 2

			TRIAL												
SUBJECT	GLASSES	HANDED	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
2	Y	R	R	R	L	R	L	R	L	L	L	R	L	R	6
3	N	R	L	L	L	L	L	L	L	L	L	L	L	L	0
4	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
5	Y	R	R	R	R	R	R	R	R	R	L	R	R	R	1
6	N	R	R	L	R	L	R	L	R	R	R	R	R	R	9
7	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
8	N	L	R	R	R	R	R	R	R	R	R	R	R	R	12
9	N	R	L	L	L	L	L	L	L	L	L	L	L	L	0
10	Y	R	R	R	R	R	R	R	L	R	R	R	R	R	11
11	N	R	L	L	L	R	L	R	L	L	L	L	L	L	2
12	Y	R	L	L	L	L	L	L	L	L	L	L	L	L	0

GROUP 2 SECTION 4 PHASE 2 TASK SEQUENCE 1

			TRIAL												
SUBJECT	GLASSES	HANDED	1	2	3	4	5	6	7	8	9	10	11	12	SCORE
1	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
2	N	R	L	L	L	L	L	L	R	L	L	L	L	L	1
3	Y	R	L	L	L	L	L	L	L	L	L	L	L	L	0
4	Y	R	L	L	L	L	L	L	L	L	L	L	R	R	2
5	Y	R	R	R	R	L	L	L	R	L	R	L	R	L	6
6	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
7	N	R	R	L	R	L	L	R	R	R	R	L	R	R	8
8	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
9	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
10	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	12
11	N	R	R	R	R	R	R	R	R	R	R	R	R	R	12
12	Y	R	L	L	L	L	L	L	L	L	L	L	L	R	1

GROUP		1	2	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	29	27	56
	BELOW MEDIAN	16	26	42
MARGINAL FREQUENCY		45	53	98

$\chi^2 = 1.302$ $\quad .3 > p > .2$

TABLE 2. Median test for comparing Group 1 and Group 2 scores.

SECTION		11	12	23	24	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	8	21	17	10	56
	BELOW MEDIAN	14	2	12	14	42
MARGINAL FREQUENCY		22	23	29	24	98

$\chi^2 = 17.21108$ $\quad p < .001$

TABLE 3. Extended Median Test for comparing Section scores.

SECTION		11	12	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	8	21	29
	BELOW MEDIAN	14	2	16
MARGINAL FREQUENCY		22	23	45

$\chi^2 = 12.51197$ $p < .001$

TABLE 4. Median Test for comparing Scores of Sections of Group 1.

SECTION		23	24	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	17	10	27
	BELOW MEDIAN	12	14	26
MARGINAL FREQUENCY		29	24	53

$\chi^2 = .90817$ $5. > p > .3$

TABLE 5. Median Test for comparing Scores of Sections of Group 2.

SECTION		11	23	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	10	18	28
	BELOW MEDIAN	12	11	23
MARGINAL FREQUENCY		22	29	51

$\chi^2 = .80436$ $\quad .5 > p > .3$

TABLE 6. Median Test for comparing Scores of Early Sections between Groups.

SECTION		12	24	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	21	10	31
	BELOW MEDIAN	2	14	16
MARGINAL FREQUENCY		23	24	47

$\chi^2 = 10.77190$ $\quad p \doteq .001$

TABLE 7. Median Test for comparing Scores of Late Sections between Groups.

SECTION		11	24	MARGINAL FREQUENCY
NUMBER OF SUBJECT	ABOVE MEDIAN	11	12	23
	BELOW MEDIAN	11	12	23
MARGINAL FREQUENCY		22	24	46

