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STUDIES OF SOCIAL GROUP DYNAMICS UNDER ISOLATED CONDITIONS

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16. Abstract

The report organizes and summarizes the scientific literature dealing with the study of human behavior and crew-interaction in situations simulating long term space flight. It includes a bibliography of all the pertinent U.S. literature available as of May 1974, and a Matrix "Analysis of Studies Summarized According to Behavioral Factors and Environmental Conditions."

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FOREWORD

This report was initiated by and prepared under the direction of Dr. Sherman P. Vinograd, Director, Biomedical Research Division, Office of Life Sciences, NASA. Dr. Richard Belleville of the Biomedical Research Division, NASA, assisted during its early development. Dr. Thora W. Halstead and Jean E. Pulliam of the Science Communication Division were project directors. Linda Pleasant, Isabel Dalsimer, Lloyd Apirian and Larry Schwartz analyzed the literature. Patricia Milburn and Mildred Harrell performed the technical work. The work was supported under NASA contract NSR 09-010-027.

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PRECIS

When one considers the potential problems which may be associated with very long duration manned space missions of the future, it is apparent that one of the very important areas of question relates to the ability of small groups of people, socially isolated from the rest of the earth's population, to function harmoniously and efficiently for extended periods of time. This area has been known by a number of terms: "group integrity", "crew interaction", "small group dynamics", and others, all of which are reasonably descriptive of its content. Regardless of which heading is preferred, the important fact remains that this is an area about which we currently have far too little usable information. Constituent practical problems, such as techniques for selection of personnel for optimum group harmony and effectiveness, selection of leaders, early identification of disruptive trends, recognition of disruptive factors, preventive methods, and corrective techniques, all require a greater knowledge than we now have of the nature and dynamics of small group function, the roles and relationships of individual members, and the kinds of changes that occur as a function of time.

Thus, the need for research emphasis is clear, and the practical informational goals desired can be defined, but the opportunities for such research are relatively few. As a consequence, it is particularly important that: (1) all past investigations and experience of this nature are well documented and carefully scrutinized, and that (2) a research approach to this problem area is planned as systematically and efficiently as possible in order to hold down the potentially associated long lead times and high costs to within reasonable limits. This survey of currently available literature on the subject is designed to enhance the first of these two requirements and thereby favorably influence the planning and implementation of the second.

It should be noted that the summaries contained in this volume are perhaps unique in the literature. They were also very difficult to prepare, due in significant measure to a troublesome lack of precision in the use of terms which seemed to characterize the literature. It was for this reason that the glossary of terms was assembled and included as a part of this report. In both concept and preparation, these summaries reflect special credit on the personnel of the George Washington University Medical Center, Science Communication Division, who participated so diligently in this effort.

It is sincerely hoped that the bibliography, summaries, glossary, and matrices which make up this volume, will provide an easily usable as well as useful reference, to the end it will help to simplify our collective course through the research maze in this complex and important area.

Sherman P. Vinograd, M.D.

CONTENTS

INTRODUCTION

The following report is designed to organize and summarize the pertinent scientific literature dealing with the study of human behavior and crew interaction in situations simulating long term space flight. The objectives are twofold, to not only review that work which has already been performed, but to provoke new research by exposing areas in which there is a deficiency of information.

There are four parts to this report, as enumerated in the table of contents. These parts are herewith described in reverse order to enable the reader to understand the development of the report.

The Bibliography includes all the U.S. literature available as of May 1974. References are listed in alphabetical order by the last name of the first author, and are cross-referenced to the corresponding surrogate document, i.e. summary, by page number. In addition, an author index, listing and cross-referencing all of the authors, is included.

Pertinent studies have been performed under a variety of environmental conditions (e.g., Antarctic, submarine). Each of these conditions is identified as a research study area in this report. Within each research study area, one or more studies have been conducted. Thus the study area Antarctic contains four studies identified as A-1 to A-4, while the study area Arctic includes one study indentified as AR-1. Each study consisted of one or more experiments, which were published in several reports. These reports have been compiled, analyzed and summarized, so that each study is presented in a single all inclusive summary. All of the summaries have the same format, which takes the form of a considerably expanded abstract.

The scientific literature dealing with this subject contains a number of behavioral characteristic terms that are frequently employed to mean a variety of things. To avoid confusion or misunderstanding, a number of these terms have been identified, and their definitions as employed in this report are presented in the glossary "Definitions of Behavioral Terms" as they are used in this survey. They are not intended to serve as absolute definitions.

The table, "Analysis of Studies Summarized According to Behavioral Factors and Environmental Conditions", consists of two matrices. The first, "Matrix of Factors Studied", correlates each research study area and individual study with the behavioral factors that were investigated in the study. This is meant to provide a rapid means of identifying the type and amount of research which has been performed. The second matrix, "Matrix of Conclusions Drawn by Investigators", identifies those studies whose investigators appeared to draw specific conclusions concerning the questions of importance to NASA, i.e. the areas of Selection, Training, Prevention, Early Diagnosis and Correction.

I. ANALYSIS OF STUDIES SUMMARIZED ACCORDING TO BEHAVIORAL FACTORS AND ENVIRONMENTAL CONDITIONS

FACTORS STUDIED

	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
SELECTION									
Intelligence			L-1	F-2;4	S-2	SS-3;11	U-3		R-3;4;11;15;39
Medical				F-4	S-2	SS-2;3;10; 11;12	U-1	M-2	R-5;11;16;27;30;39
Psychological/ Psychiatric	A-1	AR-1		F-2;3;4	S-2	SS-2;3;8;10; 11;13;14	U-1	M-2;4	R-2;3;4;5;8;9;11; 16;19;27;30;31;34, 36;37;42
Demographic Factors		AR-1	L-1	F-4		SS-14	U-2	M-1;3	R-15;16;27;34;42
TRAINING									
Psychological						SS-2;7;8			R-1;2;3;8;11;27; 39
Technical				F-4		SS-2;3;6;7; 8;9;11;12	U-1		R-1;2;3;4;8;11;27; 39
ENVIRONMENTAL CONDITIONS									
Physical Layout			L-1;2	F-2;3;4;5		SS-1;5;6;8; 9;11;12;13	U-1;3		R-9;10;13;14;19;20; 26;27

ENVIRONMENTAL CONDITIONS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Storage			L-1				U-1		
Space per man			L-1	F-1;3;5	S-2				R-9;10
Space Utilization			L-1	F-2;5		SS-1;5;6; 8;9;11; 13	U-1		
Privacy			L-1	F-3;5			U-1;3		R-13;14;19;20; 26;27
Crew Size	A-1;2;3; 4	AR-1	L-1;2	F-1;2;3; 4;5;6		SS-1;2;3;4; 6;7;8;9;10; 11;12;13	U-1;2;3	M-1;2;3;4;5	R-7;10;15;23; 24;30;33;34
Two			L-1;2			SS-1;4;10; 12			R-10;15;23;24; 33;34
Three			L-1			SS-6			R-7
Four-Ten	A-2			F-2		SS-2;3;6; 7;8;9;11; 12;13	U-1;2;3	M-1;2	R-10;15;23
Over 10	A-1;3;4	AR-1		F-1;3;4; 5;6	S-1;2	SS-5;9	U-2;3	M-1;2;3;4	R-15;24;30
Atmospheric Conditions	A-1;2;3	AR-1	L-2	F-4;5;6	S-1	SS-2;12;13	U-1;2;3	M-1;5	R-22;23;24;27; 30;38

ENVIRONMENTAL CONDITIONS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Option to escape or discontinue			L-1	F-1;2;3;4				M-2	R-24
Availability of hygiene			L-1	F-2;4;5;6		SS-9;12	U-1		R-20;24;27
Quality and quantity of food		AR-1	L-3	F-4;5		SS-3;6;11; 12	U-1;3		R-20;22;27;38
Availability of medical care				F-4					R-37
Work schedule	A-2;4		L-1;2		S-2	SS-1;2;3;5; 6;7;8;9;10; 11;13	U-2;3		R-2;6;11
Sleep schedule	A-4					SS-2;3;5;6; 8;9;10;11	U-3	M-2	R-11
Recreational schedule and equipment	A-4	AR-1	L-1	F-1;4;6	S-2	SS-3;6;8;9	U-1;3	M-2	R-6;16;20
Protective equipment or procedure against danger and toxicity	A-2		L-2						
Rank	A-2	AR-1	L-1						
External communications	A-1;2		L-1	F-2;5	S-2	SS-2;9;10;11	U-2;3	M-2	R-13;22;27; 28

ENVIRONMENTAL CONDITIONS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Limited				F-2	S-2			M-2	
Regular			L-1	F-4	S-2	SS-2;11	U-2;3	M-2	R-28
Occasional	A-1;2								
None			L-1	F-5		SS-9;10			
Length of confinement	A-1;2;3;4	AR-1	L-1;2	F-1;2;3;4;5;6	S-1;2	SS-1;2;3;4;5;6;7;8;9;10;11;12;13	U-1;2;3	M-1;2	R-9;10;15;30;35;40
One week or less	A-4		L-1;2	F-1;3;4;6		SS-1;6;9	U-2	M-1	R-10;35
One week to one month		AR-1	L-1	F-1;2;5;6	S-1	SS-2;3;4;5;7;9;10;13	U-1;2;3	M-1	R-15
Over one month	A-1;2;3	AR-1			S-2	SS-8;11;12	U-3	M-2	R-15;30;35
Mobility	A-2	AR-1	L-1	F-4;5					R-9;40
GROUP DYNAMICS									

GROUP DYNAMICS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Structure	A-1;2			F-6	S-2	SS-3	U-3		R-1;21;22;25; 34;35;38;41
Performance/ Effectiveness	A-1		L-3;4			SS-1;3;5;6; 7;8;9;10;11; 13	U-2;3		R-2;3;4;6;7;9; 10;11;12;15;20;21; 27;29;30;32;34;35; 36;37;41;42
Leadership behavior	A-1		L-1	F-3;4;5;6			U-2;3	M-1	R-7;12;17;19;21; 24;31;34;35;37; 38
Problem-solving	A-1;2			F-1	S-2	SS-2;3;10	U-3	M-1	R-7;17;19;21; 26;34
Dependence on others					S-2		U-2;3		R-3;27;42
Cohesion						SS-3;8;12	U-2;3	M-5	R-1;10;21;24;26; 31;36;38
Compatibility	A-1		L-1			SS-2;10;11	U-1;3		R-1;12;14;21;26; 27;37;40;41
Work Interaction	A-1;2					SS-8;9;10;11	U-1		R-6;8;15;21;37
Intragroup	A-1;2					SS-8	U-1		R-6;8;21;37
Extragroup						SS-9;10;11	U-1		R-8;15;37

GROUP DYNAMICS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Motivation	A-1	AR-1		F-2;6	S-1	SS-6;8;9;10; 12	U-2	M-3	R-2;15;17;26; 27;29;30;31; 37;38
Performance	A-4					SS-8;9;10			R-38
Time Utilization	A-2;4		L-1;2	F-2			U-2;3		R-19;20;36
Space Utilization			L-1			SS-1;11	U-2;3		R-21
Interpersonal communication	A-2		L-1			SS-3;8;11	U-1		R-6;12;17;21;29; 33;34;35;38
Interpersonal stress	A-1;3		L-1	F-3;5		SS-2;7;10	U-1		R-4;6;11;12;14; 16;21;24;26;27; 31;32;43
Legal structure								M-2	R-17;22;27
INDIVIDUAL DYNAMICS									
Somatic symptoms	A-1;3	AR-1	L-2	F-4;5;6	S-1;2	SS-3;4;5;7; 9;10;11;12	U-1;2	M-1	R-2;11;16;22;24; 27;28;30;31;32; 33;38
Headaches	A-3			F-4;6	S-1;2	SS-7;9	U-2	M-1	R-16;20;21;22; 24;27;30;31;32; 38

INDIVIDUAL DYNAMICS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Nausea				F-4		SS-7;9		M-1	R-16;27
Dizziness					S-1				R-16
Fatigue			L-2		S-1;2	SS-3;9;10			R-2;3;8;11;16; 27;28;30;32;38
Sleep quantity	A-1;3;4			F-2;4	S-1	SS-5;8;9;10	U-2;3		R-22;24;28;30; 32;36;38;39
Sleep quality				F-4;5;6	S-1;2	SS-5;8;9	U-1;2;3		R-16;24;27;31; 39
EMOTIONAL SYMPTONS	A-1;2;3	AR-1	L-1	F-2;4;5;6	S-1;2	SS-2;3;6;7; 8;9;10;12	U-1;2;3	M-1;2;3;4	R-1;2;3;4;6;10; 11;12;13;15;16; 19;22;23;24;26; 27;30;31;32;35;38;39
Anxiety	A-1		L-1		S-2	SS-8;12	U-3	M-1;4	R-1;16;22;30;32; 38;39
Boredom	A-1;2		L-1	F-4;5;6		SS-9;12	U-1		R-2;4;6;10;12;15; 22;28;32;35;38
Depression	A-1			F-1;2	S-1;2	SS-12	U-1;3		R-16;24;27;30;32; 35;38;39
Daydreaming	A-2					SS-10			R-16;27;38

EMOTIONAL SYMPTOMS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Moods			L-1	F-2	S-1;2		U-2;3		R-27
Desocialization			L-1		S-2	SS-3	U-1;2		R-26;27;32;34; 37;38
Personality Deterioration							U-2	M-3	R-2;3;19;23;35
Irritability	A-2			F-2		SS-6;7;9;10; 12	U-1	M-1;2	R-2;3;11;16;22; 24;27;30;31;38;39
Hostility	A-1;3		L-1		S-2	SS-2;7;8;10	U-3	M-2	R-2;10;12;13;15; 23;26;27;34;38;39
Personal Needs	A-3	AR-1	L-1	F-3;4;5	S-2	SS-4	U-1;2;3	M-2	R-12;13;14;17;21; 26;27;31;35;37
Social	A-3	AR-1	L-1		S-2	SS-4	U-1		R-12;13;14;17;20; 31;35;37
Territoriality			L-1		S-2		U-2;3	M-2	R-13;21;26;27
Privacy			L-1	F-3;4;5			U-1;3		R-13;14;19;20;26; 27;34;38;40
Biorhythmicity	A-4		L-3						R-11;16;30;34;36; 37;40

EMOTIONAL SYMPTOMS CONT'D	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Perceptual Changes	A-1;2;3	AR-1	L-1;2	F-2		SS-2;3;4;6; 7;12;13		M-1	R-2;8;9;16;17; 31;39;40
Self-perception	A-1;3	AR-1				SS-3;4		M-1	R-33
Perception of others			L-1			SS-2;3			R-17
Time Estimation			L-2			SS-6;7;12;13			R-2;8;9;16;31; 33;36;40
Size Estimation	A-2			F-2					
Psychomotor Functions			L-2	F-4	S-1	SS-1;2;3;4;5; 6;7;8;9;10; 11;12;13	U-1;2;3	M-1	R-2;3;4;9;10;11; 15;16;27;30;31; 32;34;35;37
Cognitive Functions	A-3		L-1;2	F-2;4	S-1	SS-1;2;3;5;7; 8;9;11;12	U-2	M-3	R-2;3;4;9;10;11; 13;15;16;17;23; 24;27;29;31;32; 35;36;37;38
Motivation	A-1	AR-1				SS-2;9;10;11; 12	U-2	M-3	R-1;2;3;8;9;10;11; 13;15;16;23;26;27; 28;29;30;31;37;38; 40
Performance	A-1	AR-1	L-1;2;4			SS-1;3;5;9;12; 13	U-1;2;3		R-2;3;10;11;15;16; 27;29;34;35;37;38; 39
OBSERVATIVE CONCLUSIONS									

OBSERVATIVE CONCLUSIONS	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
Self-rating scales		AR-1		F-2	S-1	SS-2;3;14	U-2;3	M-4;5	R-43
Diaries				F-2;4		SS-2;9;10			R-10;15
Psychological Tests		AR-1	L-1	F-2;4		SS-4;6;9;10; 11	U-1;3	M-1;4	R-5;10;23;27 31
Interviews	A-3		L-1	F-2	S-1	SS-2;6	U-1;2;3	M-1	R-4;5;10;15;42

CONCLUSIONS DRAWN BY INVESTIGATORS

	Antarctic	Arctic	Laboratory	Fallout Shelter	Submarine	Space Flight Simulation	Underwater Habitats	Miscellaneous	Reviews
SELECTION	A-1	AR-1	L-1	F-3		SS-2;6;7;14	U-1;2;3	M-4	R-1;2;3;5;7;8;11;12;19;21;27;28;30;31;34;36;42
a Group	A-1	AR-1	L-1	F-3		SS-2;6;7;14	U-1;2;3	M-4	R-1;2;3;5;8;11;12;19;21;27;28;30;31;36;38;42
b. Leader	A-1		L-1				U-3		R-7;31;34;42
TRAINING				F-4		SS-2;6;7;8	U-1		R-1;2;3;4;11;19;38;40
PREVENTION	A-2		L-2	F-1		SS-2;10;11	U-1;3		R-1;2;10;11;13;15;18;20;26;27;28;32;34
EARLY DIAGNOSIS OF DISHARMONY			L-1				U-1	M-2	R-9;10;12;13;14;16;27;34
CORRECTIVE PROCEDURES							U-1;2		R-6;9;13;16;21;22

II. DEFINITIONS OF BEHAVIORAL TERMS

DEFINITIONS OF BEHAVIORAL TERMS

GROUP

Cohesion - the attraction that a group holds for its members, which dictates the capacity of the group to resist dissolution.

Crew composition - general make-up of the crew from the standpoint of occupation, skills, professional expertise, status, attitudes, values and other elements of personal histories.

Crew size - number of persons comprising group.

Desocialization - breakdown of relationships between an individual or individuals and the group, evidenced by withdrawal, anti-social behavior, rule-breaking, etc.

Extra-group identification - identification with persons outside the isolated area; sense of belonging to a larger group or organization.

Group dynamics - the entire array of moving forces concerning the interrelationship of individuals with each other and with the harmony and function of the group as a whole: the laws relating to them.

Group effectiveness - degree of group accomplishment, achievement, productivity and efficiency in carrying out its assigned task(s).

Group expectancy - objectives set by the members of the group for the group; includes goals and beliefs.

Group problem-solving - the process involved in the determination of the correct sequence of alternatives leading to a desired goal for the group.

Group structure - organization of the members of the group. Factors include: member roles and their delineation, leadership, and group size and composition.

Legal structure - rule making roles and procedures of the group.

Performance (group and individual) - way in which the group or individual carries out task(s).

Subgroup interaction - relationships between members of a smaller group within the defined larger group. Deals with interaction of cliques and "in-groups".

Work/rest cycles - distribution of time between work and rest.

INTERPERSONAL

Compatibility - degree to which persons can co-exist. Factors include: co-operation, likableness, friendship, peer group relations and attraction.

Dependence on others - degree to which a person (or persons) relies on another.

Interpersonal communication - interaction between individuals; verbal/non verbal, formal/informal.

Interpersonal stress - conflict between individuals, producing physical or psychological strain or disorder.

Person perception - image that one person has of another; deals with peer ratings.

Role behavior - overt responses to activities designated by a particular position. Factors include: ascribed roles, self-perceived roles, pecking order, and emerging structure.

Territoriality - the tendency of individuals to require a specific personal territory or possession for their own exclusive use.

Work interaction - relationships between individuals working interdependently to accomplish a common task.

INDIVIDUAL

Adaptation - adjustment to an altered physical and/or social environment; (level may increase or decrease during confinement).

Anxiety - an unpleasant or fearful emotional state that is characterized by an overall feeling of uneasiness.

Biorhythm - a biologically manifested cyclic variation or recurrence of an event or state, such as the sleep cycles and circadian rhythms.

Boredom - mental state resulting from lack of motivation, interest or activity; usually expressed as a function of monotony.

Cognitive function - process which allows an organism to know and be aware; includes perceiving, reasoning, conceiving, judging.

Daydreaming - a temporary lapse into wishful or imaginative fantasy while awake with simultaneous lessening of awareness of reality.

Defense mechanisms - ways in which individuals protect themselves in or against unpleasant situations. Behavioral mechanisms include: rationalization, sublimation, projection, etc.

Depression - feelings of helplessness, hopelessness, inadequacy and sadness: melancholia.

Emotional control - ability of an individual to direct his own emotions or the emotions of others.

Hostility - aggressive feeling of anger or desire to harm another person or group.

Leadership - the exercise of authority in initiating, directing or controlling the behavior or attitudes of others with their consent. Those qualities of personality and training which make the guidance and control of others successful.

Meal behavior - actions a person takes during mealtime. Factors include the way he eats, what he eats, duration of mealtime.

Mobility - capacity for movement from place to place.

Mood - a state of emotional susceptibility, enduring for some minutes or hours, in which most of the person's emotional responses tend to be similar; e.g. cheerful mood, morose mood.

Motivation - the drive or incentive to accomplish task or goal.

Perceptual aberrations - misinterpretation or distortion of normal sensory stimuli. Some examples are: illusions, hallucinations, mistaking sounds, white-outs, time and size distortions.

Performance - the manner, efficiency and effectiveness with which an individual or group executes a task.

Personal needs - requirements of an individual for maintenance of well-being and optimal performance efficiency. Factors include primary needs, (food, water, sleep etc.), privacy, social interaction, recreation, etc.

Personality deterioration - the breakdown or disorganization of the pattern of traits characterizing an individual person. Some examples are: paranoid behavior, anti-social behavior, emotional impairment, infantilism, depersonalization, deterioration of moral standards.

Psychomotor function - muscular activity ensuing directly from a mental process.

Self perception - the image or idea that one has of oneself: individual self-appraisal.

Sleep quality - appraisal of satisfactory/unsatisfactory sleep. Contributing characteristics are: time to fall asleep, number of awakenings, how rested when awakened, degree of restlessness and amount of disrupted sleep; electro-encephalographically, the relative amounts of the individual stages of sleep.

Sleep quantity - duration or amount of sleep.

Social needs - needs, usually learned, that require the presence of an interaction with other people for their satisfaction. Some examples are: need for achievement, affiliation, prestige, dominance.

Somatic systoms - subjective physical disturbances. Some examples are: headaches, nausea, pain, insomnia, anorexia.

Time estimation - perception of the passage of time, duration; the ability to estimate various segments of time.

Time utilization - the way in which an individual uses or distributes his time.

ENVIRONMENT

Degree of confinement - a term used to connote both the extent of spatial limitations and degree of social isolation. Factors include: how much room, how much contact with outside, how different from external society.

Habitat environment - the physical conditions existing within the confines of the living/working space provided. Factors include: crowdedness, atmosphere, temperature, threat of danger.

III. RESEARCH SUMMARIES

A-1
ANTARCTIC STUDY
Deep Freeze (1955-1961; 1963-1969)

U.S. Navy Medical Neuropsychiatric Research Unit, San Diego, California

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PURPOSE

a)To measure the emotional reactions in several groups of scientists and Navy men exposed to prolonged isolation and confinement in scientific stations in the Antarctic.

b)To determine whether a man's personal history is pragmatic or theoretical as a predictor of performance.

c)To identify psychological problems engendered by isolation, confinement and other unusual environments in order to develop an efficient personnel selection method.

d)To establish satisfactory criterion measures of an extremely unusual and stressful environment.

e)To investigate the generality of attitude patterns and change among Antarctic small station groups.

f)To aid in the development of conceptually meaningful differential predictors for varied work roles in an extreme environment.

g)To determine which predictor variables can be used to set performance criteria for various occupations.

h)To examine cultural and psychological differences among a wide selection of occupational groups, over a range of cultural and psychological attributes.

i)To define the similarities and differences between popular and unpopular leaders in small groups.

SUBJECTS

a)Subjects varied from study to study but were always Naval personnel or Naval personnel and civilian scientists.

b)Number of subjects ranged from 54 to over 600.

PERIOD OF CONFINEMENT

a)Separate one-year studies. Six-month winter isolation. 1955-1961.

b)Five-year study; subjects confined for one-year periods during 1963 - 1968.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Small stations - included Byrd, Hallet, and South Pole - 14 to 40 men

b)Large station - McMurdo Sound - 150 men or more

c)Outside temperature - ranged from -140°F to 40°F

d)Winds - up to 140 knots

e)Altitude - up to 10,000 feet

f)Darkness - 6 to 8 months a year

PROCEDURES

a)The mission of the military group was that of maintaining the station in operating condition.

b)The civilians' task was to collect scientific data in various disciplines.

c)During the 6 summer months all station personnel jointly prepared for the winter confinement period.

d)During the winter months they were confined to the interior limits of the station.

e)They were isolated from the outside world except for occasional radio communications.

f)Each man assumed responsibilities prescribed by his occupational speciality.

g)Attitude tests were administered 6 months before deployment to the Antarctic.

h)Other tests were performed during the winter and summer months of Antarctic stay.

TESTS

a)Attitude Inventory

b)Leader Evaluations

c)Peer Rating Reliability

d)List of Common Symptoms

e)Standard Psychodiagnostic Record Booklet

f)Personal History Booklet

g)Supervisor Rating Reliability

h)Attitude Measurements

VARIABLES STUDIED

a)Physical adjustment

b)Expedition motivation

c)Trust in organization

d)Personal usefulness

e)Boredom

f)Group member compatibility

g)Group teamwork

h)Group efficiency

i)Group achievements

j)Equalitarian atmosphere

k)Sleep disturbances

l)Depression, aggression, and anxiety

m)Somatic complaints

n)Sources of stress

o)Cultural and psychological differences among occupational groups

p)Leadership performance

RESULTS

COMBINED RESULTS 1957-1961

ATTITUDE

a)The groups were not homogeneous in variance on any of the attitude clusters except one: attitudes of boredom were of homogeneous variance at post-winter test administration.

b)Only for group member compatibility did groups maintain a relatively constant rank order on variance over time.

c)The extent to which the members of any group shared a common level of attitude was not consistent from mid-winter to post-winter.

d)By the end of the winter, just prior to leaving the Antarctic, groups were homogeneous in regard to attitudes of personal usefulness and boredom as well as physical adjustment; in terms of motivation and attitudes about one's group, inter-group differences prevailed throughout the winter.

ADAPTATION

a)It is suspected that aspects of the immediate environment, such as work load and social boundaries of station life, are more critical for the development of emotional response variation than the fact that the men are isolated from the outside world.

b)Of greatest importance in the consideration of human adaptation is the physical and emotional health of each individual.

c)Adequacy of work performance seems to be a rather logical criterion of adaptation.

d)Ability of the individual to adjust to the other station members is a criterion of adaptation.

POPULAR LEADER

a)Hypothesis I - The hypothesis of no difference between popular and unpopular leaders on characteristics denoting individual prominence was supported. While both groups of leaders were above the population mean of 50, there was no significant difference between popular and unpopular leaders.

b)Hypothesis II - The hypothesis of no difference between popular and unpopular leaders on characteristics denoting task motivation was supported. In neither the supervisor nor peer derived measure of task motivation was there a significant difference between popular and unpopular leaders, although the popular leaders were judged by supervisors to be slightly ($p<.20$) more task-motivated than the unpopular leaders.

c)Hypothesis III - The hypothesis concerning differences between popular and unpopular leaders in social-emotional orientations was supported. On the basis of supervisor ratings, popular leaders were more emotionally controlled, adaptable accepting of authority, and motivated to be a part of the group ($p<.02$). On the basis of peer nominations, popular leaders were perceived as being more interested than unpopular leaders in maintaining group harmony ($p<.01$).

GROUP STRUCTURE

a)A group composed of compatible members does not have to spend time and energy resolving group maintenance problems which arise from interpersonal tensions.

b)Compatibility depends to some extent on role structure; roles must be carefully defined, but provision must be made for their relaxation because status-leveling is a very important consideration for group coexistence.

c)Stress and unpredictable environment tend to increase the strain on the interpersonal or group structure.

d)Change in structure may indicate change in function or mission of the group, or may indicate that the adopted structure is failing to cope with the needs of the group.

e)Greatest number of interpersonal relationships occur between work partners.

COMBINED RESULTS 1963 - 1964

a)Station members who nominated Seabees for wintering-over considered emotional stability, task performance, and social compatibility more significant than leadership performance when determining who should be selected to winter-over at a small Antarctic station.

b)For civilians, emotional stability was more significant than leadership performance.

c)For both Navy groups, emotional stability was the trait rated highest and leadership was rated lowest.

d)For the civilian group, social compatibility was rated highest.

OVERALL RESULTS

MENTAL HEALTH PROBLEMS

a)Navy men showed higher incidences of insomnia and depression than did civilians at both times.

b)Navy men and civilians both reported anxiety symptoms during the winter months.

c)Feelings of hostility were prevalent during the latter part of the year for both groups.

d)Hallet, Eights, and Palmer station personnel reported more anxiety and depression but less sleep disturbance than did personnel at Byrd and South Pole.

e)Correlations were established between personal history and development of emotional symptoms; however, these varied according to the groups involved. Naval personnel did not have the same psychological needs as civilians; therefore, specific hobbies and recreational interests predictive of emotional adjustment varied for the Navy and civilian groups.

RELATIONSHIP PREDICTABILITY OF OCCUPATIONAL GROUP AND PERFORMANCE CRITERIA

a)Clinical evaluations could predict leadership ability of Navy technical and administrative personnel but not of Navy construction personnel or civilian scientists.

b)Neither emotional stability, social compatibility, nor overall performance could be accurately predicted by clinical evaluations, personality scales, opinion survey items, or personal history.

c)Responses to questions concerning hobbies and avocational activities could be used to predict emotional stability but not task performance.

d)Of the three groups, Navy technical personnel, Navy construction personnel,

and civilan scientists, the technical group was the most predictable and the construction group the least predictable.

CONCLUSIONS

1957 - 1961

a)Groups varied in the number and nature of attitude areas in which there was significant change. None of the groups changed significantly in every attitude cluster.

b)For none of the attitude clusters was there a significant change for every group.

c)Significant changes were most frequent in attitudes related to group characteristics, such as compatibility, teamwork, and group achievement.

d)In terms of direction of change, attitude levels tended to change toward less favorability; attitude variances tended to increase over time.

e)Personnel evaluations made by small station leaders and peers appear reliable both within and between assessment time periods.

f)Esteemed leadership was found to be a correlate of relatively democratic leadership orientation, a leadership style characterized by: leader participation with the men; a personal man-to-man relationship between leader and men; and a leader who respects and seeks the opinion of his men in matters which directly concern them.

g)There was no significant difference between popular and unpopular leaders in characteristics denoting individual prominence.

h)Compared to unpopular leaders, popular leaders were more emotionally controlled, adaptable, accepting of authority, motivated to be part of the group and interested in maintaining group harmony.

i)The best single criterion measure of individual performance is a standard score based upon a combination of peer and supervisor choices of individuals with whom they would most prefer to return for further small station duty were they to return to the Antarctic.

j)The primary value of the dependent variables measured or observed lies in the fact that they are helpful in providing a conceptual definition of the criterion. This is particularly evident when the program is carried a step further in order to provide a predictive tool for screening purposes.

