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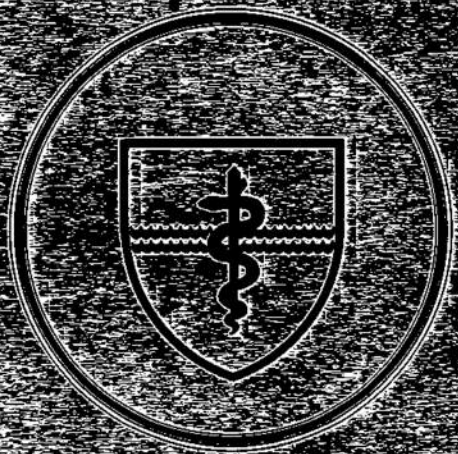

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IDENTIFICATION OF PREFERRED RESPONSE MODALITY ON VISUAL PERCEPTION AND COGNITIVE TASKS OF BASIC ENLISTED SUBMARINE SCHOOL STUDENTS

by

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Naval Medical Research and Development Command
Research Work Unit M0100.001-1023

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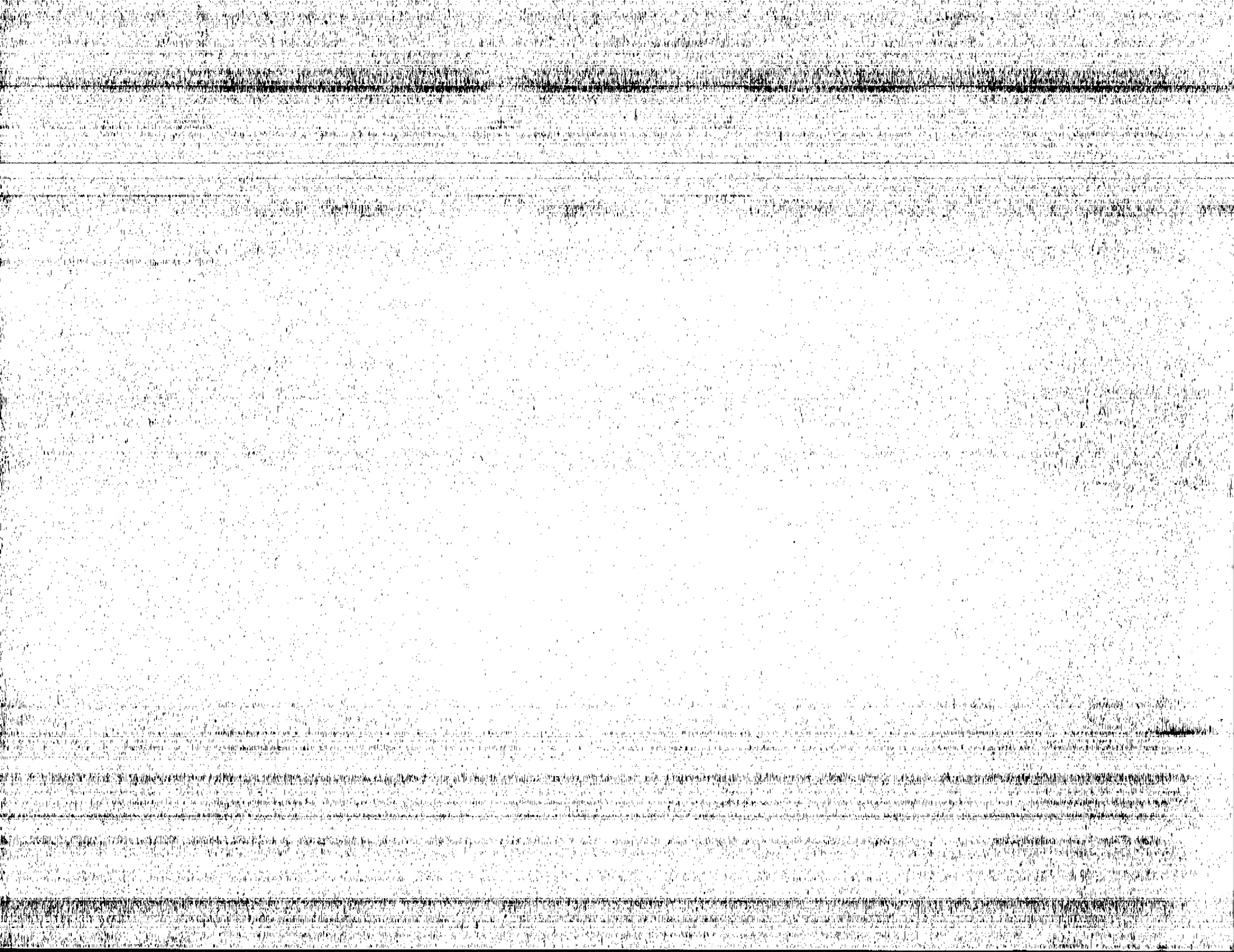

