SHALLOW HABITAT AIR DIVE (SHAD-I):

PSYCHOLOGICAL SCREENING OF DIVERS AS SUBJECTS FOR LONG DURATION SATURATION EXPERIMENTATION

by

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SUMMARY PAGE

THE PROBLEM

To present a variety of normative data obtained from a sizable sample of Navy divers, and against the backdrop of these data, to compare the four diver-subjects of Project SHAD-I, and in that way, to delineate a number of hypothetical criterion dimensions to be used on a trial basis for the psychological screening of divers for operational and experimental assignments of the future.

FINDINGS

Psychological screening data obtained from the Diver Biographical Inventory (DBI), from clinical interviews, and from several personality tests (the Minnesota Multiphasic Personality Inventory, MMPI, for example) resulted in selecting the two divers (out of four) whose MMPI profiles matched the average profiles of the diver sample. Also, they had the most diving experience, were most highly motivated and had the most favorable attitudes toward diving activities in general. Several classes of criteria for the psychological screening of divers and diver-subjects are suggested.

APPLICATION

Based upon the diver normative data presented in this study, several classes of psychological screening criteria are delineated for experimental use in selecting divers for special operation assignments, as well as for subjects for hyperbaric research in the future.

ADMINISTRATIVE INFORMATION

This investigation was conducted as a part of Bureau of Medicine and Surgery Research Work Unit M4306.02-3114BEK9 - Saturation Diving with Compressed Air. The present report is Number 3 on this work unit. It was submitted for review on 14 March 1974, approved for publication on 31 May 1974 and designated as NavSubMed RschLab Report No. 776.

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ABSTRACT

This study was designed to provide some insights into possible psychological screening criteria for U.S. Navy divers being considered for special operational assignments. Four USN divers who had volunteered for SHAD-I (Shallow Habitat Air Dive) were administered the DPSS (Depression Proneness Sentence Stems), the MMPI (Minnesota Multiphasic Personality Inventory), the DBI (Diver Biographical Inventory) and were subjected to a semi-structured clinical interview before and after the 30-day, hyperbaric (50 F.S.W.) experiment. These test and interview data were compared with the same data obtained from an independent sample of 64 divers, and provided the basis for selecting the two SHAD subjects and the two back-up divers. Construed as hypothetical diver screening criteria the major selection factors were: MMPI profiles congruent with the mean profile of the diver sample, more and varied diver experience, not depression prone, compensating trait patterns of the diver pair, not seriously habituated to use of tobacco or alcohol and strong motivation for and well-disposed attitudes toward a variety of diver-related activities. Sample copies of the experimental tests, interview schedules, and questionnaires are included as appendices, as is a bibliography of 75 references to literature in the area of diver and aquanaut selection.

TABLE OF CONTENTS

SHALLOW HABITAT AIR DIVE (SHAD-I):

PSYCHOLOGICAL SCREENING OF DIVERS AS SUBJECTS FOR LONG DURATION SATURATION EXPERIMENTATION

INTRODUCTION

The overall purpose of SHAD-I (Saturation Habitability Air Dive) was to identify any acute adaptive effects of protracted exposure of humans "saturated" in ambient air at 50 FSW equivalent pressure with a total of 16 intermittent excursion or "bounce" dives to a maximum pressure equivalent of 235 FSW.* There are at least three interrelated classes of stress factors associated with the adaptive effects of exposure to the gaseous atmosphere within the pressurized chamber:
(1) The narcotizing effects of exposure to air at elevated pressures: (2) the effects of pressure variation, gas absorption in tissues upon compression (HPNS)** and gas effusion from tissues upon decompression (Bends); and (3) the possible noxious, toxic or pathogenic effects of gaseous contaminants (carbon dioxide, for example), aerosols and airborne microorganisms.

There is yet another class of variables intrinsically involved in the adaptation of humans to a hyperbaric environment. Essentially psychological in nature, these processes of concern in this aspect of the study were the perceptual and cognitive effects of isolation, the emotional concomitants and/or effects of confinement and dense gas exposure,*** the interrelated effects of boredom, malaise and deprivation of various kinds, and changes in motivational, attitudinal, and group interaction processes. It appears that the criticality of these kinds of adaptive processes has already been recognized in the field of astronautics at least:

> *"Principal emphasis has been placed on understanding the mechanisms of man's body in the space-flight environment, and, while we know much more than was known a decade ago about bodily reactions, we still know very little about the effects of the space environmental complex on personality and well-being. These aspects of the human could prove to be the factors which limit the duration of space flight if they do not now receive the attention required." (Reference 5, p. 1141)*

In a similar vein, the author of one text in underwater medicine stated in the first sentence of the book, "It is most important, right at the outset, to realize that the problems of man's adaptation to a watery environment are primarily those of temperament." (Reference 30, p. 1, underlining supplied.)

Briefly, it was assumed in the overall planning of this study that proper analysis of the biomedical and ecological data collected before, during, and after the 30-day dive would yield some tentative evidence related to two broad questions associated with the feasibility of air as a diving medium for saturation diving.

**The reader is referred to entries 1 and 1A in the reference list for a description of the dive profile, a descriptive list of the tests and procedures used, and other details of the experiment.*

***HPNS - High Pressure Nervous Syndrome reported by Bennett during rapid compression in a helium and oxygen atmosphere.[2]*

****For example, Reference No. 3 presents the view that one contributing cause of nitrogen narcosis is the anxiety and fear experienced by the humans undergoing pressurized air exposure.*

Obviously interrelated, these two questions were: (1) Were there any significant changes in vital functions during saturated air dives of long duration; and (2) can carefully selected and highly trained divers carry out a useful schedule of diver-related activities under these conditions The present paper is focussed only upon two aspects of the second question above, namely, upon the procedures used for the psychiatric assessment of the divers who volunteered for the experiment and secondly upon a somewhat impressionistic evaluation of the psychological effects of the 30-day hyperbaric exposure based upon direct observation during the incarceration period and upon pre- and post-experimental data obtained by means of clinical interviews.

METHODOLOGY AND PROCEDURE

Dive Simulation Procedure.

This experiment took place in an experimental chamber located at the Naval Submarine Medical Research Laboratory in New London, Connecticut. Measuring nine feet in diameter, this hyperbaric chamber consisted of a 15 foot innerlock and a 9 foot outerlock equipped in such a way as to provide relatively satisfactory "hotel" accommodations for the two subjects. The saturation depth was maintained by compressed air at 50 FSW equivalent pressure with intermittent excursion dives in air or in mixed nitrogen/oxygen occurring 1-3 days apart. The total bottom time was 30 days (See References No. 1 and 1A for details).

Psychological Assessment Methodology.

Minnesota Multiphasic Personality Inventory (MMPI). The group form of the Minnesota Multiphasic Personality Inventory (MMPI) was administered to the four U.S. Navy diver volunteers under standard conditions, care being taken to encourage response to each of the 566 items. The MMPI subtests together with a descriptive statement about each are listed below:

> *The diagnostic subtests are: Hypochondriasis (Hs), exaggerated anxiety or concern about one's health; Depression (D), feelings of worthlessness and hopelessness; Hysteria (Hy), incidence of ailments such as headaches which may have no physical basis; Psychopathic Deviation (Pd), antisocial and amoral conduct; Masculinity-femininity (Mf), measure of masculine (as opposed to feminine) interests, values and emotional traits; Paranoia (Pa), suspiciousness of others' motives based upon irrational beliefs and attitudes; Psychasthenia (Pt), irrational compulsive acts and obsessive thoughts; Schizophrenia (Sc), withdrawal trends often with hallucinatory and bizarre aspects; Hypomania (Ma), irrational elation and excitement; Social Introversion (Si), avoidance of social contacts. The three validity scales are: L-scale-measures inordinate deceptive tendencies in responding to certain items; F-scale similarly measures tendency to distort responses in the direction of making themselves "look bad" on the test; K-scale, like "L", measures guardedness or defensiveness in test-taking attitudes. However, while "K" and "L" scales purportedly measure the same processes they do so in opposite ways, K by measuring the tendency to deny socially-undesirable traits and L by measuring the tendency to admit socially-desirable traits. K-score corrections were in all cases included in the scoes for the subtests recommended in the MMPI literature.4*

Depression Proneness Sentence Stems (DPSS) (Mod IV). The DPSS was an experimental procedure consisting of 30 sentence stems designed to evoke completions indicative of depressed mood and attitude, ego or self-concept deficiencies and sources of conflict. The scoring procedure consisted simply of counting the sentence completions

categorized as depressive trends, anxiety, fear, etc. (See sample DPSS and Check Sheet in Appendix A.)

Diver Biographical Inventory (DBI, Mod V). This questionnaire, abbreviated DBI, was designed as a means of obtaining detailed information pertaining to the diver's training and experience, evaluation of attitudes toward diving as a vocational choice, and a variety of biographical data related to the educational and developmental history of the candidate. (See Appendix B.)

Pre-Experimental Diver Interview Schedule. This schedule, included as an Appendix in Reference No. 6 and not republished here, was designed for use with the DBI or a similar background questionnaire and contains guidelines for a rather detailed evaluation of selected items of biographical history including suggestions for conducting a brief mental status examination.

Post-Experimental Diver Interview Schedule. This interview schedule, presented as Appendix C, is divided into five parts: (1) General Interview Probes "tapping" self-perceived performance, emotional, attitude, and interpersonal changes; (2) symptoms peculiar to the chamber situation; (3) symptomatology presumably related to gaseous and/or pressure conditions; (4) immediate psychological effects of "surfacing"; and (5) abbreviated guidelines for a brief mental status examination.