1963 - 1964

a)The group isolated in a hostile environment was most threatened by emotional instability and social incompatibility. This should be considered in screening and selecting members for an isolated group.

b)There was a consistency in emphasis of the personality-oriented behavior rather than the task-oriented behavior for both military and civilian subjects.

c)Varied and perhaps surprising partial personality composites of the "ideal Antarctic man" should dispel any notions that prediction of adjustment in this setting a simple exercise.

d)The wide variations in percentages in the groups studied is indicative of the relevancy (or irrelevancy) of the prediction sources for certain performance criteria and/or occupational groups.

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A-2
ANTARCTIC
Antarctic Summer Study (1965-1966)

Walter Reed Army Hospital
Washington, D. C.

PURPOSE

a)To present four sets of observations of a seven-man group during a 4-month journey across the polar plateau of Antarctic.

b)The four sets of observations are concerned with: 1)development of informal group structure, 2)behavior when in personal danger, 3)monotony and boredom, and 4)visual perception in whiteouts.

SUBJECTS

Seven men ages 23-34 (two seismologists, two glaciologists, one geophysicist, one topographic engineer and navigator, and one mechanic for the sleds).

PERIOD OF CONFINEMENT

Four months (October 1965 - January 1966) during the Antarctic summer.

EXPERIMENTAL CONDITIONS AND PROCEDURES

a)Weather conditions were Antarctic.

b)Subjects lived, ate, and slept in small over-snow vehicles (Sno-Cats).

c)Only contacts with the outside world were a radio and an occasional airdrop of supplies.

d)Tasks included studying and collecting data on properties of the region.

e)The party travelled 2 days out of every 3.

f)Every 5 miles (1 1/2 hours) they stopped for a few minutes so that certain measurements could be made.

g)Every third day was spent in one place carrying out more extensive measurements of the snow and ice.

TESTS AND VARIABLES STUDIED

a)Monotony - author's personal observations.

b)Boredom - author's personal observations.

c)Whiteouts - subjects' voluntary observations.

d)Sociometric rating - observations of mealtime conversations, order in which men entered the Sno-Cat for breakfast, and which man travelled in which vehicle.

RESULTS

OBSERVATIONS OF DEVELOPMENT OF INFORMAL GROUP STRUCTURE

a)Driving became a point around which the pattern of the daily work routine developed.

b)At the end of 3 1/2 weeks, vehicle complements were stable and remained the same throughout the rest of the traverse.

c)The evening meal was the main social occasion of the day.

d) RANK OF TRAVERSE MEMBERS ON VARIOUS MEASURES

Person	Interaction Measures		Order of Entry	Sociometric Rating
	Initiated	Received		
	a	b	c	d
A	1	1	1	2
B	2	2	2	1
C	3	3	3	3.5
D	4	4	4	3.5
E	5	5	5	5

e)Those men who held the three highest ranks and who tended to enter first most frequently were also the men who ranked highest on interaction and on the sociometric rating, and who were observed to hold the highest rank in their respective vehicles.

BEHAVIOR WHEN IN PERSONAL DANGER

a)Before entering the dangerous area only one man openly expressed anything that might be interpreted as apprehension.

b)Most conversation on the first night turned to a discussion of the means that would be used to work their way through the crevasse field.

c)During the early period there was no reduction in the amount of conversation.

d)After the first accident the men were found to be mostly concerned about the condition of the vehicles.

e)During the first day in the danger area conversation decreased and irritability increased.

f)The second day in the danger area the men seemed to relax and were careful and methodical in probing the surface ahead of the Sno-Cats.

MONOTONY AND BOREDOM

a)Observations showed that monotony and boredom produced a desire for change in routine, even though this change might be destructive and not in the best interests of the ultimate objectives.

b)The mechanical breakdowns of equipment upon which the group depended were anticipated with pleasure.

OBSERVATIONS OF VISUAL PERCEPTION IN WHITEOUTS

The phenomenal size of objects were consistently overestimated and the object distance was consistently underestimated.

CONCLUSIONS

a)Order of entry for breakfast, a sociometric rating, and the initiation and receipt of interaction showed high intercorrelation.

b)When in mortal danger the group behavior changed after an initial inability to perceive danger to measures that helped protect the group.

c)The group's reaction to monotony and boredom can be broken up into: widespread daydreaming, sensitivity and criticism of those on the outside, desire for change, and the erroneous interpretation of familiar sounds.

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A-3
ANTARCTIC
1960 Study

Medical Department, U.S. Naval Academy
Annapolis, Maryland

PURPOSE

To discuss the psychological effects of voluntary isolated group living.

SUBJECTS

Eighty-five male personnel.

PERIOD OF CONFINEMENT

Approximately 1 year.

EXPERIMENTAL CONDITIONS AND PROCEDURES

a)Confined inside Antarctic station; otherwise, living conditions were more than adequate.

b)Confined period included several months of complete darkness with extremely cold outside temperatures.

TESTS AND VARIABLES STUDIED

Variables were analyzed from interviews.

a)Effect of danger, hardship, and cold

b)Main stresses

c)Hostility

d)Headaches

e)Insomnia

f)Intellectual inertia

g)Impaired memory and concentration

h)Appetite

i)Sexual needs

j)Absence of usual sources of emotional gratification

k)Long-term effects

RESULTS

a)Danger, hardship, or the direct effects of cold did not represent important stresses.

b)The major stresses appeared to be: individual adjustment to a group in small quarters; the monotony; and the absence of accustomed sources of gratification.

c)There was little evidence of any hostility.

d)Headaches were frequent, probably due to lack of expressed hostility.

e)Subjects tended to have difficulty sleeping during the winter months.

f)Subjects lacked intellectual energy, especially during the winter months.

g)Mental activity and concentration were impaired probably due to the monotony.

h)Appetite increased enormously, and gains of 20 to 30 pounds were not unusual.

i)There was a slight increase in dreams relating to sex; however, isolation from women was not a severe problem.

j)The absence of usual sources of emotional gratification was not a problem for the group as a whole, but the absence they did feel increased their stress.

k)Most subjects indicated that they profited in some way from their experiences (i.e. learned self discipline or patience); no undesirable long-term effects were noted.

CONCLUSIONS

a)Cold, danger, and hardship did not appear to be major stresses.

b)The major psychological stresses observed were: the problem of individual adjustment to the group; the relative "sameness" of the environment; the absence of certain accustomed sources of emotional satisfaction.

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A-4
ANTARCTIC
1966 Study

University of Oklahoma School of Medicine; Oklahoma Medical Research Foundation; and Veterans Administration Hospital, Oklahoma City, Oklahoma

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PURPOSE

To conduct a pilot study on sleeping patterns at the South Pole station.

SUBJECTS

Thirty-two men consisting of both winter-over and summer parties from both civilian and Navy groups.

PERIOD OF CONFINEMENT

Seven days - November 13 to November 19, 1966.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

South Pole station.

TESTS AND VARIABLES STUDIED

Men were asked to carry with them and mark down several times per day their allocation of time, in 1/2 hour segments, on specially-printed IBM-type cards. Headings were Sleep, Drowsiness, and Eating; four headings of Work; and five headings of Recreation. Cards were issued and collected daily at the noon hour.

RESULTS

SLEEP AND DROWSINESS

a)Mean hours of sleep per man were 52.84 for the week or 7.55 per day.

b)Drowsy state was self reported as a mean of .49 hours per day.

c)The highest average amount of sleep was 10.5 hours per day, the highest single amount of sleep was 19 hours per 24-hour period, the lowest single day's amount of sleep was 0.

d)During every hour of almost every day someone was sleeping. The majority of sleep was done between 2:00 a.m. and 5:00 a.m.

WORK

a)Total work output was 1,820.5 hours.

b)Work alone inside contributed 896.5 hours.

c)Work inside as a member of a party claimed 615 hours.

d)Work outside alone came to only 113 hours.

e)Work outside as a member of a party produced 196 hours.

f)The mean hours spent in work per man per day came to 8.1 hours or 56.8 hours per week.

RECREATION

a)Mean time spent in recreation came to 8.6 hours per day.

b)Meals took an average of 1.5 hours per day.

c)Recreational talk (talking not in line of duty) averaged 4.5 hours per day.

d)Games and reading were approximately equal in their appeal, with each accounting for 1.35 hours per day.

CONCLUSIONS

a)The short time-sample method yields figures in surprisingly good agreement with those obtained by the continuous record method. Findings tend to confirm past studies both in the extreme variability of time sleeping and in the individual mean of nearly 8.0 hours per day.

b)The unusually long work hours may reflect both the busy summer resupply and visitor schedule, as well as the effect of perpetual daylight.

c)The amount of available time devoted to sleep at the pole is remarkably similar to that devoted in the temperate zone, reflecting what is believed to be the dominant influence of social and cultural factors in decreeing how men spend their allotted hours.

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AR-1
ARCTIC
Alaskan Air Command

Arctic Aeromedical Laboratory
Fort Wainwright, Alaska

PURPOSE

BASE STUDIES

To appraise the determinants of the morale of airmen in the Alaskan Air Command. (Morale Survey)

AIRCRAFT CONTROL AND WARNING (AC&W) SITE STUDIES

Indentified variables for the development of selection techniques to minimize the number of personal adjustment problems of men at isolated Arctic military bases. (Well and Poorly Adjusted Group Survey)

OUTSIDE STUDY

a)Obtained detailed physiological data on a group of scientists-subjects undertaking severe cross-country travel in the winter while themselves conducting many aspects of the physiological experiment.

b)Permitted ongoing psychiatric and psychological observation and testing of the participants in a hostile and stressful environment.

SUBJECTS

BASE STUDIES

a)In all, 2,637 airmen were studied.

b)At no time did the sampling consist of less than one out of each eight airmen per base.

AC&W SITE STUDIES

a)Subjects were 648 enlisted Air Force personnel.

b)The ages of the men ranged from 18 to 47 years, with median age of 20 years.

c)Seventy-six percent were enlisted airmen and 24% were noncommissioned officers.

OUTSIDE STUDY

a)Subjects were 13 male scientists.

b)The ages of the men ranged from 23 to 47 years, with a mean age of 35.

PERIOD OF CONFINEMENT

BASE STUDIES (February-July, 1949)

Six months.

AC&W STUDIES

Two to 12 months with a mean of 7 months.

OUTSIDE STUDY (1967)

Ten days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

BASE STUDIES

Eight Alaskan Air Bases:
Marks Air Force Base
Ladd Air Force Base
Barter Island Auxiliary
Davis Air Force Base
Clear Air Force Base
Elmendorf Air Force Base
Thornbrough Air Force Base
Eielson Air Force Base

AC&W SITE STUDIES

Characterized by rugged terrain, severe winter weather, and reduced mobility and communication.

OUTSIDE STUDY

Time spent outdoors in severe weather conditions except for 1 hour per day in mobile laboratory.

PROCEDURES

BASE STUDIES

a)The basic material for the study was collected by the use of an anonymous survey questionnaire upon which the airmen registered their attitudes and feelings.

b)The size of the sampling varied from 95% coverage at the smaller outlying bases to slightly better than 12% at Elmendorf Air Force Base.

c)The questionnaire was completed at the noon meal in the unit mess hall.

d)A representative sampling of married first three grades who were stationed separately was obtained by administering the questionnaire to them "on the job."

AC&W SITE STUDIES

a)The measure of ability to function in the Arctic was rated by immediate supervisors.

b)These supervisors nominated the best and most poorly adjusted men in their section or detachment.

c)A score of plus one and minus one was assigned to positive and negative nominations on each of nine items of a supervisor rating form.

d)Men whose scores were more than 1 point above or below the mean for their section were selected for inclusion in the "well adjusted" (high) and "poorly adjusted" (low) groups.

e)The two groups were compared for personal differences.

OUTSIDE STUDY

a)Basic data were obtained on each subject by a clinical psychiatric interview and a battery of objective psychological tests.

b)The preliminary psychiatric interviews were conducted under conventional circumstances on a Army base.

c)During the field phase of the experiment the subjects were interviewed and tested under the severe climatic conditions described.

d)The interviews were conducted as formally as possible on 3 or 4 days of the 10-day marching period.

e)Each psychiatric interview consisted minimally of 18 questions.

TESTS AND VARIABLES STUDIED

BASE STUDIES

Anonymous survey questionnaire studied:

1)Recreational items.

2)Airmen as members of a military unit.

3)Sexual adjustment of the men.

4)Attitudes toward services rendered.

5)Personality factors.

AC&W SITE STUDIES

a)Biographical Inventory - military history, employment record, educational background, friendship patterns, and personal characteristics.

b)Self-Appraisal Blank - description of each individual.

c)Incomplete Sentence Test.

d)Medical Symptoms List - medical complaints.

e)Anxiety Scale - modified version of Taylor Manifest Anxiety Scale.

f)Food Aversion List - aversions to food.

g)General Information Test - automotive information, sports, literature, and art.

h)Peer Nomination Form - job proficiency, ability to get along with others, and general adjustment.

OUTSIDE STUDY

a)Physiological monitoring - urine, etc.

b)Psychiatric interview - awareness, integrity, and alertness.

c)Reflex time - Achilles tendon.

RESULTS

BASE STUDIES

a)Relative morale status of bases were as follows:

AF INSTALLATION	MORALE INDEX
Marks Air Force Base	23.08
Ladd Air Force Base	21.83
Barter Island Auxiliary	21.38
Davis Air Force Base	21.26
Clear Air Force Base	21.05
Elmendorf Air Force Base	20.46
Thornbrough Air Force Base	19.93
Eielson Air Force Base	17.87

The "morale" index as computed was 0 to 61, but since no control study was conducted, it was impossible to establish the significance of "highness" and "lowness".

b)According to this survey, the recreational aspects of Alaskan duty have received undue emphasis as "morale" determinants. No particular sport engaged more than 17 of the airmen, while vicarious escapes, such as reading or movies, were overwhelmingly supported by the men.

c)Eighteen percent of the men surveyed stated that inadequate transportation was the primary obstacle preventing more general participation in active sports.

d)Seventy-five percent of the men registered the feeling that "things on the base were generally 'messed up.'"

e)Forty-seven percent would have accepted a discharge immediately if such an opportunity were afforded.

f)Sixteen percent of the airmen admitted that they found sexual satisfactions at nearby villages or towns.

g)Most undesirable responses in personality factors were traced to a single group composed of those married airmen whose separation from their families had resulted in marital or financial difficulties, and those airmen who apparently were poor psychological risks at the time of induction into the service.

AC&W SITE STUDIES

BIOGRAPHICAL INVENTORY

a)The personal history characteristics that were found to differentiate members of the poorly adjusted group were urban background and a history of minor infractions of military rules and regulations.

b)Men who reported independence at relatively young or old ages were more prone to be in the poorly adjusted group.

SELF APPRAISAL BLANK

Members of the well adjusted group tended to describe themselves as conscientious and responsible individuals who accept rather than resist authority.

INCOMPLETE SENTENCE TEST

The members of the poorly adjusted group were found to do more complaining, be more fearful of the Arctic, have greater difficulties in their interpersonal relationships, be less inclined to do better than marginal work, and be more concerned about the possibility that their Arctic assignment would disrupt their relationships with wives or girlfriends.

PEER NOMINATION FORM

Men who were identified by their supervisors as being well adjusted to the Arctic were also likely to be considered well adjusted by the other men.

JOB PROFICIENCY TESTS

Well adjusted individuals had higher scores than poorly adjusted.

SICK CALL RATE

a)Sick call records were obtained for 66 men of the well adjusted and 53 men of the poorly adjusted group.

b)The poorly adjusted group, although the smaller of the two, accounted for 66% of the total number of sick call visits of the combined groups.

OUTSIDE STUDY

MOTIVES

Where the scientific interest was high, the quantity and quality of motivation continued at high levels during the field phase.

SELF-CONCEPT AND PERFORMANCE

a)Where the self-concept was high, especially in terms of physical fitness, stamina and professional capability, the subject did well.

b)Where there was insecurity and lack of professional confidence, the subject seemed to suffer sooner and more intensely from the cold, diet, and lack of physical comforts.

REQUIREMENT ON THE MARCH

Nearly all the subjects showed an overhwhelming interest in physical prowess, less interest in psychological performance and even less scientific interest.

ANTICIPATED FEARS ON THE MARCH

The greatest fear was falling through the ice while snowshoeing on a frozen river.

ANGER

Overt expressions of anger were notably lacking.

CONCLUSIONS

BASE STUDIES

a)The recreational aspects of Alaskan service were not nearly so important as "morale" determinants in terms of airmen participation as is commonly believed.

b)There was evidence that descriptive "morale" forces stemmed from failure to convince the airmen that "things were not all messed up", lack of confidence in the Air Force system of military law and justice, failure to supply effective social and sexual outlets, lack of effective methods and means for aiding the married airmen in the solution of marital problems, and from the admission of psychologically "poor" risks into the service.

AC&W SITE STUDIES

a)Individuals who adjusted well to Arctic isolation were individuals who also adjust well to their military assignments elsewhere.

b)Isolated environments probably present a more extreme stimulus situation which more frequently and more strongly evokes maladjustive behavior.

OUTSIDE STUDY

a)The preselection process should include a psychiatric analysis of conflicting motivation.

b)If the scientific motivation outweighs the others (adventure, camaraderie, etc.) then the man will perform adequately.

c)The least distortion of role specificity predicts good performance, regardless of the totality of self-image.

d)In this experiment self programming was important during the first 3 days, and thereafter it was less crucial and perhaps not even necessary.

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L-1
LABORATORY
Project ARGUS (Advanced Research on Group Under Stress)

Naval Medical Research Institute
Bethesda, Maryland

Project ARGUS is the Navy's program of research on the effects of isolation and confinement on the social emotional well-being and performance effectiveness of small groups of men. This summary consists of three studies in this program.

PURPOSE

STUDY I (Dyads)

This study included five experiments performed under the same conditions but testing different variables. Each experiment was reported in a separate article.

1. Examined social activity and territorial behavior of socially isolated and nonisolated groups. (Altman, 1967a)

2. Studied the effects of social isolation and group personality composition on individual and team performance. (Altman, 1967b)

3. a)Assessed the role of social isolation on the process by which individuals come to learn about one another.

   b)Explored the role of personality disclosure.

   c)Studied interpersonal relations in isolated and nonisolated groups. (Altman, 1965)

4. a)Studied the perceptual changes related to personality functioning.

   b)Examined the interactive effects of social isolation and group composition. (Cole, 1967)

5. Studied the effects of isolation on subjective stress and emotional symptomatology, as modified by interpersonal need satisfactions and, in turn, the effects of these intervening processes upon performance. (Haythorn, 1966)

STUDY II (Dyads)

This study included two experiments in which the conditions were varied, but the same variables were tested. Each experiment was reported in a separate article.

1. a)Studied the development of symptomatology and stress in isolated groups.

   b)Determined whether reports of subjective stress states during isolation were indicators of inability to complete mission.

   c)Determined whether differences in the "ecology" or group environment affected stress reactions. (Taylor, 1963)

2. a)Studied personality factors relating to or predictive of endurance and adjustment to social isolation.

   b)Examined personality and perceptual changes occurring under varying conditions of social isolation. (Taylor, 1969)

STUDY III [RIM (Restricted, Isolated, Monotony); Dyads and Triads]

a)Analyzed the behavior of two-or three-man groups during a 21-day period of crowded and monotonous confinement.

b)Investigated long-term monotony and boredom in isolated groups, in order to establish a bank of information on the effects of isolation under various conditions.

c)Investigated whether such factors as group size, crowdedness, seniority of leadership, and compatibility will alter interpersonal reactions to confinement.

d)Investigated physiological effects of isolation and confinement. (This aspect of the study will not be discussed in this summary.)

SUBJECTS

STUDY I (Dyads)

a)Thirty-six men (two groups of nine pairs each; isolated group and control group).

b)Age 17-21.

c)Volunteers; just completed boot training camp.

STUDY II (Dyads)

a)One hundred and sixty-six men (83 groups of two subjects each).

b)Age 18-20.

c)Volunteers; just completed boot training camp. (Taylor, 1968)

2. a)One hundred and sixty men (80 groups of two subjects each).

b)Age 18-20.

c)Volunteers; just completed boot training camp.

STUDY III (RIM: Dyads and Triads)

a)Fifty-six men (four runs of four dyads and two triads).

b)Age 18-32.

c)Volunteers; paid $75-100; Naval enlisted men.

PERIOD OF CONFINEMENT

STUDY I (Dyads)

Isolated Pairs - 10 days; control pairs - 10 days (working hours only).

STUDY II (Dyads)

1. a)Eight days. (Taylor, 1968)

b)Eight days. (Taylor, 1969)

STUDY III (RIM: Dyads and Triads)

Twenty-one days

EXPERIMENTAL CONDITIONS

TEST FACILITY

STUDY I (Dyads)

a)Isolated pairs were confined to a 12' X 12' room containing a chemical toilet, double bunks, a metal cabinet with supplies, a table, two chairs, a plotting board for a Combat Information Center task, and a small console for the monitoring task.

b)Controls were quartered in Navy barracks.

STUDY II (Dyads)

1. Rooms (12' X 12') containing a double bunk, table, two chairs, file cabinet, Combat Information Center board, table lamp, refrigerator, and chemical toilet. (Taylor, 1968)

2. Small rooms. (Taylor, 1969)

STUDY III (RIM: Dyads and Triads)

Soundproofed, air-conditioned rooms of varying sizes (see Procedure), containing file drawers, refrigerator, micro-wave oven, bottle water, and a chemical toilet.

PROCEDURES

STUDY I (Dyads)

a)Subjects were paired according to age, education, IQ, religion, family background and size, and birth order.

b)Subjects were tested and rated on four personality dimensions:

1)Need for achievement - desire or need to accomplish some overall goal;

2)Need for dominance - the need or desire for control over others, for individual prominence;

3)Need for affiliation - the need and desire for affection and association with others;

4)Need for dogmatism - the need to believe that one's own opinions and ideas are the only important ones.

Subjects were matched in such a way that in one-third of the pairs both men were high in each of these dimensions, in one-third both were low, and in the final third one was high and one low.

c)Isolated pairs were confined for 24 hours a day. They followed a 6-hour work schedule; 2 hours in the morning, 3 hours in the afternoon, and 1 hour in the evening. The remainder of the time was for recreation, eating, etc. Controls followed the same schedule but ate at the regular base mess hall and had 10-minute breaks between tasks during which they could leave the room. After completion of work at 8:00 p.m. controls were free to use recreation facilities on the base.

d)Tasks:

1)Monitoring task

2)Syllogistic reasoning task (decoding)

3)Combat Information Center task

e)Isolated subjects received no mail, had no communication with outside, and were not permitted to have radios, watches, or calendars.

f)For recreation, isolated subjects had a deck of cards, a checker game, a cribbage board, and limited reading material.

g)Subjects were not informed of the length of the experiment.

h)Continuous observation was conducted through a one-way mirror and audio system.

STUDY II (Dyads)

1. a)Subjects were paired according to age, religion, IQ, and education.

b)The variables - general adaptation, stress, and anxiety reactions were measured under varying conditions of confinement. They were:

1)privacy - in half the groups, subjects had separate rooms at their disposal.

no privacy - the other half lived in one room.

Both rooms in the privacy condition and the single room in the no-privacy condition were similar in size and were furnished identically. Subjects in the privacy condition were assigned separate rooms for sleeping, urinating and completing questionnaires.

2)stimulation - Half the subjects were in a stimulated condition where they received verbal instructions and were asked to report room temperature and food consumption periodically. They received 5-minute radio broadcasts every 4 or 5 hours.

no stimulation - The subjects in the nonstimulated condition did not hear another human voice except in two task situations.

3)expected length of mission - Half the groups were informed that the mission would last 4 days, the other half that it would last 20 days. The actual length of confinement was 8 days.

c)No recreational materials were provided.

d)Continuous observation was carried out by means of closed circuit TV and microphones.

e)Tasks included Combat Information Center problem, a series of Prisoner's Dilemma matrices, and prepackaged questionnaires. Tasks occupied a total of approximately 2 1/2 hours of subjects' time every 24 hours. The three tasks were assigned at irregular intervals. (Taylor, 1968, 1969)

2. The second study involved the same selection procedures, environmental factors, schedules and evaluation techniques as the first. The variables studied, however, were personality and perceptual changes.

STUDY III (RIM: Dyads and Triads)

a)Each run consisted of 7 preconfinement days, a 21-day confinement period, and a 5-day post-confinement period.

b)The following conditions were manipulated:

1)Group size - each run consisted of four two-man groups and two three-man groups.

2)Crowdedness - two levels: maximally crowded and minimally crowded.

In the maximally crowded condition, there was limited storage space and the joint work space scarcely permitted exercising. In this condition there was an average of approximately 70 cu. ft. of usable space per man.

The minimally crowded condition allowed 200 cu. ft. of space per man, more storage space and a larger jointly usable space.

Room situations afforded very little privacy.

3)Seniority of Leadership - Each group consisted of a group leader and one or two followers. In half the groups, leaders were assigned from high ranking experienced men (E-4 through E-6); in the remaining groups non-rated men (E-2 and E-3) were classified as leaders.

4)Interpersonal Compatibility - Was varied by a procedure designed to assemble the most or, alternatively, least compatible set of six groups -- four dyads and two triads. The manipulations were determined by using a mathematical formula for combining Expressed and Wanted Control and Affection from the Fundamental Interpersonal Relations Orientations - Behavior and the Need Achievement score from the Edwards Personal Preference Schedule. This formula was input to a computer to determine the hypothetical compatibility of all subjects. During the experiment, half the runs utilized compatible compositions, and half employed incompatible groupings.

c)Recreational material was limited to only a few games and writing materials.

d)In addition to questionnaires, the only other activities scheduled during the run were five tasks -- vigilance, cryptography, dot estimation, descriptive sentence, and discussion tasks. No more than one task was scheduled per day, and each task was scheduled only once per week.

e)Clocks and calenders were provided so that subjects could maintain time orientation.

f)Continuous observation was maintained by means of closed curcuit TV and microphones.

VARIABLES STUDIED

STUDY I (Dyads)

1. a)Territorial patterns.

b)Social activity (distance maintained by teammates in free-time activities). (Altman, 1967a)

2. Performance. (Altman, 1967b)

3. Self-disclosure. (Altman, 1965)

4. Perceptions. (Cole, 1967)

5. a)Subjective symptomatology.

   b)Stress experiences.

   c)Performance effectiveness. (Haythorn, 1966)

STUDY II (Dyads)

1. a)General adaption.

   b)Stress reactions.

   c)Anxiety reactions. (Taylor, 1968)

2. a)Personality changes.

   b)Perceptual changes. (Taylor, 1969)

STUDY III (Dyads and Triads)

   a)Performance.

   b)Subjective stress.

   c)Mood.

   d)Symptomatology.

   e)Interpersonal functioning.

   f)Behavior.

   g)Reactions.

TESTS

STUDY I (Dyads)

For all experiments, the Edwards Personal Preference schedule and the Rokeach Dogma Scale were used to measure the need for achievement, dominance, affiliation, and dogmatism.

1. Observation. (Altman, 1967a)

2. a)Monitoring task.

   b)Syllogistic reasoning task (decoding).

   c)Combat Information Center task. (Altman, 1967b)

3. a)MMPI.

   b)Questionnaires (items related to sex, religion, income, and other personal matters).

   c)Holtzman Inkblot Test.

   d)Measures of Subjective Stress. '(Altman, 1965)

4. a)Holtzman Inkblot Test (HIT).

   b)Questionnaires. (Cole, 1967).

5. a)Subjective Symptomatology Questionnaire.

   b)Subjective Stress Scale.

   c)Monitoring Task.

   d)Syllogistic reasoning task (decoding).

   e)Combat Information Center task.

   f)Interviews. (Haythorn, 1966)

STUDY II (Dyads)

1. a)Questionnaires.

   b)Behavioral Measures. (Taylor, 1968)

2. a)Minnesota Multiphasic Personality Inventory (MMPI).

   b)Edwards Personal Preference Schedule.

   c)Holtzman Inkblot Test.

   d)A sociopathy scale (Lykken scale). (Taylor, 1969)

STUDY III (Dyads and Triads)

a)Subjective Stress Scale.

b)Spielkerger State - Trait Anxiety Inventory.

c)Hostility scale.

d)Primary Affect Scale.

e)Isolation Symptomatology Questionnaire.

f)Mood Adjective Checklist.

g)Annoyance Checklist.

h)Room Semantic Differential Scale.

i)Social Penetration Scale.

j)Behavioral Differential.

k)Primary Sociability Scale.

l)Acquaintance Survey.

m)Group Semantic Differential.

n)Group Task Inventory.

o)Hulin Satisfactory Scale.

p)Biographical Inventory.

q)Fundamental Interpersonal Relations Orientation - Behavior.

r)Edwards Personal Preference Schedule.

s)Orientation Inventory.

t)Interpersonal Trust Scale.

u)Fitzgerald Experience Inquiry.

v)Minnesota Multiphasic Personality Inventory.

w)Interpersonal Topical Inventory.

x)Eysenck Personality Inventory.

y)Barratt Impulsivity Scale.

z)Behavior Log.

aa)Interviews.

bb)Diaries.

cc)Tasks: Vigilance, Cryptography, Dot Estimation, Descriptive Sentence, and Discussion.

RESULTS

STUDY I (Dyads)

1. a)Isolated pairs gradually withdrew from one another. There was a significant decline in together activities as experiment progressed.

   b)Control pairs spent equal time at both the beginning and end of the experiment in joint and solitary activities.

   c)Isolated subjects showed continually high, exclusive, nonreciprocal use of particular beds from onset.

   d)Isolated subjects' territoriality for specific chairs and areas (around table) was low at first but steadily increased.

   e)Isolated subjects exhibited gradual withdrawal and increased "cocooning" behavior in social activities.

   f)Isolated subjects' amount of time asleep remained constant.

   g)Control subjects' chair and side of table territoriality was high at first, but dropped dramatically.

   h)Control subjects' bed territoriality was initially low but gradually rose to the level of isolated subjects.

   i)Indications that the "cocoon-like syndrome" is associated with incompatibility on personality variabilities for isolated subjects were:

      1.Incompatible, dominance - active interpersonal interaction, high territoriality.

      2.Incompatible, affiliation - social withdrawal, high territoriality.

      3.Incompatible, dogmatism and achievement - no differential territorial behavior.

      4.Incompatible, dogmatism - active social interaction.