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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
Research Work Unit M0100.001-1023

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SUMMARY PAGE

PROBLEM

To determine if the written versus the oral performances on visual perceptual and cognitive tasks would identify a preferred response modality in submarine school students. Secondly to compare the performance of these submarine school students with that of sonar operators from a previous investigation using the same visual perceptual tasks.

FINDINGS

The submarine school students' performance was similar in both the written and oral situation for all of the visual perceptual tasks except one: on the Hidden Patterns Test the written performance was significantly better than the oral performance. When their performance on the visual perceptual and non-perceptual tasks were compared to past performances of sonar operators, the sonar operators were significantly better on the Gestalt Completion Test, GCT, and Arithmetic. They were also older than the present enlisted submarine school men.

APPLICATION

These results suggest that on most visual perceptual tasks both the written and oral responses produce similar performances by the submarine school students. But with a visual perceptual task that required them to identify a configuration that had perceptual distractions, the written performance was significantly better than the oral. Since flexibility of visual closure is often very useful in carrying out the tasks that submariners are required to do, and since oral responses are used in the performance of their duties, submarine school students should be trained to give more oral responses to complex and distracting visual perceptual situations. Secondly, the comparison of sonar operators with this sample of enlisted submarine school students showed that submariners had higher speed of closure, GCT, and Arithmetic scores. Also their mean age of 24.8 was higher than the mean age of 20.24 found in this sample. The results support the idea that high cognitive abilities and speed of closure are desirable characteristics in sonar operators.

ADMINISTRATIVE INFORMATION

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ABSTRACT

This study investigated whether or not two different types of response (oral versus written) on a battery of visual perceptual tasks result in significant differences in performance in submarine school students. Secondly, the study compared their written performance to the performance in a past research investigation with submarine sonar operators using the same battery. The visual perceptual and cognitive tasks included a broad selection of visual perceptual abilities, such as speed of closure, flexibility of closure, spatial orientation, perceptual speed, and induction. Several non-perceptual measures were compared with the sonar operators' study, including the General Classification Test (GCT), Arithmetic Test, and age.

The submarine school students demonstrated similar performances in the two response modalities on all but one of the visual perceptual and cognitive tasks. Only the flexibility of closure task, as measured by ETS's Hidden Pattern Test, showed a significant difference in performance: the written responses produced a significantly higher level of performance than the oral responses for the students. Also, their performance on several of the visual perceptual and cognitive tasks, as well as on a non-perceptual variable, was significantly different from that of the sonar operators.

INTRODUCTION

In an investigation by Kinney and Luria (1980) in which visual perceptual abilities were measured using both paper-and-pencil tests and visual displays, the researchers found no independent visual spatial factors from the verbal and spatial, or perceptual factors. These results are contrary to past literature which reports separate verbal and cognitive abilities from visual spatial and perceptual abilities (e.g., Anastasi, 1976; French, 1951; Thurstone & Thurstone, 1941).

Visual perceptual response, as reported by Haber (1969), refers to all of the processes required to process a stimulus and translate the perception into a response. The visual perceptual response, according to this information processing analysis, may go through the stages labelled detection, reaction time, recognition, and identification. The present investigation attempted to compare the response modality used in the Kinney and Luria study with a different response modality in order to determine if the items used to measure visual perceptual abilities were actually buried in the variance because of the response modality asked to report or identify the visual perceptual experience. There is evidence from neuropsychological studies that persons have preferred response modalities (Smith, 1982). If this is true, then persons may perform differently using an oral modality as opposed to a written modality.