Method of Data Analysis.

One statistical limitation of hyperbaric research with humans characteristically has been the involvement of very small numbers of subjects for a given experiment. Particularly true for long duration studies, hyperbaric experiments usually carried out in pressure chambers or undersea habitats can typically provide hotel accommodations and resources, for two to five men and occasionally more.* While data from small numbers of subjects participating in separate but presumably identical experiments may be combined to form a composite sample distribution for certain variables, the likelihood that a series of sub-samples this small may be from divergent parametric populations poses some risk of distorting the characteristics or the resultant sample. Therefore, the mode of presentation of the data obtained from the four diver-volunteers for SHAD-I was simply to examine each man's data in the context of normative information where available from a sizable diver sample. Since the only diver norms available were somewhat tentative, the scores or indices obtained from each subject were compared with the same measures from the other 3 men and with the normative data. With N=4, no descriptive statistics were calculated for the SHAD subjects per se.

RESULTS

Implicit in the statements immediately above, the overall method of presenting the results of this study was to first examine the assessment data upon which the final decision to select the 2

**Large habitats have accommodated large groups in the past, for example, SEALAB II involved 3 teams of 10 divers each.*[23]

SHAD DIVERS (out of 4) was based.* At the same time, for most of the variables, normative data originating from samples varying in size from 30 to 64 U.S. Navy divers were presented for comparison purposes. Finally, impressionistic data based largely upon pre- and post-experimental interview information and upon direct observations during the experiment were reported as a means of assessing the gross psychological effects of the 30-day confinement in the compressed air chamber.

General Characteristics of the Diver Sample and the SHAD Divers.

Comparison of the four SHAD divers with the normative sample of U.S.N. divers, (N=64)** showed the degree of divergence of the SHAD volunteers from the norms. For example, the age distribution of the diver sample had a mean of 33.6 with a S.D. of 6.0 and a range of 22-47. By comparison, the SHAD divers were young, SU-I and SU-II were 28 and 26, and BU-I and BU-II were 23 and 24, respectively.

All candidates for diver training must of course meet rather stringent medical criteria (Manual of the U.S. Navy Medical Department, Article 15-30). Thus absence of any significant history of acute or chronic disease, particularly respiratory disease is one general acceptance standard. Insofar as is known there are no hard-and-fast height or weight criteria. It is true, the prevailing stereotype of the diver, particularly the hard-hat type, is one of a large, muscular, athletic man. Using the weight/height (W/H) ratio as an index, the normative sample of divers gave a mean W/H ratio of 2.6 pounds per inch, with a standard deviation 0.4. This compares to a mean W/H for a much younger sample of submariner candidates (N=88) of 2.2 pounds/inch.[7] As expected, most of the members of the older diver sample were more experienced than the four first class SHAD divers inasmuch as 61% were first class divers, 13% were 2nd class, 13% were master divers and 13% were SCUBA qualified only.

Ninety-four percent of the diver sample (N=64) were married, 4.5% were divorced and 1.5% (1 diver) was single. By comparison, three of the SHAD divers were married; one diver had been divorced several years previously. The number of years of formal education of the diver sample varied from 6 to 16, with a mean of 11.2 years and a standard deviation of 1.1 years. Fifty-five percent of the normative sample were high school graduates. This compares to a high school graduation rate of 77% in a random sample (N=257) of enlisted candidates for Submarine School in the late sixties.[8] Three of the 4 SHAD divers had achieved that level. One man only had dropped from school in his eleventh academic year.

There are probably a number of facts pertaining to the developmental history and what has come to be called the typical life style of divers who do and do not adapt optimally to protracted satur-

*Hereafter the four individual diver-subjects will be identified as follows: the two divers selected as experimental subjects will be indicated as SU-I and SU-II and the two backup divers as BU-I and BU-II.

**It is not to be assumed that this diver sample is a random one from the U.S. Navy diver population, presently consisting of slightly over 2000 divers.

ation experimentation. While not sampled in the present study, information related to typical sleep, eating and recreational habits may be fruitful areas to investigate in future studies of this kind. However, one item of life style information which is considered highly relevant in saturation-diver screening has to do with the smoking habits of the subjects under examination. Table I presents data bearing on this point.

Table I. Smoking Habits of the SHAD Subjects as Compared to a Diver and a Submariner Sample

Smoking Habits	Diver Sample (N=33)[a]		Submariner Sample (N=347)[b]		SU-I	SU-II	BU-I	BU-II
	f	%	f	%				
Do not Smoke	10	30	94	27	X	X		
Occasional Smoker	1	3	24	7				
Light Smoker (1/4 pkg./day)[c]	1	3	52	15				
Moderate Smoker (1-1 1/4 pkg./ day)[c]	16	49	160	46			X	X
Heavy Smoker (More than 2 pkg./day)[c]	5	15	17	5				

[a] The smoker item was included only in Mod V of the DBI which was administered only to 33 divers.

[b] Data obtained from a sample of graduates from the Basic Enlisted Submarine School.

[c] Note that item 46 of the DBI (Appendix B) contains approximately equivalent units for cigar and pipe smokers.

While there are some disproportionalities between the distributions in Table I the differences between the diver and submariner samples were not reliable at the 5% confidence level (Chi^2). Although substantial evidence related to the so-called "withdrawal" effect of smoking deprivation is not readily available, there are some rather tenuous but nonetheless suggestive data collected during an 84-day submerged mission indicating that undesirable psychological effects may occur during prolonged deprivation of habituated smokers.[9] Therefore, since smoking generally cannot be safely tolerated during diving experimentation, the non-smoker or light smoker history of SU-I and SU-II was a significant consideration among many others in qualifying these diver volunteers for extended saturation experimentation.

Nature and Extent of Diving Experience

Apparently one of the most relevant classes of data relied heavily upon in the early astronaut selection program was background information pertaining to the amount and quality of test pilot experience. Similarly, there is some rather tenuous evidence that the amount and kind of aquatic experience may be related to performance at the training level at least.[10]

Item number 2 in the DBI (Appendix B) asked simply for an estimate of the number of simulated and real dives entered in each man's diving log. Sixty-one percent of the diver sample indicated an excess of 300 dives had been recorded whereas only 5% (3 divers) admitted having been involved in less than 10 dives. By comparison, all of the SHAD divers except BU-II stated that they had participated in more than 300 dives. BU-II gave an estimate of 200 dives. A similar comparison for deep diving experience (greater than 100 feet, Item #3 in the DBI) disclosed that 58% of the normative sample estimated more than 100 deep dives, ranging down to 14% who indicated 25 or less dives of this type. As might be expected, the two slightly older and more experienced divers, SU-I and SU-II, had recorded 100 and 80 deep dives as compared to BU-I and BU-II with 30 and 20 100-foot dives all in the same order.

A glance at Item #4 in the DBI contained in Appendix B indicates the bias that, in general, not only is the amount of diving experience highly relevant information, but also the kind of experience is a very important aspect of the psychological screening process for diver subjects for saturation experimentation.* Table II contains the distributions for hard-hat and SCUBA experience.

It appears that on the average, divers have about 6 years hard-hat experience (Median = 6.5 years), the range being 1 to 21 years. Further, the median years experience with SCUBA is 5.4 years, the range being 0-21 years. To be noticed is the fact that the SHAD divers did not deviate significantly from the average amount of experience in these two areas of specialization within the diver field. In short, assuming other acceptance

**In an analogous vein, the fundamental assumption made in the early days of astronaut selection was that the amount and nature of test pilot experience was the best single class of predictors of astronaut performance in space.*[11]

Table II. Amount and Type of Diving Experience

Diving Experience (Yrs/Mo)	Diver Sample		SHAD-I Subjects			
			SU-I	SU-II	BU-I	BU-II
Hard Hat	f[a]	%				
None	0	0				
6 or less mo.	0	0				
1 - 3 years	10	20		X	X	
4 - 9 years	23	46	X			X
10 - 15 years	13	26				
16 years plus	4	8				
SCUBA	f[a]	%				
None	2	3				
6 or less mo.	-	-				
1 - 3 years	6	10		X	X	
4 - 9 years	30	51	X			X
10 - 15 years	17	29				
16 years plus	4	7				

[a]Data were incomplete or missing on hard-hat diving from 14 divers and on SCUBA from 5 divers. Total sample, N= 64.

criteria are approximately equated, divers with the most varied experience background, should be selected as subjects for protracted saturation experimentation. The novelty of the concept of saturation diving is attested by the fact that of the 64 divers included in the normative sample, 89% had no experience at all with saturation diving, 8% had 6 months or less experience, and 2 men (3%) had between 2 and 6 years experience. None of the SHAD volunteers had any history of saturation diving; however, both SU-I and SU-II had a year or more of specialized experience, involving, for example, the use of the Kirby Morgan Band Mask.