      5.Incompatible, achievement - withdrawal. (Altman, 1967a)

2. a)Isolated groups performed significantly better on group tasks than controls. Incompatible isolated pairs tended to do better than compatibles on group tasks.

   b)Compatible isolated pairs performed as well as or better than control counterparts. Incompatible isolated pairs performed the same or worse than control counterparts. (Altman, 1967b)

3. a)Isolated pairs exchanged some information at a level of intimacy equivalent to that achieved with their closest friends.

b)Control pairs achieved a pattern of revealing to their partner information which might be characterized as superficial and casual.

c)Observer ratings during comparable free time periods generally indicated a more active pattern of social intercourse by the isolates than by the controls.

d)Isolates were rated as being more friendly and showing more social initiative than controls.

e)The relationship between self-disclosure and different group compositions on need achievement, need dominance and need dogmatism were inconclusive. (Altman, 1965)

4. a)There were significant declines in Location, Form Definiteness and Movement, and a significant rise in Color scores before and after experimental period for both isolation and control groups.

   b)There were no significant changes in either isolation or control groups for different personality compositions.

   c)Both isolated subjects and control subjects tended to become more observant of details, but their responses were less form-definite.

   d)Isolates showed a significant decrease in perception of human form while no such change was observed in the controls. (Cole, 1967)

5. a)Isolated subjects reported greater subjective stress but no more symptomatology than did non-isolated pairs.

   b)Isolated dyads heterogeneous with regard to dogmatism reported more emotional symptomatology than did similarly composed control dyads.

   c)Dyads heterogeneous with regard to need achievement reported greater stress, regardless of conditions of isolation, and more emotional symptomatology in isolation than did dyads homogeneously low with regard to need achievement. Homogeneously high need achievement dyads reported more stress than did homogeneously low need achievement dyads in both conditions. High-achievement groups reported less symptomatology than hetero-achievement, in isolation only.

   d)Both isolated and control dyads heterogeneous with regard to need dominance reported less subjective stress and emotional symptomatology than did dyads homogeneous with regard to need dominance. The high-dominance pairs also showed less recovery from stress than other isolated pairs.

   e)Contrary to expectations, isolated dyads homogeneously high with regard to need dominance did not report greater subjective stress and symptomatology than low-dominance dyads while in isolation, although they did show slower return to normal levels of stress. (Haythorn, 1966)

STUDY II (Dyads)

1. a)More than half (535) of the two man groups did not complete the mission. Sixty-seven percent of the abort groups were under combinations of conditions involving a 20-day mission requirement.

   b)The 20-day mission requirement groups experienced the most stress.

   c)All groups showed significant increases from preconfinement measures of stress by day 1. Abort groups had higher but nonsignificant parallel means throughout confinement, but then showed significant increases in postconfinement stress.

   d)Completer groups maintained low levels of stress, withdrawal, and restlessness.

   e)Subjects of the completer groups adjusted themselves to each other more than members of abort groups did.

f)The 4-day groups maintained a fairly stable and significantly lower anxiety level than the 20-day groups throughout confinement. (Taylor, 1968)

2. a)Eight of the HIT scales showed significant changes from before to after isolation. Significant decreases occurred for Form Definiteness, Movement, Integration, Human, and Penetration. Significant increases occurred for Location, Color, and Shading.

b)All groups showed increments in Color from pre- to post-isolation, although the increase was significant only for the 20-day privacy group.

c)Groups expecting 4-day missions showed postconfinement decrements for Movements, Barrier, and Penetration.

d)Social isolation produced elevated states of anxiety and hyperactivity.

e)There were few significant relationships between MMPI pre-experimental scores or changes in scores and success in completing the mission or as a function of experimental treatments.

f)The absence of pre-experimental differences between aborters and completers indicated that MMPI scales had little power for predicting adjustment to conditions of social isolation.

g)There were also no significant pre-post findings associated with the Lykken Sociopathy Scale or the Edwards Personal Preference Scale. (Taylor, 1969)

STUDY III (Dyads and Triads)

a)For all subjects, state of anxiety increased gradually throughout the 21 days.

b)Two-man group subjects registered significantly higher state of anxieties throughout confinement than did those in the three-man groups.

c)Senior leadership in the three-man condition led to less reported anxiety than did junior leadership. The reverse of this was true for two-man groups.

d)Subjective stress was significantly elevated, and feelings of happiness depressed during confinement. The subjects in this study experienced less stress than subjects in Studies I and II.

e)While the groups were highly similar through the first 9 days of confinement, crowdedness had a greater effect on three-man groups than on dyads the remainder of the time. Least crowded three-man groups indicated feeling the least stress of all, while crowded three-man groups reported the most.

f)The Hostility Scale did not change significantly during the 21 days, but the hostility indicated towards partners was already high by the afternoon of the first day.

f)The greatest hostility was registered by the incompatible groups led by junior leaders.

h)More hostility was reported by subjects in less crowded conditions.

i)Subjects indicated that several environmental features annoyed them as early as the second day, with a significant increase in the number of items reported as annoying by day 7.

The things that subjects found the most annoying throughout confinement were: lack of reading material; lack of a shower facility; toilet facilities; lack of a TV and radio; the questionnaires; lack of sink and running water; lighting; and temperature and humidity.

Things they found least annoying were: mission rules and regulations; control center personnel; noises in the room; odors; lack of a telephone; cooking facilities; and equipment in the room.

j)The three-man groups complained less than the two man groups.

k)In general, psychological stress was low for most subjects. The confinement was difficult for a few of the individuals. Those who adapted poorly to confinement reported much higher levels of stress, hostility, and annoyances and functioned less efficiently than well-adapted subjects in most other measures employed during the experiment.

l)Task performance was affected by the experimental conditions.

CONCLUSIONS

STUDY I (Dyads)

1. a)Conditions of social isolation led to gradual increase in territorial behavior and social withdrawal.

   b)Incompatibility on personal traits dealing with interpersonal matters - dominance and affiliation - resulted in high territoriality.

   c)Incompatibility on traits of ideas and objects - achievement and dogmatism - did not affect territoriality.

   d)For social activities, incompatibilities on "egocentric" characteristics - dominance and dogmatism - caused strong interaction.

   e)Incompatibilities on "sociocentric" characteristics - affiliation and achievement - resulted in withdrawal.

   f)The data of the present study indicate the importance of individual differences in personality, as well as interpersonal composition factors on territorial and social activity behavior.

2. a)Variations in group personality composition and social isolation affect group and individual performance effectiveness.

   b)Mild degrees of stress appear to be associated with enhanced performance. Added stress is associated with a leveling off or impairment of performance effectiveness.

   c)The effects of social isolation on performance are significant and vary as a function of type of task and personality composition.

   d)Performance on an individual simple perceptual-motor task is slightly degraded in isolation whereas performance on group tasks is enhanced.

3. a)Isolated pairs gave each other more personal information of every kind, both intimate and non-intimate, than non-isolates.

   b)In general, the effects of group personality composition on self-disclosure were either negative on inconclusive.

4. a)Both isolated subjects and control subjects showed changes in perception.

   b)The isolated and control groups were under similar stress, in that few between-group differences were observed.

   c)There were no changes in HIT responses as a function of personality composition factors. (Cole, 1967)

5. a)Social isolation was associated with increased stress and emotional symptomatology.

   b)Stress was a function of interpersonal needs.

   c)Results indicated the importance of group composition to functioning in isolated environments. (Haythorn, 1966)

STUDY II (Dyads)

1. a)Groups who expected to remain in isolation a long time but who were unable to complete the mission reported more anxiety and stress than those who expected short missions and were unsuccessful.

   b)Groups under long mission expectations who were successful reported more anxiety and stress than successful groups under short mission expectations.

   c)Groups under long mission expectations in the privacy condition with no outside contact experienced the most stress.

   d)Short missions with or without contact with the outside were least stressful and anxiety provoking.

   e)This study demonstrated that variations in aspects of the group environment relationship make profound differences in tolerance to isolation. (Taylor, 1968)

2. a)Groups under the conditions of no stimulation, privacy, and expecting a long mission showed the most significant changes in perceptual responses.

   b)This study demonstrated that combinations of social isolation yielding varying degrees of stress, produced perceptual changes related to personality functioning.

   c)Good adjustment was associated with flexibility, low sociopathy, and ability to be aggressive and angry yet not hostile. (Taylor, 1969)

STUDY III (Dyads and Triads)

a)Compatibility can be manipulated by fairly simple assignment procedures, and groups composed to be, hypothetically, maximally compatible adapt better to each other in confinement, but may then focus their irritations on things or nonpersonal aspects of the situation.

b)A triad may be a better crew size than a dyad (disregarding duty requirements), but particularly and perhaps only if senior (or respected) leadership and adequate space to avoid extreme crowding are available.

c)Within the constraints of the limited leadership ranges sampled, senior leadership generally resulted in better adaptation to confinement, particularly with three-man groups and with incompatible personality compositions.

d)Extreme crowding may be more stressful or anxiety-producing for larger than for smaller groups.

e)Even in groups comprised of men well beyond the late adolescent age of the recruits used in Studies I and II men who have had in some instances a fair degree of experience in their military careers, isolation and confinement in groups for relatively short periods of time (21 days) can often produce significantly heightened negative effects.

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[Report No. 2]

L-2
LABORATORY
Anti-Submarine Warfare

Human Factors Research, Inc.
Los Angeles, California

PURPOSE

To study the performance of two men during 120 hours of continuous confinement in a low pressure, pure oxygen atmosphere.

SUBJECTS

Two volunteers, Navy enlisted men, 24 years of age.

PERIOD OF CONFINEMENT

One hundred and twenty hours.

EXPERIMENTAL CONDITIONS

TEST FACILITY

Cabin (6' x 6' x 6') in Navy low-pressure chamber device; furnished with cot and lounge chair; atmosphere of 100% O_2; pressure 3.6 psi.

PROCEDURES

a)Subject A was dressed in full pressure suit and given a low bulk diet.

b)Subject B was dressed in standard Navy flight suit and given a normal diet.

c)During confinement subjects alternated 5-hour periods of instrument reading and test taking; subject on duty occupied the lounge chair and was required to make readings of the intra-chamber recording instruments, and was given electrocardiograms, vital capacity measurements, and the series of performance tests.

d)Subjects were under constant observation by means of an observation port covered with one-way glass and a television camera.

VARIABLE STUDIED

Performance

TESTS

a)Vigilance.

b)Attention.

c)Time Perception.

d)Object Identification.

e)Memory Span.

RESULTS

a)Both subjects were forced to discontinue vigilance test after 41 hours of confinement due to severe eye strain.

b)Prior to discontinuing, A showed signs of improvement, while B's performance appeared to deteriorate.

c)Performance on the vigilance task declined as the confinement period progressed.

d)Performance scores for the first nine tests of the Memory Span reflected the simple effects of practice on the task. There was a sharp drop in performance, however, at the end of the confinement period, and scores on the tests given after the confinement period were all below the peak scores attained at the height of the learning function.

e)During confinement, scores on the Attention Test were lower on the second half than on the first half of the test.

f)Subjects' judgments of time intervals were longer than the base interval.

g)On the Object Identification Test, Subject A's performance improved as confinement progressed and Subject B's performance remained about the same.

CONCLUSIONS

No conclusions were drawn in this report.

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Human Factors Research, Inc., Los Angeles, California. 17 pages.
[Technical Memorandum 206-14]

L-3
LABORATORY
105 Days in Isolation

University of California, Davis; and
Ames Research Center, NASA, Moffett Field, California

PURPOSE

a)To evaluate the potential of social interaction as a synchronizer of biological rhythms in man.

b)To assess pituitary-adrenal function as well as other neuroendocrine stress indexes in human subjects during prolonged confinement in a controlled environment. (This aspect will not be discussed in this summary.)

SUBJECTS

Nine male volunteers, eight of whom were attending the University of California, Davis, and one of whom had recently graduated from Westminister College in Pennsylvania.

PERIOD OF CONFINEMENT

One hundred and five days.

EXPERIMENTAL CONDITIONS

TEST FACILITY

The Bioastronautics Laboratory near the University of California, Davis, campus where two groups of three men were isolated in 11' x 17', acoustically attenuated, environmentally controlled rooms, and one control group of three men living on the premises but allowed to interact socially with the technicians and visitors.

PROCEDURES

a)Experimental groups underwent 6 weeks with 24 hours of light (24L:0D) and 9 weeks with 16 hours of light, 8 hours of darkness (16L:8D).

b)Nine blood samples were obtained at 4 hour intervals for 24 hour periods on 13 of the days under confinement. Plasma-free cortisol levels were determined.

c)Urinary cortisol was determined throughout the study.

d)Each man daily "flew" a flight simulator according to a taped flight plan.

RESULTS

a)After 19 days under 24L:0D, 29 to 35 days were required to recover the shifts.

b)In one room all subjects gained weight; in the other all lost; control subjects' weights remained stable.

c)There were few complaints about food despite repetitive menu cycling.

d)Complaints and irritability were most apparent during 24L:0D due to disturbances in biorhythmicity.

e)Performance efficiency of the control group improved much more than that of the isolated groups, who maintained their performance but did not improve as rapidly.

f)A dramatic change in post-isolation brain wave patterns (alpha rhythm abnormality) was seen.

CONCLUSIONS

Whenever changes were observed, a remarkable similarity existed among the three subjects in each room, although the reactions differed between rooms despite identical environmental conditions. This suggests that caution should be exercised in the customary practice of extrapolation to the general population of those responses of a small single experimental group and further indicates that habitability is greatly dependent upon both the structure and composition of the inhabitant group.

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University of California, Davis, and Biomedical Research Division, NASA, Ames Research Center, Moffett Field, California.
1974 to be published.

L-4
LABORATORY

Programmed Environment for the Experimental Analysis of Individual and Small Group Behavior	Department of Psychiatry and Behavioral Sciences, The Johns Hopkins University Medical School, Baltimore, Maryland

PURPOSE

To investigate individual and social performance under a continuously programmed environment and thereby: 1) establish stable performance baselines upon which the effects of manipulated variables may be revealed; and 2) to permit the direct manipulation of performance as an independent variable.

SUBJECTS

Two males in each experiment

PERIOD OF CONFINEMENT

Ten days

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

1. Test area consisted of three one-room private apartment units (each 8 1/2'x11'), a social living area (14'x22') and workship (8 1/2'x13 1/2') all interconnected by a common corridor.
2. The area was designed to prevent any social interaction between experimenters and subjects.
3. Audio and video monitoring equipment in each area provided experimenters with continuous information concerning all subjects' activities.
4. Subjects could communicate with each other by intercom and could synchronize schedules for joint social activities.
5. Activities within the units could be withheld from subjects by solenoid locks remotely controlled by experiment monitors.

PROCEDURES

1. Participants were exposed to a programmatic arrangement of activities with associated fixed and optional activity sequences. The fixed activity sequence provided the minimum recycling sequence of six activities intended to maintain and assess a participant's health if he were otherwise indisposed to engage in a broader selection of activity opportunities available within the optional completion of the fixed activity sequence, and it was composed of 11 activities providing a broad range of private and social work, educational, recreational, and sustenance activities. All activities, both individual and social as well as required and optional, were scheduled on a contingent basis one to another such that access to a succeeding activity in the program demanded satisfaction of the requirements associated with the preceeding activity.
2. Each experiment consisted of a single variation in the established behavioral activities program.

VARIABLES STUDIED

Individual and social performance.

RESULTS

a)Objective indices of individual and social performance were obtained and yielded indications of optimal activity preferences and overall rates of progression through the behavioral program.

b)Subjective probes of each subject's experiment status were obtained systematically throughout the investigation.

CONCLUSIONS

a)The behavioral programming approach maintained successfully the individual and social performances of both participants.

b)This methodological approach provided experimental tools and resources to study systematic manipulations of variables related to individual and social performances in small groups isolated within a continuous residential setting.

REFERENCES

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F-1
FALLOUT SHELTER
1959 Study

American Institute for Research
Pittsburgh, Pennsylvania

PURPOSE

To evaluate psychological and social factors as they relate to shelter habitability.

SUBJECTS

Four groups with 30 subjects in each group made up of men, women, and children.

PERIOD OF CONFINEMENT (1959)

a)Pilot tests - 22-44 hours (4 groups).

b)Experimental tests - three groups for 1 week and one group for 2 weeks.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Simulated shelter with continuous auditory and visual monitoring.

b)8 square feet and 58 cubic feet per person.

PROCEDURES

Off duty time activities - reading, games, modeling, pencils, pens, and writing papers.

TESTS AND VARIABLES STUDIED

a)Agitation

b)Tension

RESULTS

a)Agitation and tension were greatest immediately following shelter entry and prior to anticipated release. Mild depression was common toward the middle of shelter stay. These effects were minimized through effective management.

b)Desire to leave mounted steadily for most people from the time of shelter entry, but did not become overwhelming within a period of 2 weeks.

c)Conflicting value systems were noted.

d)Effect of presence or absence of manager or leader was noticed.

e)Space was adequate.

f)There was little interpersonal conflict.

g)Subjects wanted more group games.

CONCLUSIONS

Psychological and social problems identified in this study which might be important in a real shelter are: (1) maximizing management effectiveness; (2) providing a situation conducive to adequate sleep; (3) minimizing conflict of social, moral and ethical values.

REFERENCES

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F-2
FALLOUT SHELTER
Family Experiment

Psychology Service
Veterans Administration Hospital
Houston, Texas

PURPOSE

To discover the psychological and emotional hazards (behavioral changes) following prolonged confinement in a fallout shelter and learn whether the effects are temporary or long-term.

SUBJECTS

Four: two adults and two grown boys (one family).

PERIOD OF CONFINEMENT

Fourteen days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Shelter underground: 8' x 10' with 7' ceiling: four bunks, an overhead light, a chemical toilet, and a powered circulating fan.

b)Field telephone for communication between radio station and family; no other external auditory or visual stimuli.

c)Could leave the shelter at any time... but didn't.

PROCEDURES

Household activities, games.

TESTS AND VARIABLES STUDIED

VARIABLES	METHODS OF MEASUREMENTS
1)intellectual, personality, and perceptual factors	Wechsler Adult Intelligence Scale (verbal half) given prior to entering shelter and immediately on leaving shelter
2)fantasy life	Holtzman Inkblot Technique & Thematic Apperception Test (given before and after leaving shelter)
3)mood	Clyde Mood Scale (given before and after leaving shelter; and once each night) self-ratings
4)perception	Perceptual measures
5)family relationships and patterns of behavior (areas of conflict, tension, anger, etc.)	After the psychological testing each subject was seen by a psychiatrist, social worker, then the boys were seen together and also the parents.
6)discomfort-comfort	Personal diaries - scored for the discomfort-relief quotient.

RESULTS

a)Intellectual functioning: no significant changes were reported.

b)Emotional state and mood: projective tests showed feelings of depression, increased irritability, friction, feelings of dissatisfaction, disgust and discomfort. Confinement produced a general depressive mood - this was also confirmed by the personal diaries. During the first 11 days the general mood of the family was similar and positive... the last 4 days no positive mood relationship existed (interactions were negative).

c)Perceptual functioning: estimate of body size increased, temporary impairment in spatial and perceptual orientation.

d)Morale: keeping busy, doing chores, maintaining the shelter and playing games were items which helped to keep the morale up.

e)Sleep: subjects slept a great deal (up to 16 hours a day) at the beginning of the experiment.

CONCLUSIONS

a)Mood changes in the direction of increased irritibility and depression were noted.

b)A constructive by-product of the experiment was a feeling of greater family unity following the shelter experience.

c)The family selected was promised a free trip to Europe (this particular family said they would do it for nothing) and this was an underlying motivation to participate in the project.

REFERENCES

CLEVELAND, S.E., I. BOYD, D. SHEER, and E.E. REITMAN. 1963. Effects of fallout shelter confinement on family adjustment. Archives of General Psychiatry 8:54-62.

F-3
FALLOUT SHELTER
Early vs. Late Confinement

HRB-Singer, Inc.
State College, Pennsylvania

PURPOSE

To validate the finding that significant relationships exist between behavior and the psychological environment of early and late confinement.

SUBJECTS

a)Group I - 33 "near normal" patients from six psychiatric hospitals.

b)Group II - 24 shelterees: two complete families (one with five and one with four members), seven partial families (one parent and two children, one parent with one child, three parents without spouse and children and two without spouses), two related children, and three lone children.

c)Group III - 26 shelterees: four complete families (one of six members, two with five members, and two with two members), three partial families (one parent with five children, one parent with two children and one parent with one child), and one unmarried adult with no family.

c)Group IV - 51 shelterees: six complete families (two with six members, one with five members, and three with four members), eight partial families (one parent with three children, one parent with two children, five parents with one child, one couple with no children), and three adults only.

e)Group V - 51 shelterees: nine complete families (one with seven members, four with six members, two with five members, and two with three members), no partial members and four adults alone.

PERIOD OF CONFINEMENT

a)Group I - 24 hours after hospital admission and again 72 hours later for 24-hour periods.

b)Group II and III - 70 hours.

c)Group IV and V - 67 hours.

EXPERIMENTAL CONDITIONS AND PROCEDURES

a)The study approximated the living standards provided under the Office of Civil Defense shelter marking and stocking program.

b)Ten square feet of living space per person were provided.

c)Total area comprised 260 square feet for living plus 40 square feet for toilet facility.

d)Shelter was located in underground concrete tunnel, adjacent to a basement section of HRB-Singer's Building Five.

e)The tunnel was 6.5 feet high and 5.5 feet wide.

TESTS AND VARIABLES STUDIED

a)Edwards Personal Preference Schedule - administered as a selection device as well as a predictor of behavior in the shelter situation.

b)Civil Defense Knowledge Test - given before and after the shelter experience to provide information about civil defense knowledge acquired during the in-shelter confinement.

c)Confinement Feelings Questionnaire - administered prior to the beginning of the shelter study as well as following the shelter study.

d)Leary Self Description Scale I - administered early in the shelter run and prior to the discharge of the shelterees from the shelter.

e)Confinement Acceptance Scale - composed of eight factors which indicate various aspects of the hardships encountered in confinement.

VARIABLES STUDIED

FACTOR	GROUP II (min. psychol. supports)	GROUP III (supplementary psychol. supports)
1. Physical Confinement	Emphasis (verbal) was made on being confined; reinforcement of behavior indicating upleasantness of confinement, crowding, etc.	Voluntary aspect was stressed; routine complaints ignored, or discussed in positive fashion. Materials (boards, hammer, ropes) were placed in shelter for their use.
2. Psychological Confinement	Democratic leadership permitted each group to set up own regulations and enforce them (no differences).	
3. Lack of Privacy	No special treatment was given either group. No privacy was arranged for either group. (Toilet facilities, however, were in a partitioned section and provided the only area of privacy.)	
4. Lack of Familiar Physical Supports	No special treatment was given either group. Belongings that would not normally be found on an individual or that he could collect quickly in an emergency were confiscated and held until departure time.	
5. Lack of Familiar Behavior Patterns	No special treatment was given either group.	
6. Lack of Familiar Interpersonal Relationships	Families were split up. Included were young children without their parents. No special supports were provided.	Family units were more unified. Supports were included to facilitate group formation (e.g. movable benches) and development of new interpersonal relationships.
7. Loss of Identity	No special treatment was given either group	
8. Fears	No special effort was made to structure situations. Subjects were informed in advance on general details only as required.	Some effort was made to reduce fears. Example: They were informed in advance on selected details of shelter structure as well as shelter living.

RESULTS

DEFECTIONS

a)No difference in defections as a function of shelter manager were observed. One effective defector in each group was observed.

b)Because the study did not result in a significant number of defections, it was, therefore, not possible to study defectors in as much depth as had been planned. The effect of defections on remaining shelterees was also not studied because of a paucity of defectors. In the instances where defections occurred there were no observable effects on those who remained in the shelter. Furthermore, because of the rapidity with which defections occurred, there was not time to obtain the intended early measures, nor was it possible to get adequate followup data.

PSYCHOLOGICAL TEST EVALUATION OF TOLERANCE OF CONFINEMENT

EDWARD'S PERSONAL PREFERENCE SCHEDULE

From the behavioral data available, it appears that the Edward's Personal Preference Schedule (EPPS) is not a good predictor of behavior within the confines of a shelter.

CIVIL DEFENSE KNOWLEDGE TEST

On the second testing, the shelterees responded to so few items as to make a really meaningful analysis impossible. Nevertheless, most answers on the second testing reflected increased knowledge of blast effects and fallout.

CONFINEMENT FEELINGS QUESTIONNAIRE

There was no significant difference between the pre- and post-shelter administrations; however, there were individual changes which seemed to be related to other factors.

SELF-DESCRIPTION SCALE I (Leary)

Again, there were no significant differences between the means on the two administrations of the love and dominance scores for the shelter groups, but a correlation analysis indicated many changes which seem to be related to the shelterees' experience in the shelter.

CONFINEMENT ACCEPTANCE SCALE

Few differences between shelter run groups were noted.

CONCLUSIONS

The following conclusions appear justified on the basis of the findings of the study under the limitations presented in the report and pending further validation procedures.

a)Certain behaviors appear to be important in the psychological environments that exist (a) at the beginning of a period of confinement and (b) following a period of confinement.

b)The psychological environments that exist early and late in a period of confinement can be (a) defined, (b) measured, and (c) controlled.

c)The analysis of the early and late administrations of the Confinement Acceptance Scale revealed no significant difference as a function of time of confinement.

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[Rept-75111-3F]

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[Rept-75111-2F]

F-4
FALLOUT SHELTER
U. of Georgia Experimental
Studies (1962-1968)

University of Georgia
Athens, Georgia

PURPOSE

a)To appraise minimal survival conditions in public fallout shelters as presently equipped and stocked with emergency supplies.

b)To evaluate the interactive effects of such variables as overloading, limited bunks and bedding, emergency sanitation equipment, marginal ventilation conditions, and minimal food and water supplies.

c)To evaluate the use of a Shelter Handbook (ES V - ES XXII)

d)To evaluate the psychological reactions and adjustment to the fallout shelter situation.

Only (d) will be discussed in this summary.

SUBJECTS

ES I - 30 shelterees; men, women, children; age - 15-50; volunteers.

ES II - 30 shelterees; men, women, children; age - 9-67; volunteers.

ES III - 30 shelterees; men, women, children; age - 7-66; volunteers.

ES IV - 30 shelterees; children, 2 adults; age - 7-12; volunteers.

ES V - 30 shelterees; men, women, children; age - 7-70; volunteers.

ES VI - 300 shelterees; men, women, children; age - 3-66; volunteers.

ES VII - 307 shelterees; men, women, children; age - 2-67; volunteers.

ES VIII - 321 shelterees; men, women, children; age - 1-67; volunteers.

ES IX - 160 shelterees; men, women, children; age - 1-65; volunteers.

ES X - 504 shelterees; men, women, children; age - 9 mos.-73; volunteers; paid.

ES XI - 722 shelterees; men, women, children; age - 6 mos.-79; volunteers; paid.

ES XII - 1,046 shelterees; men, women, children; age - 7 mos.-77; volunteers; paid.

PERIOD OF CONFINEMENT

ES I - 4 days.

ES II - 2 weeks.

ES III - 2 weeks.

ES IV - 1 week.

ES V - 2 weeks.

ES VI - 50 hours.

ES VII - 1 week.

ES VIII - 2 days.

ES IX - 2 days

ES X - 2 days

ES XI - 2 days

ES XII - 2 days

EXPERIMENTAL CONDITIONS

TEST FACILITY

a) ES I-V - A simulated fallout shelter was constructed within the Psychological Laboratories building on the campus of the University of Georgia. The shelter was of plywood and plaster board construction. The floor was concrete. Interior dimensions were 25' X 14.5" X 6.5'.

ES VI - The experimental shelter used in ES VI was located in the basement of the Georgia Center for Continuing Education on the University campus. The 300 person facility consisted of two rooms, the larger room being approximately 2500 square feet in area and the smaller room approximately 500 square feet.

ES VII-IX - The experimental shelter facilities used in these studies were all located above ground level in a building in downtown Athens, Georgia. The ES VII and ES VIII shelters were multichambered facilities on the first and second floors, whereas the ES IX shelter consisted of a single chamber on the second floor. The area of the chamber for ES VII and VIII was 3000 square feet, and for ES IX 962 square feet.

ES X - The Fallout Shelter used for ES X was located on the first and second floors of a building in downtown Athens, Georgia. The first floor area consisted of about 2450 sq. ft., and the second floor of about 1500 sq. ft.

ES XI - Eight rooms comprising the first three floors of a downtown Athens building were utilized.

ES XII - The experiment was conducted in two below-ground levels of the University Coliseum, one level composed of nine rooms and the other of three rooms.

b)

	NET SPACE/PERSON SQ. FT.	CU.FT.	TEMP	HUM.	VENTILATION CFM/PERSON
ES I	8	52	opt.	opt.	15 (20% fresh air)
ES II	8	52	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (10% fresh air)
ES III	8	52	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)
ES IV	6	39	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)
ES V	8	52	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)
ES VI	10	-	opt.	opt.	MRD Ventilation Tests
ES VII	10	-	warm	mod.	Natural plus window fans
ES VIII	10	-	warm	mod.	Natural plus window fans
ES IX	6-7	-	warm	mod.	Natural plus window fans
ES X	8	-	warm	mod.	Window fan and PVK
ES XI	10	-	warm	mod.	Window fan and VK
ES XII	10	-	warm	mod.	Building fan and VK

PROCEDURES

a)Continuous observation was made through one-way mirrors. ESVI-XII included Civil Defense Research Observers in the population of the Shelterees. During ES VII and VIII the observers were trained Shelter Managers and were supposed to assume management of the shelter if necessary.

b)Shelterees kept diaries.

c)Every study included medic(s) and/or nurse(s) in the population.

d)Methods of publicity and recruitment included news releases, talks to civic and school groups, help from previous shelterees, the use of newspaper advertisements, and a recruitment contest.

e)In each study an attempt was made to approximate the 1960 U.S. Census with regard to age, sex, education, race, and socioeconomic status.

f)Before final selection all prospective shelterees were medically screened. Volunteers were required to have physical examinations prior to participation in ES I-V. The large number of shelterees in ES VI-VII prohibited pre-entry physical examinations, but each shelteree was required to submit a self-report of his medical history and a completed medical inquiry form indicating his current state of health. Medical examinations were then given to those who listed a current ailment which might adversely affect them or others as a consequence of confinement, along with all shelterees 50 years of age and older, and in ES VI and VII shelterees under 10 years of age.

g)Each study included some form of recreation and exercise. They were not always part of an organized program but were often individual, spontaneous, and informal undertakings.

h)In the earlier studies, ES I-VI, shelterees were allowed to bring into the shelter minimal personal supplies. Items permitted included toilet articles (combs, brushes, lipstick), time pieces, eye glasses and one pack of cigarettes or tobacco. However, in ES I tobacco was excluded, and in ES III and IV time pieces were not permitted. No food or water supplies, soap, eating or cooking utensils, or bedding materials were allowed to be brought into the shelter by these occupants. Shelterees participating in ES VII-X were permitted to bring extra supplies, including recreational material allowed in the shelter, and in ES XI and XII shelterees were permitted to bring as many of the items they considered necessary for survival as they could pack into a large grocery bag.

i)Before entering the shelter, every subject underwent several evaluative procedures. Basically, this pre-shelter processing included identification, medical screening, testing, and preshelter orientation address.

j)Shelter Managers -

1)In ES I - ES IV a Shelter Manager trained by the Civil Defense was in command of the shelterees.

2)In ES V a shelter manager was appointed, but did not receive any training prior to entry in the shelter. A Shelter Management Handbook was provided for guidance.

3)In ES VI an 11-man trained staff was selected and received preshelter training.

