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COGNITIVE AND PERSONALITY CHARACTERISTICS OF EXPERIENCED AND INEXPERIENCED SONAR OPERATORS

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**Cognitive and Personality Characteristics of
Experienced and Inexperienced Sonar Operators***

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SUMMARY

The selection and placement of recruits into specific military job classifications, such as sonar operation, is an important concern of the Armed Forces. Presently, the Navy uses the Armed Services Vocational Aptitude Battery (ASVAB) to select and place submarine and surface operators. Yet, attrition among sonar trainees is high and the ASVAB has been criticized as too general a measure to differentiate or predict performance capabilities and make job classifications. Research indicates that a multidimensional assessment of physiological, cognitive, and attitudinal variables may best describe the characteristics found and desired in expert sonar operators. The present study assessed the cognitive and personality characteristics of experienced sonar operators, and determined how these operators compared with sonar trainees and non-sonar personnel on the same dimensions. A secondary concern was to examine for possible differences between submarine and surface sonar operators, because different ASVAB selection criteria are used with these groups.

Fifty men were divided into three groups. The Experienced Operator (EO) group consisted of 20 sonar instructors (10 submarine and 10 surface) with a minimum of four years ($M=9.38$ yrs.) operational experience. The Sonar Trainee (ST) group consisted of 20 men selected for sonar training (10 submarine and 10 surface) on the basis of ASVAB scores. The No Experience (NE) group consisted of 10 non-sonar Naval personnel. All subjects were administered a battery of cognitive and personality tests.

The results indicated no differences between submarine and surface sonar operators. Experienced operators as a group demonstrated higher than average visual perceptual skills which were significantly better than either group. They also demonstrated predominantly intact personality profiles characterized by low levels of anxiety, high degree of curiosity, tendency towards internal locus of control, and a predominance of positive life experiences. The sonar trainees resembled the EO group in most important dimensions, but did not demonstrate the same proficiency on visual perceptual tasks and had significantly higher anxiety scores. Discriminant analysis using the cognitive and personality test variables reached correct group classifications as high as 80% of the sample. Personality variables, particularly the State-Trait Personality Inventory, contributed most to the classification.

These results support the notion of multidimensional assessment in the characterization, selection, and placement of sonar operators. Even in this rather small study, it appeared that certain cognitive and personality variables not addressed in the ASVAB could prove useful in discriminating successful sonar operators, and that these operators do demonstrate a certain unique and identifiable profile. This study suggests that further research on the characteristics of sonar operators is warranted, particularly so the information can be used to better place trainees and reduce attrition.

INTRODUCTION

The selection of trainees for highly skilled jobs which demand extensive training is an important process for most employers. Selection can be accomplished in a variety of ways. Sometimes an employer will screen a large number of candidates on some general test and select those candidates scoring above a predetermined criterion. Another method of selection involves a thorough job analysis and an assessment of individuals based on the specific skills required of the job. Those performing best on simulated or actual job functions are given highest consideration for job selection. A third technique used to select trainees involves an analysis of the behavioral and performance characteristics of accomplished, experienced, and successful job operators (see McCormick, 1979 for review of selection techniques). This analysis of operator characteristics is often a prerequisite in designing a personnel selection procedure which helps the employer identify characteristics most desirable and/or most common in expert operators. This procedure is useful if a group of experts can be identified, and if the operators possess some similar yet unique job related attributes. Despite the logic of this procedure, it is surprising how seldom it is actually practiced in personnel selection. Often employers simply guess the characteristics or attributes deemed necessary to be successful (e.g., a salesperson should be intelligent, outgoing, verbal, and assertive). Hakel (1986) has provided a thorough review of the methods used in personnel selection.

The Department of Defense, the country's largest single employer, spends millions of dollars each year training personnel for a myriad of jobs. Over the last decade, the need to pre-screen individuals for specific jobs has become increasingly evident. This is very much the case for the specialization of sonar operation, a job on which the Navy spends millions of dollars in selection and training. Such screening should allow for optimal placement of personnel who have high job ability and would be most likely to successfully complete their training. The goal is to reduce the attrition rate of individuals who do not have the required abilities or attitudes to perform a specific job. Thus, by establishing a pre-screening criterion, a cost effective procedure for training is developed.

