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The Fourteenth Undersea Medical Society Workshop

THE DEVELOPMENT OF STANDARDIZED ASSESSMENT OF UNDERWATER PERFORMANCE II

Naval Medical Research Institute
Bethesda, Maryland

28-29 March 1977

Chairman: J. Vorosmarti

Editor: J.C. Ferguson

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Development of Standardized Assessment

of

Underwater Performance

Workshop II

J. Vorosmarti, Jr.

Chairman

J.C. Ferguson

Editor

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DEVELOPMENT OF STANDARDIZED ASSESSMENT
OF UNDERWATER PERFORMANCE WORKSHOP II

28-29 March 1977

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DEVELOPMENT OF STANDARDIZED ASSESSMENT

OF

UNDERWATER PERFORMANCE

WORKSHOP II

A G E N D A

Monday, 28 March 1977

0900 Introduction, CAPT James Vorosmarti, Jr., Chairman

0915 Keynote Address, CAPT Paul Nelson

0945 Review of SINDBAD experience, Dr. Dorothy Fletcher, LT Robert Carter

1400 Laboratory/contractor reviews (See next page for organizations and presenters.)

Tuesda, 29 March 1977

0900 Operational considerations, CAPT David Schaible

1000 Discussion of progress, CAPT James Vorosmarti, Jr.

1400 Management issues
Priorities
General Recommendations

1545 Tour of NMRI Hyperbaric Research Facility

Laboratory/Contractor Reviews *

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* Summaries of research being conducted by these organizations may be obtained by writing the presenters listed.

INTRODUCTION

CAPT James Vorosmarti, Jr., MC,USN

The first workshop concerned with this subject was held in 1973, and was the result of concern felt by researchers in underwater performance that, because of the lack of standardization in the tests being used, a large amount of information which was being gathered could not be compared. This meant that a large part of the effort done by a very small community of people could not be used efficiently. At that time, the Workshop participants developed recommendations as to the broad categories of research objectives which seemed to be pertinent to the pressing problems of underwater performance. The present Workshop was an attempt to get many of the same people back again to evaluate progress made in standardizing test procedures in the past three years, and to reevaluate the priorities and areas of research which were set up during the first Workshop and by the National Plan. This second Workshop was successful because it allowed a full discussion and a set of recommendations and priorities have been developed. Many thanks are due to all the attendees for the effort they put into their presentations and discussions. Thanks are also due to the office staff of the Headquarters of the Undersea Medical Society which kindly took care of all the details of putting on the Workshop and publishing this report.

KEYNOTE ADDRESS

CAPT Paul D. Nelson, MSC, USN

Naval Medical Research and Development Command

A bit more than three years ago, most of the participants gathered here today met with others of various backgrounds to address the problems of Navy diving performance research. We recall that that was a provocative meeting involving a large proportion of the scientific community engaged in diving research from Canada, the United Kingdom, and the United States, as well as several consultants expert in performance assessment. The select group gathered here this week will have the responsibility of summarizing where we have been during the past three years, the progress we have made in addressing questions raised at that earlier meeting, and in setting some of the priorities for future research directions. To begin, allow me to summarize briefly what I consider to have been the major guidelines for diving performance research of that workshop three years ago.

In his introductory remarks, Dr. Art Bachrach stated, "There has been a growing concern among researchers in underwater performance that a lack of standardized administration of tests exists, and a lack of standardized tests makes cross-comparison of the many studies difficult, if not impossible. Another crucial source of error in the various studies is subject variability. A look at major studies reveals that inexperienced and experienced divers have been used in studies as a theoretically homogeneous population, a particular source

of concern in view of the studies that suggest experience is a crucial factor in diver performance."

As I recall from his review of specific studies of diver performance, Dr. Bennett provided ample evidence during the first workshop of those points to which Dr. Bachrach referred.

Dr. Bachrach then pointed to two issues which should be addressed in our discussions this week: 1) the standardization of performance tests and test procedures; and 2) the heterogeneous population of divers, not only with respect to experience but to other factors as well. These are crucial issues to psychologists and physiologists concerned with performance in general, and are not specific to diving, if we are to predict behavioral outcomes under various conditions for various types of people reliably. In fact, as psychologists, we probably attend less than we should to such matters as test procedures, especially in our research publications, which accounts in good part for our inability to generalize from our data or even to replicate previous research when it is necessary to do so.

