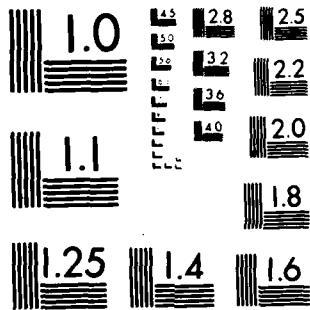


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APRIL 1983

**ESTIMATING SKILL DEGRADATION FOR AVIATION
ANTISUBMARINE WARFARE OPERATORS (AWs):
ASSESSMENT OF JOB AND TRAINING VARIABLES**

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NPRDC Special Report 83-28

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**ESTIMATING SKILL DEGRADATION FOR AVIATION ANTISUBMARINE WARFARE
OPERATORS (AWs): ASSESSMENT OF JOB AND TRAINING VARIABLES**

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FOREWORD

This research and development was performed in response to recognized Navy needs for an investigation of the effects of initial training and job conditions on skill retention under subproject RF63-522-001 (Computer-aided and Classroom Training), work unit 03.07 (Skill and Knowledge Retention). This issue was initially addressed in a paper prepared in 1976 in response to a request from the Chief of Naval Operations (OP-96), citing the concern that training and job conditions might not be conducive to the maintenance of competent performance. The objectives of the subproject are to (1) derive ways of detecting potential problems existing in the Navy and (2) recommend means to minimize performance deterioration by restructuring training and job conditions.

This is the sixth report concerned with skill deterioration. Previous reports described long-term retention of factual information in the Propulsion Engineering Basics Course, the effects of different instructional strategies on long-term retention of materials taken from that course, existing research relevant to skill and knowledge loss, a survey of the three Navy sonar communities--aviator, subsurface, and surface--to identify conditions leading to skill loss, and an assessment of job and training variables leading to skill loss in sonar technicians (surface) (STGs) (NPRDC TN 80-5, TR 81-22, SR 82-21, SR 83-18, and SR 83-26). This report describes an assessment of those variables for aviation antisubmarine warfare operators (AWs). Assessments were conducted using a job condition questionnaire.

The empirical results of this work are primarily intended for the Commander, Antisubmarine Warfare Wing, Pacific (COMASWWINGPAC), and for other agencies concerned with AW training. The development of the questionnaire method of performance assessment that uses the quality of initial training and job conditions to estimate the likelihood of skill degradation should be of interest to personnel and training managers.

Appreciation is expressed to the staff at the ASW Operational Center, Naval Air Station, North Island, particularly AWCS Guyette, and to the staff of the Training Department at COMASWWINGPAC, particularly AWCM Helenihi, AWCM Sweeney, and AWC Mauffrey, for their time, expertise, and aid in this research effort.

JAMES F. KELLY, JR.
Commanding Officer

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SUMMARY

Problem

Navy personnel in technical ratings must maintain high levels of skill and knowledge to be able to perform their jobs correctly when required. However, job conditions may not support maintaining critical skills at the required levels because of infrequent practice of tasks, inadequate feedback about the quality of the performance, long periods of nonutilization of specific skills, and interference due, for example, to assignment to task-irrelevant duties. Since the cost of measuring performance to monitor skill degradation directly is prohibitive, an indirect method for predicting skill loss is needed.

Objective

The objective of this work was to identify job conditions associated with skill and knowledge degradation in aviation antisubmarine warfare operators (AWs) using a specially developed questionnaire.

Approach

A sample of 42 AWs, with varying levels of training and experience in operating sonar systems, was administered an experimental survey questionnaire designed to provide information about initial training and job conditions associated with performing acoustic analysis. In addition, direct performance measures for both acoustic ASW knowledge factors and acoustic analysis/classification on the lofargram were obtained.

Findings

Findings support those of earlier efforts showing that the AW community is characterized by mastery level initial training, relatively frequent task practice, individual feedback, and short periods of task nonutilization. Subjects performed well on the direct performance tests that measured knowledge and passive acoustic analysis skills.

Conclusions

Results indicate that the questionnaire method accurately predicts good performance as well as bad performance. The general finding of this work indicates that good initial training and job conditions are related to good performance on objective tests. It is probable that this general technique can be used to assess the likelihood of poor performance due to skill degradation and/or training inadequacies in other technical ratings. Further, the categories of conditions may be used to suggest corrective action.

Recommendation

Job condition questionnaires should be developed for other technical ratings to determine if this method is generalizable to other technical tasks.