Another highly relevant aspect of the diver candidates' experience to be considered in the process of selecting subjects for saturation experimentation pertains to the presence or absence of any significant history of dysbaric symptomatology occurring during diving assignments of one kind or another. For comparison purposes, it is seen that 66% of the normative sample (N=64) reported no symptom history whatsoever, while the 34% with some history admitted only skin bends. The frequency of occurrence of the skin bends problem ranged from 1-9 times for the 22 divers with a median of 4 times. Too, 1.1% (one man) of the 64-diver sample required decompression treatment in one or two instances. Moreover, 6% of the normative group reported 1, 2 or 3 occurrences of oxygen toxicity in circumstances not enlarged upon. With regard to the four SHAD volunteers, BU-I admitted that skin bends had occurred during two dives while BU-II reported these symptoms in three instances. By comparison, the two divers finally selected as subjects, SU-I and SU-II, reported no history of any symptoms of any kind.

Motivational and Attitudinal Variables.

There are several lines of evidence from the literature of isolation and confinement generally[14] and from the submarine and aquanaut literature[12,13] in particular, demonstrating the relevance of individual motivation and attitudes for maintaining optimal performance during long duration missions. For example, what motives underlie the decision of men to volunteer for diver training in the first place? Table III contains data obtained from Q-sorting the responses to Item 9 bearing on this question (Appendix B).

It is immediately apparent that most of the diver sample indicated that they had volunteered for diver training for one or more of 3 reasons with almost equal frequency viz., for adventure, for pay and security and for the prestige and uniqueness of the diver role. However, only SU-I gave a modal reason given by the diver sample (Row 4 in Table III). Instead, all four SHAD divers gave responses of a pragmatic nature, that is, they had gotten in the diver field because of "interest in, and preference for" the work that divers typically do, day-in-and-day-out (row 1 in Table III).

Based upon the bias that motivational and attitudinal traits were most crucial in personality assessment, several other attitudinal items were included in the DBI. Item 7c (Appendix B) for example, asks the diver-respondent to "state in

Table III. Motivation for Volunteering for Diver Training

Reasons for Volunteering for Diver Training[a]	Divers N=64		SHAD-I Subjects N=4			
	f	%[b]	SU-I	SU-II	BU-I	BU-II
1. Preference for, and interest in diver-related activities (salvage, exploration, etc.).	3	4.6	X	X	X	X
2. Curiosity, "Wondered what it was like".	2	3.1				
3. Avoid unpleasant job or duty station.	9	14.0				
4. Adventure, challenge, thrill of diving.	18	28.0	X			
5. Prestige & uniqueness of diver role.	17	26.5				
6. More pay & security.	18	28.0				
7. Love of water (aquatic sports, etc.)	10	15.6			X	
8. Personal satisfaction	6	9.4		X		
9. Diving is "Means to an End" (get better job, etc.).	6	9.4				X
10. Don't know.	1	1.5				
No Response.	5	7.8				

[a] When multiple responses occurred, only the first two were coded.

[b] Percentage sums exceed 100%, since most respondents listed more than one reason.

your own words what there is about diving that is so satisfying to most divers?" Again categorized by Q-sorting the responses, this information is contained in Table IV.

At the outset it should be pointed out that while most of the 64 divers listed more than one class of "satisfactions" in response to this DBI item, only the first clearly-stated answer was coded and Q-sorted. Thus, it is seen that the very practical motive "pay and benefits" is roughly equivalent to the "adventure and challenge" of diving in terms of its incentive value (classes, D and E in Table IV). Tending to support this finding is evidence in the submarine literature[15,16] that threat to ego needs may be extremely stressful, a fact which suggests the probable relevance in diver screening of applying some form of procedure for evaluating the ego structures of candidates being screened. In passing, it is to be noted that the D and Pt scales of the MMPI and the DPSS (see Methodology and Procedure section of this paper) yield information shedding some light on this aspect of personality.

Perhaps less eloquent in a psychometric sense, information pertaining to personal satisfaction experienced from diving activities nevertheless may be quite helpful. Thus 12% gave "ego supportive" responses (Class C in Table IV), for example "must have unique abilities to be a diver", "must depend solely on self", "diver must be able to overcome hostile environment" etc. To be noted also is the fact that all four SHAD divers gave at least one response of this nature, which again suggests the author's bias, unvalidated at this time, that these kinds of motivational dynamics are desirable for subjects used in saturation diving experiments.

The response distributions to several other items in the DBI (Appendix B) provide additional information bearing, at least obliquely, on the attitudes of divers toward diver-related activities. For example, the response distributions to item 7a in the DBI showed that 86% of the 64 divers sampled rated the diving profession as "very important", 12% as "somewhat important" and the remainder (2%) as "not important". All of the SHAD subjects rated diving as "somewhat important" or "very important". Similarly, when asked to indicate the degree of satisfaction realized from diver-related activities, (DBI, item 7b, Appendix B), 81% of the diver sample (N=64) responded "very satisfying", 16% "somewhat satisfying" and 3% "not at all satisfying". Again all four SHAD volunteers responded "very satisfying" to this item. Finally, item 7d in DBI investigated the likelihood of the divers spending a significant proportion of their leisure time in sports diving or other diver-related activity. Of the sample of 64 divers, 37% answered "yes", 28% maybe, and 35% "no". As for the SHAD divers responses to the item, SU-I responded, "yes", SU-II "maybe", BU-I "yes" and BU-II checked "maybe".

Whereas there were no normative diver data available for comparison purposes, the question of the kinds of motivational dynamics underpinning a diver's decision to volunteer as a subject for an extended experiment such as SHAD nonetheless seemed relevant. Accordingly, the responses of the four

Table IV. Intrinsic Satisfactions Derived from Diver-type Activities

Classes of Satisfactions	Diver Sample (N=64)		SHAD-I Divers			
	f	%	SU-I	SU-II	BU-I	BU-II
A. Social Reinforcement (Closeness of group; mutual trust; "can do" attitudes)	2	3				
B. Prestige of Divers (Superman complex, new breed; glory; different life style)	2	3				
C. Ego-Supportive Function (Self dependence; unique abilities; overcoming hostile environment)	8	12	X	X	X	X
D. Adventure and Challenge (Sense of adventure and discovery)	15	23				
E. Economic Security (More pay and benefits; hazardous duty incentive pay)	16	26				
F. Relative Independence (Freedom to do job in own way; on your own)	5	8				
G. Lure of Underwater Environment (Intrigue of sea; quietness, foreign world)	2	3	X	X		
H. Diversity of Assignments (Absence of sameness; each dive different)	3	5				X
I. Sheer Pleasure of Diving (Enjoyment, like water sports)	3	5				
J. Diving not satisfying	8	12				

SHAD divers to item #10 in the DBI regarding reasons for volunteering as subjects were examined. Briefly, paraphrasing the SHAD divers' comments, SU-I indicated that he had volunteered because SHAD was a "USN first", the diving profile was challenging, and that as an experimental subject, he would gain entrance to the unique "saturation" specialty within the diving field. SU-II stated that SHAD provided a means to gain more advanced knowledge of diving. Similarly, BU-I indicated his interest in underwater habitats and that SHAD "was a vanguard program" along this line of interest. Finally, BU-II very simply stated he volunteered because he was curious as to what would happen under the proposed conditions. It is possible that some of the above motivational components may conceivably be of use in concerted efforts to interest divers in participating as subjects in future hyperbaric experimental programs.

There is considerable evidence in the general motivational literature[17,18] as well as in the more focussed literature of submarine psychology[19,20] indicating that individual differences in aptitude test scores are predictive of proximal training criteria, but not usefully predictive of the remote and more complex adjustment criteria. Measures of interests, attitudes, and values on the other hand, appear to have the greatest probability of being usefully predictive of diver retention, as well as the capacity for sustained, high-level performance under arduous conditions. One broad area of interest can be inferred from a man's preferences for certain academic subjects during his high school years. Table V presents this information.

It is immediately seen that the majority of divers and submariners alike* tend to prefer sciences and mathematics and to dislike English and Languages. Preferences for and interest in manual activities may be inferred from the fact that about 1/2 of both submariners and divers "like" manual arts and practically none dislike this training area. Whereas proof is lacking, it is believed that diver subjects should have achieved above average levels in the manual skills areas. Whether the modal aversive subject area in Table V (English/Languages) reflects a trait predictive of favorable diver-subject adjustment is hypothetical. Nevertheless it is seen in Table V the two divers finally selected for SHAD-I liked Manual Arts and disliked English and Languages. The predictive value of these and other interests and preferences of more copious samples of divers should be investigated. At present, the feasibility of constructing a Diver Interest and Value Inventory is under study by the Personnel Assessment Branch of this Laboratory.

Finally, based upon the assumption that sustained motivational and interest patterns are to a certain extent culturally determined, a gross examination of the differences in the kind of home environment the divers had spent their developmental years was undertaken. Table VI contains these data.

It is seen that the distributions for divers and submariners as presented in Table VI are not significantly

No significant differences between the preference distributions for divers and submariners were found by X^2 at the 5% confidence level.

Table V. Most and Least Liked Subjects in High School

High School Subjects	Diver Sample[a]		Submarine School Graduates[b]		SHAD Divers			
	f	%	f	%	SU-I	SU-II	BU-I	BU-II
Most Liked:								
Sciences/Math	13	43	123	56				X
English/Languages	--	--	2	1			X	
Manual Arts	8	27	52	24	X	X		
Social Sciences	5	17	43	19				
Did not attend H.S.	4	13	--	--				
Least Liked:								
Sciences/Math	4	13	16	8				
English/Languages	16	53	140	71	X	X		X
Manual Arts	1	4	--	--				
Social Sciences	5	17	41	21			X	
Did not attend H.S.	4	13	--	--				

[a] N=30; this item was added to the DBI late in the study.