One of the consultants three years ago, Dr. Warren Teichner, also spoke to the issue of test and test procedures employed in diving research. He seemed less enchanted with the emphasis on factorial structure of test performance than many of those who had worked on test development for divers and he emphasized the need for greater theoretical formulation, perhaps along psychophysiological lines, and greater attention to what we already know a good bit about in terms of stimulus control, intensity, and duration from experimental psychology as they

might apply to the diver's performance. His impression of diving performance research at that time was similar to the approach in aviation medicine and performance perhaps thirty years ago, with a rather trial-and-error search of the omnibus of unstandardized tests for those which might be most sensitive to the stress from one environmental condition or another.

In a sense perhaps we are where aviation medicine was three decades ago. The proper priority at this time in diving is life support but some day, and even in some areas of diving at present, performance on the job may be more of a problem than issues of survival or physiologic safety. Through the good offices of program managers such as Captain Bornmann in this country, we have an opportunity, indeed a requirement, to get on with important research on diver performance so that we will be prepared to offer the line our support when called upon to do so. But, again, I think the point Dr. Teichner was making is that regardless of the stage of diving medicine today relative to aviation medicine in years past, we do know a great deal more about measurement and related theories of human performance in systems than we knew in the late '40's and we should apply that knowledge to problems now being addressed.

At our earlier meeting, LCDR Tom Berghage discussed the SINDBAD test, then relatively new, as a possible performance assessment battery, an issue which will receive major attention again this week. But instructive, I think, was his insistence three years ago that we

consider in diving performance research four classes of variables significant in operational dives: 1) the environment (and type of operation); 2) the equipment; 3) the diver; and 4) the dive procedures. Combinations of these variables make a difference in terms of what we should observe and measure, how and for what purpose we choose to assess performance, and the data we analyze.

By not explicitly attending to these variables in the descriptions of our studies, we further compromise our ability to generalize, in much the same sense as Dr. Bachrach indicated in his comments on unstandardized tests and test procedures. Furthermore, knowledge about the nature of the dive, the environment, the equipment, and the dive procedures may provide us an opportunity to "build into" the operational or test dive rather direct and unobtrusive tasks, performance measurement of which would provide us the information we need without the necessity of employing SINDBAD or other such artificial tests. While the latter may be useful in controlled experimental research to assess the effects of diving conditions on human function, we must eventually develop simpler, reliable measures of equivalent human functions which can be derived in operational settings. We simply cannot carry a SINDBAD with us everywhere we go! Theory and data from laboratory research can advise us on the types of human function most likely to be affected in certain types of divers under certain conditions of diving. Reliable short-form tests of performance, even those embedded within the diver's equipment or procedures, must be developed to measure change validly in critical functions, and we must know something of the equivalence of

those tests employed in the laboratory environment.

This brings us to the question raised by another of our consultants, Dr. Chiles, at our previous meeting, namely "what is it that we are trying to predict in the operational situation?" Dr. Chiles went on to say, "We must be able to specify, with at least some degree of precision, those behaviors that are involved in, and especially those that are crucial to, the operational performance of interest. The ultimate test of the validity of the research approach depends upon the availability of reliable measures of such operational performance."

From my own concluding remarks three years ago, it seemed that we as researchers were of two general camps: those concerned primarily with monitoring psychological, physiological, and neurological states of divers (usually in a saturation diving chamber environment), and those concerned primarily with prediction of performance in an ergonomic sense (usually in an open-sea environment). We should be aware of those slightly different orientations, and, furthermore, to the possible applications of data or technology derived therefrom, as in selection, training, equipment design, dive procedures, or safety monitoring. Within those orientations, might we profit from a taxonomy of diving conditions addressed to such variable classes as those outlined by LCDR Berghage, and from specifying from the theoretical bent of Dr. Teichner and the operational performance criteria focus of Dr. Chiles the priority of different human functions of concern within various taxonomic classes of dive? Finally, from Dr. Bachrach's emphasis, we must attend

to the test standardization and equivalence problems by sharing methodologies to use, under similar and different conditions of dive as appropriate from what we might theoretically postulate to be of importance to measure under various conditions of diving.