The Armed Services Vocational Aptitude Battery (ASVAB)(U.S. Department of Defense, 1984), a test of general knowledge and specific abilities (i.e.,

mechanical, electrical), is the criterion measure presently used by the Armed Services for military selection and placement. The ASVAB has proven useful as a screening instrument, and as an overall predictor of success in training, but it has been shown to be of little value in determining the training specialty in which an individual should be placed (Murphy, 1984). Placement decisions are based upon composite scores from the 16 ASVAB subtests (See Appendix A). The subtests are highly intercorrelated, and therefore yield limited unique information. Murphy (1984, p.67) has suggested that the ASVAB composite scores do not "provide multidimensional measurement of discriminably different abilities", and the "ASVAB, as a battery, is no more useful than an equally reliable test of general mental ability". He concluded that "the use of a single test for both selection (which requires a single, unidimensional classification of each applicant) and placement (which requires a multidimensional evaluation) may stretch the best available test batteries" (p. 68).

The ASVAB is presently used to select and place individuals for sonar duty, however, the validity of using this measure has been called into question because its subtests provide little differential information for military placement and there is a high attrition rate of sonar trainees. In 1985, over 25% of the individuals selected for sonar training either failed or dropped out before their training was completed.

Figure 1 shows the attrition rate for each school throughout the training cycle. For example, at Basic Electricity and Electronics School (BE&E) it was reported that attrition was highest and that two out of three students drop for attitudinal rather than academic reasons. It has been suggested that one reason for the high attrition rate among sonar trainees is that the ASVAB is too general a criterion measure, and therefore too far removed in content from the operational task (Mackie, Ridihalgh, & Shultz, 1981).

In the past, when sonar equipment was primarily auditory in nature, personnel placement was based on performance during an auditory memory task. However, due to the recent advances in modern technology, sonar operation has become increasingly a complex visual task. Despite the complex perceptual and cognitive demands now placed on sonar technicians, placement decisions are based solely on a measure of general knowledge rather than on a measurement of any specific abilities related to sonar operation. Also, since many sonar candidates drop due to attitudinal reasons, a measure of

SONAR ATTRITION (FY85)