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INTRODUCTION

Problem and Background

The modern Navy is a complex, highly technical organization. Approximately 75 percent of Navy ratings require technically skilled personnel who must most often perform procedural tasks (i.e., those requiring the operator to perform multiple steps in the correct sequence to accomplish the job).¹ Such tasks are difficult to learn, easy to forget, and the most likely to result in critical errors. Vineberg and Joyner (1982), in a review of military studies, found that the ratings classified as hardest to learn and requiring the most training were those in which it was most often predicted that errors would result in failure to carry out missions or in losses of ships, planes, and personnel.

It has been demonstrated that the level of initial training and the quality of job conditions affect the degree to which procedural skills are degraded over time (Hurlock & Montague, 1982). Since investigation has shown that ratings differ as to the quality of initial training and job conditions (Wetzel & Montague, 1983), some ratings may be more vulnerable to skills loss than others.

Navy personnel in technical ratings must be well trained and must maintain high levels of skill and knowledge to be able to perform their jobs correctly when required. Yet training for particular skills may suffer from lack of resources or time because of the need to economize or because of other tradeoffs. Furthermore, to maintain skill on complex procedural tasks, individuals need frequent opportunity to practice that skill and receive feedback about the quality of their performance on the task. Failure to provide opportunity to practice with adequate feedback is likely to produce skill degradation. The degradation of these critical skills directly affects personnel readiness and is of real concern to the Navy.

In an earlier study (Wetzel & Montague, 1982), subject matter experts (SMEs) in the Navy's three sonar communities--surface, subsurface, and aviation--were surveyed to identify training and job conditions indicative of serious skill degradation problems. Analysis of interview results showed that, because of the training and job conditions experienced by surface sonar technicians (STGs), it was highly probable that their skill would degrade over time. Thus, in a follow-on effort, a sample of STGs was administered a questionnaire requiring subjective estimates of initial training and job conditions (Wetzel, Konoske, & Montague, 1983). Analysis of questionnaire responses supported the conclusions reached by Wetzel and Montague; that is, they suggested that training quality was marginal, task nonutilization periods after initial training were long, on-job practice was infrequent, and feedback about task performance was inadequate. When direct measures of performance were used to assess STG competency on critical sonar skills, their test scores were very low. The results of this research effort indicated that the questionnaire method was useful in identifying a potential performance problem in STGs.

For the aviation sonar community, Wetzel and Montague found that the initial level of learning was high, practice of the critical job tasks was fairly frequent, individual feedback about performance was consistent and of good quality, and periods of task nonutilization were short. Because of the relatively high quality of the training and job conditions, it was expected that skill levels on these critical tasks would be comparably

¹Fredericks, P. and Montague, W. E. San Diego: Navy Personnel Research and Development Center, Letter report to Chief of Naval Education and Training, Ser 638, 16 October 1980; subj: IQI evaluation of fleet feedback questionnaire.

high when measured. However, the cost of monitoring skill levels by direct performance measurement is prohibitive. It requires considerable time from testees as well as from instructors or supervisors, and it ties up equipment. It also requires the development of a standardized system for carrying out the testing, scoring, data storage, and reporting. The usefulness of an alternative method of proficiency assessment that uses the quality of initial training and job conditions to estimate the likelihood of skill degradation needs to be evaluated.

Objective

The objective of this work was to identify initial training and job conditions associated with skill and knowledge degradation for aviation antisubmarine warfare operators (AWs). It was undertaken to evaluate further the questionnaire method for assessing the expected performance quality of AW operators. Since results of the prior study (Wetzel & Montague, 1983) suggested good conditions of training and skill maintenance for AW's, it was expected that those results would be reconfirmed.

APPROACH

Subjects and Procedure

Forty-two AWs, ranging in rank from chief petty officer to third class petty officer, were selected on the basis of their participation in the ASWWINGPAC Quarterly Exam. All subjects were members of aviation ASW squadrons (S3-A) stationed at the Naval Air Station, North Island, and all had training plus varying amounts of experience in performing acoustic analysis.

A job condition questionnaire was administered to the subjects immediately prior to the administration of the ASW Wing quarterly examination, which is administered on a regularly scheduled basis to all acoustic analysts stationed at NAS North Island. All of the subjects were tested in one test administration. The examination was scored by the experimenters using grading criteria supplied by the ASW Wing staff.

Materials

Job Condition Questionnaire

The job condition questionnaire was an experimental survey device designed to assess the quality of initial training in acoustic analysis, practice on the job, feedback conditions, and lengths of nonutilization periods. Questionnaire items are shown in Figure 1.