[b] Abstracted from reference No. 8, N=220 for "most liked" and 197 for "least liked" subjects.

Table VI. Type of Home Environment

Home Environment	Divers[a] f	Divers[a] %	Submariners[b] f	Submariners[b] %	SHAD Divers SU-I	SU-II	BU-I	BU-II
On a farm	5	16	8	10				
Village (<2.5K pop.)	4	13	20	24		X		X
Small City (Pop. 2.5-25K)	13	42	20	24				
City (Pop. 25-100K)	3	10	18	22				
Large City (>100K)	6	19	17	20	X		X	

With df=3, p of X^2 =>5%

[a] N=31; item was added to DBI late in study.

[b] This sample of enlisted submariners was the control group (N=83) in the drug abuse study listed as #21 in the reference section of this paper.

different. However, if one groups the rows in Table VI with "small city", village, farm as opposed to cities, it is seen that only 29% of the divers as compared to 42% of the submariners had come from cities, (differences, significant at 1% level by X^2, df=1). There are numerous forms of possible explanations for these differences, for example, the opportunities to develop interest in aquatic activities, sports and the like, may be more rife in smaller demographical areas. However, no known relationship between the quality of divers and geographical origin exists, a fact attested by the divergence of backgrounds of the SHAD subjects indicated in Table VI.

Personality Test Score Patterns of Divers.

While factual data bearing specifically upon the question of the unique personality characteristics of Navy divers are rather sparse, there is at least a scattering of descriptive information on the subject presently in the literature. For example, the Edwards Personal Preference Schedule profiles of 20 Navy divers showed that the mean diver scores were significantly higher on the Aggression and Change sub-tests and significantly lower on the Affiliation, Nurturance and Intraception sub-tests as compared to an equal-sized, non-diver control group.[22] Too, the same

study demonstrated that Navy divers tended by-and-large to prefer from a set of equal-probability bets those with the most risk involved (in this study, money), suggesting that the attitudes of divers toward danger and hazards may in part explain their occupational choice.

Further, there are a number of references to personality and demographic correlates of diver performance published in the account of SEALAB II.[23] For example, two mood scales, "happiness" and "psychological well-being" correlated significantly with diver adjustment (-.74 and .74 in that order, N=28). Also, later-born divers and those from small towns adjusted better than first-born and those reared in larger urban environments. Similarly, a more recent study focussed upon demographic and sociological information obtained from 95 Navy divers indicated that as compared to a non-diver sample of enlisted Navy men divers more frequently admitted having run away from home, playing hookey and having a history of one or more arrests.[24]

The major personality measure used in the present study was the Minnesota Multiphasic Personality Inventory (MMPI). The first of the two diver studies cited above also included MMPI profiles from each of the 20 Navy divers in their sample.[22] As compared to an equivalent size group of non-diver, Navy men, only one significant difference was reported in the study mentioned above, namely, that divers tended to obtain lower scores only on the Mf* scale of the MMPI. This single finding was construed, quite correctly, by the authors as a chance difference since, 12 of the 13 MMPI failed to show significant (5% confidence levels, t-test) differences.

As indicated above, the MMPI was administered to a sample of 30 Navy divers located in the New London area in the Fall of 1972. At about the same time, a sample of 20 non-diver enlisted Navy men were administered the MMPI under the same conditions. Statistics derived for each of the MMPI subtests for these two groups are contained in Table VII.

At the outset, possible differences between the MMPI pattern of the diver sample in Table VII and that of a similar-sized (N=20) sample of Navy divers already in the literature should be investigated.[22] The MMPI profile of mean raw scores for the 30 divers in Table VII was virtually identical to that of the sample of 20 divers published in reference #22. Interestingly, only the mean Mf score in Table VII was significantly higher (5% level, t-test) than the published subtest score. The fact that the Mf mean in the published paper was the only MMPI subtest significantly different (lower) than the control mean in that study tends to negate the argument for the spuriousness of the earlier finding.

The differences between the diver and control group means in Table VII reached significance for the F, K, Pt and Sc sub-tests of MMPI. The F and K differences, suggest that divers tend to be slightly more guarded or defensive than the control group. That is, more so than the less mature submariner control group, divers are prone to deny

See the Methodology and Procedure section of this paper for a brief description of this MMPI subtest.

Table VII. Comparison of the MMPI Profiles for Each SHAD-I Subject with Representative Profiles of a Navy Diver Sample and a Non-diver Navy Enlisted Sample

MMPI Sub-tests[a]	Divers (N=30) Raw Scores M		Divers (N=30) T-Scores M	Non-Diver (N=20) Raw Scores M		Non-Diver (N=20) T-Scores M	SHAD-I Subjects Individual T-Scores SU-I	SU-II	BU-I	BU-II
L	3.9	2.1	49	3.2	1.8	47	43	43	50	43
F	4.1	1.9	54	5.4*	4.2	56	48	47	53	55
K	15.6	4.7	56	11.0**	4.0	48	46	46	59	42
Hs	11.8	3.3	51	12.5	4.8	53	34	41	46	39
D	17.7	4.2	52	19.5	6.4	57	41	51	58	56
Hy	19.8	4.3	55	20.2	4.6	56	47	44	60	44
Pd	24.3	3.8	62	25.8	4.6	66	41	53	63	42
Mf	23.7	3.9	56	23.3	4.7	56	41	42	75	61
Pa	9.1	2.5	54	9.4	3.3	55	56	58	67	62
Pt	23.8	4.7	51	26.8**	7.4	57	37	58	52	52
Sc	23.3	3.7	52	28.4**	8.2	61	40	51	51	48
Ma	20.9	4.6	59	21.8	3.5	62	56	72	63	63
Si	22.1	11.5	47	24.6	13.41	50	47	41	55	55

*,** Null probability (two-tailed), 5% and 1%, respectively, by t-ratio between the means of the diver and non-diver samples.

[a] MMPI sub-test abbreviations are explained in the text of this report, p. 2.

socially undesirable traits (low F) while at the same time admitting more desirable characteristics (high K). It has been this author's experience with the F and K score interactions that T-scores in the 50-60 range with no deviant* subtest scores of note are found in well motivated people who attach relatively high values to their social needs, and are adaptable and resourceful in a variety of circumstances. Further, the lower mean Pt score for divers suggests emotional stability, fewer fears and anxieties, and realistic self confidence. Another indicant of the adjustment resources of divers is in the low-average score on the Sc (Schizophrenia) scale, which suggests optimal reality contact, and generally favorable attitudes toward the environment in general and society in particular.

A comparison of the MMPI T-score profiles of the SHAD subjects with the diver normative data in Table VII shows few remarkable deviations. The comparative profiles are presented graphically in figure 1.

With the normative raw score data for the Navy divers transformed to T-scores, it is possible to compare the individual profiles of the SHAD diver candidates with the group data. Accordingly, it is seen that the two divers selected, SU-I and SU-II fit the pattern of mean subtest scores provided by the 30 divers most closely. Only one exception is noted, namely SU-II's elevated score on Ma (Hypomania). However, there is evidence in the clinical literature[25] that a high Ma score with average or low scores on Pd and on the 3-score group, Hs, D and Hy (sometimes called the neurotic triad) usually suggests an outgoing, enthusiastic somewhat uninhibited man with unusual capacity for sustained activity but with very little likelihood of acutely maladjustive behavior. While not significant departures from the norms, the two divers used as back-up subjects, BU-I and BU-II, showed deviations of 6 or more T-score points from the diver means on from 3-5 of the MMPI scales.**

A "caveat" should be clearly stated with regard to the utilization of divergent MMPI or other similar test score patterns as criteria for rejection of divers as experimental subjects. Whereas the comparative MMPI profiles in Table VII and Fig. 1 suggest that divers as a group are well-adjusted, there are no substantive data to indicate that significant deviations of specific MMPI subtest scores necessarily are

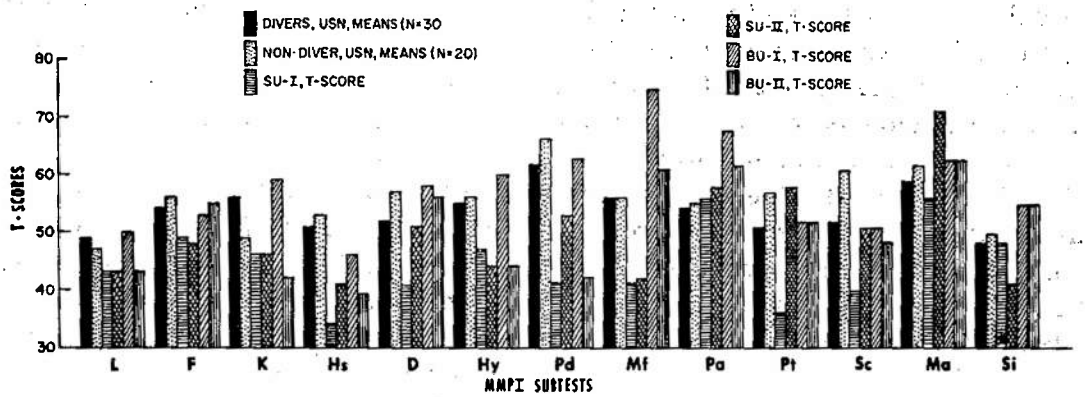

Fig. 1. Comparative MMPI Profiles of Divers and Non-divers

Conventionally, T-scores greater than 70 are considered significant departures from normal. The T-score transformation is a linear one applied to the raw scores in standard score form, the resulting distribution having a mean of fifty and a S.D. of ten.[4]

**The Mf scale (Masculinity-Feminity) T-score for one of the back-up divers exceeds T-score 70 (Fig. 1). The construct validity of this scale is unknown, but for men with above average verbal ability (in the absence of elevations on any other MMPI scales) a high Mf score is often indicative of broad interests, particularly in the arts, aesthetics and philosophy.[25]*

contra-indicative of acceptance of divers as experimental subjects. Rather, based upon the general clinical literature[4,25] and upon a meager amount of case history material,[6,26] a broad working hypothesis emerges: The likelihood of severe maladjustive behavior (even frank pathology) during experiments involving long term confinement and some degree of risk will be much greater in candidates with significant elevations on any 2 or more of the 10 diagnostic subtests (assuming the validity scales are within normal limits). Some critical MMPI subtests pairs are Pt/D, Pd/Ma, Sc/Pt, Ma/D, Hy/Pt and quite likely other combinations.*

Desirable and Undesirable Characteristics of Divers.