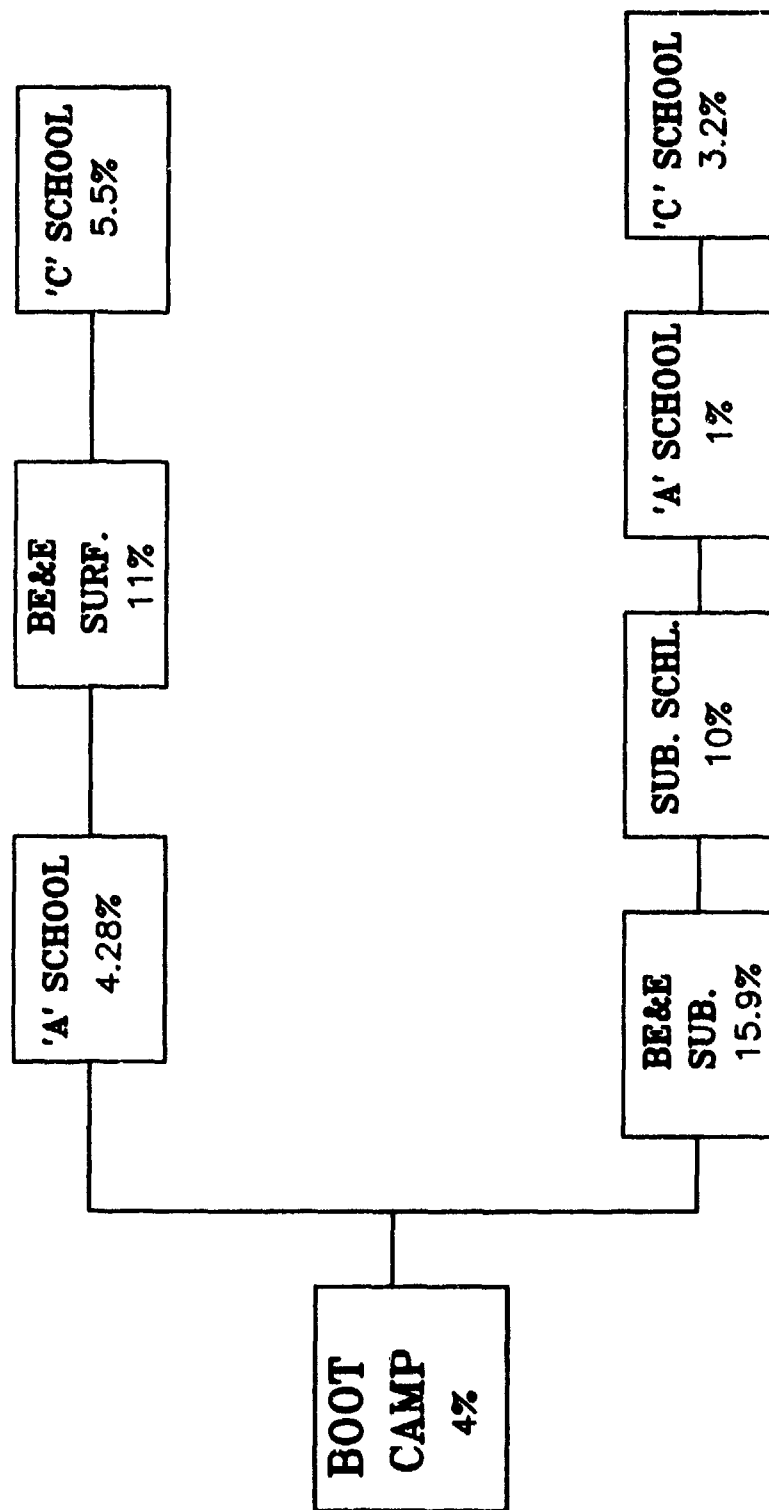


Figure 1. Attrition flow chart indicating the percentage of trainees who dropped out or failed in each school throughout the 1985 training cycle.

general knowledge alone is not sufficient for the selection of sonar technicians.

In response to the need for a revised, more comprehensive sonar selection criterion, research efforts have focused on attempting to delineate some of the perceptual and cognitive abilities which might differentiate highly competent from less competent sonar technicians. Kinney, Luria, and Ryan (1980), at the Naval Submarine Medical Research Laboratory (NSMRL), identified five measures which discriminated good from poor sonar performers, namely: three visual measures - near acuity, near lateral phoria, and texture discrimination; one cognitive measure - the General Classification Test (GCT); and one attitudinal measure - the Internal/External Locus of Control test. Based on these results, they concluded that perceptual, motivational, and intellectual factors should be considered jointly when attempting to develop an adequate sonar selection criterion.

Research seems to indicate that tests such as the GCT and the ASVAB may not be ideal tools for the selection and placement of sonar operators (Lewis & Rimland, 1980). Furthermore, it appears that good sonar operators may possess intellectual, perceptual, and personality characteristics that are different from less skilled and nonselected operators (Kinney & Luria, 1980; Mackie, et al., 1981). However, little is known about the unique abilities of expert sonar operators, and what makes them different from sonar trainees and/or non-sonar personnel. The purpose of the present study was to assess these characteristics in experienced operators and then determine how new sonar trainees and non-sonar personnel compared on the same cognitive and personality dimensions. A secondary concern was to examine for possible differences between sonar operators selected for submarines versus surface ships, since ASVAB criterion scores are different for each type of training. This study was exploratory in nature and thus no a priori hypotheses were specified.

METHOD

Subjects

Fifty U.S. Navy men between the ages of 17 and 38 ($M = 25$) were recruited on a voluntary basis from the Fleet Anti-Submarine Warfare Training Center (ASW), the Naval Submarine Base (SB), and the Naval Health Research Center (NHRC), all located in San Diego, CA.