These, then, are the issues we raised and those which should guide our workshop discussions this week. What progress have we made? What difficulties have we encountered? Were those issues, after all, really important in terms of what we know about the problems and operational requirements in Navy diving? And, in a general sense, what are the priorities of problems to be addressed over the next three to five years of diving performance research? I wish you well in your deliberations and hope that indeed our collaborative and individual efforts over the past few years will reflect some progress, however slight.

RATIONALE AND STATUS OF THE DEVELOPMENT OF A SYSTEM FOR INVESTIGATION OF BEHAVIOR UNDER STRESS

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This report[1] describes the development of a flexible but integrated system designed to facilitate the assessment of the effects of various stressors upon the structure in the individual subject of factorially discriminable abilities, traits, and states. The criteria which guide this development are illustrated by means of performance test scores obtained with the system for six subjects during exposures in the hyperbaric chamber to 1600 fsw (Fletcher, 1976).

Design has been directed towards a reliable and efficient system adaptable to the requirements of different laboratories studying personnel selection, training, and testing, equipment test and development, and biomedical effects of a variety of stressors. The need for such a broadly applicable performance measurement system was discussed in the first workshop in this series (Bachrach, 1975). Apparatus components to display performance test stimuli and to record subject responses have been designed on the basis of earlier performance test systems, such as that described by Reilly and Cameron (1968). These

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1 The full transcript of this report may be obtained from the author.

display and response elements have been interfaced with a digital minicomputer by electronic components. To administer and score performance tests, computer programs have been written following test protocols developed to administer brief and repeatable tests to individual subjects.

Current developmental efforts include, of course, development of tests of additional abilities, traits, and states that affect human performance.

TABLE 1

Examples of abilities under evaluation for inclusion in the performance research system.

PERCEPTUAL ABILITIES	MEMORY AND COGNITIVE ABILITIES
Flexibility of Closure	Memory Span
Perceptual Speed	Associative Memory
Spatial Orientation	Induction
Spatial Scanning	Deduction
Visualization	General Reasoning
Stress Sensitivity	Verbal Comprehension
Length Estimation	Number Facility
Vigilance	Mechanical Knowledge and Skill
Time Estimation	Judgment
Monitoring	Flexibility of Set
	Associational Fluency
PSYCHOMOTOR ABILITIES	**PHYSICAL PROFICIENCY ABILITIES**
Multiple Limb Coordination	Static Strength
Manual Tracking	Dynamic Strength
Response Orientation	Explosive Strength
Reaction Time	Trunk Strength
Manual Dexterity	Extent Flexibility
Finger Dexterity	Dynamic Flexibility
Wrist-Finger Speed	Gross Body Coordination
Arm Movement Speed	Gross Body Equilibrium
Arm-Hand Steadiness	Stamina

These, and the present tests, follow test methods available in the literature, such as tests described by Fleishman (1967) and French, Ekstrom and Price (1969). Each test is developed towards the criterion of providing a relatively pure and stable measure of an ability defined by factor analytic experimentation (see Cattell, 1971). Therefore, a major aspect of present development is multivariate experimentation to assess the extent to which this criterion has been met. These experiments are designed, also, to assess test reliability (see Bain and Berghage, 1974). In the course of this experimentation, computer subroutines are being developed and selected to facilitate the multivariate treatment of the alternative scores for different tests administered to various subject groups under different levels of stress. By this means, it will be practical to combine data obtained by different laboratories to assess the relevance of the abilities tested to the prediction of performance under stress, for example in underwater work (Egstrom et al. 1976), to obtain estimates of test validity, and to establish test norms for specified subject groups. The combination of data from widely different test sites would permit broader generalizations concerning the interactions of test, subject, and stress characteristics.

Application of the initial form of this performance measurement system during hyperbaric exposure to 1600 fsw resulted in evidence of adequate test reliability for most of the twelve tests administered. For each of the six subjects tested, test scores appeared to provide sensitive descriptions of the effects of hyperbaric stress upon performance level for discriminable aspects of performance. Data are being

accumulated in this experiment and in continuing research to attempt to provide operational definitions of the effects of different stresses upon the change in the patterning of abilities assessed by different tests and assessed by alternate scores for single tests.