4)In ES VII shelter managers received no pre-training. The shelter managers were obtained in the following manner. A sign placed on the front door of the shelter read: "FIRST MALE ADULT IN THE SHELTER: GO TO THE SUPPLY AREA AND PICK UP THE RED BOX. FOLLOW THE INSTRUCTIONS ON THE FRONT OF THE BOX. A MAP OF YOUR SHELTER AND THE NUMBER OF PEOPLE IT WILL HOLD ARE ON THE BACK OF THE BOX." Instructions on the front of the Handbook directed the temporary Shelter Manager to pass out job pamphlets to male or female adults next entering the shelter. Inside each pamphlet was a primary in-

struction: "If you do not wish to do this job, return these instructions to the person from whom you received them." If the shelteree kept the pamphlet, he automatically became a member of the temporary shelteree staff. The last duty of the temporary staff was to select a permanent staff from data to be obtained from the Shelteree Information sheets.

5)In ES VIII through XII Shelter Managers had no pre-training. As the shelterees entered the fallout shelter, they were directed by a sign reading "Handbook and Supplies" to the following sign near the Handbook reading: "The first three adults to read this sign are Temporary Shelter Managers. Find the Handbook and begin following the instructions on the front of the HANDBOOK - immediately." The temporary Shelter Managers were supposed to distribute leaflets describing the various duties of the Shelter Managers, have each shelteree (over age 17) fill out an Information Card, and select a permanent Shelter Management Staff.

k)Shelter Supplies:

	FOOD cal./person/day CONSUMED	SANITATION	BUNKS	BLANKETS	BATH WATER	COFFEE	CIG.	RECREATIONAL SUPPLIES
ES I	315 Cal. Bulgur wafer	Chemical toilet	No	No slept on concrete floors	No	No	No	No
ES II	787 Cal. Bulgur wafer	Chemical toilet	No	No Slept on corrugated fiberboard	No	No	1 pk.	No
ES III	814 Cal. Nabisco biscuit	Chemical toilet	No	No Slept on corrugated fiberboard	No	No	1 pk.	No
ES IV	552 Cal. Nebraska cracker + 296 Cal. carbo-suppl. = 848 Cal.	Chemical toilet	No	No Slept on corrugated fiberboard	No	No	1 pk. adults	paper & pencils
ES V	808 Cal. (Bulgur wafer, Nabisco biscuit, Nebraska cracker, carbo suppl.)	Chemical toilet	No	No Slept on corrugated fiberboard	No	No	1 pk	No
ES VI	306 Cal. Nebraska cracker + 208 Cal. carbo suppl. = 514 Cal.	Chemical toilet	No	No Slept on corrugated fiberboard	No	No	1 pk.	No
ES VII	776 Cal. Cracker and carbohydrate suppl.	Chemical toilet	cots, sleep mattresses, and blankets		No	No	Yes	Yes
ES VIII	655 Cal. Cracker and carbohydrate suppl.	Chemical toilet	cots, sleep mattresses, and blankets		No	No	Yes	Yes
ES IX	560 Cal. Cracker and carbohydrate supplement	Chemical toilet	sleep mattresses and blankets		No	No	Yes	Yes
ES X	568 Cal. Cracker and carbohydrate supplement	Chemical toilet	sleep mattresses and blankets		No	No	Yes	Yes
ES XI	358 Cal. Cracker and carbohydrate supplement	Chemical toilet	sleep mattresses and blankets		No	No	Yes	Yes
ES XII	551 Cal. Cracker and carbohydrate supplement	Chemical toilet	sleep mattresses and blankets		No	No	Yes	Yes

VARIABLES STUDIED

a)Psychomotor Skills (ES I-IV).

b)Reactions

c)Discomforts

d)Social and personal adjustment/adaptation

e)Activity/Behavior

TESTS

The following tests were used for the Pre-Shelter Testing:

a)Possessions Inquiry (ES VII-XII).

b)Orientation Inventory (ES VIII)

c)Pre-Shelter Questionnaire (included such items as CD information/preparedness, anticipated discomforts, socio-economic status, supervisory experience, personality sub-scales, management motivation) (ESI-XII).

d)Leadership Sub-Scale of the MMPI (ES VIII-XI).

e)Rorschach (ES I, II).

f)Minnesota Multiphasic Personality Inventory (ES I, II, III, V).

g)Psychomotor Tests (ES I- IV).

h)Intellectual Tests (ES I-V).

i)Bell Adjustment Inventory (ES IV).

j)California Test of Personality (ES IV, V).

During the confinement, diaries were kept by the shelterees, and continuous observation of the shelterees was made by means of one-way mirrors.

After confinement the Post-Shelter Questionnaire was administered (included items concerned with adjustment to confinement, discomfort factors, tolerance to shelter living, sociometric choices, shelteree reactions).

RESULTS

ES I-IV

a)No serious loss in psychomotor coordination was reported.

b)The chemical commode was a constant complaint in ES I, II, and III.

c)Nausea reactions existed in all groups, and were attributed to either lack of sleep, cramped quarters, or new social adjustments.

d)Defections:

ES I - 8 defections
ES II - 5 defections
ES III - 2 defections
ES IV - 12 defections

Only six of the 27 defections were medical; the others were due to mild psychological problems.

e)During ES II and ES III, the most time-consuming activities in order of magnitude were sleep, quiet reflection, conversation, and recreation.

f)Discomforts (mentioned in order of frequency).
ES I - Sleeping conditions, lack of space, uncomfortable temperature, lack of bathing facilities, chemical toilets, odors.
ES II - Lack of bathing facilities, odors, (same frequency: chemical toilets, sleeping conditions, uncomfortable temperature), lack of space.
ES III - Lack of bathing facilities, sleeping conditions, odors (same frequency: chemical toilets, uncomfortable temperature), lack of space.
ES IV - Chemical toilets, sleeping conditions, odors, lack of space, lack of bathing facilities, uncomfortable temperature.

g)Recreation - Games such as bingo, cards, and checkers were improvised from cardboard pallets during ES I, II, and III. Group singing was frequent during all four studies. A talent show was held during ES III.

ES V

a)The Shelter Handbook provided adequate direction for adjustment to the shelter conditions of ES V.

b)Analyses of the data from the Cognitive Vigilance Task indicated no deterioration in speed or accuracy.

c)Chief complaints during ES V were lack of bathing facilities, boredom, sleeping conditions, and uncomfortable temperature.

d)There were no deleterious physical effects from the confinement. Primary physiological complaints were headaches and colds.

e)There was no loss of mental acuity.

f)Eight defections occurred due to sickness and, in the children's case, home-sickness.

g)During ES V, games such as cards, bingo, and checkers were improvised by the shelterees. Group singing was a frequent activity, and a play was presented.

ES VI

a)Headaches and nausea were common medical complaints.

b)Major shelteree discomforts were sleeping conditions, the chemical commode, and lack of bathing facilities.

c)The overall opinion of subjects' adjustment to shelter life was good, with the young people being deemed best adjusted, and the adults least adjusted.

d)No defections occurred during ES VI.

e)Recreation consisted of games, cards, bingo, group singing, and a talent show.

ES VII

a)Headache complaints were most prevalent during the first two days of confinement and tended to diminish thereafter.

b)In order of frequency mentioned on the Post-Shelter Questionnaire the following eight sources of discomfort were indicated: no bathing, toilets, dirt, space, noise, smells, water, and inability to sleep.

c)In their evaluation of fellow shelterees, approximately one-third of the shelterees listed children as being a bother.

d)Sixty-two defections occurred during ES VII. Eleven of the defections occurred for medical reasons. Fifty-one of the defections were for non-medical reasons such as homesickness, bad shelter conditions, and departure of other family members.

e)Recreation periods were held in the large room on the first floor. The female shelterees were the initiators and maintained the impetus of these periods. Interest was high for all recreational periods. Group activities included bingo games, song-fests, a beard contest, and a talent show. Individual and smaller group activities included playing cards and games, reading, and listening to the radio.

ES VIII

a)Five areas of discomfort were cited by one-third or more of the shelterees. These, in order of frequency mentioned, were: no bathing, toilets, space, heat, and dirt.

b)Eight defections occurred during this 2-day confinement. Three of the five non-medical defections left to accompany a sick family member. The remaining two left because they were uncomfortable and could not adapt to the shelter situation.

c)The most frequent positive diary comments involved general remarks or comments about other persons in the shelter. The most frequent negative comments focused on complaints about lack of space.

d)Headaches were a common complaint made by the shelterees.

e)Most forms of recreation were either individual or small-group activities, including reading, knitting, doing school homework, listening to radios, smoking, talking, and playing games such as cards and checkers. The major group activity was a 20-minute Saturday evening talent show.

ES IX

a)During ES IX, various individual or small-group recreational activities existed much of the time. These included such pastimes as guitar playing, card playing, drawing with crayons, and reading. At 6:00 P.M. Saturday, a 45-minute, shelterwide talent show was held, consisting of card tricks, singing groups, and joke telling.

b)Headaches were a common complaint made by shelterees.

c)Five sources of discomfort were indicated by one-third or more of the persons who completed the questionnaire. In order of frequency mentioned, these items were: poor sleeping conditions, no bathing, space, drinking water, and no coffee.

d)Twenty-two defections occurred during ES IX. Fifteen left within 24 hours of entry. Seven of the 22 left to accompany family members who defected. None defected for medical reasons.

e)Negative diary comments centered on space and fatigue.

f)When asked to list three items considered desirable for a shelter stay, the top three mentioned by occupants were bedding, food, and recreational items.

g)Various individual or small-group recreational activities existed much of the time. These included such pastimes as guitar playing, card playing, drawing, and reading. A talent show was held on Saturday evening.

ES X

a)Headaches were a common complaint among the shelterees.

b)Much restlessness occurred among shelterees.

c)Six major sources of discomfort were lack of bathing, toilets, sleeping conditions, temperature, smells, and space. Almost one-third of the shelterees added boredom, dirt, lack of coffee, and noise.

d)Eighty-seven defections occurred in this experiment. Twenty-eight left to accompany family members. Nine shelterees claimed medical problems for early exit. Seventy-eight defections were categorized as psychological, attributable to extreme overcrowding in the large central room of the shelter during the temporary phase, organizational problems of temporary staff management, length of the pre-processing phase, and inappropriate preparedness and attitude.

e)The chief complaint in the diaries was lack of space.

f)Group singing was about the only organized recreational activity during ES X. However, small group and individual activities existed most of the time. Such activities included games, card playing, reading, singing, listening to the radio, coloring and talking.

g)There were approximately equal numbers of positive and negative scorable comments on shelteree diaries. There was an increase in positive comments and a decrease in negative comments as the study progressed.

h)Recreation - Group singing, successful in only a few instances, was about the only organized activity in ES X. However, small group and individual activities existed most of the time. Such activities included games (especially cards), reading, singing, listening to the radio, coloring and much conversation.

ES XI

a)Headaches were a common complaint among the shelterees.

b)The percentage of positive responses increased and the percentage of negative responses decreased as the study progressed.

c)Chief discomfort complaints, listed in order of frequency, were lack of water for washing, toilet facilities and sleeping difficulties.

d)Eighty-two defections occurred during ES XI. Eleven shelterees left for medical reasons. Twenty-one left to accompany other defections. The remaining shelterees left for non-medical reasons such as overcrowding or uncomfortable temperature.

e)The morale of the shelterees upon exit was fairly high.

f)Recreation - Group singing (by floors) held great interest for the shelterees. Entertainment by way of skits, talent shows, spelling and history bees was popular and drew good attention and participation. The bicycle-operated ventilation fan provided great interest for the children, who were always lined up for turns. Shelterees listened to radios, especially ball games and Sunday-morning gospel music. One portable phonograph was observed, as well as dancing. Besides the radios, other popular individual activities included card-playing, chess and other games, reading, napping, and especially conversation. An attempt was made to collect books and magazines to form a shelter-wide library.

ES XII

a)Headaches were a common complaint made by the shelterees.

b)Lack of space received the highest number of complaints in the diaries.

c)Discomfort complaints, listed in order of frequency, were sleeping difficulties, temperature, and crowding.

d)Forty-eight defections occurred during ES XII. Nine shelterees left for medical reasons. Thirteen subjects left to accompany other defectors.

e)There were no formal shelter-wide, or room-wide, recreational activities in ES XII. A great deal of individual recreation, such as cards, games, radios, books, and letter writing, took place.

CONCLUSIONS

a)Psychomotor skills suffered no ill effects from confinement.

b)Six factors which one-third or more of the shelterees designated as major sources of in-shelter discomfort were lack of bathing facilities, chemical toilets, lack of space, sleeping conditions, uncomfortable temperatures, and odors.

c)Sleeping was often difficult because of crowding, temperature, and ventilation.

d)Diary analysis indicated that the lowest morale point was reached in the middle of a confinement period.

e)With regard to personality testing, no attenuation of mental abilities, attention span, concentration, or mental efficiency was indicated in test results. Neither were there any adverse effects on personal and social adjustment scores as a result of shelter confinement.

f)Shelterees participating in the longer confinement studies gave longer estimates of endurance for extended stay than those shelterees participating in studies of shorter duration. Estimates given by men exceeded those of the women and children.

g)When asked if they would have volunteered for an occupancy test had they known what it would be like, 88% of all responding shelteress answered in the affirmative, and 74% stated that they would volunteer for another study.

h)ES VII through ES XI included some form of organized recreation. Group singing was a popular activity in ES I, II, III, IV, VI, VII, X, and XI. Talent shows were held in ES III, VI, VII, VIII, IX and XI. A play was given in ES V. Individual and small-group activities such as card playing, games, reading, listening to radios, and talking took place.

i)Difficulties in efficient performance by untrained shelter staff personnel centered around: (1) lack of trained leadership experience, (2) lack of motivation to carry out all tasks assigned, (3) improper sectioning of the shelter population, (4) inability or refusal to follow Handbook instructions, (5) reluctance to assume leadership positions, (6) concern of shelterees with their families rather than with the shelter population as a whole, and (7) difficulties in communication between staff and shelterees.

j)Defections resulted from a number of variables. Among these variables were management, space provision, shelteree attitude, and environmental austerity. Defections were classified as medical or non-medical; there were a majority of non-medical defections. Out of 3,510 shelterees, 344 shelterees defected.

k)Frequent medical complaints were headaches and nausea.

l)There were no serious psychological problems.

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F-5
FALLOUT SHELTER
Navy Protective Shelter Tests

Navy Medical Research Institute
Bethesda, Maryland

PURPOSE

a)To determine if the shelter, as designed and constructed, will sustain life and insure an adequate degree of post-shelter physical fitness.

b)To determine the extent of agreement among shelterees on the relative subjective or psychological importance of environmental and interpersonal discomfort sources in the prototype shelter.

c)To determine the relative importance of psychological discomfort in terms of both "acuteness" and "generality" of discomfort.

d)To determine the relationship between relative subjective importance of discomfort factors over time.

e)To determine the significance of interaction between and among a limited number of factors which appear of major importance in fallout shelter habitability.

SUBJECTS

a)Two hundred volunteers; no reward offered as an inducement for individuals to volunteer.

b)Two groups: one group tested in winter (96 recruits and four staff members): one group tested in summer (96 recruits and eight staff members).

PERIOD OF CONFINEMENT (February, 1962 and August, 1962)

Two weeks for each group.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Shelter was a standard, corrugated steel, Navy ammunition magazine; 48' X 25'; buried under 5' of earth.

b)Little room was available for free movement.

c)Bunks, toilet facilities, 10 sq. ft. and 100 cu. ft. space were provided for each individual.

d)Shelters lacked light, air and humidity.

e)The summer group was not only overcrowded but also experienced temperatures as high as 87 degrees.

PROCEDURES

a)Subjects had no knowledge of duration of the test.

b)One team in each section, consisting of approximately 12 men, was responsible for preparing and serving food.

c)Two meals were served daily.

d)No limit was placed on the amount of drinking water a subject could consume.

e)No water was available for washing or shaving during the 2-week period.

f)Although the shelter staff was in direct contact with the monitoring station, the recruit subjects had absolutely no contact with the outside world during the 2-week period of their confinement.

g)Two days prior to entering the shelter, the subjects were administered the scale involving ranking of all 21 discomfort sources.

h)On day 2 in the shelter, the Likert-type scale, which tapped 13 discomfort factors, was administered.

i)On day 7 in the shelter, the ranking scale was administered for the second time.

j)On day 12 in the shelter, the Likert-type scale was administered for the third time.

VARIABLES STUDIED

a)Lack of water for washing.

b)Lack of privacy.

c)Boredom.

d)Lack of exercise.

e)Lack of organization.

f)Inability to concentrate.

g)Concern about the outside.

h)Inadequate leadership.

i)Odors.

j)Noise.

k)Temperature and humidity.

l)Toilet facilities.

m)Food.

n)Dirt.

o)Behavior of others.

p)Bunks.

q)Sleeping difficulty.

r)Crowding of the shelter.

s)Lights while awake and sleeping.

RESULTS

WINTER TEST

a)Lack of water for washing, food, crowding and dirt constituted the leading sources of discomfort in descending order.

b)Stress during the period was mainly emotional.

SUMMER TEST

a)Lack of water for washing remained the leading cause of psychological discomfort, while temperature and humidity ranked second, dirt third, and food fourth.

b)Stress was more physiological than emotional.

CONCLUSIONS

a)There is an obvious relationship between environmental variables and psychologic response to these factors in determining man's tolerance to shelter living.

b)Factors in the physical environment ranked ahead of the people per se as sources of psychological discomfort.

c)The morale and emotional well-being of protective shelter inhabitants may be equally as important as physical well-being.

d)The five leading discomfort sources in the winter test were food, lack of water for washing, crowding of the shelter, dirt, and behavior of others.

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F-6
FALLOUT
1959-1960 Tests

Naval Radiological Defense Laboaratory
San Francisco, California

PURPOSE

To determine the feasibility of a bomb and fallout shelter.

SUBJECTS

a)Two hundred male subjects; volunteers; two experiments of 100 subjects each.

b)1959 - 92 inmates
5 deputy sheriffs
3 USNRDL investigators
1960 - 100 inmates

PERIODS OF CONFINEMENT

a)1959 - 2 weeks

b)1960 - 5 days

EXPERIMENTAL CONDITIONS AND PROCEDURES (1959, 1960)

TEST FACILITY

25' x 48' arched roof.

OFF DUTY TIME ACTIVITIES (1959)

a)Games at tables.

b)Library service.

c)Record player.

d)Pinochle.

e)Chess.

f)Whist.

g)Movies.

VARIABLES STUDIED (1959, 1960)

a)All aspects of shelter environment - temperature, humidity, carbon monoxide.

b)Actions and responses of subjects.

c)Medical and psychological factors.

TESTS (1959, 1960)

a)Continuous observation made by way of closed circuit TV and audio systems.

b)Recording of medical, environmental and psychological conditions.

c)Questionnaires.

RESULTS

1959

a)Major discomforts were restricted water, lack of space, seating discomfort, noise, diet, boredom, sleeping conditions, and environmental conditions. No bathing or shaving was possible.

b)Between the fifth and seventh days, many mentioned that they were starting to feel tired and listless and were having difficulty in remembering details.

c)Group cleanliness was a problem.

d)Medical problems were minimal.

e)Some loss of weight occurred, averaging 2 pounds on one diet and 4 pounds on another diet.

f)A strong motivation was maintained among the inmates, all strongly desiring to finish the test.

g)Questionnaires indicated:

96 occupants would have volunteered again
96 occupants could have stayed another week
91 occupants could have stayed for another 2 weeks
88 occupants could have stayed for another 3 weeks

h)A shelter organization was formed, partly mandatory and partly permissive. Inmates formed themselves into groups with elected leaders reporting to shelter management personnel.

1960

a)Major discomforts in order of rank were noise, ventilation, lack of space, sleeping conditions, diet, restriction of water for purposes other than drinking.

b)A general lowering of standards of behavior was observed in the group, and a lack of interest upon the part of most occupants in matters of civil defense, which was attributed to a deliberate passive role adopted by the shelter commander.

c)Medical complaints were infrequent and minor. Headaches were most frequent.

d)Questionnaires indicated:

99 of the occupants indicated they could have stayed for another week
92 occupants could have stayed for another 2 weeks
80 occupants could have stayed for another 3 weeks
15 occupants indicated that occupancy was a difficult hardship.

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S-1
SUBMARINE
Nautilus (1959)

U.S. Naval Medical Research Laboratory
New London, Connecticut

PURPOSE

a)To assess the psychological and psychophysiological effects of living under the conditions existing during prolonged submergence.

b)To detect subtle changes in the oxygen-carrying capacity of the circulating blood that might appear as a result of slight alterations in the atmospheric conditions.

Only the psychological and psychophysiological effects will be reported.

SUBJECTS

a)Thirty men; Navy enlisted men from the crew of the Nautilus.

b)Age: 21-43 years, mean age - 27.3 years.

c)Two groups of 15 men each.

PERIOD OF CONFINEMENT

Two hundred and sixty-five hour dive.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)U.S.S. Nautilus, completely submerged.

b)Atmosphere - 21 volumes percent oxygen.

PROCEDURES

Measurements were taken daily, but only on one of the two groups each day. The two groups were measured on alternate days.

VARIABLES STUDIED

a)Fatigue

b)Stress

TESTS

a)Critical Flicker Frequency.

b)Hand Tremor Test.

c)Self-Rating Scales (sleeping habits, aches, pains, moods, tensions, feelings toward shipmates, performance efficiency, and interests).

d)Interviews.

RESULTS

a)Fatigue

1)Starting about the sixth or seventh day, there was a decrease in the quality and quantity of sleep.

2)Subjects reported more fatigue on days 2 and 3 than on day 1, but on subsequent days no variations from normal were reported.

3)Dizziness, irritation of eyes, abdominal tensions and difficulty in breathing were reported infrequently and showed no trends in daily ratings.

4)More frequent and severe headaches occurred as mission progressed.

5)Muscular tension became greater during the last 6 days.

b)Stress

1)Ten percent of subjects reported unhappy moods during cruise.

2)Twenty percent of subjects reported some difficulty concentrating and "less over-all efficiency".

3)A deteriorating trend in group morale started the sixth to seventh day.

4)Lowered motivation started the sixth to seventh day.

CONCLUSIONS

a)Optimal adaptation to the submerged conditions occurred during the first 5 to 6 days.

b)Starting from about the sixth to seventh day submerged, the quality of adaptive processes declined.

c)The trend toward less effective adaptation apparently revised about the 10th day which might be due to termination of submergence and anticipation of shore leave.

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S-2
SUBMARINE
Polaris

U.S. Navy; and Department of Psychiatry and Behavioral Sciences, University of Oklahoma Medical Center, Oklahoma City

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PURPOSE

To observe behavioral reactions to prolonged submergence.

SUBJECTS

Two crews of 140 volunteers.

PERIOD OF CONFINEMENT (1964-1965)

Two 60-day runs.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Submarine; closed ecological system.

b)Five cubic yards of private space per man.

c)Four hundred feet in length and at least 6'4" from deck to overhead throughout.

PROCEDURES

a)Selection criteria: intelligent; emotionally stable; good physical condition; results of psychiatric screening and testing.

b)Tasks: domestic chores; operation and maintenance of habitat equipment.

c)Work/rest schedules: two 4-hour work shifts daily (6-18 men worked the same hours).

d)Activities: formal lectures; recreation; movies; books.

e)Communication: only wire service news available.

TESTS AND VARIABLES STUDIED

a)Behavior as observed and reported by submariners.

b)Adjustment patterns as observed.

RESULTS

BEHAVIOR

a)Sexual interest was expressed in several ways - pin-up pictures, topic of conversation.

b)Vulgar language was used frequently.

c)Hostility was released through joking or small feuds between small groups.

d)Pecking orders were established.

e)Minor anxieties resulted.

f)Headaches and insomnia were the most common somatic complaints.

g)Five percent of the crew of officers were treated for psychological problems, mainly mild anxiety reactions but ranging to paranoid-schizophrenia.

ADJUSTMENT

Adjustment of the Crew to the Isolation of Prolonged Submergence (Based on a 90-day Period).

Stage of Adjustment	Occurrence	Psychological Reactions of Crew
Pre-submergence	Prior to submergence (28 days)	Slight elevation of mood which turns downward just before submergence
Submergence	1st week	Rebounding of mood to mild elation
"One-quarter-way Syndrome"	2nd-3rd week	Depressive trend; increase in sick call; development of disturbances in sleep patterns; adolescent gang behavior leading to 'friendly competition'; evident sexual humor
"Half-way Syndrome"	4th-5th week	Low point in mood; feeling of depression pervasive; verbalized complaints; appetite and bowel function changes, complaints of headache and muscle aches, difficulty in concentration, sleep disturbances; introspection and intrapersonal withdrawal; intensely sarcastic humor; in a few cases loss of normal circadian clues and reports of brief depersonalization-like episodes
"Three-quarter-way Syndrome"	6th-7th week	Sudden elevation of group mood; return of sexual humor; tendency toward physical contact possibly in anticipation of approaching heteresexual activity
"Final Week Syndrome"	8th week	Majority of crew continues to show uplift in mood; some individuals show a depressive tendency either because of fear of returning home to resume social and sexual masculine role or because of failure to achieve a self-imposed goal
"Channel Fever"	end of 8th week	Hypomanic state in which individual has sense of well being, of being capable of an excessive amount of work, and a feeling of diminished need for work
Docking	tie up alongside shore	Return of mild depressive state; feeling of fatigue; depression possibly due to dissolution of crew group with accompanying friendships or because of the surrendering of passive, dependent, womb-like state which existed onboard ship

CONCLUSIONS

a)The major operative stresses in the environment which interfere with the team formation are lack of objective reward for expended efforts, the inability to communicate with persons in the outside world, the lack of sufficient personal territory, the nonvariability of physical environmental stimuli, the concern for the conduct and welfare of the family, and, finally, the presence of nuclear weapons aboard.

b)The common mode of adjustment to the exotic environment of the Polaris submarine appears to a depressive one.

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World Medicine, pp. 55-56. January 14.

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American Journal of Psychiatry 125:25-30.

SS-1
SPACEFLIGHT SIMULATION
Ames 1962 Study

Ames Research Center, NASA
Moffett Field, California

PURPOSE

a)To evaluate the performance of subjects on particular tasks.

b)To consider the stresses produced by restricted work space and schedules.

SUBJECTS

Two subjects: a physiologist and a pilot.

PERIOD OF CONFINEMENT (April, 1962)

Seven days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

A cone shaped capsule: 123 cubic feet of useable space:
two seats, one of which reclined and provided a cot for sleeping.

PROCEDURES

a)Work-rest schedules: 4 hours on-duty and 4 hours off-duty; the subjects alternated work and rest periods.

b)Performance tasks: information processing; estimation of the rate of a pointer movement; assessment of mission status; vigilance, pattern discrimination; navigation computation and tracking.

VARIABLES STUDIED

a)Performance was measured by pattern discrimination and information processing.

b)Such factors as time of day, day to day, within shifts, day vs. night shifts, and complexity of task were considered.

RESULTS

PATTERN DISCRIMINATION

a)Day to day performance tended to improve during the early days of confinement and became slightly worse at the end.

b)Some variation in performance was related to time of day. Performance was better during the night and poorer during the day which might be due to more activity during the day.

c)One subject's performance within shift decrement did not vary significantly over the confinement, whereas the other subject's performance improved within shifts for days 2,3,4 and worsened during the last 3 days.

d)Varying the pattern size had no effect on the subjects' performance.

INFORMATION PROCESSING

a)Individual day to day performance improved as confinement continued.

b)The subjects' performance was affected by the shifts which might be related to their typical manners of working.

c)Shift differences persisted throughout the mission. The differences became more pronounced as the mission progressed.

d)Task complexity had no effect.

REALISM

Both subjects knew they were still in the hanger and felt that only navigation approached realism.

CONCLUSIONS

Performance was maintained throughout the mission. The stresses of the mission did not affect the subjects' performance.

REFERENCES

PATTON, R.M. 1963.
Behavioral testing during a 7-day confinement: The information processing task.
Ames Research Center, Moffett Field, California. 21 pages.
[NASA TN D-1973]

PATTON, R.M., and R.J. RANDLE, JR. 1963.
Behavioral testing during a 7-day confinement: The pattern discrimination task.
Ames Research Center, Moffett Field, California. 15 pages.
[NASA TN D-1974]

RATHERT, G.A., Jr., N.M. MCFADDEN, R.F. WEICK, R.M. PATTON, G.W. STINNETT, and T.A. ROGERS. 1964.
Minimum crew space habitability for the lunar mission.
Ames Research Center, Moffett Field, California. 62 pages.
[NASA TN D-2065]

PURPOSE

To evaluate the selection techniques and training used for the Douglas Space Cabin Simulator, and to determine the results of confinement.

SUBJECTS

Four subjects: male; college students; age - 21-27 yrs.

PERIOD OF CONFINEMENT

Two runs: a 12-day preliminary run; and a 30-day run.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Space cabin simulator; 12' in diameter, 40' in length.

b)Pressure 7.0 p.s.i.

c)Atmosphere 50% O_2, 50% N.

PROCEDURES

a)Work-rest schedule: subjects had the same work-rest cycles, 12 hours awake/8 hours asleep, but different specific work-rest schedules. Subjects one and four slept from 2400 hours to 0800 hours; subjects two and three slept from 1500 hours to 2300 hours. All sleep and wake time scheduled.

b)Tasks: subjects maintained cabin systems (CO_2 removal, atmospheric supply and pressurization, instrumentation, water and waste management, trace contaminant control, temperature control and air lock operation), and performed Orbiting Landing Approach Flight Simulator program (simulated surveillance, tracking and rendezvous in space).

c)Crew selection was based on a detailed biographical questionnaire, individual interviews by a psychologist, evaluation by a team of psychologists and a physical examination. Eight subjects from 25 were chosen for good physical health, well-balanced personality, good social adjustment and education/experience in engineering, the physical sciences or biological sciences.

d)A 4-week training program of films, lectures and demonstrations and a 4-week on-the-job training in and about the simulator were part of the program.

e)Various psychological tests and extensive interviews were made on the eight selectees. All personnel involved with the trainees rated them on personal qualities, leadership ability, social capabilities and training performance. The trainees participated in eight 3-hour sensitivity training sessions to increase the trainees' awareness of each others' feelings.

f)The four crew members were then selected on the basis of the sensitivity program, individual psychological tests, group tests, instructor evaluations, individual interviews and training performance.

TESTS AND VARIABLES STUDIED

TESTS

a)Individual tests: Wonderlic Personnel Test, academic achievement; Gordon

Personnel Profile, personality/temperament test; Edwards Personal Preference Schedule, personality variables; Motivation Analysis Test, personal interests and drives; Leadership Opinion Questionnaire, structure and consideration; and Fundamental Interpersonal Relations Orientation, strength of the desire to give or to receive in three interpersonal areas (inclusion, control, and affection).

b)Group tests: subjects participated in various cooperative and competitive group games so that psychologists could observe their interaction under group pressures; they also completed two social preference types of questionnaires.