Subjects were divided into three primary groups (Experienced Operator, Sonar Trainee, and No Experience) based upon the amount of experience they had operating sonar equipment. The Experienced Operator (EO) group consisted of 20 sonar instructors (10 surface and 10 submarine) from the ASW school, ($\bar{M}$ age=29.65 yrs), all of whom had a minimum of four years ($\bar{M}$ =9.38 yrs) operational sonar experience. The Sonar Trainee (ST) group consisted of 20 men ($\bar{M}$ age=20.3 yrs) selected for sonar duty on the basis of ASVAB test scores. These men were presently attending the "A school" phase of their sonar training (10 in surface and 10 in submarine training). The No Experience (NE) group consisted of 10 Navy men ($\bar{M}$ age=25.6 yrs) who were corpsmen or administrative personnel from SB or NhRC and had no previous sonar training or experience. The EO group was selected to represent accomplished and successful sonar operators with acknowledged expertise. The study was most interested in describing characteristics of this group. The ST group was chosen to represent individuals who were potential sonar operators. Because these individuals were selected for sonar differently than experienced operators, we attempted to determine the similarities and/or differences between the two groups of operators. The NE group was used as a comparison group of Navy personnel who would be similar to the other groups in most respects except sonar selection and training. Although it was not possible, it would have been helpful to test subjects who had dropped out of sonar training.

Instruments

All subjects were administered a battery of cognitive and social-personality measures chosen for the specific types of descriptive and objective information each would yield. The cognitive tasks consisted of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) (Wechsler, 1981) and the Raven Standard Progressive Matrices (RSPM) (Raven, 1956). Standard administration and scoring procedures were followed as outlined in the test manuals.

The social and personality measures consisted of the Minnesota Multiphasic Personality Inventory (MMPI) (Hathaway & McKinley, 1951), including additional scales for anxiety (A), ego strength (Es), repression (R), and alcoholism (MAC). The MMPI is a 566 item self report inventory which assesses various dimensions of personality. It is one of the most widely used tests for clinical assessment of personality disturbances. It is not a

test recommended for personnel selection (see Matarazzo, 1986) and therefore was used in exploratory fashion to describe personality dimensions in each group.

A test used by Kinney, Luria, and Ryan (1980), the Rotter (1966) Personal Opinion Questionnaire (POQ), is a 20 item self report instrument which measures the extent to which individuals possess an internal (e.g., accepts responsibility for own actions and consequences) versus external (e.g., does not control own destiny) locus of control. They suggested that this test may be an essential ingredient in assessing attitudes on life and work. On this recommendation the POQ was included so as to describe sonar operators in the locus of control construct.

The battery also included the Life Experience Scale (LES) (Sarason, Johnson, & Siegel, 1978) which purportedly measures the extent to which a person has experienced positive and negative life events during the past year. This measure was employed to determine the relative presence of life stress in the sample groups and examine for possible group differences in life experience. Lastly, the State-Trait Personality Inventory (STPI) (Spielberger, 1979) was administered. The STPI attempts to assess one's relative degree of anger, curiosity, and anxiety, as determined by both State and Trait sensitive scales. This instrument was developed with Navy support and has been norm referenced on Naval personnel and college students. It should be pointed out that the instruments utilized in this study were selected to assess some, not all, dimensions of cognitive and personality constructs, and should not be considered as comprising an exclusive or exhaustive set of measures.

Procedure

Subjects who volunteered for the study were first told of the nature and duration of the experimental procedures. After informed consent, subjects were given a packet of test materials (MMPI, LES, POQ, STPI) to complete individually and return. Subjects were scheduled for a testing session approximately one week after receiving the self report test packet. During the individual test session, the WAIS-R and the RSPM were administered. Testing was performed by a licensed male psychologist and a female graduate student. The session was completed in approximately 90 minutes.