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PSYCHOLOGICAL TESTING 426.7 METERS UNDERWATER

LT Robert Carter, MSC,USN*

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In 1976 the U. S. Navy conducted the deepest open-ocean dive ever accomplished, diving to the depth of 350 m. Later that year an experimental dive to 426.7 m was performed to ensure the safety of future open-ocean operations at similar depths and to assess divers' ability to do useful work using available equipment. This 30-day dive included 11 days at 426.7 m, and was conducted in a helium-oxygen atmosphere with an oxygen partial pressure of 304 mmHg. Six U.S. Navy divers, who were experienced saturation divers, served as subjects for the physiological, psychological, and equipment tests conducted during the dive.

The purpose of the psychological tests was to detect any changes of cognitive abilities associated with compression and decompression between sea level and 426.7 m. It was anticipated that, at some depth, a helium-oxygen mixture such as the one used in this experimental dive would begin to affect divers' mental abilities adversely, just as air does at shallower depths. However, impaired abilities would be potentially more dangerous at greater depths because topside personnel can exercise less effective control during saturation diving,

* Presently at Pennsylvania State University

and because of the relatively slower safe ascent rates from a saturation dive. In many ways, a saturation diver is on his own, and should be capable of dealing effectively with his environment. The question is, how deep can we go before divers' mental abilities are appreciably impaired compared with their abilities on the surface? This question remains unanswered, although there is evidence that we are approaching our depth limit.

All six divers who participated in the experimental dive were tested on the surface prior to the dive, at 426.7 m, and near the surface during decompression. Psychological testing was conducted in both dry and immersed environments at all three depths. The psychological tests required verbal responses, and they measured spatial orientation, memory, scanning of blueprint-like material, numerical skill, ability to visualize in three dimensions, and speed and flexibility of perception. It was found that abilities were impaired at 426.7 m, compared with abilities at or near the surface. Particularly impaired were ability to work with numbers and perceptual speed. There was also a tendency for performance to be poorer in the water than on the surface, and this tendency was constant at all depths tested. The scores obtained prior to the dive and late in the decompression were virtually equivalent, and were generally superior to those obtained at 426.7 m.

It is interesting to note that Dr. Baddeley has reported to this meeting that he found these same mental abilities to be impaired during a dive to 305 m. If further replication of these findings is forthcoming, impairment of cognitive abilities during deep dives will

be an established fact, and it will be necessary to decide how much impairment is acceptable. In these replication attempts it would be worthwhile to test whether impairment of cognitive abilities is a stable feature of life at 426.7 m, or whether the impairment is transient, as are some of the signs associated with HPNS (High Pressure Nervous Syndrome).

Operational Considerations

SUMMARY

CAPT David L. Schaible, USN
Commanding Officer

Naval Explosive Ordnance Disposal School

Indian Head, Maryland

Capt. Schaible presented his views in this area of diver performance as a member of the line user community. Capt. Schaible emphasized the fact that Navy diving jobs generally have few types of tasks in common and it is an oversimplification to refer to the tasks of "the Navy diver". However, he agreed that task analyses of diving jobs were needed. The U.S. Navy diving community has not been able to predict well enough the ability to cope with training stress in UDT or EOD school, and the prolonged stress of operational situations. It needs to know how to allay the diver's fears and train him to cope with stress. Capt. Schaible commented on research on the diver's performance in cold water by emphasizing the operational realities of the pre and post-dive cold of ambient air, stating that this stress could be just as severe as cold water and should also be studied. Capt. Schaible stated that psychologists could, and have, helped the diving community. He gave as an example, the test of reading ability designed for the EOD school as a predictor of the diver's ability to master the academic portion of the curriculum. Capt. Schaible emphasized the need to transfer the in-

formation obtained through research into the diving training and operational communities, and stated that he wished he had known earlier about Dr. Egstrom's work with weight belts, buddy breathing, and training experience with the Mark XII suit.

DISCUSSION OF PROGRESS

SUMMARY

Capt. Vorosmarti, Workshop General Chairman, led a discussion of progress in performance assessment testing since the last workshop in 1973. A good deal of time was spent discussing what the term "standardization of testing" meant. The major problems regarding standardization appear to be three: standardization of the test itself, standardizing the method of test administration, and standardization of the analysis of results. It was noted that we often assume that tests are asessing the same stressor or variable. Test standardization is an area with a number of complexities; although a definition of standardization was requested several times during the discussion, no comprehensive single definition was provided. Concerning uniformity of procedure in the administration and scoring of tests, the majority of the participants deplored the fact that differences in tests, testing techniques, and analysis make it impossible to compare studies across experiments and laboratories. One participant observed that the diving community is much too small to tolerate inefficient collection of data which does not permit cross-comparison of results, and that the few laboratories engaged in diving performance should be using procedures which are comparable or at least capable of being analyzed and compared. There is a certain irony in the problem of standardization

across laboratories in view of the admittedly small number of individuals involved.