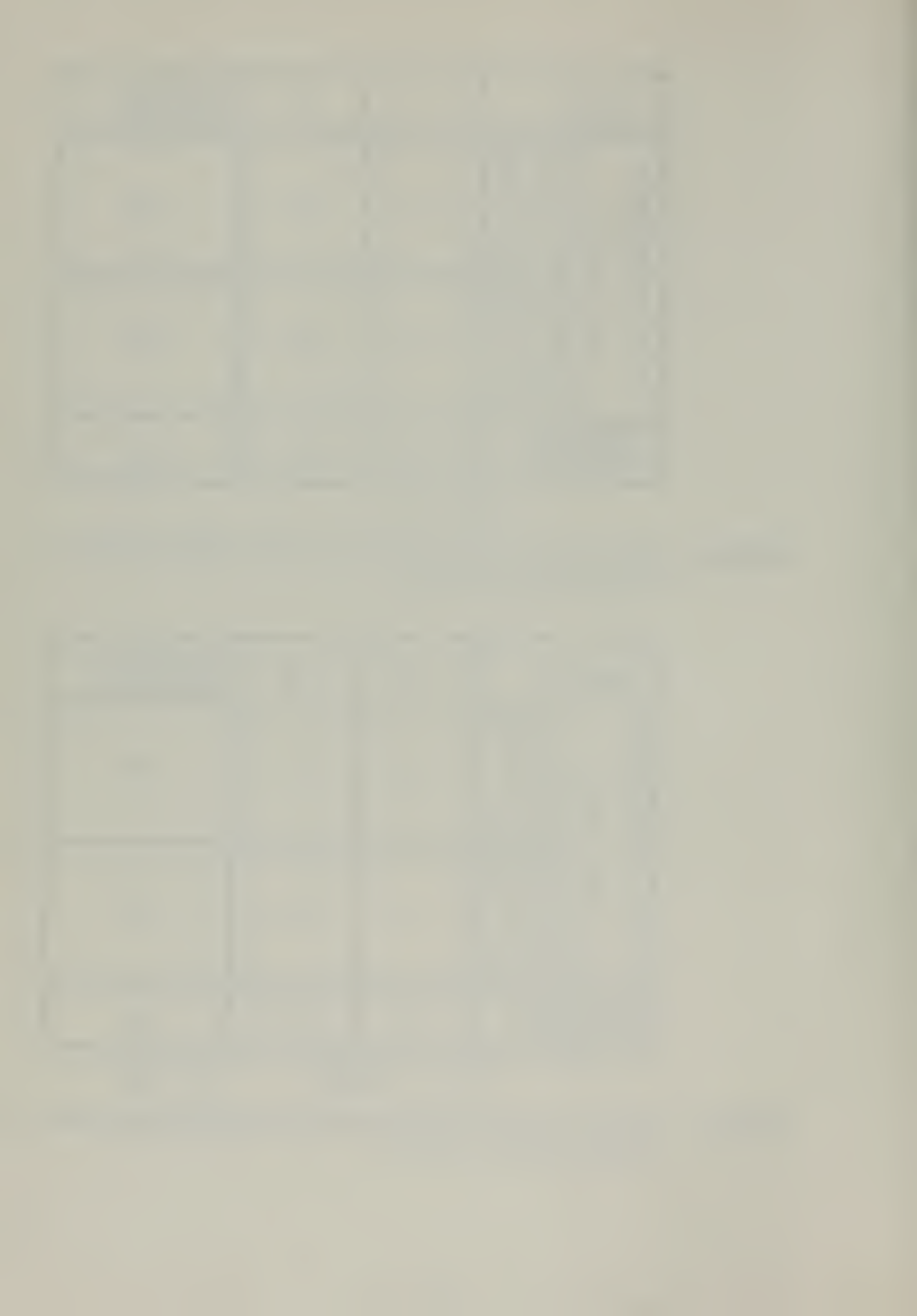
$\chi^2 = 0$

TABLE 8. Median Test for comparing Scores of Early Section in Group 1 to Late Section in Group 2.

SECTION		12	23	MARGINAL FREQUENCY
NUMBER OF S" SUBJECTS	ABOVE MEDIAN	21	17	38
	BELOW MEDIAN	2	12	14
MARGINAL FREQUENCY		23	29	52

$\chi^2 = 5.40217$ $p \doteq .02$

TABLE 9. Median Test for comparing Scores of Late Section in Group 1 to Early Section in Group 2.