RESULTS

Where possible, the various test raw scores were converted to standard scores. Each test had its own set of normative data for purposes of comparison, and these were considered in the overall factor of the data. The first order of analyses dealt with the variable of submarine or surface ship sonar training within the EO and ST groups. Analyses of variance (2 groups x 2 sonar types) were performed on each of the WAIS-R IQ scales (Verbal, Performance, and Full Scale), RSPM raw and percentile scores, LES, POQ, and MMPI and STPI scales. Only one significant, ($F(1,38)=5.26$, $p<.05$), group difference emerged with submarine personnel scoring higher on the Hysteria scale of the MMPI than did surface personnel. Given the large number of tests of significance, it is possible to obtain such a difference by chance. Furthermore, the difference on this isolated subtest is clinically not meaningful, particularly in light of the numerable measures on which the groups performed similarly. This overwhelming similarity between submarine and surface training groups prompted a collapsing of subjects across this variable. The remaining analyses involved 20 EO, 20 ST, and 10 NE subjects.

Cognitive Measures

The mean scores of all cognitive measures for each group are provided in Table 1. The IQ data indicated average to above average intellectual functioning of all three groups with no significant differences between the groups. Since differences between the EO and the ST groups were of primary interest, separate planned comparisons were conducted to examine for these. Of note is the EO mean Performance IQ score of 113.3 which is considerably higher than the population mean score of 100. Similarly, the EO group performed substantially above population norms on the Block Design subtest ($M = 13.2$, average is 10 with a standard deviation of 3). Between group differences were found on only two WAIS-R subtests. For both the Arithmetic and Object Assembly subtests, the EO group performed significantly better than the ST group, ($F(1,39)=4.46$, $p<.05$ and $F(1,39)=5.61$, $p<.05$, respectively). A significant advantage also was found for the EO group on the Perceptual-Organization factor, ($F(1,39)=4.17$, $p<.05$) (see Cohen, 1957 for factor descriptions) of the WAIS-R (average of Block Design and Object Assembly scores). Performance on the other two IQ factors (Memory and Verbal) were similar for each group and within normal limits.

Table 1: Mean Scores on Cognitive Measures for Each Group

Variable	EXPERIENCED OPERATORS (n = 20)	SONAR TRAINEES (n = 20)	NO EXPERIENCE (n = 10)	NORM DATA*
WAIS-R				
Full Scale IQ	110.45	110.15	103.30	100.00
Verbal IQ	106.50	109.55	102.00	100.00
Performance IQ	113.30	108.20	104.70	100.00
Information	11.75	11.15	11.10	10.00
Vocabulary	11.10	11.05	10.60	10.00
Arithmetic	11.60 ^{a b}	9.95	9.10	10.00
Comprehension	11.30	11.10	10.20	10.00
Similarities	11.10	10.80	10.40	10.00
Digit Span	11.20	11.10	11.00	10.00
Picture Completion	11.55	10.90	10.10	10.00
Picture Arrangement	11.80	12.45	10.70	10.00
Block Design	13.15	12.05	11.70	10.00
Object Assembly	11.25 ^a	9.60	10.40	10.00
Digit Symbol	10.70	9.80	10.40	10.00
Percept-Organiz. factor	12.20 ^a	10.83	11.05	10.00
Memory factor	11.40	10.53	10.05	10.00
Verbal factor	11.31	11.03	10.58	10.00
RSPM (raw scores)	52.80 ^b	52.80 ^c	47.60	
RSPM (percentiles)	89.40	83.60	67.90	50.00

^a EO group significantly different from ST group at $p < .05$.

^b EO group significantly different from NE group at $p < .05$.

^c ST group significantly different from NE group at $p < .05$.

* Norm referenced population mean scores.

The RSPM raw scores for the EO and ST groups were virtually identical ($M=52.8$) and significantly different, ($F(2,49)=5.36$, $p<.05$), from the NE group ($M=47.6$). The raw scores were converted to percentile scores to compensate for differences in age between the groups (See Peck, 1970 for conversion table and norms). Each of the groups performed above the 50th percentile with the EO group achieving the highest score ($M=89.4$). The analyses of the percentile score data provided similar results. The EO and ST groups were not statistically different from one another, but both were significantly different from the NE group.