The factor that Kinney and Luria identified in the separate factor analysis on the eight paper-and-pencil tests which they labelled visual or perceptual factor may have had some confounding influence (Guilford, 1972). The visual perceptual tests that loaded on that factor were Hidden Pattern, Perceptual Speed, and Gestalt Completion Test. This study tried to separate the differences between the performance on the oral and written modalities on each of the visual perceptual tests in the battery. In addition, the performance of the present subjects on some non-perceptual variables was compared to the performance of the sonar operators examined by Kinney and Luria (1980).

Two hypotheses were examined in this study: (1) There is no significant difference between the written and oral performances of enlisted submarine school students on tests of perceptual and cognitive abilities. (2) There is no significant difference between various non-perceptual measures of enlisted submarine school students' performance and the performance of a past sample of sonar operators.

METHOD

Subjects Thirty-seven volunteers from the Naval Submarine School at the Naval Submarine Base New London, Groton, CT participated in the study. Subjects ranged in ages from 18 years 5 months to 28 years 11 months with a mean age of 20 years 24 months. Subjects' educational levels and handedness varied.

Test Battery All subjects were administered a series of visual perceptual tests and other non-perceptual tests and tasks. Test results for the General Classification and Arithmetic tests were obtained from the records. The selected tests used in the report were those tests used in a former study by Kinney and Luria (1980) who reported detailed descriptions of the factors that these tests supposedly measure. Table I lists the tests used in the present study. Other tests were administered and other observations made as a part of the study; however, they will not be presented until further analyses have been completed.

TABLE I. THE TESTS ADMINISTERED IN THIS STUDY

Visual Perceptual and Cognitive Tests

1. Hidden Patterns Test, Educational Testing Service
2. Perceptual Speed (Identical Forms) Thurstone & Jeffrey (1956)
3. Figure Classification, Educational Testing Service
4. Cube Comparison Test, Educational Testing Service
5. Gestalt Completion Test, Educational Testing Service, (French, Ekstrom, & Price, 1963)

Non-Perceptual Measures

1. Age - Date of birth was recorded and age was calculated from DOB
2. General Classification Test and Arithmetic Test
3. Internal-External Control (Rotter, 1966)

Procedure The 37 students were individually introduced to the senior investigator. At that time the purpose of the research was explained, and each subject was given an identification number. Each test was explained when presented to the subject. The oral or written presentations were given in a counter-balanced pattern to control for practice effects. Half of the subjects produced oral responses first; then the same tests were given and written responses were required from the subject during the second part of the testing. The other subjects produced written responses to the test first, and then oral responses were requested to the tests. Total testing time was 75 to 90 minutes. All volunteers were tested for handedness and to see if they needed corrective lenses.

RESULTS

The first question was whether or not there would be a significant difference between the written and oral performances of the enlisted submarine school students on the various perceptual and cognitive tests. Table II gives the mean scores and their standard deviations for the various tests with both response modalities. A randomized block analysis of variance was performed on all sets of written and oral performances on the tests. The written performance on the Hidden Patterns Test was significantly higher than the oral performance (F (1,27)=6.039, $p < .05$) for this group of enlisted submarine school students. This test supposedly measures the ability to identify one or more configurations in spite of perceptual distractions. There were no differences between the two response modalities on the other tests.

TABLE II. MEAN SCORES ON VISUAL PERCEPTUAL AND COGNITIVE TESTS FOR WRITTEN AND ORAL RESPONSES

Tests	Response Modalities			
	Written		Oral	
	M	SD	M	SD
Hidden Patterns Test	79.00	16.07	71.84	22.68
Perceptual Speed	66.57	10.67	70.49	15.86
Figure Classification	69.49	19.42	70.78	15.91
Cube Comparison	27.38	7.78	28.51	8.32
Gestalt Completion	12.97	5.07	13.75	4.25

The second question was whether or not there were significant differences between these submarine school students and a former sample of sonar operators. Differences between the means were analyzed using the Student t test for the visual perceptual, cognitive, and the non-perceptual variables. Four of the variables, one perceptual, two cognitive, and one non-perceptual variable were significantly different from the former sample of sonar operators. Table III gives the means and standard deviations of the scores on the various tests for both response modalities. The Hidden Patterns Test was not analyzed due to a difference in scoring techniques. However, this was the only visual perceptual test that produced significant differences in performance under the written and oral response for this sample.