There was general agreement that there has been no standardization of tests and testing procedures up to the present time as a result of a number of factors, not the least of which is the complexity of stress and stress assessment. It was observed that this problem of cross-comparison of results is not unique to the diving community, but has occurred in other areas of stress research with humans. Indeed, the complexity of stress research led one observer to note that an extreme concern for standardization of tests might cause the researcher to miss other variables affecting performance. Nevertheless, the majority of participants believe that the goal of standardization and cross-comparison is indeed a worthwhile one to pursue.

The group did not believe that all was lost regarding the effective study of diver performance, and noted that there had been some real progress in the last few years since the previous workshop. Progress, for example, has been made in areas of developing more precision in the tests being used; fewer tests are being developed on site which have no validity or reliability other than the experimenter's perception of face validity. Perhaps the greatest progress has been in the area of reducing the number of tests in use to those most useful in measuring stress changes in divers. The group recognized that progress has been made in measuring the physical and mechanical restraints imposed by work equipment and packages in the performance of work which contribute further to the stress of the diving environment. In

general, there has been progress in a greater sophistication and realistic appreciation of problems, methodology, and the development of the tests themselves. The most general progress is in the selection of problems and possible solutions. A more realistic and diving-oriented approach, with more planning in the use and analysis of current tests, including a greater appreciation for the importance of base-line measurement, is now used.

One observer noted that a major danger of cross-comparison without standardized tests is improper inference of causative factors. He noted, for example, that in a group of tests on performance which differed in results, the cause was attributed to a difference in the oxygen level in the chamber when it was more likely that task variabilities, subject variability, and administering the tests differently were the causative factors.

Another aspect of standardization discussed was the establishment of norms, and there was again some disagreement as to the adequacy of the norm group for the original SINDBAD battery. The original form was a paper-and-pencil test which was administered to a standardization sample of over 600 Air Force personnel. Test-retest reliability and factor purity of the tests for measuring certain abilities were also established. However, the test was not standardized on a representative sample of the type of subject for which it was designed. On the question of test validity, a SINDBAD user stated that the tests have not been validated for divers. The tests have been validated for civilians in educational settings, in studies such as aging and life-

span curves, but have not been systematically validated for any large group under stress. A conclusion that could thus be drawn from the discussion is that there is a need for standardization, reliability, and validity of tests for diving. Some of this work on SINDBAD is currently being accomplished, primarily at the University of Pennsylvania.

To accomplish a kind of standardization, a call was made for a reasonable amount of overlap among investigators and tests, rather than trying to use identical tests under identical situations. It was generally acknowledged that there is never going to be one standardized battery of tests which would be available to all researchers. Some of the group agreed that it was neither realistic nor desirable to select one test, or even one battery that everyone would use at the present stage of knowledge and with the diversity of diving problems and situations.

DISCUSSION OF PRIORITIES -- SUMMARY

A group discussion of research priorities was led by Dr. Bachrach, Naval Medical Research Institute. The basis for the discussion was the list of priorities in Part #6 of the "National Plan for the Safety and Health of Divers in their Quest for Subsea Energy": Cognitive and Psychomotor Performance (January 1976). Although Dr. Bachrach acknowledged at the outset that substantial agreement with the Plan priorities might be assured because he and three other workshop attendees (Egstrom, Fletcher, and Vaughan) prepared them, the discussion brought out some changes in priorities and emphasis. Research priorities of this workshop, incorporating those elements of the National Plan priorities which were unchanged, are outlined as follows:

1. <u>Task analysis under specified environmental conditions</u>.