A discriminant function analysis was performed to determine the extent to which combinations of the cognitive variables could classify subjects into their respective categories. The best discriminant function included the RSPM raw scores and the Perceptual Organization factor score. However, even this best solution could only correctly classify 58% of the sample. Experienced subjects were most correctly classified (60%), yet 7 (35%) ST and 3 (30%) NE subjects were falsely classified as Experienced Operators. These results indicate the lack of separation or degree of similarity among the groups, particularly between EO and ST subjects.

Personality Measures

Mean scores of all the personality measures for each group are presented in Table 2.

Data on the Life Experience Survey were analyzed initially to determine if any of the groups had extenuating life circumstances which might influence findings on other personality measures. No group differences were found on the LES for either positive or negative life events. When compared to normative data presented by Sarason et al. (1978), the groups in this study tended to have more positive and fewer negative life experiences. The EO group had a slightly greater mean number of positive events and lower mean number of negative events than the other two groups. There did not appear to be any evidence to suggest that any group of subjects had an unusual amount of adverse life experiences such that different profiles would be expected. Therefore the remaining analyses were completed under the assumption that the groups were comparable in life experiences.

The MMPI scales were analyzed both in terms of group comparisons and individual clinical comparisons to normative data. As shown in Table 2,

Table 2: Mean Scores on Personality Measures for Each Group

VARIABLES	EXPERIENCED OPERATORS (n = 20)	SONAR TRAINEES (n = 20)	NO EXPERIENCE (n = 10)	NORM DATA*
MMPI Scales				
L	51.75	51.00	51.50	
F	54.55 ^a	57.00	60.20	
K	58.00	53.32	54.30	
HS	54.15	52.37	50.60	
D	56.30	53.21	55.70	
HY	58.10	55.58	53.40	
PD	63.00	61.68	61.60	
MF	62.50	60.47	59.30	
PA	54.80	59.42	54.00	
PT	56.30	61.21	53.00	
SC	58.30	62.58	59.90	
MA	61.90	68.58	63.90	
SI	55.80	55.37	56.20	
A	49.35	52.37	48.30	
R	57.85 ^a	52.63	53.80	
Es	57.80	53.11	56.90	
MAC	58.50	61.95	57.20	
Life Experiences Survey				
Positive Events	16.20	16.00	13.80	9.74
Negative Events	7.45	8.37	9.80	6.22
Personal Opinion Quest.	7.20	7.63	8.00	8.15
State-Trait Person. Inv.				College Navy
State Anxiety	13.90 ^a	19.11	16.00	17.00 22.00
State Curiosity	27.20 ^b	27.00 ^c	23.00	26.00 28.00
State Anger	10.70	10.79	14.20	11.00 14.00
Trait Anxiety	15.45 ^a	18.47	17.10	17.00 18.00
Trait Curiosity	28.85 ^b	28.95 ^c	25.40	29.00 28.00
Trait Anger	17.95 ^b	19.68	23.60	17.00 20.00

^a EO group significantly different from ST group at $p < .05$.

^b EO group significantly different from NE group at $p < .05$.

^c ST group significantly different from NE group at $p < .05$.

only one significant ($F(1,38)=4.64$, $p<.05$) group difference was found and this was on the Repression scale, with the EO group ($M=57.85$) scoring significantly higher than the ST group ($M=52.63$). The MMPI was not designed to assess or interpret group mean scores on its scales and caution must be exercised in examining these data. It can be observed from the group mean data, as well as individual data, that a number of subjects obtained relatively high scores on the Hypomania and Psychopathic Deviate scales (all groups averaged greater than a T-score of 60). The Hypomania score was the highest scale for 60% of all subjects, and 30% of the subjects in each group had scores > 70 on this scale. People with high scores on this scale have been associated with characteristics of being restless, emotionally labile, impulsive, adventuresome, narcissistic and grandiose, although caution must be taken in interpreting this scale in isolation. Within each group there were some subjects who had two or more scale scores > 70 : EO group, 8 of 20; ST group, 9 of 20; and NE group, 4 of 10. The proportion of subjects with these profiles is similar across the groups, and is no higher than what is reported in the normal population (Hathaway and Meehl, 1951).