Performance Measure

The purpose of the ASW Wing quarterly examination is to assess operator proficiency of both knowledge factors and lofargram analysis and classification skills. The knowledge factors are tested on a paper and pencil test, consisting of 50 multiple-choice and fill-in questions that cover physics of sound, acoustic intelligence, and computation items. The lofargram analysis and classification test requires the operator to perform analysis and classification procedures on five static, linear lofargrams.

JOB CONDITION QUESTIONNAIRE

Formal Training

1. How long ago was your last formal training (FRS) in gram analysis? (Circle the number of months)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 longer
2. How well could you perform acoustic analysis/classification after you had completed FRS training? (Circle one)
a b c d (where a = never could perform the task correctly, b = could perform the task correctly half of the time, c = could perform the task correctly most of the time, and d = could perform the task correctly every time)
3. While you were in FRS, which of the following best describes your ability to do the task? (Circle one)
a b c d (where a = skills in analysis and classification were equally poor, b = could do both very well but better at analysis, c = could do both very well but better at classification, and d = skills in analysis and classification were equally good)

Practice

4. How many deployments (i.e., 6-month cruise) have you made as an acoustic analyst? (Circle one)
a b c d e (where a = 0, b = 1, c = 2, d = 3, and e = 4 or more)
5. How many hours per week do you average actually performing acoustic ASW in flight? (Circle one)
a b c d e (where a = 0-1 hours, b = 2-3 hours, c = 4-6 hours, d = 7-10 hours, and e = more than 10 hours)
6. How many hours per week do you average studying or practicing acoustic ASW? (Circle one)
a b c d e (where a = 0-1 hours, b = 2-3 hours, c = 4-6 hours, d = 7-10 hours, and e = more than 10 hours)
7. Since the last wing test (December), what is the longest period of time that you have not performed analysis and classification? (Circle the number of weeks)
1 2 3 4 5 6 7 8 9 10 11 12

Feedback (In answering the following questions, circle one)

- a b c d e (where a = never, b = rarely, c = some of the time, d = most of the time, and e = always)
8. When you have correctly classified a target on an exercise, do you receive feedback about your analysis (sound source, predominant spectrum, line characteristics)?
 9. When you have correctly classified a target on an exercise, do you receive feedback about intelligence information (ERP range, TPK)?
 10. When you have incorrectly classified a target on an exercise, do you receive feedback about your analysis of the target?
 11. When you have incorrectly classified a target on an exercise, do you receive feedback about intelligence information?
-

Figure 1. Job condition questionnaire.

FINDINGS

Correlational analysis between results of the job condition questionnaire and the performance test scores was precluded because of low variability among responses to the job condition questionnaire and the test scores.

Job Condition Questionnaire

Level of Initial Learning

Table 1, which provides frequencies for operator estimates of the degree of original learning on acoustic analysis and classification procedures (items 2 and 3), shows that their estimates were relatively high. Sixty-nine percent of the subjects estimated that they could perform acoustic analysis correctly most of the time after training; and 26 percent, that they could perform the tasks correctly all of the time. Only one student estimated that his skills in acoustic analysis and classification procedures were poor while in training. Approximately 26 percent of the subjects reported having had formal training in acoustic analyses and classification within the previous 6 months (item 1).

Table 1

Subjects' Estimates of Acoustic Analysis and Classification Skills Over Time

Response	Frequency	Percent ^a
Description of Skills While in Training at FRS (Item 3)		
Skills in analysis and classification were equally poor.	1	2.4
Could do both very well but better at analysis.	1	2.4
Could do both very well but better at classification.	9	21.4
Skills in analysis and classification were equally good.	30	71.4
No response	1	2.4
Description of Skills After Training (Item 2)		
Never could perform task correctly.	0	0.0
Could perform task correctly half of the time.	2	4.8
Could perform task correctly most of the time.	29	69.0
Could perform task correctly every time.	11	26.2
Number of Months Since Last Formal Training in Acoustic Analysis/Classification (Item 1)		
0-3 months	7	16.7
4-6 months	4	9.5
7-9 months	6	14.3
10-12 months	7	16.7
13 months or longer	17	40.5
No response	1	2.4

^aTotals do not always equal 100 because of rounding.

Practice

Table 2 provides frequencies, means, and standard deviations (SDs) for items concerning the amount of practice (items 5 and 6). Over 85 percent of the subjects said they spent only 3 hours a week or less practicing acoustic ASW in flight. However, 54 percent said they practiced or studied gram analysis for at least 4 hours per week; and 31 percent, over 10 hours per week. Only 10 percent reported that they had made more than one deployment as an acoustic analyst.