NUMBER OF SUBJECTS		GLASSES	NO GLASSES	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	19	37	56
	BELOW MEDIAN	15	27	42
MARGINAL FREQUENCY		34	64	98

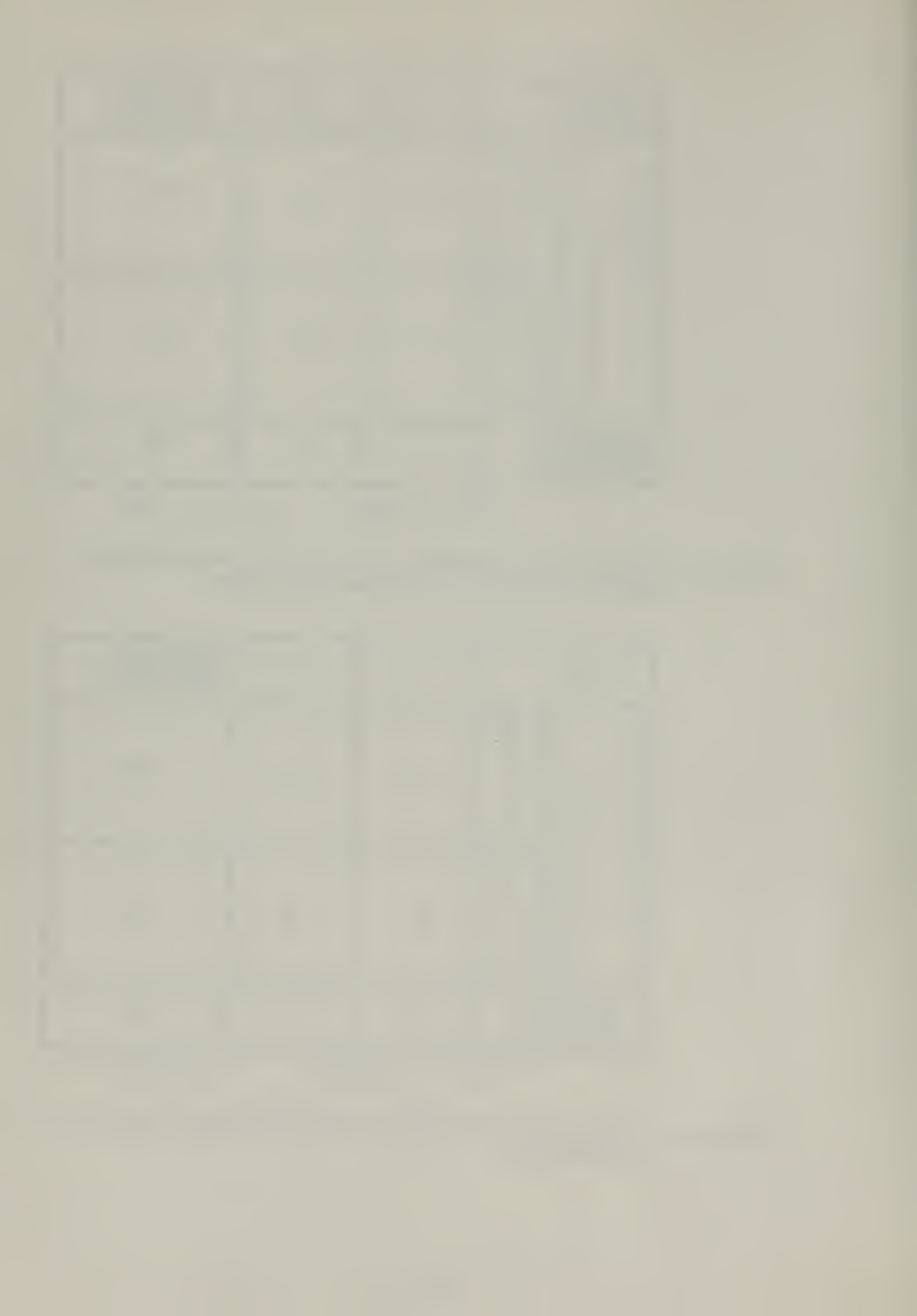
$\chi^2 = .00093$ $\quad .98 > p > .95$

TABLE 10. Median Test for comparing Scores of Subjects Who Wear Glasses to the Scores of Those Who Do Not.