The Personal Opinion Questionnaire (POQ) assessed locus of control on a continuum from external to internal locus. The group mean scores did not significantly differ on the POQ. In comparison with group data reported by Rotter (1966), it appeared that the subjects in this sample reported a similar yet slightly higher degree of internal locus of control. Such comparisons were made observationally not statistically, and serve only to provide approximate expectations for scores on the POQ.

Group mean scores on the State-Trait Personality Inventory are shown in Table 2. The State variables yielded a significantly higher anxiety score ($F(2,48)=6.34$, $p<.01$) for the ST group and a significantly higher anger score ($F(2,48)=4.73$, $p<.05$) for the NE group. Spielberger (1979) provided normative data on these scales for both Navy personnel and college students. In comparison with these norms, it appears that the discrepancy between ST and EO state anxiety scores is due to a relatively low score for the EO group. The mean score of this group compares with the 5th percentile of Navy personnel and the 25th percentile of college students. Virtually the same pattern of results occurred with the Trait variables. In addition, the NE group had a significantly lower trait curiosity score ($F(2,48)=3.51$, $p<.05$) than the ST and EO groups.

To determine the extent to which the personality variables could discriminate the group membership of subjects, a series of discriminant function analyses were run. The best single classifier of subjects was the STPI. The best function for discrimination included the STPI and five of the MMPI scales (MA, PD, A, R, and MAC). With these variables, the total correct classification was 74%, including 80% of the EO group, 74% of the ST group, and 60% of the NE group. Regardless of the function used in the analysis, the EO group was the easiest to correctly classify, reaching as high as 90% using only the state measures of the STPI. It should be noted that better classification was achieved using the personality variables than the cognitive variables.

When personality variables were combined with cognitive variables, a discriminant function equation using the RSPM raw scores, the WAIS-R Perceptual Organization factor, the STPI, and the MMPI PD, MA, A, R, and MAC scales was able to correctly classify 80% of the subjects.

DISCUSSION

Despite the small sample size and exploratory nature of this study, some interesting and provocative findings emerged. One finding, which has never been documented before, was the striking similarity between submarine and surface ship sonar operators across numerous cognitive and personality variables. Even though candidates for each training group are selected on the basis of different ASVAB criteria, we found no differences between these two groups. It may be that the tests used in this study were just not sensitive to the differences which exist between the groups. This finding would seem to question the use of the ASVAB, or any measure for that matter, in placing submarine and surface sonar trainees separately. There appears to be very little difference in the skill demands for both types of sonar operation, and therefore having similar human abilities would seem desirable. The performance and personality characteristics for the selection of sonar operators in general have yet to be adequately determined, let alone make finer discriminations between submarine and surface ship operators.

The crux of the study attempted to characterize expert sonar operators on cognitive and personality dimensions and thereby assist in the selection of future successful trainees. The experienced operators demonstrated a relatively high Performance IQ with particular skill in Block Design and a significantly high mean score on the Perceptual Organization factor. This

strength in visual perceptual problem solving was corroborated by high performance on the RSPM (89 percentile). These performances are certainly well above average in comparison with the general population and the NE group. The ST group performed more closely to the EO group, but did not demonstrate quite the same proficiency in visual perceptual skills.

The difference between the EO and ST groups in visual perceptual performance is interesting and somewhat paradoxical. The experienced operators were selected for sonar at a time when sonar operation was more of an auditory task. More recently, the computerization of the sonar process has increased the visual information provided to sonar operators. One might expect, therefore, that it would be beneficial to select new trainees for high visual perceptual abilities. Yet the ST group seems only slightly above average on these tasks, and not as skilled as the experienced group. It may be that the high level of experience with visual detection tasks has sharpened certain visual perceptual skills (i.e., attention to visual details and irregularities, spatial mapping of objects, assembly of visual information into meaningful two and three dimensional objects) in the experienced operators, thus accounting for such well developed abilities. One can only speculate as to the innateness versus acquisition of these spatial and visual perceptual abilities. It may be worthwhile for the Navy to investigate the relationship of superior visual perceptual abilities to current sonar performance and the extent to which these abilities can be learned. Another issue for investigation would be the extent to which such abilities are maintained across the age span of the sonar operator.