VARIABLES

a)Selection techniques were measured by the outcome of the mission.

b)The physical and mental condition of the subjects during confinement was measured by questionnaires, taped diaries, monitors, performance on problem solving tasks, arithmetic, speech perception, an arm-hand manipulation test, and individual and group interviews after confinement.

RESULTS

a)All crew members adjusted well to each other in confinement; no serious hostilities or frictions developed. One interpersonal problem occurred between the leader and sub-leader over some critical remarks the leader made to the sub-leader.

b)Crew members consciously avoided any open display of hostility; they treated irritating conditions with humor to relieve the tension.

c)The crew felt that the outside monitors had not functioned in a professional manner and had not used the suggestions made by the crew during the 12-day run. The crew felt the monitors were disinterested and lacked organization.

d)The crew felt that the most valuable part of their traning was the social sensitivity training program because it made them aware of each others' feelings.

CONCLUSIONS

a)As a result of the thorough selection and training program, it was felt that any of the subjects could have successfully completed the 30-day confinement without any personal conflicts developing.

b)The crew viewed the program as interesting, challenging and personally satisfying.

c)The post-isolation group debriefing and individual interviews all indicated that the crew had derived much personal satisfaction from their experience, had good group feeling and rapport, and had a strong desire to participate in subsequent runs.

d)During both runs, the crew was exposed to visiting dignitaries, to newspaper and magazine reporters and cameramen, and to national TV coverage. All visitors were impressed by the morale and cohesiveness of the crew.

e)Personal opinion and peer rating forms filled out weekly by the four crewmen during their confinement indicated that the crew had a friendly and cooperative attitude toward each other and that all had a definitely positive attitude toward the experiment.

REFERENCES

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Douglas Aircraft Company, Inc., Santa Monica, California.
[Douglas Paper No. 3446]

SS-3
SPACEFLIGHT SIMULATION
30-Day Mission

General Electric, Missile and Space Division
Valley Forge Technology Center
Philadelphia, Pennsylvania

PURPOSE

a)To evaluate crew performance and effectiveness.

b)To evaluate the suitability of the gaseous atmosphere.

c)To develop criteria which can be applied to the design of space stations.*

*Only the first objective will be reported.

SUBJECTS

Four subjects: volunteers; age - 28-29 yrs.; three married and one single.

PERIOD OF CONFINEMENT

Thirty days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Cabin inside a 39' space environment simulator.

b)Inside cabin diameter - 12' 6".

PROCEDURES

a)Subjects selected on the following criteria:

1)Relevant military flying or submarine experience.

2)Technical civilian education and current work assignment.

3)Superior general intelligence.

4)Strong psychomotor coordination.

5)Absence of potentially disabling emotional conflicts.

6)Strong emotional defenses.

7)Psychosocial adaptability.

8)High task and personal motivation.

9)Excellent physical condition.

b)Psychological tests (Alpha Examination; Gurford-Zimmerman Temperament Survey; AU-L Study of Values; Social Reaction Inventory), interviews, training performance appraisals, and leadership group discussions were used as techniques of selection.

c)Work/rest cycle - each crew member had the same work/rest cycle, but separate sleeping hours and schedules.

d)Sleeping period - 6 hours for the first day, later changed to 7 hours because of undue fatigue.

e)Performance tasks: higher order mental functions (digit span, mental arithmetic, number retention); reaction time; eye-hand coordination; vigilance; rendezvous (rendezvous techniques, rendezvous console, thrusting schedules, rendezvous procedure); and docking.

f)Recreation: tape recorder, books, cards, chess and various other games provided.

g)Observation: crew monitored by cameras.

VARIABLES STUDIED

a)Performance as measured by digit span, mental arithmetic, number retention, reaction time, eye-hand coordination, vigilance, rendezvous and docking.

b)Interpersonal and intragroup relationships as measured by a modification of the Fiedler Adjective Scale.

c)Emotional stability of the subjects as derived from comments in their diaries.

RESULTS

MEALS

The men had no complaints about their meals, in fact, they seemed to enjoy them more at the end of the mission than at the beginning.

PERFORMANCE

a)Higher order mental functions: digit span remained stable; arithmetic tasks produced differences between subjects, some remaining stable, others improving slightly; number retention produced little change in performance over the 30 days.

b)Reaction time: no significant change in performance.

c)Eye-hand coordination: performance improved on this task during confinement.

d)Vigilance: day to day variability in performance of two tasks - 'meters only' and 'green-off'; no decrements occurred under warning formats.

e)Rendezvous and docking were successfully performed by all subjects.

INTERPERSONAL INTRAGROUP RELATIONS

a)A continuous increase in intragroup psychological distance was noted as mission progressed.

b)Group structure broke down.

c)Subjects tended to remain to themselves during confinement.

d)Group cohesiveness measured over an 80-day span (30 days pre, 30 days during and 20 days post) was maximum on day 16 prior to entry, followed by a decline to the lowest point on the 29th day of the mission. A sharp increase took place on the 29th day of the mission and on the second day of post-mission. and continued to increase throughout post-mission period.

EMOTIONAL STABILITY

a)The 30-day confinement tended to increase the variability for the group in terms of self perception and interpersonal perception.

b)The crew members' concept of self became more stable on an individual basis.

c)Crew members maintained psychological stability.

CONCLUSIONS

a)All subjects showed increased self-assessment stability over the course of the 30 days.

b)Performance was maintained at a high level throughout the mission.

c)It appears that the subjects, experiencing sharply curtailed social stimulation, turned inward to themselves and were able to use their own emotional defenses to sustain themselves.

REFERENCES

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Space station system simulation: Results of a 4 man/30-day mission simulation program.
Valley Forge Space Technology Center, Philadelphia, Pennsylvania.
[Document No. 64SD679]

SS-4
SPACEFLIGHT SIMULATION
Lunex II (1966)

Honeywell Lunex II
Minneapolis, Minnesota

PURPOSE

To show results of the Minnesota Multiphasic Inventory (MMPI) in determining the behavior and psychological evaluation of crew performance.

SUBJECTS

a)Two subjects served as scientists/engineers.

b)Subjects were male, married, aged 38 and 34 and in excellent health.

PERIOD OF CONFINEMENT (1966)

Eighteen days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

Lunar vehicle simulator with free volume of 115'.

TASK

Simulated lunar rock collection and rescue and repair tasks in an inflated full pressure suit in the area adjacent to the simulator.

MMPI

a)Administered as part of the behavioral and psychological evaluation of crew performance.

b)Administered on the first day in the lunar vehicle and on the last day 4 hours before the termination of the study.

RESULTS

a)Operator's results suggested decreased effectiveness in censoring negative self descriptions, increased social needs, and less impulse control.

b)The second subject, operator two, showed a decrease in feelings of well being and a tendency to develop physical complaints under stress.

CONCLUSIONS

a)In comparing the profiles of the two individuals, the results indicated that operator one accumulated and dissipated reactive inhibitors more rapidly than operator two.

b)On continuous performance tasks the error of operator one would exceed those of operator two, while on distributed performance tasks the error scores and reaction times for operator one would be less than those of operator two.

REFERENCES

BURNS, N.M., and F.W. AYERS. 1966.
MMPI profile changes during an 18-day confinement study.
Perceptual and Motor Skills 23:877-878.

SS-5
SPACEFLIGHT SIMULATION
Manned Orbiting Laboratory
(MOL)

USAF School of Aerospace Medicine
Aerospace Medical Division
Brooks Air Force Base, Texas

PURPOSE

To evaluate the effects of work/rest schedules compounded by sleep deprivation on crew performance.

SUBJECTS

a)Twenty subjects: paid volunteers, who had just completed basic training. There were two subjects on each run.

b)Results are based only on 13 subjects; seven subjects terminated.

PERIOD OF CONFINEMENT (Jan. 1965 - April 1967)

Ten 12-day runs.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Two B-52 photo pods were mounted on top of each other. The living area had a cot, card table, chair, eating facilities, and a commode. The working area contained psychomotor test equipment.

PROCEDURES

a)Work/rest schedules: both subjects on each run were on the same work/rest schedule with alternating rest periods. Work/rest schedules:

Run Number	Work/Rest Schedule
1	4/2
2	4/4
3	16/8
4	4/2
5	4/4
6	16/8
7	4/2
8	4/4
9	4/4
10	16/8

b)The 12 days were divided into 3 sections: basic schedule effect - days 1 through 7: sleep deprivation - days 8 through 10 (subjects worked continuously with no sleep); and recovery - days 11 and 12.

c)Performance tasks: Complex Coordinator; Multidimensional Pursuit Test; The Neptune (vigilance meters, short term memory, arithmetic, tracking); Multiple Reaction Time Task; Complex Discrimination Time Test.

d)Relationships between subjects and the staff were intentionally made impersonal and casual.

TESTS AND VARIABLES STUDIED

a)The effects of work/rest schedules and sleep deprivation on: performance as measured by Complex Coordinator, Multidimensional Pursuit Test, The Neptune (vigilance meters, short term memory, arithmetic, tracking), Multiple Reaction Time Task, and Complex Discrimination Reaction Test.

b)Sleep as reported by the subjects on a reporting form.

RESULTS

PERFORMANCE

a)Subjects on the 16/8 schedule performed the poorest on day 1. All schedules showed progressive decrements during sleep deprivation. By day 10, subjects on the 16/8 schedule were performing better than subjects on the 4/4 schedule and subjects on the 4/4 schedule were performing better than subjects on the 4/2 schedule. During the recovery period, subjects on the 16/8 schedule performed better than subjects on the other two schedules on four tasks - vigilance, arithmetic, tracking and Complex Coordinator.

b)No significant time of day effects were reported.

c)All schedules showed learning.

SLEEP

a)Subjects on the 16/8 schedule reported consistent sleep patterns across days and in comparison to each other, whereas subjects on the 4/4 and 4/2 schedules reported large differences across days and in comparison to each other.

Summary of analyses of variance (days x schedules interaction only)

Tasks	Schedule (days 1 – 7)	Sleep deprivation (days 8 – 10)	Recovery (days 11 – 12)
Neptune			
Vigilance	NS	NS	$P < .01$ $C > \begin{cases} A \\ B \end{cases}$
Arithmetic	NS	NS	$P < .05$ $C > A > B$
Tracking	NS	NS	$P < .001$ $C > B > A$
Short-term memory	NS	NS	NS
Complex Coordinator	NS	$P < .005$ $C > B > A$	$P < .005$ $C > \begin{cases} B \\ A \end{cases}$
Multiple Reaction Time	$P < .05$* $\begin{cases} B \\ A \end{cases} > C$	NS	NS

A = 4/2 schedule.
B = 4/4 schedule.
C = 16/8 schedule.
*Subjects on the 16/8 schedule performed significantly poorer on day 1 only and on two of the four variations (levels) only.

CONCLUSIONS

a)All schedules showed learning curves.

b)There were no differences in performance as a function of work-rest schedules so long as schedules were the only experimental manipulation.

c)All schedules showed progressive decrements during sleep deprivation.

d)Subjects in the 16/8 schedule performed better during sleep deprivation.

e)All schedules showed rapid and substantial recovery from sleep deprivation.

f)The 16/8 schedule provided the best recovery.

g)Subjects showed substantial improvements by the end of the first day, even though they returned to a demanding schedule. It should be noted that recovery was not as complete on the 4/2 schedule.

h)Large individual differences were seen in subjects whose schedules required interrupted sleep.

REFERENCES

HARTMAN, B.O., and G.K. CANTRELL. 1967.
MOL: Crew performance on demanding work/rest schedules compounded by sleep deprivation.
USAF School of Aerospace Medicine, Brooks Air Force Base, Texas.
[SAM-TR-67-99]

SS-6
SPACEFLIGHT SIMULATION
Martin Marietta (1962)

Martin Marietta Aerospace Group - Space Systems Division, Baltimore, Maryland

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PURPOSE

To evaluate the effects of long term simulated lunar flights on crew performance.

SUBJECTS

a)Four subjects: three-man crew and a communicator; age - 31-38 years.

b)Only the three crew men were confined.

PERIOD OF CONFINEMENT

a)Two 75-hour runs - Flight I and II (June 5-8, June 19-23, 1962).

b)One 163.5-hour run - Flight III (July 6-12, 1962).

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)The test facility was divided into the following areas: a main vehicle simulator; a one-man excursion vehicle simulator; a control room; and the analog facilities.

b)The main vehicle simulator was divided into a flight deck, sleeping area, off-duty area, toilet, a maintenance and response area, and galley.

PROCEDURES

a)Work/rest cycles: Flight I - a 24-hour cycle, 8 hours of uninterrupted sleep, 10 hours of on-duty time, and 6 hours of off-duty time mixed with on-duty time; Flight II and III - a 26-hour cycle, two 4-hour sleep periods, 10 hours of work, 8 hours of relaxation.

b)Tasks: flight control tasks; system monitoring; management tasks; navigational tasks; time estimation; and reaction time.

c)Crew training and evaluation: knowledge and practice of simulator operating procedures and flight control tasks; collection of baseline data (preflight) on all tasks; medical evaluation; and psychological examination (Wechsler Adult Intelligence Scale, Rorschach Projective Test, and interviews).

d)Recreation: music system; inflight exercise program.

e)Job assignments:

FLIGHT I	FLIGHT II	FLIGHT III
Pilot A - engineer	Pilot A - commander	Pilot A - navigator
Pilot B - navigator	Pilot B - engineer	Pilot B - commander
Pilot C - commander	Pilot C - navigator	Pilot C - engineer

TEST AND VARIABLES STUDIED

a)Performance as measured by the flight control tasks, system tasks, detection of malfunctions, navigational tasks, time estimation, and reaction time.

b)Behavior as measured by subjective reports, taped crew conversations, and the psychological evaluation tests and interviews.

c)Physical condition of the crew as measured every 6 to 8 hours and the medical evaluation.

RESULTS

PERFORMANCE

a)No serious decrements in performance occurred. The crew experienced some difficulties due to insufficient training.

b)There was an increase in performance levels between Flights I and II due to familiarization and revised crew checklists.

c)No decrements in estimating time were recorded.

d)There were no discernable performance decrements due to duty cycles, but it was felt that the 26-hour cycle was superior to the 24-hour cycle. The crew felt that long sustained duty periods in excess of 4 hours made the monitoring tasks more difficult.

BEHAVIOR

a)Time estimation and reaction time tasks did not indicate any stress due to confinement or sensory deprivation.

b)The crew experienced no full adaptation to either the 24-hour or 26-hour cycles.

c)Generally, the crew felt the food was well prepared and enjoyable.

d)Although there were no gross psychological or personality problems, irritability increased as the mission progressed.

PHYSICAL CONDITION

a)Flight I - crew members were fatigued due to duty cycles.

b)No serious medical problems arose.

CONCLUSIONS

a)The crew maintained an adequate level of performance.

b)The results of numerous psychophysiological tests of the crew indicated no abnormal stress reaction due to prolonged confinement of the mission.

c)The success of this mission was due to the crew being professional aviators interested in space flight problems.

d)The authors felt that the greater the training and preparation for the flight the less chance there would be for flight difficulties.

e)Length of flight (up to 7 days) did not appear to be a factor in precipitating disturbances in the personality or social spheres with the crew members who participated in each of the flights.

REFERENCES

GRODSKY, M.A., and J.P. BRYANT. 1962.
Crew performance during simulated lunar missions.
Space Systems Division, Martin Marietta, Baltimore, Maryland. 281 pages.
[ER-12693]

HATCH, H.G., Jr., J.S. ALGRANTI, D.L. MALLICK, H.E. REAM, and G.W. STINNETT. 1964.
Crew performance during real-time lunar mission simulation.
Langley Research Center, Hampton, Virginia. 17 pages.
[NASA TN D-2447]

MALLICK, B.L., and H.E. REAM. 1963.
Crew performance and personal observations on lunar mission simulator.
Presented at the 31st Annual Meeting, Institute of Aerospace Sciences, New York, January 1973.

SS-7
SPACEFLIGHT SIMULATION
Manned Environmental System
Assessment (MESA)

The Boeing Company
Seattle, Washington

PURPOSE

To evaluate a closed operating life support system. Only the effects of confinement on crew behavior during MESA II will be discussed since MESA I was aborted after 4 1/2 days due to toxicological problems.

PERIOD OF CONFINEMENT (March 2 - April 1, 1964)

Thirty days.

SUBJECTS

a)Five subjects: age - 26-36 yrs.; two subjects were supplied by NASA and three were Boeing employees.

b)Two of the men from Boeing participated in the 4-day manned run of the 17-day integrated pre-test, which was run to provide the necessary confidence in the life support system to conduct the 30-day mission.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

Altitude chamber, a closed life support system.

PROCEDURES

a)Work/rest cycle: 4 hours off-duty and 8 hours on-duty.

b)Training: The subjects spent 3 weeks prior to the mission on system familiarization, pre-test medicals and behavioral testing.

c)Tasks: monitoring and maintenance of equipment; maintenance of medical and nutritional records.

TEST AND VARIABLES STUDIED

a)Performance as measured by tracking, monitoring and time estimation tasks.

b)Psychological factors as measured by NRL Scale, Myers Scale, Subjective Stress Scale, Hostility Scale and a questionnaire to assess group annoyances, efficiency of thought, unusual visual and auditory experiences, restlessness, physical complaints, time tedium, lonesomeness, and worry.

RESULTS

PERFORMANCE

a)Tracking tasks - no significant changes.

b)Monitoring tasks - some improvement as confinement progressed.

c)Time estimation - no significant changes.

PSYCHOLOGICAL FACTORS

a)The crew developed a negative attitude toward the behavioral assessment program.

b)The confinement was not stressful to the crew.

c)One incident of tension headache and vomiting took place.

d)No perceptual aberrations occurred and decrements in the visual field were not significant.

e)Annoyances increased as did personal friction, irritability and hostility.

f)Subjects felt less happy, comfortable, and satisfied during confinement.

g)Time passed slowly.

h)There was an increasing dislike for the experimenters.

i)Speech and memory facilities remained constant and subjects did not fantasize.

j)Food, the behavior of others, noise, the toilet facilities, worries about the outside and boredom bothered the crew most.

CONCLUSIONS

a)Overall, the crew handled the confinement well.

b)There were no serious decrements in performance.

c)The subjects were able to adapt to the confinement; it was not particularly stressful for the crew.

d)The behavioral problems that existed were the result of poor motivation on the part of the crew.

e)The author suggested that extensive crew selection and training should be considered when planning future long term tests in order to obtain motivated individuals.

REFERENCES

BOEING COMPANY. 1964.
Manned enviornmental system assessment.
National Aeronautics and Space Administration, Washington, D.C. 335 pages.
[NASA CR-134]

SS-8
SPACEFLIGHT SIMULATION
90-Day Mission

Advance Biotechnology and Power Department
McDonnell Douglas Astronautics Company
Huntington Beach, California

PURPOSE

To evaluate the following in a closed ecological system: performance of life support system; ability of crew to operate and maintain the systems; and the requirements for maintaining the crew's physiological and psychological well-being in order to perform mission duties efficiently.*

* Only the ability of the crew to operate and maintain the systems and the requirements for maintaining the crew's psychological well-being will be reported.

SUBJECTS

Four subjects: graduate students; volunteers; age - 22-31 yrs.

PERIOD OF CONFINEMENT (completed Sept. 11, 1970)

Ninety days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)A double-walled horizontal cylinder which was used as a space station simulator/closed life support system.

b)One hundred percent oxygen environment obtained from liquid derived oxygen.

c)The chamber was divided into an equipment room and crew living area, separated by an acoustic barrier.

PROCEDURES

a)Work/rest cycles: two crewmen up/two crewmen down schedule. Sleeping period: crewmen one and two - 2300 to 0700 hours; crewmen three and four - 1300 to 2100 hours. Crewmen had at least 3 hours of free time each day.

b)Selection criteria: crew members who possessed the following qualities-scientific and technical skills and capabilities, emotional maturity and mission motivation, good physical health, ability to withstand isolation, leadership identification, and crew compatibility. Eight subjects were selected after extensive screening and objective and psychological testing. These eight subjects were subjected to an extensive training program of lectures, demonstrations and practice sessions. The final crew selection was based on the observations made during training on group formation, the training results, psychological data, subsystem knowledge and health data.

c)Tasks: maintain, monitor and repair the life support system; everyday tasks of living, eating and sleeping; additional tasks which included onboard experiments and other support experiments.

d)Recreation: exercise program, ex. bicycle; TV; radio; film; books; writing materials; art supplies; board games; cards; dice; tapes; cameras and film; musical instruments; and pico-projector library.

TESTS AND VARIABLES STUDIED

a)Performance as monitored by television cameras, microphones, computer readouts, display of simulator parameters outside the chamber and communication links.

b)Psychomotor devices - the Langley Research Center Complex Coordinator, the Critical Task Tester Experiment, and the Response Analysis Tester; and efficiency in maintaining, monitoring and repairing the life support system of the simulator.

c)Cognitive performance as measured by a Descriptive Sentence Test.

d)Sleep behavior as measured by a sleep questionnaire, electroencephalographic, and electroculographic recordings taken from 39 nights of sleep divided between two crewmen.

e)Subjective moods as measured by the Primary Affect Scale, the Hostility Scale, the Group Confinement Inventory, the Subjective Stress Scale, and the Isolation Symptomatology Questionnaire.

f)Crew personality changes as projected in the Rorschach Inkblot Test.

g)Crew reaction to the environment as measured by the Habitability Inventory Questionnaire.

h)Interpersonal behavior as tested by the Sociometric Test, the IBR Personal Space Measure, TV cameras, microphones. Verbal interaction and crew location and activity were observed by cameras and microphones to assess group cohesiveness.

RESULTS

PERFORMANCE

a)No serious degradations in performance were recorded; in fact, there was a trend to slight improvement as the mission progressed.

b)All scheduled tasks were completed, except those deleted because of conflicts with maintenance tasks.

c)Maintenance and repair task performance were maintained at a high level throughout the mission.

d)The crew used initiative and creativity in making repairs.

e)An improvement in time requirement to perform tasks continued throughout the mission.

COGNITIVE PERFORMANCE

Performance remained at a high level for all crewmen throughout the mission.

SLEEP BEHAVIOR

a)Variability existed in sleep duration throughout the mission for all crewmen. Sleep quality showed a tendency toward disruption.

b)A gradual increase in sleep time occurred during the first 30 days. The two crewmen who changed their diurnal cycles presented a greater lag in this gradual sleep time increase.

SUBJECTIVE MOODS

a)Crew morale was good except for a period of 10 days about two-thirds of the way through the mission. This decline in morale was caused by a lack of stimulating activity and a decreased mission task schedule.

b)There were periods of mild hostility for all crewmen.

c)The mission did not produce severe psychological stress in the crewmen.

d)Anxiety levels remained constant. Tedium, unreality, and contemplation varied among the crewmen.

e)Negative reactions to confinement were infrequent.

f)The mission was not a particularly happy or pleasurable experience for the crew. Level of happiness varied little throughout the mission. There were no significant changes for crewmen concerning anger.

CREW PERSONALITY CHANGES

Significant personality changes occurred in three of the four crewmen.

Crewman 1 - emotional control improved.
Crewman 2 - personal tension increased although basic anxieties decreased.
Crewman 3 - showed symptoms of anxiety and tension. He did not trust the test and would not take the second one.
Crewman 4 - affectional need increased, but basic anxiety was reduced.

CREW REACTION TO THE ENVIRONMENT

a)Complaints were rare. The habitability provisions were acceptable to the crew.

b)The most used recreational materials were TV, books, writing materials, and music. The least used materials were cards, dice and games in which competition is a factor.

INTERPERSONAL BEHAVIOR

a)Interpersonal differences were minor. No serious hostilities developed, and those that did develop usually concerned an operational omission.

b)There was no friction between crewmembers and support personnel.

c)Little group cohesiveness developed. Relationships among crewmembers were characterized as close-working, professionally motivated, impersonal, and noninteractive.

CONCLUSIONS

CREW PERFORMANCE

a)The training program should be flexible with respect to schedule and subject matter for long duration simulations of this type.

b)Cohesion training was effective in reducing the frequency and severity of inter-crew difficulties.

c)Performance of the crew was excellent in accomplishing the normal operation of the systems and in the successful completion of the main repair and maintenance tasks.

STAFF SELECTION

Selection of the outside staff was by all measures successful.

HABITABILITY EVALUATION

Factors have been indentified which may be crucial to the acceptability of a habitat. These are: crew motivation, crew adaptability, duration of habitat utilization, and initial acceptability of accommodations.

BEHAVIORAL PROGRAM

a)Although reported intercrew hostility was minimal, few interpersonal relations developed.

b)Subjects were unusually lethargic and required increasing amounts of sleep.

c)The minimal behavioral effects noted during this 90-day test did not provide sufficient information to permit extrapolation to missions of greater duration.

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[NASA CR-112019]

SS-9
SPACEFLIGHT SIMULATION
Project Hope

Human Factors Research Department, Lockheed-Georgia, Marietta, Georgia; and Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

PURPOSE

To evaluate the effects of work-rest cycles on performance and attitude variables.

SUBJECTS

SUMMARY OF INDIVIDUAL EXPERIMENTS

Study	Characteristics
Work/rest cycle	16 college students tested around-the-clock for 96 hours. Schedules used were 2/2, 4/4, 6/6, and 8/8. Subjects not confined.
Work/rest ratio	20 college students tested for 96 hours. Schedules used were 4/2 (N = 10) and 6/2 (N = 10). Subjects not confined.
Operation 360	11 combat ready Air Force personnel (B-52 crew members) tested for 15 days on 4/2 schedule while confined to the crew compartment.
HOPE II	5 cadets and 1 newly graduated officer from the Air Force Adacemy tested for 15 days on 4/2 schedule while confined to crew compartment.
HOPE III	10 newly graduated pilots (Air Force officers) tested for 30 days on 4/4 schedule while confined.
HOPE IV	4 graduates and 6 cadets from the Air Force Academy tested for 12 days on a 4/4 schedule with 44 hours without sleep imposed on days 6 and 7 of confinement.
HOPE V	5 Air Force Academy graduates and 5 newly graduated Air Force pilots, otherwise same as HOPE IV.
HOPEs VI & VII	12 newly graduated Air Force pilots tested for 12 days on a 4/2 schedule with 40 hours without sleep imposed on days 6 and 7 of confinement.

PERIOD OF TESTS (1956-1962)

a)Six 96-hour runs (work/rest cycle and work/rest ratio)

b)Four 12-day runs (Hope IV, Hope V, Hope VI, Hope VII)

c)Three 15-day runs (Hope II, Operation 360)

d)One 30-day run (Hope III) Subjects believed duration was to be 40 days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Subjects were confined or unconfined as stated in experiment description.

b)Confinement was in a simulated advanced aerospace system crew compartment, divided into a five-station work area, a leisure area, and a sleeping area.

c)No outside telephone communication was available.

PROCEDURES

a)Work/rest schedules tested:

96-hour runs	2 runs, 4 hours on-duty and 2 hours off-duty: 2 runs, 6 hours on-duty and 2 hours off-duty: 2 runs, 2 subjects randomly assigned to 1 of the 4 work/rest cycles - 2 hours on-duty and 4 hours off-duty; 6 hours on-duty and 6 hours off-duty; 8 hours on-duty and 8 hours off-duty.
Operation 360	4 hours on-duty and 2 hours off-duty.
Hope II	4 hours on-duty and 2 hours off-duty.
Hope III	4 hours on-duty and 4 hours off-duty.
Hope IV	4 hours on-duty and 4 hours off-duty.
Hope V	4 hours on-duty and 4 hours off-duty.
Hope VI	4 hours on-duty and 2 hours off-duty.
Hope VII	4 hours on-duty and 2 hours off-duty.

b)Sleep deprivation: during the sixth and seventh days of Hope IV and Hope V, each subject remained awake and worked 11 consecutive 4-hour duty periods. During Hope VI and VII, the procedure was similar but subjects worked only 40 hours instead of 44 without rest. Supplemental tasks (the Ohio State Psychological Test and the Matrices and Mathematical Programming Test) and two programmed texts, "The Analysis of Behavior" and "Matrices and Mathematical Programming", were employed during the sleep deprivation periods.

c)Subjects received program orientation and training.

d)Performance tasks included arithmetic computation, warning lights and probability monitoring, and auditory vigilance. Pattern discrimination was used as a performance task in the 96-hour runs and in Operation 360. Code lock solving and target identification, which are group performance tasks, were added tasks during Hope II-VII. Each 2-hour work span was divided into low, intermediate or high performance demands.

TESTS AND VARIABLES STUDIED

96-HOUR RUNS

a)Effect of work/rest cycles on performance was measured by arithmetic computation, pattern discrimination, warning lights and probability monitoring, and auditory vigilance.

b)Subject's general activity and attitudes were also studied in the multi-schedule runs. General activity was observed by the experimenter and recorded in his logbook. Attitudes concerning food, comfort of the work station, sleeping quarters, and the subject's adjustment of his schedule were subjectively measured by questionnaires.

OPERATION 360

Effect of work/rest cycles on performance was measured by arithmetic computation, warning lights and probability monitoring, pattern discrimination, and auditory vigilance.

HOPE II AND III

Effect of work/rest cycles on performance was measured by arithmetic computation, warning lights and probability monitoring, auditory vigilance, target identification, code lock solving and as recorded in the experimenter's logs.

HOPE IV, V, VI, AND VII

a)Effect of work/rest cycles and sleep loss on performance was measured by arithmetic computation, warning lights and probability monitoring, auditory vigilance, target identification and code-lock solving which was recorded in the experimenter's logbooks.

b)Psychophysiological factors were studied in most of the experiments but will not be reported.

RESULTS

PERFORMANCE

a)No significant performance differences were noted for subjects in the 96-hour experiments in which subjects were on one of four work/rest cycles - 2 hours on and 2 hours off, 4 hours on and 4 hours off, 6 hours on and 6 hours off, 8 hours on and 8 hours off; but on the basis of subject preference and overall adjustment the 2-hour and 4-hour cycles were superior to the 6-hour and 8-hour cycles.

b)In the other 96-hour runs the performance levels for the 4 hours on and 2 hours off schedule and the 6 hours on and 2 hours off schedule did not show that either schedule was superior. The study did suggest from the poor sleeping habits of the subjects on the 6 hours on and 2 hours off schedule that continued confinement would have resulted in severe performance decrements.

c)No consistent patterns between subjects concerning their performance level were evident in Operation 360. Some subjects had decrements in performance whereas other subjects did not. There were well marked diurnal rhythms in performance levels. It was felt that the test conditions had less adverse effects on those with a higher level of motivation.

d)In the Hope IV-VII studies performance levels were higher for subjects on the 4 hours on and 4 hours off schedule than for subjects on the 4 hours on and 2 hours off schedule.

e)The period of sleep loss during the Hope IV-VII studies resulted in significant decrements in performance. Sleep deprivation produced greater decrements in performance during Hope VI and VII which used the 4 hours on and 2 hours off schedule than during Hope IV and V which used the 4 hours on and 4 hours off schedule.