PHASE		1	2	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	25	31	56
	BELOW MEDIAN	26	16	42
MARGINAL FREQUENCY		51	47	98

$\chi^2 = 2.21542$ $\quad .1 < p < .2$

TABLE 11. Median Test for comparing Scores of Subjects in Phase 1 and Phase 2.



SEQUENCE		1	2	MARGINAL FREQUENCY
NUMBER OF SUBJECTS	ABOVE MEDIAN	26	30	56
	BELOW MEDIAN	24	18	42
MARGINAL FREQUENCY		50	48	98

$\chi^2 = .71543$ $\quad .3 < p < .5$

TABLE 12. Median Test for comparing Scores of Subjects in Sequence 1 and Sequence 2.

HANDEDNESS	LEFT	RIGHT	TOTAL
NUMBER OF SUBJECTS	7 (9.8)	91 (88.2)	98

$\chi^2 = .089$ $\quad .95 > p > .9$

TABLE 13. Comparison of the Number of Left-Handed Subjects in the Experiment to the Expected Number Based on the Percentage of Left-Handed Persons in the Population.

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	2	9	11
	RIGHT	2	54	56
MARGINAL FREQUENCY		4	63	67

$p = .11050$ $\varphi = .22842$

TABLE 14-1. Fisher Exact Probability Test for determining the exact probability of the observed distribution of Dominant Hand vs. Dominant Eye using criterion of 12 like responses for eye dominance.

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	3	8	11
	RIGHT	1	55	56
MARGINAL FREQUENCY		4	63	67

$p = .01205$

TABLE 14-2. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 14-1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	4	7	11
	RIGHT	0	56	56
MARGINAL FREQUENCY		4	63	67

p = .00043

TABLE 14-3. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 14.1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	4	13	17
	RIGHT	2	59	61
MARGINAL FREQUENCY		6	72	78

p = .01695 φ = .31390

TABLE 15-1. Fisher Exact Probability Test for determining the exact probability of the observed distribution of Dominant Hand vs. Dominant Eye using a criterion of 11 or more like responses for eye dominance.

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	5	12	17
	RIGHT	1	60	61
MARGINAL FREQUENCY		6	72	78

p = .00146

TABLE 15-2. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 15-1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	6	11	17
	RIGHT	0	61	61
MARGINAL FREQUENCY		6	72	78

p = .00004

TABLE 15-3. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 15-1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	4	15	19
	RIGHT	2	60	62
MARGINAL FREQUENCY		6	75	81

$p = .02258$ $\varphi = .28842$

TABLE 16-1. Fisher Exact Probability Test for determining the exact probability of the observed distribution of Dominant Hand vs. Dominant Eye using a criterion of 10 or more like responses for eye dominance.

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	5	14	19
	RIGHT	1	61	62
MARGINAL FREQUENCY		6	75	81

$p = .00222$

TABLE 16-2. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 16-1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	6	13	19
	RIGHT	0	62	62
MARGINAL FREQUENCY		6	75	81

$p = .00008$

TABLE 16-3. Fisher Exact Probability Test for a Distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 16-1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	5	15	20
	RIGHT	2	67	69
MARGINAL FREQUENCY		7	82	89

$p = .00527$ $\varphi = .34269$

TABLE 17-1. Fisher Exact Probability Test for determining the exact probability of the observed distribution of Dominant Hand vs. Dominant Eye using a criterion of 9 or more like responses for eye dominance.