Can a group of highly-trained, professional divers, when asked to consider the characteristics of divers, produce meaningful clues as to the major personality traits typifying the members of this group? On the assumption that this could be done, indeed that these hypothetical traits would be dimensionable as potential selection criteria for divers, item 8a and 8b in the DBI (Appendix B) were designed and administered to the 64 divers in the normative sample and to the four SHAD divers. The opinions of the 64 divers as to the most descriptive traits of an "excellent" as well as a "very poor" diver were categorized by the Q-sorting technique of content analysis. These distributions are contained in Tables VIII and IX.

It is seen in Table VIII that in the opinion of the present sample of 64 divers, the most characteristic class of traits found in an effective diver has to do with his reliability, capacity to assume responsibility, his adaptibility and so on (Category E, first response in Table VIII). Further, physical attributes, general fitness and the like, and the proficiency level of diver-related skills (Category C) are almost equally desirable for effective divers. Emotionality (Category H) is also important.

As to undesirable traits for divers, the modal opinions of the diver sample are the "Faulty Life Styles" (G), "Emotional Instability" (E), "Unreliability" (F), and "Deficient or Inappropriate Motivation" (D) in descending order of the proportion of the 64 divers mentioning the categories.

Three of the four SHAD divers agreed with one or both of the modal nominations for the most desirable diver traits (Table VIII). On the other hand, only two of the SHAD volunteers mentioned the modal first or second trait proposed by the normative diver sample as the most undesirable trait to be found in divers (Table IX). Whereas the vitiating effects of projection, denial and repression argue against the acceptance of the consonance of self-observations with modal traits as useful diver selection data, one older study in the submarine literature suggests certain methodological possibilities of this approach in a military assessment situation.[27] In any event, the most pertinent application of

In non-diver subjects confined to an elevated intensity of sonar "beeps," 3 subjects with Pt/D elevations developed a high level of anxiety, two men showing chronic anxiety during a 5-day exposure[26] and one suffering an acute anxiety reaction during a 24-day study.[6]

TABLE VIII. Desirable Traits of Effective Divers

Desirable Traits	Diver Sample: First[a] f	First[a] %	Second[a] f	Second[a] %	SHAD Divers: SU-I	SU-II	BU-I	BU-II
A. Traits Related to General Ability (Intelligence, etc.)	11	18	5	8			X	X
B. Specialized Aptitudes (Mechanical, etc.)	2	3	1	2				
C. High Level of Diving Skills (ability to use diver equipment, experience, etc.)	8	12	10	16	X			X
D. Physical Attributes (Coordination, general fitness, etc.)	5	8	17	27		X	X	X
E. Personal Reliability (Responsible, adaptive, sense of commitment, etc.)	16	25	12	18		X	X	
F. Drive Level (Industrious, capacity for sustained activity, etc.)	7	11	1	2		X		
G. Attitudes/Interests (Dedicated, intrinsic interests in diving, etc.)	2	3	4	6	X			
H. Emotionality (Controlled, levelheaded, calm, etc.)	8	12	6	9	X			
I. Ego-related Traits (Absence of self-doubt, confidence, etc.)	4	6	2	3				
No response	1	2	6	9				

[a]First and second mentioned responses to item 8a in the DBI (Appendix B). Sixty-four Navy divers responded to this DBI item. All 3 responses of the SHAD divers were coded.

TABLE IX. Undesirable Traits of Effective Divers

Undesirable Traits	Diver Sample: First[a] f	First[a] %	Second[a] f	Second[a] %	SHAD Divers: SU-I	SU-II	BU-I	BU-II
A. Low Mechanical Ability (all thumbs, inept, etc.)	5	8	8	13				
B. Poor Physical Condition (Poor general health, obese, sickly, etc.)	5	8	6	9			X	X
C. Skills and Knowledge Deficiencies (inadequate diver skills, poor social skills, e.g. uncooperative, etc.)	4	6	3	5	X			X
D. Deficient or Inappropriate Motivation (Unenthusiastic, pay motivation only, etc.)	5	8	7	11	X	X		
E. Emotional Instability (Fearful, hysteria-prone, etc.)	9	14	9	14	X		X	
F. Unreliability/Irresponsibility (Reckless, poor judgment, lackadaisical, etc.)	7	11	9	14		X		
G. Faulty Life Style (Drinks or smokes excessively, nonadaptive, etc.)	14	21	13	20		X	X	
H. Inappropriate Attitudes (Too carefree, casual interest in diving, etc.	5	8	2	3				X
I. Inadequate Ego Structure (Lack of self confidence, introverted, passive, etc.)	5	8	2	3				
No response	5	8	5	8				

[a]First and second mentioned responses to item 8b in the DBI (Appendix B). Sixty-four Navy divers responded to this DBI item. All three responses of each of the SHAD divers were coded.

these opinion data would seem to be as guideposts or leads as to the most critical personality dimensions around which to develop a diver selection methodology.

First Impressions of the Quality of the Adjustment of the SHAD Divers.

While admittedly inexact and biased, case histories nonetheless often provide tentative notions which often lead to more precise observations and data collection strategies. Therefore, impressions from pre- and post-experimental interviews, from an integration of the personality test data, from daily observations of SU-I and SU-II within the chamber, and from daily examination of the diving log were "pooled" into a brief memorandum transmitted to the SHAD Project Coordinator about two weeks after termination of the experiment.[28] The following statements were quoted from that memorandum:

1. There were no perceptual changes reported or observed other than one diver reported voice communication seemed attenuated; visually, the "closeness" of the chamber remained unchanged.

2. The SHAD divers' self-observations regarding their own and the other diver's performance on the various tests and procedures repeated daily suggested that performance remained the same or improved with practice. That is so except when their motivation to carry out certain tasks declined appreciably and their attitudes toward certain of the experimenters deteriorated somewhat. Therefore it appears likely that some of the day-to-day fluctuation in several of the performance tests (if they occurred), may have been the result of degradation of subject motivation and/or attitude deterioration.

3. Interrelated with (2) above is the impression that both men's attitudes regarding the significance of certain tests and procedures deteriorated considerably about midway through the experimental period. This was inferred from the frequency of use of such descriptors as boring, annoying, ridiculous, etc., in reference to certain data collection procedures. Further, any modification in the scheduling of these tests tended to exacerbate the negative emotional reactions associated with these attitudes. For reasons unknown, the two divers' demand for "structure of events" as time went on increased greatly. This impression is based upon the frequency of interview responses to the query "What was most annoying as time went on?" Answers given for example were: changes in routine, 2-hour procedure substituted for a 45' one, experimenter was late (or early), or the introduction of an unscheduled data-collection session. Apparently this somewhat rigid "need for structure of events" was to a degree "blocked" by the imposition of two unscheduled, data-collection routines on the day before surfacing when, according to both divers' independent statements, R&R was scheduled. The results were overt symptoms of rather generalized hostility in both men, with rather intense emotional outbursts and enhancement of negative attitudes directed toward the experimenters. In sum, stress exposure seems to enhance the need for structuring environmental events. A corollary statement: if this need is frustrated, rather intense emotional behavior and negativism of attitudes are expected outcomes.

4. Somatic symptomatology possibly correlated with changes in general emotionality as the experiment progressed was infrequently mentioned, and then, the symptoms were quite obscure. While neither man complained of reduced quality of sleep, both emphasized insufficient quantity of uninterrupted sleep. Possibly the most consistently mentioned symptom was fatigue. Both stated repeatedly that they were very tired throughout the 30 days. The interview probe, as to whether they were characteristically fatigued on the "outside" during a normal diving work day or week evoked emphatic negatives from both. In sum, besides boredom, sleep deficiencies, confinement, deprivation of various kinds and lack of exercise as possible fatigue-inducing factors, the question remaining unanswered by this study is, simply stated, "are there any atmospheric-related factors directly or indirectly contributory to what appears to be chronic fatigue during experiments of this kind".