The personality measures also yielded some interesting results regarding the sonar groups. The EO group is best described by these measures as being low in number of reported negative life events, high in positive life experiences, low in anxiety, relatively high in curiosity and internal locus of control, and generally intact with regard to personality assessment. The ST group was fairly similar to the EO group with the exception of significantly higher anxiety scores. This study did not seek to explain why differences exist between groups. One could speculate that trainees may be more anxious given their status as students under the pressure of ongoing performance evaluation. The experienced operators, on the other hand, were instructors who had reached an elevated status and seemed to enjoy their current work situation. Perhaps, as suggested by the data, it helps to be

curious, adventuresome, self-motivated, achievement oriented, optimistic, and low in anxiety in order to become a successful sonar operator.

As with the cognitive variables, the groups did not differ dramatically on the personality measures. The single best predictor of group membership was the STPI, with little improved accuracy using additional measures. The experienced operators were once again the easiest to classify, and the trainees were next easiest. This order of classification accuracy is in direct line with the extent of homogeneity in each group. The EO group appeared to demonstrate a pattern of unique characteristics, whereas the ST group followed a similar yet less consistent pattern, and the NE group showed no consistent pattern. It seems relevant to selection that personality measures can yield descriptive and discriminant information about a group of expert sonar operators, and suggests that something like the STPI might be a useful part of a screening battery. It should be made clear that this study did not directly investigate selection, placement, or attrition, and that these are inferences which warrant further research.

This study did not attempt to validate or displace the ASVAB as a screening and placement tool. It would appear that the recently selected sonar trainees bear similarities to the experienced operators, and that the ASVAB may be useful for determining the larger pool from which sonarmen are selected. The similarities between the ST and EO groups also may be related to the fact that a great deal of attrition has already occurred (i.e., 29% for the submarine group) prior to the subjects attending their respective 'A' school (see Figure 1). However, because the trainee group performed so close to average on most of the measures in this study, it would appear that a high proportion of people in the general population would be screened into the selection pool. In addition, the ASVAB does not assess perceptual organization skills or personality dimensions which were found in this study to distinguish expert operators. The findings of this study suggest that the ASVAB may be a useful screening tool, but may not be an adequate placement instrument for sonar given its lack of sensitivity to important characteristics of successful sonar operators. It certainly seems that further research is warranted to replicate this study with a larger sample and to explore other methods which might predict successful sonar operators and reduce attrition. One suggestion emanating from this study would be to select trainees on the basis of superior visual perceptual abilities who

also were low in anxiety and anger while high in curiosity, positive life experiences, and internal locus of control. If trainees with these characteristics proved successful through training and job performance, then our findings would be strengthened, and the Navy would benefit from additional criteria for sonar selection.

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APPENDIX A

ASVAB SUBTESTS

1. General Science
2. Arithmetic Reasoning
3. Word Knowledge
4. Paragraph Comprehension
5. Numeric Operations
6. Coding Speed
7. Auto and Shop Info.
8. Mathematics Comprehension
9. Electronic Information
10. Verbal
11. General Information
12. Shop Practice
13. Attention to Detail
14. Auto Information
15. Shop Information
16. Mechanical Composition

ASVAB CLASSIFICATION CRITERIA FOR SONAR TECHNICIANS

- I. Surface Sonar Requirements.
 - A. Mechanical Knowledge + Electronic Information + General Science subtest scores = 156.
 - B. Above score + Arithmetic subtest score = 218.
- II. Submarine Sonar Requirements.
 - A. All requirements needed for Surface Sonar.
 - B. Word Knowledge + Arithmetic + Mechanical Comprehension subtest scores = 147 with minimum Word Knowledge subtest score of 41.
 - C. Verbal + Arithmetic + Mechanical Comprehension subtest scores = 147 with a minimum Verbal subtest score of 41.

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