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	6	14	20
	RIGHT	1	68	69
MARGINAL FREQUENCY		7	82	89

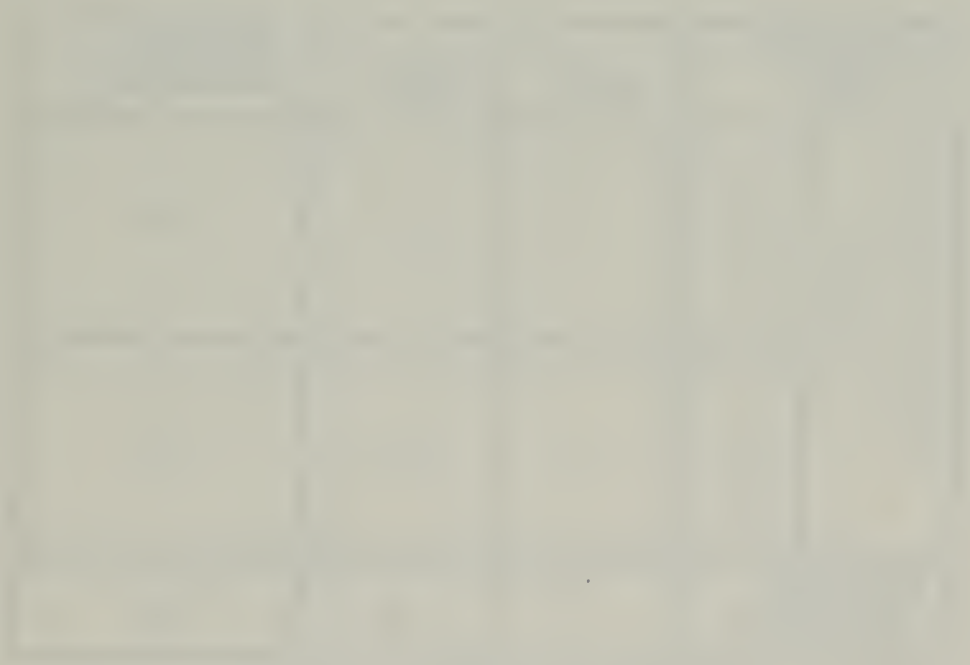
p = .00038

TABLE 17-2. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 17-1).

DOMINANT HAND		LEFT	RIGHT	MARGINAL FREQUENCY
DOMINANT EYE	LEFT	7	13	20
	RIGHT	0	69	69
MARGINAL FREQUENCY		7	82	89

p = .00001

TABLE 17-3. Fisher Exact Probability Test for a distribution of Dominant Hand vs. Dominant Eye more extreme than that observed (TABLE 17-1).