CREW BEHAVIOR

HOPE II-VII

a)Initially, subjects had difficulty in falling asleep quick enough in order to efficiently use off-duty time. However, most subjects reported adaptation after 3 to 4 days.

b)In Hope II and Hope III, subjects were generally able to stay alert on the job after the first 3 to 4 days.

c)Such physical discomforts as soreness of body parts, headaches, feelings of nausea, sore eyes, cold symptoms, and foot irritations were common complaints.

d)During Hope II and III subjects' logs noted that a few conflicts between crew members occurred early in the mission due to fatigue and sleepiness. During Hope IV-VII there were more conflicts after the period of sleep loss. However, subjects indicated and experimenter observations confirmed that the nature of conflicts was such that "mission effectiveness" would not have been compromised.

e)Subjects became bored with their work.

f)Major off-duty activities were:
Hope II - sleeping and personal hygiene.
Hope III - reading, letter writing, games, sleeping, and personal hygiene.

96-HOURS RUNS (with the 2/2, 4/4, 6/6, and 8/8)

a)No differences related to work/rest cycles for states of alertness, fatigue or adaptability were reported.

b)There was a great deal of conversation between subjects and experimenters.

c)Off-duty activities were:

sleeping - 70% of the time.
eating - 12% of the time.
reading, playing cards or relaxing - 18% of the time.

d)Several subjects expressed resentment toward the experimental routine.

e)Subjects on the 2-hour and 4-hour cycles maintained their motivation to continue better than subjects on the 6-hour or 8-hour cycles.

f)The 6-hour and 8-hour subjects developed a negative attitude toward the experiment which would have resulted in performance decrements if the confinement had continued.

OPERATION 360

a)Four subjects were able to get enough sleep in this experiment but one could not adjust to the sleeping schedule. He reported much suffering from sleep deprivation as the confinement progressed.

b)Four of the subjects felt they could have continued in confinement indefinitely.

c)Five of the six subjects in the second group tested (a volunteer group) said that they could have performed their normal (B-52 crewman) duties on the 4/2 schedule.

CONCLUSIONS

a)The results suggest that the test conditions have less adverse effects on subjects who are highly motivated.

b)With proper selection of personnel for sleep adaptability, the 4/4 schedule can be followed indefinitely and the 4/2 schedule for fifteen days. The 4/4 schedule permits essentially normal performance responses in relation to stresses such as sleep loss.

MAJOR METHODOLOGICAL FINDINGS

a)Asymptotic levels of performance on the battery of tasks were achieved after approximately 48 hours of performance.

b)The test-retest reliabilities of the tasks were quite high.

c)With the exception of those measures representing assessments of the same function in two different ways or under two different conditions, the tasks were essentially orthogonal.

d)The tasks can be used to confront the operator with a substantial range of workloads, from the relatively light to the extremely heavy.

e)A variety of observational measures (ratings of alertness by experimenters, subject diaries, etc) were found to be of assistance in the on-going conduct of the experiments and the maintenance of equipment, but of little or no other value.

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SS-10
SPACEFLIGHT SIMULATION
SAM (2-Man)

USAF School of Aerospace Medicine
Aerospace Medical Division
Brooks Air Force Base, Texas

PURPOSE

To evaluate the psychological and behavioral effects of confinement in a spaceflight simulator.

SUBJECTS

Eighteen subjects: all rated pilots; two men in each mission

PERIOD OF CONFINEMENT (1960)

a)Two 30-day runs.

b)Six 17-day runs.

c)One 14-day run.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Space capsule simulator.

b)Two 30-day flights at 18,000 ft.

c)Four 17-day flights at 33,500 ft.

d)Two 17-day flights at ground level.

e)One 14-day flight at 18,000 ft.

f)No outside communication.

PROCEDURES

a)Tasks: management of logistic aspects of flight (waste disposal, food preparation and recycling of fluids); monitor and control internal environment (manage cabin pressure, oxygen concentration, carbon dioxide level, and humidity); and operation of psychomotor tasks (tasks such as monitoring, discrimination, encoding, decoding, arithmetic and problem solving).

b)Selection: no psychiatric selection to match compatible individuals. Subjects were given psychiatric evaluations as part of their overall medical evaluation.

c)Work/rest schedules: psychomotor tasks for 2 to 3 hour periods during the day and 5 hours during the night for an average of 11 or 12 hours a day. Subjects were able to sleep for five straight hours during the night. When not manning the psychomotor tasks, subjects monitored and controlled the internal environment and managed the logistic aspects of the mission. There was not much time for rest during the day.

VARIABLES STUDIED

a)Behavior was measured by pre-and post-flight psychiatric tests and by inflight observations by TV, concealed microphones, and diaries.

b)Interaction was measured by pre- and post-flight psychiatric tests and inflight observations by TV, concealed microphones, and diaries.

c)Performance was measured by the psychomotor tasks - monitoring, discrimination, encoding, decoding, arithmetic, and problem sloving.

RESULTS

PERFORMANCE

a)Proficiency in performance varied from one flight to another.

b)During some flights performance remained at a stable level, whereas in other flights performance decreased.

BEHAVIOR

a)No perceptual aberrations were noted.

b)Somatic symtoms occurred occasionally.

c)The monotony of the experiment caused reminiscing, fantasizing, and drowsiness.

d)There was a tendency for subjects to become disoriented as to day and night time.

e)The men tended to curse and tell jokes to relieve tension.

f)Crew adjustment to work/rest schedules was achieved in 5 to 21 days.

g)There were no serious emotional changes.

INTERACTION

a)Interpersonal tensions varied in the flights. Only one crew was free of interpersonal tensions.

b)Feelings of irritation were often present when the men were fatigued. Most interpersonal irritations and tensions were suppressed, but usually expressed unconsciously or in the men's diaries.

c)Subjects refrained from expressing their hostilities because of their motivation to have a successful mission.

d)There were some negative feelings toward the ground control.

CONCLUSIONS

a)No serious problems arose due to confinement and isolation.

b)Although there was friction and tension between individuals, mission goals were sufficient to prevent any serious overt hostilities.

c)Monotony seemed to be a major problem.

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Aerospace Medicine 32:603-609.

SS-11
SPACEFLIGHT SIMULATION
60-day (1968)

Advance Biotechnology and Power Department
McDonnell Douglas Astronautics Company
Santa Monica, California

PURPOSE

To evaluate the physiological, behavioral and man-machine problems during a 60-day confinement study and their effects on crew behavior.

SUBJECTS

Four subjects: college students; volunteers; age - 22-28 yrs.

Subject	Age	Marital Status	Current Field of Study
I	26	Single	Psychology
II	28	Single	Oriental Philosophy
III	25	Married	Music
IV	22	Single	Zoology

PERIOD OF CONFINEMENT (Completed April 19, 1968)

Sixty days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Cyclindrical chamber, 12 feet in diameter and 40 feet long.

b)Closed life support system.

PROCEDURES

a)Work/rest schedule: two men on duty at all times. Each man was scheduled to have 8 hours of sleep a day. The schedule could be modified for unscheduled maintenance or other activities.

b)Tasks: domestic chores; operation, maintainance and monitoring of life support system; perceptual motor tasks; and behavioral tests.

c)Selection cirteria: age 21-30; good health; above average intelligence. The final selection of four subjects and two alternates was based on proficiency during training and/or psychological evaluations. Such factors as individual motivation to ensure mission success, individual grasp of program objectives, proficiency in learning subsystems and equipment, and ability to function as part of the crew were taken into consideration in the final selection.

d)Training: altitude chamber indoctrination; space station operations; biomedical monitoring; personal hygiene; food preparation; physical fitness; first aid; communications; housekeeping; group dynamics; behavioral testing and behavioral testing equipment; human anatomy and physiology; and design philosophy for man-machine control systems.

TEST AND VARIABLES STUDIED

a)Habitability assessment of the simulator was measured by a habitability scale which measured the annoyance level of such items as noise, dirt, bunks, boredom, etc.

b)Crew performance was measured by the Perceptual-Motor Performance Console which included 10 tests: arm hand steadiness, finger dexterity, manual dexterity, response orientation, control precision, multilimb coordination, rate control, perceptual speed, reaction time, and mirror tracing.

c)Crew motion characteristics were recorded by photoelectric relays.

d)Ability to receive remote instruction was evaluated from proficiency on a speed reading course.

e)Behavioral dynamics of personal interactions were measured by crew interaction scales/questionnaires and by the Isolation Symptomatology Questionnaire, the Group Confinement Inventory, the Primary Affect Scale, and the Subjective Stress Scale (SSS).

f)The crew was monitored by one-way view ports, moving TV cameras, and an intercom system.

RESULTS

HABITABILITY

a)The mean annoyance value for all items was 0.77 which indicates less than "very little" annoyance.

b)The ratings changed little over the period of testing. The most irritating features of the test were sleeplessness, food, and noise.

CREW PERFORMANCE

a)A gradual shift in crew activities toward command center from the exercise area.

b)No significant changes in overall crew travel during the mission.

ABILITY TO RECEIVE REMOTE INSTRUCTION

A formal course in speed reading was presented to the subjects to evaluate constructive use of crew time.

REMOTE INSTRUCTION PROGRAM RESULTS

	Before	After	
	Reading Rates (words/minute)	Reading Rates (words/minute)	Comprehension (%)
Subject I	298	1170	95
Subject II	318	1380	90
Subject III	359	1448	75
Subject IV	900	1875	100
Average	468	1468	90

BEHAVIORAL DYNAMICS

a)The mission was not particularly stressful to the crew members.

b)Interpersonal conflicts were minor.

c)Strained relationships developed between test subjects and outside support crew.

d)Boredom and monotony were not problems during the mission.

e)The crew functioned well throughout the mission.

CONCLUSIONS

a)Psychological status of the crew members remained excellent; the test conditions were not particularly stressful to the four subjects.

b)A habitability assessment of the SSS indicated that mean ratings of crew annoyance ranked in the minimal to mild range.

c)Perceptual motor skill performance, after showing initial improvement, remained constant or continued to improve throughout the testing period.

d)An assessment of crew dynamics and interactions indicated that the four subjects functioned smoothly as a crew throughout the test.

e)All four crewmen completed a course in reading dynamics, demonstrating that formal and creative educational programs can successfully be incorporated into future studies.

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[NASA CR-98500]

SS-12
SPACEFLIGHT SIMULATION
1965 Simulation

U.S. Naval Air Engineering Center
Philadelphia, Pennsylvania

PURPOSE

To evaluate the physiological and psychological effects of the following: breathing pure oxygen at reduced pressures; long term full pressure suit occupancy; and habitability aspects of confinement.*

*Only the psychological aspects of confinement will be reported.

SUBJECTS

a)There were eight subjects: aviators; university graduates with degrees in science, engineering or mathematics; volunteers; officers.

b)Six subjects acted as the experimental group and were divided into two groups. The individuals in each group worked the same hours. One group worked a day shift and the other worked a night shift. The remaining two subjects comprised a small control group.

PERIOD OF CONFINEMENT (1965)

Thirty-four days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)The experimental group was in a large low pressure chamber, 100% oxygen atmosphere, with total pressure of 356 to 368 and oxygen partial pressure of 152 to 160.

b)Twenty days of the confinement were at a simulated altitude of 27,000 feet.

c)The control facility was a plywood cottage - 8' X 8' X 16' - with a layout similar to that of the experimental facility.

PROCEDURES

a) Selection: criteria for selection included willingness to volunteer, a technical aptitude, a verbal aptitude equal to that of Mercury astronauts, superior flying ability, and good physical condition.

b)Subjects received two weeks of training and orientation.

c)Tasks included: individual response to light stimuli; group responses to light stimuli; estimates of level of aspiration; and perceptual motor tasks.

TASKS AND VARIABLES STUDIED

a)Verbal learning and affective changes were measured by a test which involved learning to associate pairs of nonsense syllables and meaningful words.

b)Interpersonal relations and group cohesiveness were measured by the Fiedler Adjective Scale which was modified by Borislow. Measurements were taken before, during and after confinement.

c)Motivation was measured by a hand dynamometer.

d)Symptoms of confinement were measured by a questionnaire filled out daily by the subjects.

e)Performance was measured by individual and group responses to light stimuli; estimates of level of aspiration; and perceptual motor tasks.

RESULTS

VERBAL LEARNING AND AFFECTIVE CHANGES

There were no significant affective changes.

INTERPERSONAL RELATIONS

a)Group cohesiveness did not significantly change during confinement.

b)Subjects did not allow themselves to build up hostilities.

MOTIVATION

a)The motivation of the group, as a whole, varied throughout the mission.

b)A constant increase in motivation was recorded from days 1 to 8.

c)After day 12 motivation decreased until day 18; it increased until day 30 then decreased again.

SYMPTOMS OF CONFINEMENT

a)Being impatient with other subjects occurred frequently in the experimental group but not in the control group during confinement. Irritability increased in intensity as the mission progressed.

b)Anxiety was highest at the beginning of the mission.

c)Restless sleep was the most frequently reported symptom.

d)Inactivity was a recurring complaint of three subjects.

e)Weak and sore muscles were reported frequently in the early part of the mission.

f)Reported symptoms of irritability, inactivity, dirtiness, and lack of interest became more frequent toward the end of the mission.

TIME ESTIMATION

a)There were no significant correlations between time estimation and anxiety.

b)Subjects overestimated time at first and then progressively their estimates became more accurate.

PERFORMANCE

a)Error levels fluctuated little from day to day with minimal or no decrement in performance during the mission for both individual and group performance.

b)Learning was a factor for the individual performance responses for the first 14 days.

c)As measured by estimates of level of aspiration, goal seeking behavior of the men, as individuals, tended to increase over confinement.

d)During the first 10 days of confinement the day shift performed better than the night shift, then both shifts were equal for 3 days. For the remainder of the confinement the night shift performed better than the day shift.

CONCLUSIONS

STRESS

a)Symptoms of stress were reported by both the experimental and control groups.

b)The control subjects reported more emotional symptoms and stress than the experimental group due to boredom and a feeling of being of secondary interest to the study.

NUTRITION

The nutritional aspect of the study was noteworthy only in that the diet was very well accepted and appeared to be adequate in all aspects.

GENERAL

The most common single source of annoyance to the subjects was the ratio of temperature/humidity. Although fairly precise control could be maintained by the automatic equipment it appeared that no single set of conditions could satisfy all of the six experimental subjects for very long.

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[NASA CR-708]

SS-13
SPACEFLIGHT SIMULATION
1959 Simulation

U.S. Naval Air Material Center
Philadelphia, Pennsylvania

PURPOSE

To study the effects of confinement on performance.

SUBJECTS

a)Six subjects: enlisted men, all stationed at the Naval Air Material Center; age - 18-29 yrs.

b)Four controls.

PERIOD OF CONFINEMENT (1959

Eight days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

The experiment was conducted in a potassium superoxide closed breathing system. The capsule was divided into two compartments: one for eating, recreation, and hygiene; the other for work and sleeping.

PROCEDURES

a)The task program consisted of: Key Tap Test; Visual Tracking Task; Multiple Solutions Test; Time Estimation Test; Autokinetic Task; Group Cohesiveness Test (a motor task); atmospheric monitoring; Battleship Game.

b)The crew was monitored continuously by two television cameras and concealed microphones.

c)Selection technique: The following measures were used in the selection of the subjects: the Taylor Manifest Anxiety Scale; the Cornell Index; Personality Orientation Device; Study of Values; the Rorschach; The Bender-Gestalt test; the Thematic Apperception Test; and an intra-personal rating scale marked by senior scientists in the lab. Subjects were selected from a group of 24 volunteers out of an original group of 40 men.

d)Work/rest cycles were 13 hours of work and 11 hours of rest each day. Each subject's cycle was the same, but their schedules were different.

e)Control subjects were tested in the same manner as the experimental subjects, but they were not confined.

VARIABLES STUDIED

Performance: such factors as rigidity, vigilance, tracking, time estimation, and suggestibility were considered.

TESTS

a)Time Estimation Test

b)Multiple Solutions Test

c)Key Tap Test

d)Battleship Game

RESULTS

TIME ESTIMATION

The confined subjects overestimated the passage of time when compared to the control subjects. The degree of overestimation increased as the length of confinement increased.

MULTIPLE SOLUTIONS TEST

a)No significant differences were recorded between the results of the control and experimental groups.

b)All subjects revealed some improvement in performance which might be attributed to learning.

KEY TAP TEST

a)The only significant source of variation was that of confined subjects.

b)Control subjects were not employed for this part of the test.

BATTLESHIP GAME

All subjects' responses showed some improvement.

CONCLUSIONS

Confined subjects' performance was adequate.

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SS-14
SPACEFLIGHT SIMULATION
Selection of Spaceflight Candidates

USAF School of Aerospace Medicine
Brooks Air Force Base, Texas

PURPOSE

To examine psychiatric and peer rating methods in the selection of space flight candidates.

SUBJECTS

Fifteen career pilots initially selected from 60 candidates. All were:

a)College graduates ages between 26 and 35.

b)Graduates of/or students at the USAF Aerospace Research Pilots School.

c)With three exceptions, the subjects were the oldest or the only male child in their families.

PROCEDURES

a)Two psychiatrists and one psychologist evaluated each crew menber and ranked him from 1 to 15 according to their judgment of his suitability for space flight.

b)Candidates ranked each other after all lived together for 10 days in a competitive situation.

RESULTS

Comparison of Rank Orders

	Psychiatrist			Composite	
Subject*	A	B	Ψ‡	Evaluator	Peer
Ace	6a†	13	14	13	12
Ben	10a	2a	2a	4	15
Cap	13	14	15	15	3
Don	14	15	12a	14	11
Eif	3	4	2b	2	10
Flip	8a	9a	6a	9	4
Gil	1a	7	9	8	8
Hud	6b	9b	2c	5	9
Imp	5	1	2d	1	7
Jake	1b	9c	1	3	5a
Kip	4	6	10a	7	5b
Lem	8b	12	12b	12	1
Mick	10b	5	10b	11	12
Ned	12	2b	6b	6	2
Ole	15	7	6c	10	13

*Code names are assigned without reference to actual names, initials, or order of examination.
†Letter indicates those cases in which no rank distinction could be made between two or more candidates by the shown evaluator or in composite.
‡Psychological testing.

The degree of interevaluatór agreement was only fair. When a composite, self-determined ranking of candidates was developed, only one of the examiner's' top five candidates was selected by the candidates themselves; however the peer composite agreed with the evaluator composite of three

of the five in the lowest ranks.

CONCLUSIONS

a)An analysis should be made of personality factors which contributed to the success of such men as Columbus, Magellan and the Wright brothers.

b)Problems of selection could be diminished by mutual sensitivity, empathy and consideration on the parts of both psychiatrists and candidates.

c)The flight surgeon under psychiatric tutelage should conduct an on-going evaluation of crew members as a "back-up" to the selection process. The flight surgeon would thus become intimately familiar with individual personalities and group dynamics.

d)Psychiatric considerations in aerospace medicine have opened new and strange vistas for ways to understand the motivations and emotional limits of man.

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U-1
UNDERWATER
Ben Franklin (1969)

Grumman Aerospace Corporation
Bethpage, New York

PURPOSE

To evaluate the psychological and physiological reaction to long-duration confinement and isolation and to provide space programs with information on crew reactions, the man-machine interface, habitability and biological isolation.

Only the psychological reactions will be reported. The information obtained concerning crew reactions and habitability will be discussed.

SUBJECTS

Six subjects: two oceanographers, two pilots, a relief pilot oceanographer, and a NASA crew member; age - 34-46 yrs.

PERIOD OF CONFINEMENT (July 14 - August 14, 1969)

Thirty days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)A submersible vessel of cylindrical shape - 48' x 10', with 3500 cubic feet which included the deck, bunks, storage areas, and equipment areas.

b)A closed ecosystem.

PROCEDURE

a)Selection criteria: desire and ability to participate; compatibility not a determining factor.

b)Training: review of ship system and equipment; review of the maintenance procedures; crew demonstration and dock-side time trials, training on the Langley Research Complex Coordinator.

c)Crew member assignment and function:

Assignment	Function [Primary]	[Secondary]
1)Mission Leader	Scientific	Operations
2)Oceanographer	Scientific	None
3)Pilot	Operations	Scientific
4)Oceanographer	Scientific	Maintenance
5)Pilot	Operations	Maintenance
6)Engineer	Life Sciences Studies	Maintenance

d)Tasks: domestic chores; maintenance and operation of ship and equipment; life science experiments; ocean experiments.

e)Recreation: cassette player with musical tapes; playing cards; scrabble; a dart board; drawing pads; water colors; games; books.

TESTS AND VARIABLES STUDIED

PREMISSION

a)Base-line psychological, physiological, and motor skill performance profiles were determined on each crewman for comparison with data obtained during and after the mission.

b)Psychological - dominance-submission, social adjustment, anxiety, need to achieve, need to affiliate, and mood profiles were determined by:

Interviews
Rorschach Test
Primary Affect Scale (PAS)
Subjective Stress Scale (SSS)
Group Confinement Inventory (GCI)
Edwards Personal Preference Scale (EPPS)
Continuous Addition
FIRO-B
Minnesota Multiphasic Inventory (MMPI)

c)On the basis of these profiles and close premission association with crew members, two investigators attempted independently to predict crew adaptability and reaction to human-engineering and environmental limitations of the vessel.

d)Physiological - the following base-line measurements for physiological reactions to confinemnt were taken:

EEG
Physical fitness index
Wrist and forearm strength
Recovery pulse
Blood pressure
Oxygen utilization
Weight

e)Motor Skill Performance - crewmen practiced on the Langley Research Center Complex Coordinator with the intent of reaching a plateau of performance.

DURING MISSION

a)Psychological - data on psychological variables were obtained during the mission by means of a daily questionnaire log which included a Mood Scale Check List, a Subjective Stress Scale, and a Sleep Recall Questionnaire. Not all items were sampled daily.

b)Physiological - Physiological measurements taken premission were also taken at regular intervals during the mission.

c)Motor Skill Performance - during the mission, daily tests of proficiency were carried out on the Langley Research Center Complex Coordinator.

d)Habitability - quantitative data on social adaptability, area utilization, and crew activity were obtained by use of time-lapse photography and intermittent voice tape recordings.

The following habitability measurements were also taken:

Preferences with respect to food
Environmental measurements

Use of water and sanitary facilities
Recreation
Activity
Use of bunks
Measurement of task performance

POSTMISSION

Psychological and physiological tests administered prior to the mission were repeated. Intensive individual interviews were also conducted.

RESULTS

PSYCHOLOGICAL FACTORS

a)As time passed the crew showed a general trend toward personal withdrawal and an increased need for privacy.

b)Depression was greatest at the mid-point of the confinement.

c)None of the crew suffered serious deterioration in performance on the Langley Research Complex Coordinator

d)Problems resulted from failures and misunderstandings in communication with the surface crew.

e)The logs, the psychologists, and topside command were targets for the release of crew frustrations.

f)Lack of private communications was a source of annoyance.

g)Very little group activity or games took place; as the mission progressed the men tended to remain alone unless assignments required them to be together.

h)Listening to music was the most frequent free time activity of the crew.

i)All the men had trouble sleeping at various times during the mission.

j)Tension increased gradually.

K)Motivation and morale remained high. Motivation for mission success helped to solve problems of indifference before they got out of hand.

MAINTENANCE

The crew showed flexibility and resourcefulness in being able to organize, modify and adjust their workload to fit the operating conditions.

HABITABILITY

a)Individual food ratings varied from good to bad. Complaints about the food increased with time.

b)Major habitability complaints were surface communication, food, forward seats, clothing, forward table, bunks, temperature control, accessiblity, hot water, galley space, time line, noise.

c)The principle complaint was a lack of privacy.

PREDICTOR VARIABLES

a)The independent predictions of crew adaptability made by two of the investigators were nearly identical. They predicted nearly all of the crew incompatibilities that became evident during the mission. This indicated that the current understanding of people permits prediction of behavior with acceptable reliability. The predictions are summarized in the following table. Crew members were identified by code (X,Y) to prohibit identification.

Predicted Behaviors and/or Responses	CORRECTLY PREDICTED Yes	No
Will defer to topside under pressure	X	
Very conscious of responsibility	X	
Anxious	X	
Asserts authority	X	
Will come in conflict with X	X	
X will control behavior though upset	X	
Great need for recognition	X	
X will collide with Y (he did, but controlled himself)		X
Strongly motivated - will carry on even if unburdened	X	
Least likely to provoke conflict	X	
Will not be a leader in developing group cohesiveness		X
Difficult but will accommodate	X	
No. 1 irritant	X	
No. 2 irritant	X	
Extremely competent	X	
Reveals anxiety but controls it	X	
Crew will close ranks and resist over hostility	X	
Hostility will arise if power resource fails	-	-
X will be annoyed by mess	X	
Housekeeping		
Difficult because of limited space	X	
Insufficient storage area	X	
Lack of training will prevent a clean, orderly, inspectable environment	X	
Untidiness could cause hostility	X	
Hygiene		
Spaces adequate, difficult to keep clean	X	
Clean up may result in hostilitites		X
Ear infections will be present		X
If a cold or other infection occurs will spread	X	
Showers will give way to sponge baths	X	
Water will become contaminated	X	
Cold water for bathing will be unacceptable	X	
Water		
Taste will be unacceptable	X	
Expect cold water will become contaminated	X	
Will run short of hot water	X	
Food		
Will not be liked	X	
Will not affect health	X	
Need hot food, cooked in more conventional manner	X	
Carrying of pantry supplies will result in some hostility based on consumption	X	

Predicted Behaviors and/or Responses	Correctly Predicted Yes	No
Recreation		
Crews will at first be very busy-little time for recreation	X	
Will play group games-cards		X
Conversation will be a major recreation		X
Entertainment will eventually become more individual	X	
Two sets of earphones would help	X	
There will be much general talk	X	
Art supplies will probably not be used	X	
Eating will be a major source of enjoyment	X	
Crew Quarters		
Use as storage area will reduce acceptability	X	
Location will interfere with sleep; privacy	X	
Quarters provide little opportunity to exhibit territoriality	X	
2 crewmen will show some territoriality	X	
Bunks should get favorable comment regarding comfort (Silica gel and Li OH Panels were stored under mattress)		X
Complaints about headroom	X	
Complaints about absence of lights	X	
Curtains will not provide sufficient noise isolation for light sleepers	X	
Temperature & Humidity		
Lack of controlled temp/humidity will result in complaints	X	
If humidity is high will cause skin irritation	X	
Will complain of cold when near bottom	X	
Work Stations		
Command & Control Station not well Human Engineered but well understood by crew-will not result in problems	X	
Lack of Writing & Work Stations will be complained about	X	
NAVOCO cannot monitor equipment & see outside at same time	X	
Crew will have numerous complaints & recommendations	X	

b)Negative interaction occurred between men who were predicted to be incompatible more often than between individuals expected to be compatible.

CONCLUSIONS

a)Although there were minor irritations, annoyances, and many complaints, the overall mission was a success.

b)The author suggests that more training, improvements in food, provisions for privacy, and selection on the basis of compatibility might have helped to avoid these irritations and annoyances.

HABITABILITY

a)The techniques used in habitability analysis, based on time-lapse photographic records, provided a basis for habitability prediction techniques applicable to future spacecraft programs.

b)Environmental monitoring, including trace contaminants, was possible with simple manual equipment now available.

c)The authors suggest that facilities for preparing hot meals and an adequate selection of meals based on the preferences of the actual crew are of prime importance.

d)The water system should be designed so that it can be drained, inspected and cleaned periodically. Hot water should be made available for periodic showering.

PSYCHOLOGICAL

a)Pre-mission psychological profiles of each of the six crewmen enabled the investigators to predict certain relationships among the men during the mission.

b)Analysis of the results of the Group Confinement Inventory revealed pertinent information including the following: the crewmen became more negative about their environment as time progressed; annoyance with partners increased steadily throughout the mission; annoyance with mannerisms of others was greatest in retrospect; general tension increased gradually; overall crew compatibility was highest at the end of the third week; level of conflict was highest during the middle part of the mission; the crewmen sought more privacy as the mission progressed; and boredom with environment increased with time.

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[NASA TM X-64548]

U-2
UNDERWATER
Sealab

Office of Naval Research
Department of the Navy
Washington, D.C.

PURPOSE

SEALAB I

a)To confirm shore laboratory investigations of the physiology of saturation diving.

b)To determine the characteristics and suitability of undersea habitats for the support of swimmmers performing various tasks in offshore waters.

c)To determine man's efficiency in the performance of various classes of tasks while living under saturation conditions.

SEALAB II

a)To study individual and group reactions to extreme, prolonged stress in a field situation.

b)To explore systems analysis and mathematical modeling as means of analyzing conditioning procedures in small isolated groups.

c)To expand knowledge of adjustment and adaption of groups of men to stressful environments. Measure group and individual work performance of aquanauts.

d)To collect data useful for future screening of personnel.

e)To determine man's general ability to do useful work at a depth of 200 ft. in a realistic ocean environment under saturated diving conditions.

f)To determine physiological changes in man as a result of extended diving.

g)To identify any neurological and psychophysiological changes in man as a result of extended diving.

SEALAB III*

a)To establish assembly time baselines for specific underwater works, against which subsequent deep water work could be compared.

b)To illuminate potential problem areas, in particular to document any adverse effects of the bulky Mark VIII diving equipment and unbilicals.

c)To estimate the physiological work loads imposed by the various aspects of the task, again to provide necessary information for later evaluation of response to deep ocean work.

*The Sealab III program was cancelled, and the only work done was carried out at the Naval Civil Engineering Laboratory at Port Hueneme.

SUBJECTS

SEALAB I

Four Navy subjects.

SEALAB II

a)Twenty-eight Navy divers and civilian scientists.

b)Three teams of 10 men each.

c)One man from Team I remained to continue with Team II.

d)One man from Team I joined Team III.

SEALAB III

a)Six-man team.

b)Four regulars and two alternates.

c)Navy and civilian members.

PERIOD OF CONFINEMENT

SEALAB I (July - August 1964)

Eleven days.

SEALAB II (August 28 - October 14, 1965)

Fifteen days for each team.

SEALAB III (July and August 1965)

Twelve hours for each of the two dives.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

SEALAB I

a)Laboratory - 9' diameter x 40' long.

b)Depth - 192 ft.

c)Atmosphere - 79% He, 17% N, 4% O_2.

d)Habitat temperature - 78°F-90°F.

e)Water temperature - 65°F.

f)Clear warm water and hard bottom conditions (Bermuda).

SEALAB II

a)12' diameter x 57.5 long cylinder.

b)Depth - 205 ft.

c)Atmosphere - 73-75% He, 21-22% N, 4-5% O_2; pressure - 6.8 atmos.; humidity - 60-80%.

d)Habitat temperature - 82°F-88°F.

e)Water temperature - 47°F-56°F.

f)Continental shelf, ocean conditions (La Jolla, California).

SEALAB III

a)This study included only the underwater construction task termed Divercon I.

b)10' diameter x 10' high domed cylinder open at the bottom.

c)Depth - 50 ft.

d)Atmosphere - Mark VIII gear.

e)Location - Naval Civil Engineering Laboratory, Port Hueneme, California.

f)The Sealab III habitat on the sea floor was never occupied, all work was performed by divers from the surface.