5. Very little evidence for any subjective correlates of pressure-related problems was obtained from the interview. However, excursion dives were anticipated eagerly by both divers as a means of speeding up passage of time. Both were perplexed as to why they became "really narced" on one dive only, namely the 200' dive on 9 Oct. 1973, while other deeper excursions (they said) did not produce these effects. Both explained these paradoxical findings on the fact that they were unusually tired prior to that particular 200' excursion. Too, when asked "when bottomed during the "bounce" dives, was your condition such that you could carry-out 2-3 hours diver-type tasks?" Both mentioned fatigue as a limitation but stated, if the tasks were meaningful diver activity (and not experimental tests), they felt they could and would perform effectively. One implication of both divers recall of the "bounce" phases of the experiment is that should significant performance decrements as measured by the various test procedures be observed during these excursions, the very real possibility of these degradations being the result of diminished motivation rather than from the effects of dense gas, elevated temperature or whatever should be taken into consideration in interpretation of the change data.

6. One major concern in the psychiatric screening of the diver volunteers was to disquality any candidate whose personality profile was in any way suggestive of inordinately elevated anxiety levels coupled with obsessive-compulsive traits. This was done in the selection of these two subjects. Apparently, little, if any, fear or anxiety was experienced by either man during the saturation or the bounce phases. However, both expressed considerable concern about the possible hazards of the decompression phase, the major reason being (they said) was that they were led to believe that the tables had never been checked out beforehand. One man indicated that he did experience some vague "tingling, pins-and-needles" senstations about midway in the decompression phase. However, neither reported, in retrospect, any symptoms suggesting decompression problems of any significance.

7. In addition to the semi-structured interview conducted on each diver before and after the "dive", a brief Mental Status Examination was also conducted (paragraph 5.0, appendix C). Briefly, there was no evidence of thought disturbance of any kind in either man. The affective signs usually associated with "relief", the end effect, so-called (elation, verbosity, hyperexcitability), were not observed in either diver during the post-experimental interview 20 hours after surfacing though these indices were observable earlier. Instead, a moderately depressed mood state, somewhat typical of anticlimactic situations was obvious in both men. Sensorium was clear with no evidence of disorientation (time, place or person). Tests of both remote and recent memory were unchanged from pre-experimental data. No motor abnormalities were observed. In short, there were no differences of any significant magnitude noted in comparing the pre- and post-experimental MSE observations.

SUMMARIZING COMMENTS

The major objectives of this paper were threefold: First, to present a variety of biographical, personality and psychometric data obtained from a sizable sample of experienced Navy divers. Second, against the "backdrop" of these normative data, to compare the psychological screening data obtained from the four Navy divers who had volunteered for the SHAD-I experiment. Third, from an integration of impressions of the quality of the SHAD divers' adaptation to the experimental conditions with the screening data to delineate hypothetical screening criteria to be validated in future studies.

The obvious assumption throughout this paper is that a hiatus in hyperbaric research exists in the area of development of usefully valid techniques for the psychological screening of divers for activity in the field as well as for subjects for hyperbaric experimentation. Recent writings in the aerospace field argue for the increasing relevance of personnel selection. "For long duration missions, crews will have to be even more carefully selected than they are now," (Reference 5, p. 1142). Also,

in the same reference, "Psychological selectivity in training will be even more important when crews are no longer composed of highly motivated robust test pilots, but include scientists and other civilian personnel" (p. 1142). Similarly, at least one worker in the diver research field has clearly indicated his opinion that the most feasible means of avoiding the untoward effects of high pressure exposure is by careful selection of optimally adaptable subjects.[29]

Accordingly, based upon the psychological screening data described in the methodology and procedure section of this paper, the impression was that the basis for recommending the two experimental subjects (out of the 4 diver volunteers) appeared, in retrospect, to have been essentially correct. These selection criteria were: (1) having personality profiles on the MMPI most congruent with MMPI normative data obtained from a sizable sample of Navy divers (Table VII and Fig. 1); (2) SU-I and SU-II were approximately equivalent in verbal aptitude, similar interests (same USN rating), similar motivation for volunteering for the experiment, and a friendship history of some duration; (3) they appeared to have compensatory temperamental and social trait profiles, but with no evidence of serious neurotic or behavorial abnormalities; (4) neither had any history of treatment nor consultation for emotional or adjustment problems of any nature; (5) neither diver appeared from the test and interview data to be in any way depression-prone; (6) they had relatively more and varied deep diving experience; (7) neither was an habituated smoker; and (8) both had strong motivation for and favorable attitudes toward diver activities of all kinds.

In contrast to previous hyperbaric studies conducted by the Personnel Research Branch of NSMRL (e.g. reference #31), the present approach was unobtrusive in the sense that no daily psychometric rating or other data was collected directly from the subjects during the dive. Rather, a reliance was placed upon direct observation of the subjects, periodic examination of the diving log and upon the pre- and post-experimental interview data interpreted in the context of the personality profiles of the diver-subjects constructed from the diagnostic test data obtained prior to the onset of the experiment.

Accordingly, impressionist statements pertaining to the quality of the adaptation of the two divers to the conditions existing during the 30-day experiment were presented in the previous section of this paper and will not be repeated here. All in all, it appeared that the two divers adjusted adequately, probably more so than the two back-up divers would have adjusted to the same conditions. Obviously, the data presented in this paper do not in any sense prove this statement; nevertheless, these same data provide examples of the kind of clinical observations, and the types of psychometric information that may prove useful for screening divers and diver-subjects in the future. However, this is an empirical matter, each hypothetical variable or class of variables suggested in this paper requiring careful validation in the context of well-planned, hyperbaric studies of the future.

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DPSS-MOD IV
July 1972

NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY
Incomplete Sentences

This is an Experimental Form
Prepared by: Benjamin B. Weybrew, PhD.

Name_____ Rate/Rank_____ Date_____

Formal Education (Years)_____ Age (Nearest Year)_____
To

Instructions: You will notice that the sentences below are not complete. We are asking you to make a complete sentence out of each one. You need not be too concerned about grammar or sentence length. Simply write down the first thing that comes into mind. Please work as rapidly as you can, but don't rush, as there is no time limit. If possible, do not omit any. Thanks in advance for your cooperation.

1. He worried . . . . . .

2. One feels useless . . . . . .

3. I feel . . . . . .

4. My appetite . . . . . .

5. The future . . . . . .

6. What makes me discouraged . . . . . .

DPSS-MOD IV
July 1972

7. When rejected, he . . . . . .

8. My greatest fear . . . . . .

9. Morning is . . . . . .

10. I am . . . . . .

11. Sometimes I want . . . . . .

12. Things looked hopeless . . . . . .

13. Being with other people . . . . . .

14. My greatest fault . . . . . .

15. What disgusts me most . . . . . .

16. I have . . . . . .

DPSS-MOD IV
July 1972

17. I felt like giving up . . . . . .

18. My sleep . . . . . .

19. I still enjoy . . . . . .

20. My self-confidence . . . . . .

21. I . . . . . .

22. One feels needed . . . . . .

23. My health . . . . . .

24. What makes me angry . . . . . .

25. My . . . . . .

DPSS-MOD IV
July 1972

26. One feels guilty . . . . . .

27. Life . . . . . .

28. If I fail . . . . . .

29. If there were no way out . . . . . .

30. In the future, I . . . . . .

MOD-5 (For use in Diver Experimentation)

NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY

DIVER BIOGRAPHICAL INVENTORY (DBI)

Prepared for experimental use by:
Benjamin B. Weybrew, Ph.D.

NAME:_____

AGE:_____ HEIGHT:_____ WEIGHT:_____

1. Diving Qualification (If USN):

MASTER _____ 1st_____ 2nd_____ SCUBA_____

2. Approximately how many dives (both simulated and real) have you entered in your diving log?

Less than 10_____ 10-25_____ 26-50_____ 51-75_____

76-100_____ 101-200_____ 201-300_____

MORE THAN 300_____

3. Approximately how many dives to depths greater than 100 feet (both chamber and water) have you made? _____

4. About your diving experience:

	Year Training Completed	Years Active Experience
HARD HAT	_____	_____
SCUBA	_____	_____
Saturation Diving	_____	_____
Other	_____	_____

5. Have you ever had: (Indicate the number of times)

	1	2	3	4	5	6	7	8	9+
a. Pain only Bends									
b. Skin Bends									
c. Bends Associated with muscular weakness									
d. Unconsciousness and/or convulsions associated with diving									
e. "Chokes"									
f. Pneumothorax									
g. Air Embolism									
h. Shallow water black-out									
i. Oxygen toxicity symptoms									

6. How many times have tou been treated with re-pressurization for a diving accident?

	Number of Times Treatment Used								
	1	2	3	4	5	6	7	8	9+
Table 1									
Table 2									
Table 3									
Table 4									

7. How would you rate your attitudes about diving?

a. In terms of importance of diving as a profession:

Not at all important___; Somewhat important___; Very important____

b. In terms of personal pleasure and satisfaction you derive from diving:

Not at all satisfying___; Somewhat satisfying___; Very satisfying___

c. Can you state in your own words what there is about diving that is so satisfying to most divers? _____

_____

_____

d. If you had a great deal of liesure time, would you be likely to spend most of that leisure time sport diving? YES___NO___MAYBE___

8. Traits that characterize divers:

a. List three traits or characteristics that you might use to describe an excellent diver?

(1)_____(2)_____(3)_____

b. Likewise, list three traits or characteristics that you might use to describe a very poor diver?