TASKS	RR	RL	LR	LL	TOTAL
NUMBER OF RIGHT EYE RESPONSES	(217) 203	(217) 216	(217) 224	(217) 225	868

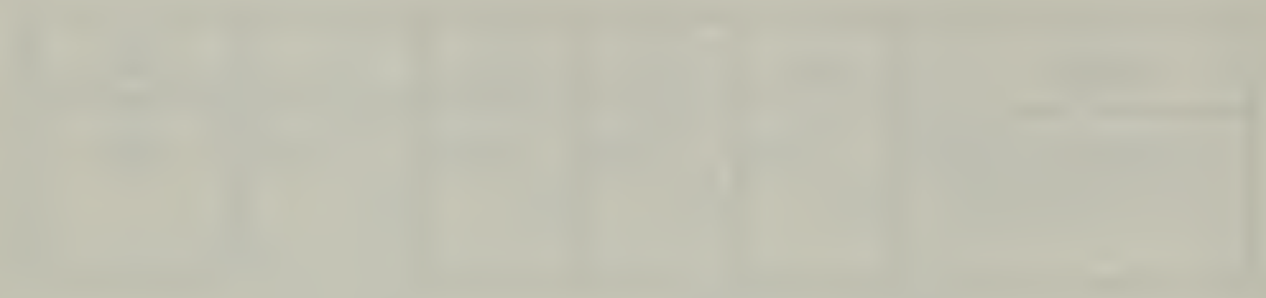
$\chi^2 = 1.4285$ $p \doteq .7$

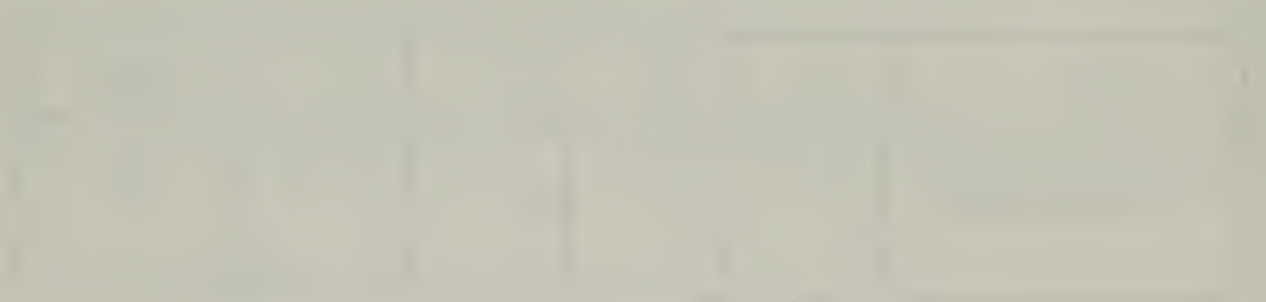
TABLE 18. Frequency of right-eye responses by all subjects to four different tasks.

TASKS	RR	RL	LR	LL	TOTAL
NUMBER OF RIGHT EYE RESPONSES	(49) 35	(49) 48	(49) 56	(49) 57	196

$\chi^2 = 6.5888$ $.1 > p > .05$

TABLE 19. Frequency of right-eye responses by a reduced population (excluding one-eyed subjects) to four different tasks.





HAND USED IN SIGHTING TASK	RIGHT	LEFT	TOTAL
NUMBER OF RIGHT-EYE RESPONSES	(98) 91	(98) 105	196

$\chi^2 = 1.0$ $\quad .5 > p > .3$

TABLE 20. Frequency of right-eye responses by the population (excluding one-eyed subjects) using the indicated hand for sighting.

TARGET EYE	RIGHT	LEFT	TOTAL
NUMBER OF RIGHT-EYE RESPONSES	(98) 83	(98) 113	196

$\chi^2 = 4.59$ $\quad .05 > p > .02$

TABLE 21. Frequency of right-eye responses by the population (excluding one-eyed subjects) using the indicated target eye.

HAND USED IN SIGHTING TASK		RIGHT	LEFT	MARGINAL TOTAL
TARGET EYE	RIGHT	35	48	83
	LEFT	56	57	113
MARGINAL TOTAL		91	105	196

$\chi^2 = .77$ $\quad .5 > p > .3$

TABLE 22. A chi-square test of the contingency of hand used in sighting to target eye.

PREFERRED EYE		RIGHT	LEFT	MARGINAL FREQUENCY
INCONSISTENT RESPONSES	RIGHT HAND	21	11	32
	LEFT HAND	16	12	28
MARGINAL FREQUENCY		37	23	60

$\chi^2 = .16650$ $\quad .5 < p < .7$

TABLE 23. A chi-square test of the distribution of contralateral eye responses on Preferred Eye vs. Hand Holding Cup

PREFERRED EYE		RIGHT	LEFT	MARGINAL FREQUENCY
INCONSISTENT RESPONSES	LEFT EYE	9	13	22
	RIGHT EYE	28	10	38
MARGINAL FREQUENCY		37	23	60

$\chi^2 = 5.02105$ $\quad .02 < p < .05$

TABLE 24. A chi-square test of the distribution of contralateral eye responses on Preferred Eye vs. Target Eye.

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13. ABSTRACT

An experiment was conducted to determine the prevalence of right-left eye preferences and the relationship of eye preference to handedness and task factors. The experimental task was a sighting task. The independent variables were direction of sighting (two levels) and hand used in sighting (right or left). The dependent variable was the eye used in sighting. Handedness was defined as the hand used in writing. Each of 98 Ss underwent 12 sighting trials which replicated the 4 sighting conditions 3 times. 68.3 percent of all Ss gave 12 unilateral eye responses. Using 9 out of 12 unilateral eye responses as a criterion of eye preference, there were 69 right-eyed Ss (67 right-handed, 2 left-handed), 20 left-eyed Ss (15 right-handed, 5 left-handed) and 9 Ss (9 right-handed, 0 left-handed) who showed no eye preference. The phi-coefficient between eye preference and handedness for those showing eye preference was .34. Analysis of the responses of those showing a mixed preference showed a significant task effect.

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