PROCEDURE

SEALAB I

a)The crew duties included: repair and maintenance of the Sealab equipment, general housekeeping observation and filming of sea life and Sealab operations, and gathering of marine biological samples.

b)Blood samples, urine samples, electrocardiograms, and other physiological measurements were taken on a routine basis of the subjects during the occupation, as well as 9 days before and 5 days after the undersea exposure.

c)The effects of variations in atmosphere were monitored.

d)Psychological observations were made of crew actions and interactions. The crew had been selected on the basis of individual capabilities and physiological profile, with no respect to possible psychological incompatibilities.

SEALAB II

a)Vital functions which might assist topside control in medical management of the experiment were monitored. These studies included daily blood analysis, inspection of urine and saliva, pulmonary function, electrocardiographic recordings, body temperature control, exercise tolerance, and routine physical tests.

b)During Sealab II decompression runs, a test program applying gas chromatography to determine the dissolved gas levels in urine was conducted.

c)Pre- and post-dive neurological examinations included assessment of the cranial nerves, motor system, sensory sytem, cerebellar function, gait and station, and screening test for aphasic signs. EEG and autonomic variables (heart rate, respiration, finger pulse response, galvanic skin response and basal skin resistance) were obtained. The autonomic variables were scored for basal levels, spontaneous fluctuations in basal activity and response to stimuli.

d)Two methods were investigated to record physiological parameters of free swimming subjects: (1) the acoustic underwater telemetering of EKG signals from the swimmer to the habitat and wire transmission to the surface vessel, and (2) the use of a miniaturized unit which was carried by the swimmer and recorded EEG and eKG.

e)Psychomotor tests used during the program were designed to measure the application of maximum force (strength test), manipulative dexterity, eye-hand coordination, and the cooperative assembly by four divers of a three-dimensional configuration. On most of these tests, data were obtained on dry land, in shallow water, and during submersion in Sealab.

f)The program also included auditory and visual tests. Pre-dive and post-dive hearing tests were administered to each diver. Data were collected in the water on color and form discrimination, and the optical properties of light transmission as well as the observation of underwater lights. Results were also obtained on the ability of the divers to perform mental-arithmetic tests, both before and during the submersion period.

g)In addition to the specific tests described above, the men were under continual surveillance during submersion by closed-circuit television and open audio channels. The behavior of the men was systematically observed and recorded. These data included eating and sleeping habits, activity levels, variation of mood, morale, motivation, and the general spirit of cooperation. Following the submersion period, each diver completed questionnaires and medical examintions, and was interviewed.

SEALAB III

a)Divers were given three questionnaires to fill out. The purpose was to extract their ideas of the human factors important to Divercon I.

b)Heart rate recordings were taken during the mission using water proofed chest electrodes connected by 200 ft of cable to an electrocardiogram recorder.

c)Divers were observed in order to assemble a detailed time sequence of work elements.

TESTS

SEALAB I

a)More than 30 physiological values were derived daily from eaoh subject, covering all useful parameters of blood morphology, blood chemistry, basal metabolic function, body temperature, and general physiological status.

b)General observations were made of the psychological responses of the crew during the operation.

SEALAB II

a)Psychological tests and questionnaires.

b)TV observation and audio surveillance.

c)Interviews.

d)Self-reports.

e)Physiological tests.

SEALAB III

a)Three questionnaires - Trouble Shooting Check, a Task Element Ranking Form, and a Diving Factor Ranking Form.

b)Heart rate recordings.

c)"Work" was recorded by a surface person aided by an underwater observer.

VARIABLES STUDIED

SEALAB I

Physiological response to Sealab conditions was measured.

SEALAB II

a)Performance behavior

b)Mood changes

c)Adjustment and adaptation to the Sealab environment

d)Amount and quality of sleep

e)Meal behavior

f)Activity level and patterns.

SEALAB III

Performance

1)Task difficulty

2)Task importance

RESULTS

SEALAB I

During the first 4 days the subjects were somewhat uncomfortable, noting joint aches and headaches.

PHYSIOLOCIAL EFFECTS

a)No adverse physiological effects were noted from the test results.

b)There appeared to be a clearly defined slowing of all physiological functions, under conditions of an undersea environment.

ATMOSPHERIC EFFECTS

a)When oxygen levels were held at 4 percent, or in excess, the aquanauts reported an improved sense of well-being, whereas at levels of 3 to 3 1/2 percent this was not the case.

b)There appeared to be a significant increase in individual susceptibility to nitrogen narcosis after He-O_2 saturation.

PSYCHOLOGICAL EFFECTS

a)Group cohesion and general effectiveness of interaction were remarkably good, considering the spectrum of personalities and talents involved.

b)Throughout the experiment, foul language served to replace actual interpersonal conflicts.

c)During Sealab, the men accentuated their personality idiosyncrasies.

d)Discontent was directed toward the topside control.

e)Subjects, from the movement of their entry, moved at about half speed.

f)News that the men could communicate with home perked them up.

g)Subjects developed a great sense of independence when they realized they could survive without assistance. This destroyed the "buddy" system and resulted in an accident.

SEALAB II

PHYSIOLOGICAL

a)In general no significant changes were noted in the physiological parameters monitored. However, an increase was noted in some serum enzyme levels (notably lactic dehydrogenase) during the first 3 to 5 days of undersea expsoure; levels slowly returned to normal values.

b)Results indicated that a high correlation existed between the amount of dissolved gas in the urine and the ambient atmospheric concentration.

c)Progress was made in developing a system for the monitoring of vital signs of free swimmers.

d)All pre-dive EEG's during resting, waking, activation, and periods of sleep were interpreted as being within the criteria for normal. The post-dive records were distinguished by more rapid onset of sleep and the appearance of large amounts of spindle stage and slow-wave sleep.

e)Neurological changes were found in the post-dive examination of only one man.

f)The men were questioned in order to ascertain whether neurological symptoms were present while they were in the habitat. Sixteen men reported suboccipital, retro-orbital, or generalized headaches. For most the headaches were mild, but three divers had headaches so severe they were obliged to go to bed. The headaches were most severe on awakening and abated with activity. Three individuals reported that their thought processes were slowed, and two subjects experienced euphoria for the first few days. Sleep problems, getting to sleep as well as staying asleep, were reported by some divers.

g)The only significant difference between the pre-dive and post-dive basal means was for skin conductance. The pre-dive conductance mean was significantly higher, reflecting the higher degree of arousal before the dive. These data are consistent with the EEG findings of more drowsy records and quicker onset of sleep during the post-dive examinations.

PSYCHOLOGICAL

a)The "common fate" environment increased group cohesiveness.

b)A factor analysis of the variables studied supplied the following picture of a high scoring diver. He was highly regarded by his leader as a worker and was highly chosen by his peers as a desirable teammate; he was a good performer (on the basis of achieved diving) and reported a low level of overt fear. He also spent little time communicating with people outside Sealab and a good deal of time in interaction with his teammates, while spending little time lounging in the laboratory area. He also missed few meals.

c)Personality measures given prior to the dive failed to predict adjustment.

d)Three major demographic variables were considered as probable predictors of successful adjustment: age, birth order, and size of home town. Older, laterborn divers from small towns adjusted best to the multiple stresses.

e)First borns logged less diving time and made fewer sorties from Sealab. This was correlated with fear.

f)Mood scale results indicated well-being and happiness correlated significantly with adjustment. The divers who reported themselves most happy were least successful in adjusting, while those who perceived themselves as most vigorous and alert showed the best adjustment.

g)The picture of the desired leader which emerged from the test results was of an older, mature, perhaps aloof man rather than someone more social, fearless and high performing.

h)Sharing in group reactions and activities correlated positively with good performance.

i)Food was not a primary source of gratification in Sealab.

j)Gregariouness was positively associated with amount of diving time, and this supported the view that social interaction is strongly related to successful adaptation.

k)There was no evidence that any aquanaut made a territorial claim, however, this may have been due to lack of space rather than desire.

l)Perceived stress increased dependency on leaders.

SEALAB III

QUESTIONNAIRES

a)When asked to evaluate tasks from very easy to very difficult, the divers classed almost all tasks as easy.

b)Tests that required ranking of tasks in sequential order of difficulty or importance provided the best results.

c)The tasks involving handling of the large Divercon I components were ranked most difficult, while the use of hand tools and equipment inspection received the lowest scores.

d)The importance of inter-diver communication and special equipment was stressed, while communications to the surface were depreciated.

HEART-RATE RECORDINGS

a)Average heart rate responses underwater ranged from about 100 bpm for light tasks to 140 bpm for heavy tasks.

b)As the diver left the water and walked to his seat with 150 lbs of gear, heart rate averaged 160 bpm.

OBSERVATIONS OF WORK

a)Diving work was classified in productive and non-productive categories.

b)Time/work schedules were developed.

CONCLUSIONS

SEALAB I

a)Tests indicated that human subjects could live and work under pressure at 193 ft in the open ocean without significant physiological problems.

b)Total performance, in underwater conditions, as measured in output-hours did not reach sea-level norms.

c)The ability to perform required tasks was more important in the selection of personnel than the meticulous matching of personalities.

d)Motivation was of paramount importance.

e)The authors suggest that: it is important to establish clear-cut lines of command prior to any venture; and all future undersea manned ventures will require improved coordination of medical and engineering phases with a great degree of control vested in the medical complement of the team.

SEALAB II

a)No significant short-term physiological changes occurred to cause deterioration of the aquanauts' physical condition.

b)There was a clear degree of diver adaptation to cold water, as shown both by interviews with the aquanauts and by pre-dive and post-dive cold-water-immersion physiological measurements.

c)There was a degradation of performance which increased with the complexity of the task being accomplished. Data indicated that part of the performance decrement was associated with personality variables.

d)No significant pre-dive or post-dive neurological or EEG changes were found while the only significant difference in psychophysiological variables was a drop in arousal level from pre-dive to post-dive.

e)The impression was gained that the amount of work accomplished and the comparatively good showing in the psychomotor performance tests were due to the combination of very high morale, the aggressive achievement-oriented motivation, and the high expertise and long experience of most of the divers.

f)Good work records in the water suggested that divers should be of relatively pragmatic disposition and able to contend with stress and danger without being preoccupied with them.

g)Persons who tended to be good mixers also tended to achieve more in terms of diving operations.

h)Social interaction was strongly related to successful adaptation to a vigorous environment.

i)Based on the analysis of the overall performance of the aquanauts, criteria can be developed to assist in the selection of future aquanauts.

SEALAB III

a)The main lesson was that one must take into account the limitations in performance imposed on the underwater observer himself and establish an observation system which properly balances the capabilities of underwater and surface personnel.

b)The tasks emerged as fairly rigorous, involving some heavy workloads, but could be accomplished by two-man teams in 10 to 12 hours under ideal conditions.

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U-3
UNDERWATER
Tektite

Office of Naval Research, Department of the Navy, Washington, D.C.; and National Aeronautics and Space Administration, Washington, D.C.

PURPOSE

TEKTITE I

a)To evaluate and develop means to observe crew behavior.

b)To study the behavior and effectiveness of a small group of highly trained men living under stressed and isolated conditions.

c)To study biomedical responses of men living under high nitrogen-partial-pressure saturated conditions in the marine environment for an extended period.

d)To learn whether man as an aquanaut may develop new kinds of sleep requirements which differ from those of land based man.

e)To learn whether man may also develop serious sleep disturbances during his attempts to adapt to the ocean floor environment.

f)To observe the effects of two-way video between the habitat and mission control.

TEKTITE II

a)To evaluate the behavioral dynamics of small groups during missions in hostile environments.

b)To perform research studies on crew selection, composition, command structure and crew rotation.

c)To study habitability preferences of aquanauts living and working in confined quarters.

d)To study the effects of unexpected perturbations on crew behavior and performance.

e)To determine the possible effects of nitrogen narcosis on performance.

f)To observe the effects of two-way video between the habitat and mission control.

SUBJECTS

TEKTITE I

a)Four marine scientists from the Department of the Interior.

b)All males, aged 31-35 years.

TEKTITE II

a)Forty-eight subjects.

b)Forty scientists and eight engineers.

c)Age - 23-45 years.

d)Five subjects in each mission (four scientists and one engineer); six 20-day missions organized as two sets of three missions with four engineers serving for 30 days each and rotating at the half way point to each set.

e)One mission of five women.

PERIOD OF CONFINEMENT

TEKTITE I (Feb. 15-April 16, 1969)

Sixty days.

TEKTITE II (1970)

a)Four missions of 14-day runs.

b)Six missions of 20-day runs.

EXPERIMENTAL CONDITIONS AND PROCEDURES

TEST FACILITY

a)Two domed cylinders 12.5' diameter x 18' high connected by a tunnel and standing on a support base.

b)Depth - 49 ft.

c)Atmosphere - 92% N, 8% O_2; humidity - 42%-60%; pressure - 2.3 atmospheres.

d)Location - Greater Lameshur Bay, St. John Island, U.S. Virgin Islands.

PROCEDURES

TEKTITE I

a)Tasks performed included domestic chores, habitat maintenance and repair, marine science research, and biomedical and behavioral science programs.

b)Recreation activities were conversation, guitar playing, reading and cards.

c)Work/rest cycles; 17 hours and 18 minutes per day:

1.7 hrs direct marine science research
2.3 hrs marine science support
1.5 hrs biomedical and behavioral science
1.9 hrs habitat maintenance and repair
0.5 hrs open
2.7 hrs self maintenance
3.0 hrs recreation
3.7 hrs resting and sleeping.

TEKTITE II

a)Work/rest cycles; 24-hour day:

6.4 hrs marine science
1.3 hrs habitat maintenace
0.4 hrs other work
8.4 hrs sleep
1.8 hrs self maintenance
4.9 hrs recreation
0.8 hrs other.

MEASUREMENTS

TEKTITE I

a)Pre-mission testing; in-depth interview, base-line mood scales, Rorschach protocol, psychomotor tests, and biomedical tests.

b)Continuous observation by closed circuit TV and microphones.

c)Electroencephalograms.

d)Sleep log.

e)Langley Research Center Complex Coordinator.

f)Post-mission tests and interviews.

TEKTITE II

a)Data collected by teams of psychological observers who were students at the University of Texas at Austin.

b)Pre-mission psychological testing.

c)Continuous observation by closed circuit TV and microphones.

d)Self-reports. Each acquanaut filled out a mood adjective checklist twice a day.

e)Post-mission debriefing.

VARIABLES STUDIED

TEKTITE I

a)Behavioral Measurements.

Behavioral reactions of individuals
Emotional adjustment/stability
Manifest anxiety
Intrahabitat communication
Objective and levels of motivation
Time/motion study
Morale
Group cohesiveness
Leadership function
Overt aggression
Sleep assessment

b)Life History Questionnaire - Prediction Technique.

TEKTITE II

a)Command structure.

b)Crew composition.

c)Selection and prediction.

d)Group dynamics.

e)Isolation and confinement.

f)Performance.

g)Time lines.

h)Problem solving.

i)Work/rest cycles.

j)Communication.

k)Stress perturbation.

PREDICTOR VARIABLES

TEKTITE I

a)Age.

b)Education.

c)Employment.

d)Present Family.

e)Parents.

TEKTITE II

a)Age.

b)Years SCUBA experience.

c)Participation in religious activity.

d)Parents' education.

e)IQ.

f)Birth Order.

g)Life History Questionnaire.

RESULTS

TEKTITE I

a)There was a gradual shift toward later arising and retiring times. Only slight difficulty in going to sleep. No severe loss of sleep or disruption of sleep cycles. Average of 8 hours of sleep a night. All subjects indicated a need for more sleep. Heart rate during sleep was elevated over that for pre- and post-dive nights. EEG evidence indicated longer and deeper sleep.

b)Experience in the Tektite I habitat did not affect performance on a complex psychomotor task as measured by the Langley Complex Coordinator.

c)Age - the group was quite homogeneous in age. In selecting men for unusual environments, it is necessary to have men who have sufficient experience such that their potential is known, yet who are young enough that they have sufficient stamina and resilience to withstand the rigors of unusual environments.

d)Education - all subjects had a history of a comparatively regular education and even progress toward degrees.

e)Present Family - all four were married.

f)Men did not act as individuals in a vacuum. Life and work were influenced by their fellow team members.

g)The aquanauts spent 432.15 man-hours in the water during the mission.

TEKTITE II

a)Average amount of time spent working for aquanauts was 8.04 hours per day.

b)The team scoring highest on sleep spent 39.6% of its time sleeping in contrast with the lowest which spent only 30.8%.

c)Psychologically each group appeared to have established an initial norm for work and to have generally maintained this level of output throughout the mission.

d)When a scientist was team leader, his personal goals coincided with his mission goals.

e)Habitat maintenance took an average of 5.27% of mission time overall and did not differ significantly across missions.

f)Those who spent more time caring for themselves were less likely to participate in group recreational activities.

g)Individual gregariousness was positively associated with performance.

h)Vehicle design should provide variability (particularly visual), good food with minimal waste, adequate work aids, individual privacy, and adequate garbage disposal, and must avoid "multiple use" spaces.

i)Privacy was very important, especially to individuals who did not relate well to the group.

j)The most popular place was the control room where contact with topside was available.

k)Crews made most use of TV, music, magazines, books, and the video-phone in their off-duty time. They did not make much use of games.

l)Food flexibility was recommended.

CONCLUSIONS

TEKTITE I

a)The authors suggest that saturation dives of the Tektite type can be conducted safely, provided that a rigorous safety program is implemented.

b)Tektite I proved that long excursions by aquanauts in undersea habitats are feasible and can be applicable to civilian and military needs.

c)Man adapted to the stresses that accompany undersea habitation at 43 feet.

d)Aquanauts slept longer during the dive than during the pre- or post-dive period.

TEKTITE II

a)The aquanauts felt very little anxiety or depression during their stay in the habitat.

b)The crew said they preferred books, music, TV, and the video phone for recreation.

c)Conversing was the most frequent leisure activity.

d)The most popular place, except during meals and bull sessions, was the bridge or control room where contact with topside was available.

e)All subjects achieved a respectable level of performance.

f)Positive moods, including concentration, activation, social affection, pleasantness, strongly predominated though they decreased somewhat as mission duration increased.

g)There were few conflicts.

h)A two-way video link seemed to reduce feelings of isolation and overt hostility toward remote operational personnel.

i)Both male and female aquanauts adapted successfully to life in a confined environment.

j)Differences in performance found between teams probably resulted in large part from the setting of group norms for behavior by crews in the absence of externally imposed standards.

k)Teams in which a scientist-aquanaut was leader achieved more Marine Science work than those with engineers as leaders.

l)Group relations and performance were better when the engineers and scientist-aquanauts played an active role in each other's field of expertise.

m)Analysis of time factors in habitat behavior showed significant shifts in activity over time. Aquanauts spent less time working and more time in leisure and sleeping in the second half of the mission than in the first half.

n)In-habitat activity variables were strongly related to performance. Behavior in long (20-day) missions were generally more stable than in 2-week missions.

o)The Life History Questionnaire proved to be a very effective predictive instrument.

p)Results showed that meaningful data could be collected from natural groups over time by employing observational methodology.

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M-1
COAL MINE DISASTER

National Academy of Sciences
Washington, D.C.

PURPOSE

a)To examine individual and group behavior in a coal mine disaster.

b)To carry out basic research in human behavior by examining the men's behavior during entrapment, their physical and especially psychological state after rescue.

SUBJECTS

a)Nineteen miners, age - 22-58, divided into three groups by the nature of their entrapment.

Group I	12 men, 22-58 years of age.
Group II	6 men, 29-49 years of age.
Group III	1 man, age not available.

b)Twelve non-trapped miners who worked in the day shift on the day of the disaster were matched up with trapped miners for: type of work, age, education, religion, and marital status, for a comparison.

PERIOD OF CONFINEMENT

a)Group I	6 1/2 days.
b)Group II	8 1/2 days.
c)Group III	8 1/2 days.

EXPERIMENTAL CONDITIONS AND PROCEDURES

GROUP I

a)Cavity measuring 12' x 30' with 10 men.

b)Another cavity about same size with two men (injured).

c)Both cavities were at the bottom of the 13,000 foot level wall.

GROUP II

a)Main cavity of 30'-40' long, about 10' wide and 4'-6' high.

b)Cavity located at the top of the 13,000 foot level wall.

GROUP III

a)Located about 75' from Group II.

b)Cavity was 4' wide by 4'-5' long and 5'-6' high.

ENVIRONMENT

a)Temperature - 80°F.

b)High concentration of methane and carbon dioxide.

c)Odor of corpses.

d)No light, food or water after the third day.

e)The semi-isolated man was trapped for 8 1/2 days about 75 feet away from the group of six. He was without food and water for the entire period.

TASKS

Attempts to escape: explored the mine, hollered through the pipe, beat on pans and pipes.

TESTS AND VARIABLES STUDIES

Variables studied: feelings, behavior, attitude, reactions, immediate memory, attention and concentration, visual-motor coordination, analytic thinking, and handling of unstructured material.

MEASURED BY:

a)Interviews

b)The Vocabulary, Digit Span, and Block Design sub-tests of the Wechsler Adult Intelligence Scale.

c)Counting backwards from 20 to 1, and counting backwards from 100 by 7's.

d)Bender-Gestalt drawing test.

e)Rorschach Ink Blot test.

f)Sentence Completion test.

RESULTS

a)The fear of not being rescued was uppermost in the minds of the trapped miners. The sounds of rescue operations were interpreted by some as the sealing off of the mine. This fear was dealt with by denial and their companions' reasoning.

b)More anxiety and pessimism were felt as time progressed, especially in the group of six. This may have been due to the pinned miner and isolated man.

c)There was a single outburst of irritableness in the group of six and one of hostility in the group of 12. These situations were handled by the other miners by direct action or reasoning.

d)The presence of dead and decomposing bodies was a source of stress.

e)There were no major morale problems when the men were actively trying to escape during the first 3 days in the group of 12.

f)There seemed to be different leaders for various roles:

leaders that knew a great deal,

leaders that promoted trying to escape, and

those that kept the morale up.

g)These roles changed back and forth.

h)There was much despair with some members giving up hope of rescue.

i)They felt anticipation when they lost control.

j)Almost all of the trapped miners experienced one of the following psycho-physiological symptoms during entrapment:

respiratory symptoms,

gastrointestinal symptoms,

cardiovascular symptoms,

genitourinary symptoms,

skin symptoms,

musculoskeletal symptoms, or

headaches.

k)The group of six had fewer complaints than the group of 12, possibly due to the presence of a dying man which drew their attention away from their own problems.

l)Almost all experienced hallucinations, which were caused by sensory deprivation.

m)The trapped miners did not score lower on psychological tests than non-trapped miners.

n)Interviewers observed tenseness and anxiety in the trapped miners.

o)There seemed to be evidence of stress in both the non-trapped and trapped miners.

p)The anxiety reactions of the miners were characterized by depressive features:

self-preoccupation,

self-depreciation,

indecision, and

constriction of thought and imagination.

q)The escape period was a task-oriented situation (this was the first 2 or 3 days). The survival period (without food, light, water) was an emotion-oriented situation (last half of the entrapment).

CONCLUSIONS

a)Psychological tests indicated that being trapped for 6 1/2 to 8 days with little food and water and with the threat of death affected the miners less than expected.

b)The Sentence Completion Test indicated that trapped miners experienced subjective anxiety with self-preoccupation, uncertainty, and questioning of personal adequacy.

c)There was some evidence that age and years of experience were factors in resistance to the stresses involved.

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M-2
PENTHOUSE
(1965)

Space Sciences Laboratory
University of California, Berkeley

PURPOSE

To investigate: 1)legal-political; 2)nutritional; and 3)social-psychological factors of a confined group.

SUBJECTS

a)Penthouse II - 6 subjects, age 21-28 years.

b)Penthouse III - 12 subjects, age 20-39 years.

c)The subjects were volunteers and well paid.

d)Twelve staff members were present during both studies; they were allowed to leave the Penthouse at any time and were not subject to the experimental conditions. One of the psychologists took the part of a subject during Penthouse III.

PERIOD OF CONFINEMENT

a)Penthouse II - 88 days. (2 March - 28 May 1965)

b)Penthouse III - 43 days. (15 June - 28 July 1965)

EXPERIMENTAL CONDITIONS

TEST FACILITY

Penthouse of a building at the University of California campus. Living space consisted of 2600 feet surrounded by a terrace of about 9800 square feet.

PROCEDURES

a)Tasks: Penthouse II - prisoner's dilemma games, discussion sessions, exercise, and medical routines for the nutritional experiments; Penthouse III - participation in sham legal cases, discussion sessions, exercise, and medical routines for the nutritional experiments.

b)Recreation: card playing, television, radio, reading, movies, and occasional walks.

c)Meals: Penthouse II - subjects given a formula diet; Penthouse III - six subjects given a formula diet like Penthouse II, and six subjects given the Gemini diet which is a diet of packaged, dehydrated, bite-sized items.

d)Restrictions: Penthouse II - none, allowed visitors, phone calls and mail; Penthouse III - no visitors allowed, restricted telephoning, no restriction on mail.
For both studies lights were supposed to be out at 11 and bedtime was designated as 11 P.M. - 7 A.M.

e)Selection Technique: questionnaires and personality inventories, physical exam and an interview. Recruited through the University of California. Researchers attempted to find congenial subjects for Penthouse III which was not attempted for Penthouse II.

TESTS

a)Ergometer.

b)Political and mental questionnaires.

VARIABLES STUDIED

a)Rule-creating and rule-violating behavior as measured by day to day observations and remarks from the logs.

b)General behavior and attitudes as observed and as measured by social-psychological tests.

RESULTS

RULE-CREATING AND RULE-VIOLATING BEHAVIOR

a)Subjects were reluctant to formulate rules for their own governance.

b)The rules set up by the researchers were resisted and evoked complaints.

c)Subjects disposed of rules whenever they wanted. For instance, subjects stayed up past bedtime and watched TV. Subjects in Penthouse III made phone calls during restriction time.

d)Penthouse III's behavior did not show as much latent and patent hostility, distress, and anti-law behavior as Penthouse II.

GENERAL BEHAVIOR

a)As time passed subjects became more irritable, depressed and prone to outbursts of temper.

b)Subjects did not devise techniques for settling internal differences and therefore became more tense and more irritable.

c)A sharp drop in group activity occurred in the latter part of both studies.

d)Subjects staked out areas for exclusive use and became hostile when others trespassed.

e)Penthouse II subjects used the prisoner's dilemma game as a weapon against the investigators. The game resulted in a two-person zero-sum contest between the subjects and the investigators.

f)Subjects showed solidarity when confronted by investigators.

g)Subjects in Penthouse III were willing to consider cases in the sham legal trials with a pro-con decision.

CONCLUSIONS

a)In a group confined for purposes of physiological experimentation it is feasible to extend the spectrum of the investigation to include psychological, sociological, political, and legal behavior of the group.

b)Penthouse II and III groups permitted observation of the formation of what has been called "legal structure of a confined micro-society".

c)Greater resistance existed to political and legal investigation than to psychological and sociometric testing.

d)Micro-societies were reluctant to formulate rules for their own governance.

e)Both affectional and aggressive feelings were insulated due to the effects of crowding.

f)The investigators were unable to persuade the subjects to devise conscious techniques for settling their internal differences.

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M-3
PRISON STUDY

Department of Justice
New Zealand

PURPOSE

a)To determine whether personality deterioration is one of the effects of imprisonment.

b)To show that imprisonment is characterized by a loss of cognitive efficiency and loss of motivation.

SUBJECTS

a)Eighteen subjects - separated into three groups.

b)Group A - those in prison for the first time. (prison environment)

c)Group B - those on probation. (outside world)

d)Group C - longer-term prisoners and those who had served previous prison terms. (prison environment)

e)Six matched pairs were made from Groups A and B, based on: sex, nationality, age, marital status, educational background, occupation, and comparisons were made between Group A and Group B and Group A and Group C.

TEST AND VARIABLES STUDIED

a)Test battery included - Koh's Block Design Test, McGill Delta Block Test, Digit Symbol subtest of the Weschsler Bellevue Scale.

b)Variables measured were deterioration in personality, loss of cognitive efficiency and decrease in motivation.

RESULTS

a)Deterioration in personality was not significant.

b)Slight cognitive loss was found but was not significant.

c)A decrease in motivation was not shown.

CONCLUSIONS

a)A larger sample is needed and a longer time interval between testing.

b)Few studies have results that confirm the author's hypothesis (Purpose of Study) that confinement leads to deterioration.

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M-4
EVALUATION OF TESTS

Texas Christian University
Fort Worth, Texas

PURPOSE

a)To examine personality characteristics that have appeared to be significant predictors of personal and interpersonal adaptation under conditions of isolation, stress and long-term confinement.

b)To identify factorially defined, reliable, and administratively appropriate measures which could be used in future research on the selection of space crew personnel.

SUBJECTS

a)One hundred and ninety-eight Army ROTC cadets and officers from Texas Christian University and the University of Texas at Arlington were tested, but only the scores of 157 were used. Data from 41 subjects were excluded due to psychometric consideration.

b)Ages ranged from 18 to 34 years, with a mean age of 20.3 years.

EXPERIMENTAL CONDITIONS AND PROCEDURES

I. Part I of the report dealt with the selection and administration of the tests (instruments).

a)The literature was reviewed to ascertain

1. Predictors of personal and group adaptation to isolation, stress and confinement.

2. Behavioral and personality dimensions related to adaptation to isolation, stress and confinement.

b)An experimental test battery consisting of 24 instruments was assembled. This battery consisted of personality, biographical and attitude instruments, as well as a medical history form that appeared to provide measures of the behavioral-personality dimensions sought.

c)Subjects were tested in groups of 10 to 40 each, in classrooms at their respective universities.

d)Each subject was given a package containing all tests and instructed to follow directions.

e)Completion of the entire battery of tests required three sessions per group, totaling 7 to 9 hours.

f)All the data gathered took the form of self-ratings or self-reports.

II. Part II of the report dealt with the factor of self-ratings or self-reports of the test results.

a)Of the 34 tests and instruments given to each individual, only the results of 18 tests were utilized.

b)One hundred and thirty-four variables were identified; of these 63 were included in the factor analysis, and the remainder were considered outside variables.

c)A comparison of the different tests revealed 231 duplicator or similar items. Each individual's response to these questions was compared. Thirty-seven subjects, who made a relatively large number of illogical responses, were excluded from the data. Four additional subjects, who were missing certain data, were also excluded.

d)Factor analytic method.

1. The method used involved the extraction of principal components, conversion to universe principal components, and transformation toward a simple structure.

2. Eighteen principal components were extracted, and 11 of these were converted to universe principal components.

TESTS AND VARIABLES

The following tests and variables were utilized in the factor analysis.