Table 2
Subjects' Estimates of Amount of Practice

Response	Frequency	Percent ^a
Time Spent Performing Acoustic ASW in Flight (Item 5)		
0-3 hours per week	36	85.7
4-6 hours per week	6	14.3
7-10 hours per week	0	0.0
More than 10 hours per week	0	0.0
Mean	3.29	
SD	0.71	
Time Spent Studying or Practicing Acoustic ASW (Item 6)		
0-3 hours per week	10	23.8
4-6 hours per week	13	30.9
7-10 hours per week	6	14.3
More than 10 hours per week	13	30.9
Mean	7.26	
SD	3.68	
Time Spent Deployed as Acoustic Analyst (Item 4)		
0 deployments	17	40.5
1 deployment	21	50.0
2 deployments	1	2.4
3 deployments	1	2.4
4 or more deployments	2	4.8

^aTotals do not always equal 100 because of rounding.

Feedback

Table 3 presents frequencies for the amount and type of feedback received. Sixty-two percent of the subjects reported that they receive feedback on analysis procedures most or all of the time when they have incorrectly classified a target, compared to 45 percent when they have classified the target correctly. For acoustic intelligence, 38 percent reported receiving feedback most or all of the time when they classified a target incorrectly; and 29 percent, when they classified a target correctly.

Table 3
Subjects' Estimates of Frequency and Type of Feedback

Frequency of Feedback	Type of Feedback			
	Analysis		Intelligence	
	Frequency	Percent ^a	Frequency	Percent ^a
Correct Classification (Items 8 and 9)				
Never	4	9.5	6	14.3
Rarely	7	16.7	14	33.3
Some of the time	12	28.6	10	23.8
Most of the time	12	28.6	7	16.7
Always	7	16.7	5	11.9
Incorrect Classification (Items 10 and 11)				
Never	4	9.5	6	14.3
Rarely	2	4.8	6	14.3
Some of the time	8	19.0	12	28.6
Most of the time	12	28.6	5	11.9
Always	14	33.3	11	26.2
No response	2	4.8	2	4.8

^aTotals do not always equal 100 due to rounding.

Nonutilization

Table 4, which provides frequencies for subjects' estimates of lengths of nonutilization periods, shows that the periods are relatively short. About 74 percent of the subjects have never had a period of more than 4 weeks when they had not performed analysis and classification.

Performance Measure

Table 5, which presents results of the ASW wing test, shows that subjects performed relatively well overall on the knowledge test. However, they performed better on the computational items than they did on the fact items. Also, subjects performed relatively well on the gram test, particularly on the analysis task.

Table 4

Subjects' Estimates of Periods of Nonutilization (Item 7)

Response	Frequency	Percent
1-2 weeks	20	47.6
3-4 weeks	11	26.2
5-6 weeks	4	9.5
7-8 weeks	4	9.5
9-10 weeks	0	0.0
11-12 weeks	1	2.4
No response	2	4.8

Table 5

Results of ASW Wing Quarterly Exam

Test	Raw Score		Mean Percent Correct
	Mean	SD	
<u>Knowledge Test:</u>	40.03	4.18	80.06
Fact items	30.89	3.82	77.22
Computation items	9.13	0.46	91.30
<u>Gram Test:</u> ^a	11.42	1.75	76.13
Analysis items	4.42	.33	88.40
Intelligence items	3.10	.98	62.00
Classification items	3.83	.46	76.60

N = 23.

^aOnly 23 of the 42 subjects took the gram test.

DISCUSSION

Operator responses to the job condition questionnaire in this effort supported the structured interview data obtained from SMEs (Wetzel & Montague, 1983) documenting a high level of initial training, relatively frequent practice on the task, individual performance feedback (including information about errors), and relatively short periods of task nonutilization. The subjects performed at a high level of proficiency on the knowledge and performance tests, as predicted by the questionnaire method.

Also, this study supports the Wetzel et al. (1983) study, in that the questionnaire method was successful in assessing the initial training and job conditions. It is probable that this general technique can be used to assess the likelihood of poor performance due to skill degradation and/or training inadequacies in other technical ratings. It is important to note that, since the specific items used relate to initial training and job conditions for a specific rating, different questionnaires would have to be constructed for

each of the ratings investigated. It does appear, however, that the concept of assessing level of initial training, frequency of practice, amount and quality of feedback, and lengths of task nonutilization is generalizable to ratings other than sonar operators.

CONCLUSIONS

The questionnaire method of performance estimation appears to be useful in identifying potential performance problems due to training inadequacies or skill degradation resulting from specific job conditions. Further, the categories of conditions may be used to suggest corrective action.

RECOMMENDATION

Job condition questionnaires should be developed for other technical ratings to determine if this method is generalizable to other technical tasks.

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