Table III. MEAN COMPARISON OF PERCEPTUAL, COGNITIVE, AND NON-PERCEPTUAL VARIABLE BETWEEN SONAR OPERATORS AND SUBMARINE SCHOOL STUDENTS

Variables	Groups: Sonar Operators n =100 M	SD	Submarine School Students n =37 M	SD	t
Gestalt Completion Test	15.6	4.0	12.97	5.07	3.76*
General Classification Test	60.2	7.2	57.11	5.52	2.65*
Arithmetic Test	58.6	6.1	56.19	6.38	2.01*
Hidden Patterns Test	166.3	34.9	79	16.07	:
Age	24.8	5.2	20.24	2.34	5.11*

df = 80
*p .05 two-tailed test
: Comparison not made because of difference in scoring techniques.

DISCUSSION

Performance on the visual perceptual tests was similar for both the written and oral response modalities for all the tests except the Hidden Patterns Test. This particular type of test--as defined by Thurstone (1938)--is controversial, however, because it has some confounding factors. Factor analyses have shown that it is possible to fit this test into several categories, but neither visual closure nor perceptual speed truly explains it (Guilford, 1972). The test's visual, right-hemisphere stimulus, requiring a left-hemisphere response, resulted in significantly better written performance. It is quite possible that the overlearned written response dominates the less used oral response. The resulting response may have been the result of many underlying processes. Moreover, the subjects may have used more inner verbalization to solve the oral task which required that they produce a different number from one to ten for each correct identification. If, for example, the correctly identified pattern was in the third figure, the subject would have to control his impulse to say any of the other nine numbers. However, in the written response situation the subjects were just required to mark an X beneath the correctly located item. Moreover, the process of the stimulus encoding and production of a verbal or oral response are both complex. The written response modality may just be easier than the verbal for this type of task.

The two cognitive measures, GCT and Arithmetic, distinguished between the sonar operators and the enlisted submarine school students. The Gestalt Completion Test, which was previously identified by Kinney and Luria (1980) as a visual or perceptual factor, factor loading .76, was also significantly different for the two samples. Sonar operators performed better on this test. It may be noted that the sonar operators have been subjected to a much higher level of screening. In addition they were significantly older and therefore possibly more mature.

These findings suggest that on particular visual perceptual tasks, as measured by the Hidden Patterns Test, better performance is produced with a written response. But on the other tasks the submarine school student could just as easily give either a verbal or written response to a visual perception task. Moreover, submarine school students and sonar operators differ on cognitive abilities as measured by the GCT and Arithmetic. Visual perceptual ability also differs between the groups, although this particular visual perceptual ability may have a cognitive component in it. Lastly, age was also a contributing variable in differences between the groups. Age also brings with it a different level of maturity and possibly some changes in visual perceptual and cognitive performances.

Further analyses are needed to incorporate other important variables such as handedness, speed of manual performance, and possibly an objective measure of oral response so as to evaluate reaction time. In addition physiological measures should be examined simultaneously to determine if the different response modalities actually correlate with specific brain activity in either hemisphere.

REFERENCES

Anastasi, A. (1976). Psychological testing (4th ed.) New York: Macmillan.

French, J. W. (1951). The description of aptitude and achievement tests in terms of rotated factors. Psychometric Monographs, No. 5.

French, J. W., Ekstrom, R. B., & Price, L. A. (1963). Manual for kit of reference tests for cognitive factors.(Rev), Princeton, NJ: Educational Testing Service.

Guilford, J. P. (1972). Thurstone's primary mental abilities and structure-of-intellect abilities. Psychological Bulletin, 77, 129-143.

Haber, R. N. (Ed.) (1969). Information processing approaches to visual perception. New York: Holt, Rinehart and Winston, Inc.

Kinney, J. S. & Luria, S. M. (1980). Factor analysis of perceptual and cognitive abilities tested by different methods. Perceptual and Motor Skills, 50, 59-69.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs: General and Applied, 80, No. 609.

Smith, A. (1982). Symbol digit modalities test revised. Los Angeles, CA: Western Psychological Services.

Thurstone, L. L. (1938) Primary mental abilities. Psychometric Monographs No. 1.

Thurstone, L. L., & Thurstone, T. G. (1941). Factorial studies of intelligence. Psychometric Monographs, No. 2.

Thurstone, T. G. & Jeffrey, T. E. (1956). Perceptual speed Chicago, IL: Industrial Relations Center, University of Chicago.

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