(1)_____(2)_____(3)_____

9. Would you please state, in your own words, why you volunteered for diver training in the first place?

_____

_____

_____

_____

10. Similarly, please state, in your own words, the major reasons for your volunteering for this experiment:

_____

_____

_____

_____

_____

GENERAL BIOGRAPHICAL INFORMATION

General Background

11. What is your marital status?

    a. Never married
    b. Married
    c. Separated
    d. Divorced

12. Do you now have, or have you recently had any serious personal or family problems? (i.e., family illness, death, broken home, etc.)

    a. Yes
    b. No
    c. Undecided

13. How did your parents feel about your taking diving training?

    a. Strongly in favor of it
    b. Somewhat in favor of it
    c. Didn't particularly care one way or the other
    d. Somewhat opposed to it
    e. Very much opposed to it

14. How did your wife react to your volunteering for this experiment?

    a. Strongly in favor of it
    b. Somewhat in favor of it
    c. Didn't particularly care one way or the other
    d. Somewhat opposed to it
    e. Very much opposed to it
    f. Not married

Schooling and Work Experience

15. Which one of the following subjects did you like the most in high school?

    a. Did not attend high school
    b. Sciences and Mathematics (i.e., Physics, Chemistry, Algebra, etc.)
    c. English or Languages
    d. Manual Arts (Shop work, Civics, etc.)
    e. Social Sciences (History, Geography, Civics, etc.)
    f. Other (Please specify)_____

16. Which one of the following subjects did you like the least in high school?

a. Did not attend high school
b. Sciences and Mathematics (i.e., Physics, Chemistry, Algebra, etc.)
c. English or Languages
d. Manual Arts (Shop work, Drafting, etc.)
e. Social Sciences (History, Geography, Civics, etc.)
f. Other (Please specify)_____

17. If you did not graduate from high school, why did you leave? (Please check the MOST important reason)

a. Found school work difficult
b. Just lost interest
c. Had to work as there was not enough money at home
d. To enter the service
e. Because of other personal or family problems
f. Other (Please explain)_____
_____
_____

18. Generally, how were your high school grades? (leave blank if you did not attend high school)

a. Excellent
b. Good
c. Fair
d. Poor
e. Don't know

SKIP TO ITEMS #21 AND #22 IF YOU DID NOT ATTEND COLLEGE

19. Which of the following subjects did you like the most in college? (Mark only one)

a. Math or Physical Sciences
b. English or Languages
c. Social Sciences (Psychology, Sociology, History, etc.)
d. Business Courses (Accounting, Management, etc.)
e. Other (Explain)_____

20. Why did you leave college? (Please mark the MOST important reason; omit if you are a college graduate)

a. Found college work difficult
b. Just lost interest
c. Had to work, as there was not enough money at home

20. (Continued)

d. To enter the service
e. Because of other personal or family problems
f. Other (Explain)_____

21. Did you work while in high school?

a. No
b. Usually had a part-time or summer job
c. Occasionally had a part-time job
d. Worked full-time and went to school part-time
e. Did not go to high school

22. While you were in grade and high school, how many times did you change schools?

a. None
b. Once or twice
c. 3 to 5 times
d. 6 times or more

23. How many jobs have you quit because you didn't like them?

a. One
b. Two
c. Three
d. Four or more
e. None

24. Did you hold an elected office while you were in high school? (i.e., student body president, junior class president, student council, captain of the football or basketball teams, a social or academic club president, etc.)

a. Yes
b. No
c. Did not attend high school

25. Did you win any scholarship awards while you were in high school?

a. Yes
b. No
c. Did not attend high school

SMRL DEPRESSION PRONENESS SENTENCE STEMS — CHECK SHEET — SCORED BY: _____

SUBJECT'S NAME _____ RANK/RATE _____ DATE _____ CODE _____

ITEM NUMBER	RESPONSE CATEGORIES																					ADDITIONAL CATEGORIES AND/OR COMMENTS ABOUT SPECIFIC ITEMS
	OMISSION	UNCLEAR	DENIAL	DEPRESSION	AGITATION	HOSTILITY	AGGRESSION	RETARDATION	PASSIVITY	FRUSTRATION	ANXIETY	FEAR	INADEQUACY	INSECURITY	EGO WEAKNESS	REJECTION	GUILT	MOODINESS	CONFLICT	UNREALITY	SOMATIZATION	
1																						
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39																						
40																						
SUM OF CHECKS FOR EACH CATEGORY																						NUMBER OF CATEGORIES USED FOR EACH ITEM
PERCENTAGE																						

Home and Family

26. Up to age 18, what type of community did you live in, for the most part?

a. On a farm
b. In the country (or a village of less than 2500 people, but not a farm)
c. In a small city (2500 to 25,000)
d. In a city (25,000 to 100,000)
e. In a large city (More than 100,000)

27. Which of the following describes the status of your natural parents? (mark all that apply)

a. Both alive and living together
b. Married, but living apart
c. Legally separated or divorced
d. Father deceased
e. Mother deceased

ANSWER EITHER #28 OR #29

28. Until the age of 18 with whom did you live MOST of the time?

a. Both natural parents
b. Father only
c. Mother only
d. Stepfather and mother
e. Stepmother and father

29. a. Stepfather only
b. Stepmother only
c. Legal guardian
d. With other relatives
e. (Other (Friends, foster parents, etc.)

Please answer the following questions in terms of THE PEOPLE WHO RAISED YOU, regardless of whether you were raised by your real parents, step parents, foster parents, or legal guardian.

30. How old was your father when your parents were married?

a. Don't know
b. Younger than 18
c. 18-20
d. 21-29
e. 30 or older

31. How far did he go in school?

a. Completed grade school
b. Attended high school
c. Completed high school
d. Attended college
e. Graduated from college

ANSWER EITHER ITEM #32 OR #33

32. What was your father's CHIEF occupation while you were growing up?

a. Military (Army, Navy, Marines, Coast Guard, Air Force)
b. Public Service (Policeman, Fireman, Federal Agent, etc.)
c. Sales (Salesman, Store Clerk)
d. Semi-skilled or unskilled worker (miner, factory worker, truck driver, watchman, etc.)
e. Skilled worker (machinst, mechanic, shop foreman, electrician, locomotive engineer, etc.)

33. a. Clerical worker (office clerk, bookkeeper, secretary, office supervisor, etc.)
b. Wild life and Agricultural (farmer, a ranch owner or worker, forester, fisherman, etc.)
c. Business (small store owner, manager, factory owner, manager, etc.)
d. Semi-professional (artist, musician, entertainer, draftsman, technician, etc.)
e. Professional (Physician, Lawyer, Scientist, Engineer, Teacher, Pharmacist, etc.)

34. What were your father's average yearly earnings while you attended high school?

a. Less than $4,000.00
b. From $4,000.00 -- $5,000.00
c. From $5,000.00 - $9,000.00
d. More than $10,000.00

MARK ONE IN <u>BOTH</u> ITEM #35 AND #36

35. Which of the following <u>BEST</u> describes your father or male guardian as you knew him?

a. Considerate
b. Understanding
c. Efficient
d. Like a buddy
e. Didn't know him well enough

36. a. Strict
    b. Stubborn
    c. Moody
    d. Weak
    e. Disorganized

37. How far did your mother go in school?

    a. Completed grade school
    b. Attended high school
    c. Completed high school
    d. Attended college
    e. Graduated from college

38. Did your mother have a job outside the home?

    a. She had a full-time job most of the time
    b. She occasionally had a full-time job
    c. She had a part-time job most of the time
    d. She occasionally had a part-time job
    e. She didn't work at all

ANSWER ONE IN BOTH #39 AND #40

39. Which of the following BEST describes your mother as you knew her?

    a. Considerate
    b. Understanding
    c. Efficient
    d. Like a companion
    e. Didn't know her well enough

40. a. Strict
    b. Stubborn
    c. Moody
    d. Weak
    e. Disorganized

41. In your family, were you

    a. the only child?
    b. the oldest child? (of 2 or more)
    c. the youngest child? (of 2 or more)
    d. a middle child? (neither oldest nor youngest of 3 or more)

42. When you were growing up, how strict were your parents about the companions you chose?

a. More strict than most parents.
b. About as strict as other parents.
c. Less strict than most parents.

43. How often did your entire family go out together? (to a movie, picnic, etc.)

a. Never (less than 2 times a year)
b. Less than once a month
c. More than once a month, but less than once a week
d. About once a week
e. More often than once a week

Miscellaneous

44. Generally, how much confidence do you have in your ability to succeed at a task?

a. Somewhat less than average
b. Average
c. More than average
d. Considerably more than average

45. In which ONE of the following personal characteristics do you feel it is MOST necessary for you to improve?

a. Speech or language ability or habits
b. Personal habits, (i.e., smoking, drinking, neatness, etc.)
c. Relations with others
d. Education or general knowledge
e. None of these

46. Mark the statement that most nearly applies.

a. I do not smoke
b. I am an occasional smoker (smoke at parties, when offered, etc.)
c. I am a light smoker ($\frac{1}{4}$ pkg cigaretts, or pipefuls, or one cigar per day)
d. I am a moderate smoker (1-1$\frac{1}{4}$ pkgs cigaretts, or 10 pipefuls, or 8 cigars per day)
e. I am a heavy smoker (2 or more pkgs cigaretts, or more than 10 pipefuls, or more than 8 cigars per day)

48. To which ONE of the following activities do you devote most time during your off-duty hours?

a. Reading (light material, magazines, newspapers, novels, etc.)
b. Playing cards
c. Listening to the radio or watching TV
d. Working in a shop (mechanics, woodworking, laboratory, etc.)
e. Social drinking (service clubs, bars, private parties)
f. Study(involving non-fiction texts, etc.)