   The environment should be viewed as a stressor and the effect of stress on the task as an integral part of the task analysis should be analyzed.

   a. Elements of the task analysis should include:

      1) Energy costs and physical working capacities

      2) Sensory requirements, e.g., hearing, vision, touch

      3) Cognitive requirements, e.g., memory, reasoning, computation

      4) Psychomotor assessment, e.g., dexterity, coordination

      5) Work strategies and procedures

      6) Recommendations for task restructuring

b. Elements of environmental stress adaptation should include:

1) Training for stress adaptation

2) Studies to determine the mechanisms for specific adaptation to stressors which limit:

a) Sensory and perceptual capabilities, e.g., underwater vision, spatial orientation, and tactile discrimination

b) Cognitive processes, e.g., procedure-following, memory, vigilance, problem solving

c) Psychomotor processes, e.g., dexterity, simple and complex assembly, coordination

d) Physical work capacity, e.g., strength, endurance, range and speed of motion, agility

2. Human engineering studies of all diver-related life-support systems, work-support systems, and tools should be carried out to ensure compatibility with human capabilities and safety. Additional elements should include:

a. Training in the use of the above life and work support systems and tools

b. Equipment design

3. Compensatory programs to deal with the above problems. Some examples of these are:

a. Selection criteria and procedures

b. Training and education

c. Job aids

A comparison of Workshop priorities, and those of the National Plan (see Appendix), reveals essentially only a change in emphasis. Task analysis remained the first priority in both lists, but the discussion emphasized the importance of environmental conditions as stressors, and the viewpoint that stress adaptation must be an integral part of the task analysis. Several attendees stressed the importance of the environmental effect of depth on neurophysiological and cognitive functioning. Thus, environmental stress adaptation moved from third to first priority. A second change in emphasis is the importance of training, reflected by its inclusion in all three priorities. This increased emphasis on training supports the overall priority list of the National Plan, in which selection and training were given first priority.

Although equipment design was moved into human engineering to reflect its increasing impact on human performance, discussants agreed that equipment must also become an integral part of the task analysis. The energy cost and use of equipment for a certain job becomes an important part of a task analysis.

GENERAL RECOMMENDATIONS

1. The stresses of diving require more precise definition
   a. Identification and differentiation of psychological, physiological, and environmental stress factors
   b. Comparative analysis of heat and cold stress
2. Diver performance requires further refinement
   a. Differentiation of measures of human abilities
   b. Development and assessment of relevant and valid underwater performance measures
   c. Reassessment of diver performance on compressed air
   d. Reassessment of small-team interaction in submersibles
   e. Examination of manipulator technology as it affects performance underwater
   f. Evaluation of performance in alternative diving systems, such as 1-ATA systems, and further study of operator performance in alternative systems, such as small submersibles
   g. Analysis of tasks of diving jobs
   h. Analysis of physiological-behavioral stresses on diver performance to plan for stress management

APPENDIX

NATIONAL PLAN PRIORITIES*

The committee recommends that research is needed on the following topics to provide information on the cognitive and psychomotor aspects of diving. These topics are arranged in order of priority.

1. There is an urgent need for systematic identification of the specific kinds of work requirements that are current or future problems for working divers. Examples of these problems are:

   a. Task analysis of the jobs divers perform, to increase safety and effectiveness. Elements should include:

      1) Energy costs and physical working capacities.

      2) Sensory requirements, e.g., hearing, vision, touch.

      3) Cognitive requirements, eg.g., memory, reasoning, computation.

      4) Psychomotor assessment, e.g., dexterity, coordination.

2. Human engineering studies of all diver-related life-support systems, work-support systems, and tools should be carried out to ensure compatibility with human capabilities and safety.

3. Stress adaptation studies should be conducted to determine the mechanisms for specific adaptation to stressors which limit:

   a. Sensory and perceptual capabilities, e.g., underwater

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*This list was included in Part #6, Cognitive and Psychomotor Performance, of the National Plan for the Safety and Health of Divers in their Quest for Subsea Energy.

vision, spatial orientation, and tactile discrimination

b. Cognitive processes, e.g., procedure-following, memory, vigilance, problem solving

c. Psychomotor processes, e.g., dexterity, simple and complex assembly, coordination

4. When the limiting mechanisms are known, compensatory programs should be established to deal with these problems. Solutions will result if the following are improved:

a. Selection criteria and procedures

b. Training and education

c. Equipment design

d. Work strategies and procedures

e. Task restructuring

f. Job aids

DISTRIBUTION LIST FOR UMS WORKSHOP

Entitled

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This workshop evaluates the progress made in standardizing test procedures since the last workshop which was held in 1973 and re-evaluates the priorities and areas of research which were set up during the first workshop and by the National Plan. A set of recommendations and priorities were developed.

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