Mark as many as apply in items #49 and #50

49. In which of the following activities or hobbies have you been so interested that you have devoted considerable time and energy to them?

a. Music (playing an instrument, singing in choirs, etc.)
b. Ride motorcycles, fly planes, sail boats
c. Nature study or gardening
d. Art (drawing, painting, etc.)

50. a. Taking part in dramatics or debating
b. Writing or Journalism (stories, school paper or yearbook)
c. Religious activities (other than choir singing)
d. Outdoor team sports (football, baseball, basketball, etc.)
e. Outdoor individual sports (golf, tennis, hunting, fishing, Scuba, etc.)
f. Other hobbies or preferred activities (of considerable interest)

_____

_____

_____

About your interests in Aquatic and other sports or activities

(Please circle the letter before the ONE most appropriate response category)

51. How old were you when you learned to swim?

(a) less than 4; (b) 5-7; (c) 8-10; (d) 11-13
(e) 14-16; (f) 17-19; (g) 20 or older

52. At standard pressure, how long do you think you could hold your breath?

(a) less than 20 seconds; (b) 21-40 seconds; (c) 41-50 seconds;
(d) 51-80 seconds; (e) 81-100 seconds; (f) 101-120 seconds
(g) 121-140 seconds; (h) 141-160 seconds; (i) 180 seconds (3 minutes) or longer

53. Without any equipment, how far can you swim underwater?

(a) 5 yds or less; (b) 6-10 yds; (c) 11-15 yds; (d) 16-20 yds;
(e) 21-25 yds; (f) 26-30 yds; (g) 31-35 yds; (h) 36-40 yds;
(i) 41-45 yds; (j) 46-50 yds; (k) 50 yds (half the length of a football field) or longer) (l) Cannot "free swim" underwater

54. Have you ever come close to drowning?

(a) Yes; (b) No

55. If yes, at what age did this occur?_____

56. During the years since you were 14, what sports other than swimming and diving have you engaged in actively? (Please list them)_____

_____

_____

_____

_____

GUIDELINES FOR POST-EXPERIMENTAL DIVER INTERVIEW

INSTRUCTIONS TO INTERVIEWER: The following outline is designed only to provide very general interview probes so as to obtain approximately the same interview responses from all diver-subjects. However, open-ended questions for each subject matter area are recommended when indicated.

1.0 GENERAL INTERVIEWER PROBES.

1.1 Self-perceived Performance.

Did you notice any significant change in your performance on the tests and in implementing the various procedures day-in and day-out? If so, on what tests? Approximately when during the dive did they occur? What, in your opinion caused these changes?

1.2 Motivation and Attitudes.

1.21 As the study progressed, did you notice any change in your readiness or willingness to put maximum effort into the tests and procedures? If so, what was the direction of change? When did it occur? Can you describe how you felt.

1.22 During the study, did your attitudes toward the experimenters, toward the relevance of the individual tests, and the experiment as a whole change? If so, in what way did they change, when? In your view, what events, conditions, etc., caused these attitude changes?

1.3 Affect and Emotional Status.

1.31 As the study went on did you notice any significant changes in mood, i.e., how excited, happy, sad, or depressed you felt? Were these changes cyclic, i.e., occur and reoccur periodically? Any particular time of the waking period did they occur? In your opinion, what caused these changes?

1.32 Was there any time or times during the study, when you were extremely apprehensive, anxious or "uptight"? If so, when? Did the cause(s) of this tension come from inside the chamber, and/or from the interrelationship with the experimenters and/or from causes outside the experimenter, e.g., your family.

1.33 In general, did you tend to be more, less or about same in terms of how tired you felt (as compared to normal work week for a diver)? If significant fatigue did occur, when did you notice it most? What caused it, in your view?

1.34 Was there any change in the quantity and quality of sleep you were able to get during the study? Take you longer to get to sleep? Wake up more often than usual? Feel rested afterwards? Describe, when did it occur, how severe, problem effects (e.g., on mood, performance, etc.).

Did you dream more/less than usual during the confinement? Can you recall any dream content? Would you mind describing the dreams you can recall?

1.4 Interpersonal Processes.

1.41 Did you notice any change in your relationships with the other subject(s)? If so, in what way?

1.42 Insofar as you can tell, did your affective relationships with your fellow-subjects (i.e. how well you liked (disliked) them (him)etc.).

2.0 SYMPTOMS PECULIAR TO THE CHAMBER SITUATION.

2.1 Any peculiar sensations in stomach or head during routine saturation period, before and after excursions. Describe.

2.2 Did the walls of the chamber "look" different after a while, e.g., closeness, changes in contour, etc. When, in the dive (early, mid, late, etc.) did this occur. Describe the experience(s).

2.3 Anything different about the sounds you heard e.g., shipmate's voice, your own, the experimenter's. Louder, softer, more/less unpleasant. Describe.

2.4 How many of the following symptoms did you experience from time to time (e.g., 4 or more times) during the study?

	Yes	No	When during Experiment?	Given Medication?
Ringing in Ears	___	___	_____	_____
Eyes burn	___	___	_____	_____
Eyes blurred	___	___	_____	_____
Toothache	___	___	_____	_____
Chest Pains	___	___	_____	_____
Headache	___	___	_____	_____
Earache	___	___	_____	_____
Cold (s)	___	___	_____	_____
Vague Dull Aches	___	___	_____	_____
Other symptoms (describe)	___	___	_____	_____

3.0 SYMPTOMATOLOGY PECULIAR TO DENSE GAS EXPOSURE, DECOMPRESSION SICKNESS, ETC.

3.1 How did you feel when you first reached saturation depth? Be as detailed as you like.

3.2 Describe how you felt in the first 4-5 hours of the dive?

3.3 Describe before and after feelings during the first excursion. Fearful? Did you have bends symptoms? Describe. HPNS? Describe. "Narced"? Give details.

3.4 In general, in subsequent excursions how were you affected? Fearful, worried? "Narc" indicators, same, milder, or more severe than first excursion? Bends symptoms, absent, same, milder, or worse than first excursion?

3.5 Any joint, muscle, abdominal, head, etc., aches and pains following the first excursion? Yes____; No____. Following later excursions? Yes____; No____. Describe.

3.6 Comparing 2nd, 3rd, etc. excursions from X feet to first excursion, what differences (if any) in the way you felt during descent, bottom, ascent? Describe.

3.7 While at saturation depth, did you.

Feel capable of 2-3 hours physical work? Yes____ No____
Feel reasonably well rested? Yes____ No____
Feel "clear headed" enough to solve arithmetical problems? Yes____No____
Feel interested in doing the tests as well as possible? Yes____ No____

While "bottomed-out" during excursions, did you.

Feel capable of 2-3 hours physical work? Yes____ No____
Feel reasonably well rested? Yes____ No____
Feel "clear headed" enough to solve arithmetical problems? Yes____No____
Feel interested in doing the tests as well as possible? Yes____ No____

3.8 Any significant feelings, aches/pains, etc., during decompression to surface? Describe.

4.0 IMMEDIATELY UPON OPENING THE CHAMBER,

4.1 Did you notice any unusual visual or hearing experiences? Yes____No____ If so, describe.

4.2 Did you experience any disorientation?

4.3 Any dizziness, unsteadiness underfoot, etc?

5.0 MENTAL STATUS EXAMINATION.

If interviewer has sufficient training and experience in conducting Mental Status Examinations M.S.E., evaluation of the following processes should be checked (to be compared with the same data collected pre-experimental):

5.1 Sensorium Abnormalities.

Orientation, time, place, person.
Memory, remote, immediate.
Attention and immediate recall, e.g. digits, forward and backward.
Reaction time, e.g. color naming.
Problem solving, e.g. serial sevens.

5.2 Abnormalities of Motor Activities.

Muscular tension, tremor, etc. e.g. handwriting, drawing.
Speech abnormalities.
Expression and posture.

6.0 PERSONAL SATISFACTIONS AND DISSATISFACTIONS FROM RECENT DIVE.

List all interviewee cares to mention.

7.0 SUGGESTIONS FOR IMPROVING FUTURE STUDIES OF THIS KIND.

Be as detailed, frank and candid as you'd like.

8.0 MOTIVATION FOR VOLUNTEERING FOR FUTURE STUDIES OF THIS KIND.

APPENDIX D

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13. ABSTRACT

This study was designed to provide some insights as to possible psychological screening criteria for U. S. Navy divers being considered for special operational assignments. Four USN divers who had volunteered for SHAD-I (Shallow Habitat Air Dive) were administered the DPSS (Depression Proneness Sentence Stems), the MMPI (Minnesota Multiphasic Personality Inventory), the DBI (Diver Biographical Inventory) and were subjected to a semi-structured clinical interview before and after the 30-day, hyperbaric (50 F.S.W.) experiment. These test and interview data were compared with the same data obtained from an independent sample of 64 USN divers, and provided the basis for selecting the two SHAD subjects and the two back-up divers. Construed as hypothetical diver screening criteria the major selection factors were: MMPI profiles congruent with the mean profile of the diver sample, more and varied diver experience, not depression prone, compensating trait patterns of the diver pair, not seriously habituated to use of tobacco or alcohol and strong motivation for and well-disposed attitudes toward a variety of diver-related activities. Sample copies of the experimental tests, interview schedules, and questionnaires are included as appendices, as is a bibliography of 83 references to literature in the area of diver and aquanaut selection.

14. KEY WORDS	LINK A		LINK B		LINK C	
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