Test (Instrument)	Variables Included
1. Ascendance-Submission Reaction Study	Ascendance-Submission
2. Adult Opinion Survey	Emotional Stability, Social Extraversion, Conscientiousness, Cyclothymia vs. Schizothymia, Agreeableness vs. Hostility Relaxed Composure vs. Suspicious Excitability, General Activity, Paranoid Sensitivity
3. Barratt Impulsivity Scales	Motor Control, Variability, Interest Feeling, Risk, Social Interaction, Impulse Control
4. Gordon Personal Profile	Responsibility, Sociability
5. Repression-Sensitization Scale	Psychological defense mechanisms ranging from repression to sensitization
6. Gordon Personal Inventory	Cautiousness, Personal Relations, Vigor
7. Thurstone Temperament Schedule	Active, Vigorous, Impulsive, Dominant, Stable, Sociable, Reflective
8. Internal-External Scale	Measure of generalized expectancy
9. Test of Behavioral Rigidity	Flexibility
10. S-R Inventory of Anxiousness	Anxiety Response
11. Self-Disclosure Questionnaire	Amount of information about self person has disclosed to others
12. Fundamental Interpersonal Relations Orientation - Behavior (FIRO-B)	Expressed Inclusion, Expressed Control, Expressed Affection, Wanted Inclusion Wanted Control, Wanted Affection
13. California Psychological Inventory - Rational	Sociability, Responsibility, Achievement, Conformity, Dominance
14. Illogical Score	Illogical Score
15. Consistency Score	Consistency

16. Edwards Personal Preference Schedule - Inverse	Order, Exhibition, Autonomy, Affiliation, Intraception, Succorance, Dominance, Abasement, Nurturance, Change, Aggression
17. Social Insight - Inverse	Passivity, Competition, Aggression.

RESULTS

I. Part I results

a)With respect to biographical and personal history items, three variables were reported to be consistent predictors of adaptation to isolation, stress and confinement. Each of these variables was positively related to good adaptation:

1. Age
2. Absence of delinquency
3. Low need for avocational activity

b)Behavioral and personality variables, which consistently discriminated individual differences in adaptation to the stresses of isolation and long-term confinement, were conceptualized in terms of the following eight behavioral-personality dimensions:

1. Energy Level
2. Autonomy-Dependence
3. Impulse Control
4. Rigidity-Flexibility
5. Need of Change
6. Emotional Stability
7. Interpersonal Relations
8. Aggression

II. Part II results

Factor analysis of the correlations among the 63 personality measures (variables) produced 11 factors. Of these, three major factors were identified: Social Dominance; Rational Self-control; and Stable, Relaxed vs. Unstable, Suspicious. Three lesser factors were labeled as Social Dependence; Cyclothymia vs. Schizothymia, and Cultured, Restrained Sociability. The other factors were Agreeableness vs. Hostility; Passive vs. Aggressive; Non-Expressive; and Heterosexuality.

CONCLUSIONS

These conclusions were drawn in Part II of the report and were based on an evaluation of all of the information.

a)Based on the correlations of the scales of 18 instruments it was concluded that five instruments would provide adequate measures of eight, reasonably well defined factors; these instruments were the Adult Opinion Survey, Thurstone Temperature Schedule, California Psychological Inventory, Gordon Personal Profile, and Gordon Personal Inventory. Administration of these five would take approximately 2 hours.

b)This study disclosed dimensions of individual differences which appear to have promise for personnel selection.

c)Responses considered illogical could prove to be important and highly useful in selection of personnel for missions characterized by long duration, isolation, and confinement.

d)When the results of the study were viewed in the light of the personal characteristics sought for space crew personnel (Part I), it was concluded that more definitive measures of personality were needed than were offered by measures of broadly-defined dimensions.

REFERENCES

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Normative studies of personality measures related to adaptation under conditions of long duration, isolation, and confinement. Final report. Part II: Factor analytic investigation.
Institute of Behavioral Research, Texas Christian University, Fort Worth, Texas. 132 pages.

SELLS, S.B., and R. TREGO. 1973.
Normative studies of personality measures related to adaptation under conditions of long duration, isolation, and confinement.
Final report. Part I: Personal characteristics for successful adaptation.
Institute of Behavioral Research, Texas Christian University, Fort Worth, Texas. 27 pages.

M-5
MOUNTAIN CLIMBING EXPEDITION

Berkeley Institute of Psychological Research, San Francisco, California

PURPOSE

To assess individual behavioral patterns and interpersonal relations which developed during the 1963 American Mount Everest expedition.

SUBJECTS

Seventeen climbers

EXPERIMENTAL CONDITIONS AND PROCEDURES

1)The climb to the summit of Everest presented many natural hazards both in terms of terrain and weather conditions.

2)Each team member rated himself and all his fellow teammates, the latter procedure including his preferences for a leader and a colleague, before, during and after the expedition.

3)Observations on individual behavior and interpersonal relations were made by a psychologist travelling with the team.

4)Results were correlated with independent psychological assessments.

TEST

1)Terman Concept Mastery Test - verbal intelligence.

2)D-48 - non-verbal test of intelligence ability

3)General Information Survey

4)Watson-Glaser Critical Thinking Appraisal

5)Chapin Social Insight Test

6)Strong Vocational Interest Blank

7)Ten General Values

8)Six Spranger Values

9)Allport-Vernon-Lindzey Study of Values

10)California Authoritarianism Scales - enthnocentrism, fascism and political-economic conservatism.

11)Gough Adjective Test List - used for both self and peer ratings and by independent assessors.

12)California Psychological Inventory.

13)Edwards Personal Preference Inventory

14)Myers-Briggs Type Indicator

15)Minnesota Multiphasic Personality Inventory

16)Bass Orientation Inventory

17)Welsh-Barron Art Scale

18)Gottschaldt Figures Test

19)Barron Human Movement Scale

RESULTS

1)Team members rated a person's general characteristics as more important than his professional expertise.

2)The group placed high values on empirical and aesthetic concepts, tended to overestimate social needs and underestimate economic needs.

3)Self and peer ratings on the 60 words in the Adjective Check List ranged from 5 to 43 words with longer lists tending to be more negative.

4)Group cohesion broke down at one time when a fatal accident occurred; otherwise, the group norm established the individual's worth to the team and avoided overt subjective reactions.

5)Independent psychological assessments made during pre-mission were accurate predictors of behavior, and post-mission results correlated highly with group opinions of each other.

CONCLUSIONS

1)The individual's handling of himself and others was the criterion for performance.

2)Enduring personality traits were of prime importance in establishing interpersonal relations while random and unpredictable events were not.

REFERENCES

LESTER, J.T. 1965.
Behavioral research during the 1963 American Mount Everest Expedition; correlates of field behavior.
Berkeley Institute of Psychological Research, San Francisco, California.
74 pages.

R-1
REVIEW/SUBMARINE

Angiboust, R.

PURPOSE

To discuss psychological factors likely to be encountered during operation of the lunar laboratory.

CONFINEMENT REVIEWED

Submarine

REVIEW OF STUDIES

COHESION AND GOOD RELATIONS WITHIN THE GROUP DEPEND ON

a)The physical environment.

b)A sense of security.

c)Organization of work, relaxation and sleep.

FACTORS WHICH PROMOTE A GOOD PSYCHOLOGICAL STRUCTURE

a)Conditions resembling life on earth are essential.

b)The activity schedule should resemble that of terrestrial habits.

c)Interest and motivation need to be continually stimulated.

d)Television is important as a link with daily life on earth.

e)Individual psychological traits are important, particularly the motivation of each member.

f)Wise organization of a group can counteract behavioral incompatibility to some extent.

g)Organization depends on selection, preparation and training.

LONG PERIODS OF TRAINING ARE IMPORTANT IN ORDER TO

a)Provide opportunity for the observation of the group.

b)Acquaint the group with each other.

c)Familiarize the group with the operations, equipment, etc. in order to:

1)Develop feelings of security.

2)Foster group unity.

3)Organize human relationships necessary for successful operation of the lunar laboratory.

REFERENCES

ANGIBOUST, R. 1967.
Psycho-sociological problems of small, isolated groups working under extreme conditions.
In: F. Malina, ed. Life Sciences Research and Lunar Medicine. Pergamon Press, New York. pp. 11-20.

PURPOSE

To review and summarize research on isolation and disorientation as it relates to the problems of space flight.

REVIEW OF STUDIES

SAM

a)As confinement progressed indications of reduced crew motivation appeared.

b)Although there were feelings of disharmony and resentment, crew morale was high throughout mission.

c)Individual differences affected crew interactions.

d)No gross perceptual aberrations were evident.

e)No serious physiological and psychological problems were noted.

HOPE

This study demonstrated that if crews are properly selected and motivated, they can work up to periods of 2 weeks using a 4 hours on and 2 hour off work/rest schedule.

GENERAL

a)Most of the studies indicated that the psychological variables are generally more influential than the physiological variables.

b)Prolonged confinement causes decrements in psychomotor skill performance, memory, judgment and learning ability.

c)Proficiency in performance cannot be maintained much beyond 20 hours of continuous performance without rest.

d)Skill in vigilance and monitoring is susceptible to fatigue effects.

e)Some subjects become increasingly irritable and even hostile under conditions of confinement.

f)Degree of confinement can affect time perception.

g)Prolonged commitment to exacting duties and continued monitoring of equipment causes bordom and fatigue.

h)Studies have shown that crew members can maintain their performance levels on a working schedule of 4 hours on and 4 hours off.

i)Discomfort, malfunction of equipment, confinement, and fatigue produce hostilities and personality deteriorations in some subjects; however, other studies have not shown any significant personality effects.

j)As time in confinement progresses prolonged performance is sometimes characterized by unevenness, irregularity, less precise responses, queuing or delaying of responses, filtering of certain categories of stimuli, stereotyping of responses, and increased errors.

SELECTION

a)Good techniques of selection, training, and human engineering can increase man's ability to tolerate the stresses of space flight.

b)Crew members should be selected who have ability to tolerate the stresses of space.

c)Training should include exposure to sustaining prolonged periods of confinement and isolation.

CONCLUSIONS

a)The conditions of isolation are very conclusive to disorientation, since these may at times involve:

1)Elimination of certain sensory cues.

2)Gross distortion of the ways in which sensory cues are presented.

3)Distortion of ability to sense and perceive cues accurately.

b)Astronauts and their crews will not suffer from the potentially detrimental effects of isolation and disorientation provided that:

1)The astronaut and crew are appropriately selected and trained.

2)They are provided with piloting and related tasks.

3)They are provided with continuous contact with essential aspects of the enviornment.

c)Once the stimuli, responses and basic physiological and psychological mechanisms are understood for specific space flight missions, techniques of selection, adaptation and training, and human engineering may be used to increase man's ability to tolerate the stressful conditions and to perform as a reliable unit within any spacecraft system.

REFERENCES

CHAMBERS, R.M. 1964.
Isolation and disorientation.
In: J.D. Hardy, ed. Physiological Problems in Space Exploration. Charles C. Thomas Publisher, Springfield, Illinois. pp. 231-292.

R-3
REVIEW/SPACEFLIGHT Chambers, R.M., and Fried, R.

PURPOSE

To review scientific literature on the psychological aspects of space flight.

CONFINEMENTS REVIEWED

a)Space flights.

b)Space flight simulators.

REVIEW OF STUDIES

GENERAL PSYCHOLOGICAL FINDINGS

a)Perceptual disorientations are caused by illusions of vision, motion and body position.

b)The requirements of space require the crew members to adjust to work/rest schedules that are not related to normal day-night activities.

c)Feelings of irrationality, irritability, euphoria, exhilaration and other maladaptive reactions caused by isolation and confinement will also influence crew members' performance.

d)Fatigue can result in decrement in performance, impaired judgment, slower reaction time, reduced vigilance, degradation of attitude, increased ranges of indifference, loss in timing, and disintegration of perceptual field.

e)Errors and decrements in performance tend to increase with load stresses.

f)The emotional behavior of men in space is apt to alter as a function of the physiological and psychological stresses he encounters - uncertainty, hazardous environment, weightlessness, isolation and confinement - which might produce dramatic changes in the emotional behavior and personality of an individual.

g)Confinement can cause such performance decrements as:

1)Irregularity in performance.

2)Performance oscillations.

3)Increase in error amplitude.

4)Decreases in proficiency in some parts of a task and not in others.

5)Changes in timing task components.

6)Reduction in performance output.

7)Inadvertent control inputs.

8)Failure to detect changes in the stimulus field.

9)Errors in retrieving, integrating, storing, and processing information.

10)Sudden changes in rate of performance.

11)Response lags.

12)Overcontrolling or undercontrolling.

13)Perceived disintegration of the perceptual field or display.

14)Dissociation of corrective response from appropriate control unit.

15)Loss of proficiency.

Eckstrand (1959) pointed out some of the steps in training astronauts which should be taken:

a)Improved techniques for maintaining performance levels.

b)Improved techniques for fostering retention of skills and knowledge.

c)Improved techniques for developing skills to operational proficiency.

d)Improved types of orientations and training.

e)Techniques for simulating interactions between physiological stressful environments and psychologically stressful tasks.

Astronaut Selection

Ruff (1959) considers the following characteristics important in selecting an astronaut:

a)High level of intelligence.

b)Drive regarding the project.

c)No overdependence on others.

d)Ability to tolerate close associations and extreme isolation.

e)Ability to function outside familiar surroundings.

f)Ability to respond predictably.

g)Motivations based on interest in project.

h)No evidence of impulsivity.

i)Ability to tolerate stressful situations and react appropriately.

REFERENCES

CHAMBERS, R.M., and R. FRIED. 1963.
Psychological aspects of space flight.
In: J.H. Brown, ed. Physiology of Man in Space. Academic Press, New York.
pp. 173-256.

R-4
REVIEW/PSYCHOLOGICAL ASPECTS OF SPACE FLIGHT Christensen, J.M.

PURPOSE

a)To sample some of the relevant information to space flight.

b)To identify areas that will require further attention before predictions in the behavioral area for the Mars trip can be made with confidence.

REVIEW OF STUDIES

CONTRIBUTIONS OF PSYCHOLOGY TO THE MARS MISSION

a)Man can help achieve the required reliability and effectiveness by active involvement in most if not all of the necessary operations (rendezvous, guidance and control, etc.).

b)Voas has stated that "Man's primary role in the operation of space vehicles will be to increase system reliability."

c)Westbrook has estimated that based on current technology, an automatic control system (three-axes) for a round trip between earth and moon would have a reliability of 0.22.

d)Planning and designing for a flight to Mars require the most detailed knowledge of man's perceptual, motor, and intellectual skills and of the effects that a variety of truly unusual environments has on these skills.

SELECTION AND TRAINING OF THE SPACECREW

a)Selection of the original seven astronauts - all were superior in intelligence, exceptionally stable emotionally and unusually capable of withstanding severe physical stresses.

b)For verbal/symbolic tasks any factor that influences learning is likely to have the same effect on retention.

c)Rehearsal of highly skilled tasks should occur on at least a daily basis.

d)It is recommended that heavy reliance be placed on performance aids such as checklists, manuals, etc; they do not deteriorate with time and they are not affected by stressful situations.

ENGINEERING PSYCHOLOGY

a)Display and control requirements - such factors as lack of meaningful horizon, lack of conventional reference points, lack of "up" and "down", etc. challenge the ingenuity of the engineer and the psychologist to present both an accurate and meaningful display.

b)Personal tethering and propulsion - Mueller shows that a simple tether line used in a fish-like fashion represents a dangerous oversimplification of the problems. Personal propulsion systems will not be the simple rocket gun devices that served Buck Rogers so well.

EFFECTS OF OTHER UNUSUAL ENVIRONMENTS ON PERFORMANCE

a)While there is considerable information on the physiological effects of acceleration of varying degree and duration, there is not a comparable amount on behavioral effects.

b)Chiles reports that some crew members revealed in post-mission interviews that, although marked interpersonal antagonisms existed among some of the members, these antagonisms were never revealed during the experiment.

c)The real challenge will be to design a system that will require and will use the crewmembers in essential jobs that are challenging enough to prevent monitoring and boredom, yet sufficiently below the maximum level of capability to allow for possible performance deterioration or for emergencies.

INTELLECTUAL SKILLS

a)Man's greatest contribution will be in the realm which we term "intellectual".

b)One task that man will perform will be maintenance.

CONCLUSIONS

THE USE OF MAN TO STUDY SPACE

Particular emphasis in research should be in the design of suitable controls and displays, design for ease of maintenance, the effects of long-term weightlessness and the effect of multiple stresses.

REFERENCES

CHRISTENSEN, J.M. 1963.
Psychological aspects of extended manned space flight.
Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. 29 pages.
[AMRL-TDR-63-81]

R-5
REVIEW/SUBMARINE Duffner, G.J.

PURPOSE

To report group research on personnel selection and to deal with problems of the submarine environment, existing assessment processes, and research hypotheses related to certain development methodology.

CONFINEMENTS REVIEWED

Submarine

REVIEW OF STUDIES

STRESS FACTORS

a)Instability of the submarine as a weapon.
b)Nature of submarine operations.

EXISTING ASSESSMENT PROCESSES

a)Psychologic tests.
b)Physical examination.
c)Sensory testing.
d)Fifty pound pressure test.

CRITERION RESEARCH METHODS

a)Pools of traits, defining the good and the poor submariner.
b)Performance and achievement criteria.
c)Sociometric criteria.

PREDICTOR RESEARCH

PRESENT PREDICTOR COMBINATIONS

a)Training task observations.
b)Base battery.
c)Mental tests (Arithmetic, etc.)
d)Personal history.
e)Semi-structured interviews by submarine medical officers, candidates assessed on background factors, job history, etc.

PREDICTOR VARIABLE USED EXPERIMENTALLY

a)Semi-structured T.A.T.
b)Modified picture completion.
c)Masculine role test.

PREDICTOR VARIABLES USED ON OPERATION HIDEOUT

a)Basic battery.
b)Manual dexterity.
c)Rigidity.
d)Sentence completion.
e)Rorschach (individual).

REFERENCES

DUFFNER, G.J. 1954.
Crew selection for submarine duty.
U.S. Armed Forces Medical Journal 5:1192-1198.

R-6
REVIEW/OFF DUTY TIME

Eberhard, J.W., and Smith, K.T.

PURPOSE

This study analyzes the available off duty time in long duration space missions and suggests ways to use off duty time.

CONFINEMENTS REVIEWED

a) Arctic

b) Antarctic

c) Ships

d) Submarines

e) Missile bases

REVIEW OF STUDIES

TIME FINDINGS

a) There are two components of off duty time in the long duration studies:

1) Scheduled off duty time.

2) Unscheduled free time resulting from the excess time scheduled for other activities.

b) Men in general and men in special environments have approximately 5 hours a day free time.

c) Crew size is based upon heavy work phases of the mission.

d) Men in confined space with little work to do are unwilling to share their work load.

e) Reduced sleep time requirements may result from a weightless environment and from the problems of confinement and boredom in long duration missions.

f) Off duty time may exceed 10 hours per day during deep space periods of the mission.

ACTIVITY FINDINGS

a) Discretionary activities should depend upon the free choice of each crew member.

b) Men in confinement prefer work to free time.

c) Talking, reading fiction, watching movies and television are the most frequently performed activities by confined groups.

d) Men in confinement take almost twice as long to eat as men in the general population.

e) Exercise is an infrequently performed activity for all of the adults studied.

f) Recreational facilities have historically been the source of significant morale problems for confined groups.

PRINCIPLES RELATED TO OFF DUTY TIME

a) The amount of free time for each crew member should be determined in light of scheduled opportunities and contingencies.

b) In long duration space flights, due to the reduced activity possibilities, free time should be limited to about 5 hours per day.

c) The mission time line should be designed to insure that the maximum amount of social interaction is possible during off duty times. In extreme cases of interpersonal conflict, off duty times can be rearranged to reduce the amount of off duty interaction.

d) Task rotation should be considered a normal routine to curtail the unwillingness of crew members to share their limited work load should contingencies arise which limit a crew member's work opportunity.

PRINCIPLES IN DESIGNING DISCRETIONARY ACTIVITIES

a) Selection of discretionary activities must take into account crew members' preferences and the influence of long duration confinement on these preferences.

b) Discretionary activities should be selected that tend to reduce the anticipated monotony and increase sensory stimulation.

c) Rules relative to activity performance should be considered in the design, integration, and use of activities in the spacecraft.

REFERENCES

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Serendipity Associates, McLean, Virginia. 33 pages.
[NASA CR-93834]

EBERHARD, J.W. 1967.
The problem of off duty time in long duration space missions. Volume II: Final Report.
Serendipity Associates, McLean, Virginia. 104 pages.
[NASA CR-96721]

EBERHARD, J.W., and K.T. SMITH. 1967.
The problem of off duty time in long duration space missions. Volume III: An annotated bibliography.
Serendipity Associates, McLean, Virginia. 202 pages.
[NASA CR-96737]

PURPOSE

a)To study the contribution which the leader and the members of a group make to the task performance under varying conditions of stress in small group situations.

b)To discuss the type of leadership style which is most appropriate to group performance.

REVIEW OF STUDIES

Effect of Stress on the Leader's Contribution to the Task

a)Mann has stated that the relationship between all personality attributes of the leader and group performance has generally been low and he cites medians of only .15 to .25 for even the best measures.

b)Fiedler and Meuwese (1963) have shown that the leader's intelligence and ability scores correlate highly with group performance primarily when the group environment is pleasant and relaxed, and when good interpersonal relations exist within the group.

c)Meuwese and Fiedler (1964) studied seniors in the Army and Navy ROTC programs at University of Illinois. The experiment involved 54 three-man groups, with sets of 18 groups randomly assigned to one of three conditions:

1)low stress.

2)internal stress.

3)external stress.

Each group performed two creative tasks in succession 1)Pay Proposal of ROTC program (equalize benefits among Army, Navy, and Air Force cadets) and 2)Fable task (write down a fable or story). The results suggest that the stress of the situation caused the leader to be anxious, and that the leader's anxiety, in turn, interfered with his ability to concentrate his efforts on the task. The major importance of the data is that the intelligence of leaders on their task relevant abilities is utilized by the group primarily under conditions of minimal stress.

d)Meuwese and Fiedler (1964) showed that the effectiveness of the group is contingent upon the interaction of the leadership style and the difficulty of the group situation for the leader.

CONCLUSIONS

a)It seems likely that the group, operating under serious threat and external stress, might require a therapeutic leadership which will enable the members to reduce their anxiety level to manageable size so that task relevant activities can be tackled.

b)In general, a highly structured and controlling leadership is most effective under either conditions of high or low stress.

c)Under intermediate conditions of stress, a more permissive, less structured style of leadership is most efficient.

REFERENCES

FIEDLER, F.E. 1965.
The effects of stress on small group performance.
Texas Christian University, Fort Worth, Texas. 33 pages.
[NASA CR-76333]

R-8
REVIEW/SPACE CABIN SIMULATORS (SAM) Flinn, D.E.

PURPOSE

To discuss problems of choosing individuals who can perform the required tasks of space flight under psychological stress.

CONFINEMENT

SAM

In SAM illusions of body image, distortion of space and time and hypnagogic-like imagery have occurred as a result of the stresses of confinement fatigue and the restricted perceptual field.

BASIC PERSONALITY STABILITY

a)To be effective and reliable, the astronaut must be free of significant emotional conflicts and anxiety.

b)He must be able to work with others under stress during training period.

c)A subject that will do well in space is one who:

1)Is mature.

2)Is well integrated.

3)Is motivated.

4)Has a normal self critical faculty.

5)Is capable of forming group identification.

6)Has ability and developmental experiences.

7)Is able to rely on others (ground crew).

d)A pilot's flying experience may not serve as an effective screening device since space flight missions involve relative passivity and require that the pilot be more of a monitor than a pilot.

CONCLUSIONS

a)Test pilots are considered to be good applicants for space crews because they already possess highly developed skills and a high level of adaptability.

b)The astronaut assessment program should be one which differentiates between high levels of adaptability to the stresses of military flight, considers the candidate in terms of psychological requirements that are relatively unique to space flight, and assesses basic personality stability in an attempt to predict maladaptive behavior.

REFERENCES

FLINN, D.E. 1961.
Psychiatric factors in astronaut selection.
In: B.E. Flaherty, ed. Psychophysiological Aspects of Space Flight (Symposium on Psychophysiological Aspects of Space Flight, Brooks Air Force Base, Texas, 1960). Columbia University Press, New York. pp. 87-95.

R-9
REVIEW/EFFECTS OF CONFINEMENT Fraser, T.M.

PURPOSE

a)To define the nature of confinement stress and to make an examination of its psychophysiological effect on man.

b)To critically review the literature making analysis of data from many sources.

REVIEW OF STUDIES

a)The 60 or so studies reviewed can be classified as simulator studies, confined chamber studies, cockpit studies, vehicle studies, submarine studies, spacecraft studies, etc.

b)The operational conditions of the studies reviewed range from those of bedrest to those of Gemini spacecraft.

c)The focus of this review is to integrate the findings of the various studies with respect to physiological and psychological effects of confinement and tolerance to confinement.

CONCLUSIONS

PSYCHOLOGICAL RESPONSE TO CONFINEMENT

a)The effects of perceptual aberrations on the single isolate can be reduced with motivation and experience.

b)The occurrence of perceptual aberrations is greatly reduced when two subjects are isolated together, and it disappears in larger groups.

c)Psychological factors affecting group performance should be investigated and integrated into the astronaut selection process.

d)While confinement, in itself, has little effect on intellectual or complex psychomotor performance, perceptual isolation reduces these types of performance.

e)Confinement probably has little effect on time perception, while perceptual isolation may cause gross errors in time estimation.

PHYSIOLOGICAL RESPONSE TO CONFINEMENT

a)In confinement, the response to stress is non-specific (viz: changes in pulse rate, blood pressure, EEG, etc.) and combined with specific changes due to the reduced mobility.

b)An important area for investigation is the possibility of reduced resistance to new forms of stress associated with the "resistive stage" of stress theory.

c)In situations involving long-duration confinement, the "initial heightened activity begins to show the effects of an adaptive process during the second week and appears to be maintained for about 2 months before a resurgence of stress phenomena occurs."

d)Due to the paucity of data on the effects of long-duration confinement, studies should be performed to evaluate the effects suggested in this study.

TOLERANCE OF CONFINEMENT AND VOLUME REQUIREMENTS

a)"Above the threshold of acceptability, volume is not a major constraint regardless of duration. Below the threshold of unacceptability, volume is the major constraint regardless of duration. Between the thresholds, the effects of volume may be modified by other factors."

b)Confinement induces stress to an extent dictated by factors such as severity and duration, habitability, and personal factors.

c)Tolerance threshold curves show that for periods of confinement of 30 to 60 days, about 150 cubic feet of free volume space per man is needed.

d)Tolerance was modified by habitability, work, rest, recreation, and exercise schedules.

e)It is suggested that weightlessness may improve tolerance to confinement by alleviating the restrictive aspects of confinement.

REFERENCES

FRASER, T.M. 1966.
The effects of confinement as a factor in manned space flight.
National Aeroanutics and Space Administration, Washington, D.C. 176 pages.
[NASA CR-511]

R-10
REVIEW/HUMAN CONFINEMENT EXPERIENCE Fraser, T.M.

PURPOSE

To outline the nature of the problems resulting from confinement on the basis of 60 studies of operational and experimental human confinement.

CONFINEMENTS STUDIED

Human confinement experience

Type of Study	Confinement Conditions	No. of subjects per run	Volume per man (cu. ft.)	Duration days
Simulator	SAM one-man space simulator	1	47	7
Single man	SAM one-man space simulator	1	47	1½
	Vostok spacecraft simulator	1	90	?1
Simulator Several men	Lockheed-Georgia crew system mock up–OPN 360	5,6	250, 183	15
	Ditto – HOPE II	6	187	15
	Ditto – HOPE III	10	110	30
	Ditto – HOPE IV&V	10	110	12
	Ditto – HOPE VI&VII	6	187	12
	U.S. Navy ACEL converted pressure chamber	6	75	7
	Ditto	6	75	8
	North American Aviation conical mock-up	3	67	7
	North American Aviation cylindrical mock-up	4	375	7
	North American Aviation disk-like mock-up	2	800	4
	SAM two-man simulator with simulated mission	2	106	14, 30 17
	Republic converted altitude chamber	6	211	14
	Douglas orbiting vehicle simulator	4	250	30
	General Electric two-compartment simulator	4	215	30
	Martin Baltimore lunar mission simulator	3	133	3, 7
	NASA Ames conical capsule	2	61.5	7
	NADC long range mission simulator	5	140	5
Confinement Chambers	University of Maryland programmed environment	1	1368	152
	University of Georgia simulated fall-out shelter	10	65	3
	Ditto	10	65	3
	Ditto	10	52	3
	Ditto	30	52	4
	Ditto	30	52	14
	Ditto	30	52	14
	Ditto	30	39	7

(continued)

Type of Study	Confinement Conditions	No. of subjects per run	Volume per man (cu. ft.)	Duration days
	USNRDL fall-out shelter	100	117	14
	Ditto	100	117	5
	Lockheed Georgia flight station mock-up	8	125	4
	Coffin-like open capsule	1	28	7
Aircraft cockpit	F-84 aircraft cockpit	1	30	2½
	WADD aircraft escape capsule	1	27.5	2
Armored Vehicle	Armored personnel carrier:			
	Type M 59	10	30	4 hrs
	Type M113, in motion	12	23.3	8 hrs
	Type M113, stationary	10	28	12 hrs
	Type M113, in motion	11	25.5	24 hrs
	Type M113, in motion	11	25.5	24 hrs
Submarine	Submarine Nautilus, 1956, submerged and cruising	36	1600	11
	Submarine Seawolf, 1957, submerged	100	570	60
	Submarine Nautilus, 1958, submerged under ice-cap	100	570	4
	Submarine Triton, 1960, submerged around world	100	570	83
Chair rest	SAM: overstuffed back-tilted chair	1	25	4
Bed rest	Lankenau hospital, continuous bed rest, no sitting	1	25	45
	SAM: continuous bed rest, no sitting	1	25	28
	SAM: bed rest studies with and without prophylaxis	1	25	14
Spacecraft	Mercury, MA-6	1	47	8 hrs
	Mercury, MA-7, MA-8	1	47	12 hrs
	Mercury, MA-9	1	47	1½ days
	Vostok I	1	90	12 hrs
	Vostok II	1	90	1 day
	Gemini III	2	40	5 hrs
	Gemini IV	2	40	4 days
	Gemini V	2	40	8 days
	Gemini VI	2	40	1 days
	Gemini VII	2	40	14 days

REVIEW OF STUDIES

PSYCHOLOGICAL EFFECTS

a)If habitability is close to acceptable in confinement for a well-motivated trained individual, overt psychological effects may not be observed, and even covert effects, as judged by interview, diary evaluation, psychological testing, and performance measures may be negligible except in extremes of confinement.

b)Monotonous environment has deleterious effects as evidenced by impairment of thinking, childish emotional responses, and disturbances of visual perception leading to the occurrence of both unstructured and fully structured visual illusions.

c)A man, even though alone, can apparently learn to cope with perceptual aberration.

d)Apart from emotional reactions, the sheer discomfort of confinement can be severe.

INTERPERSONAL RELATIONSHIPS

a)Feelings of resentment and hostility either directed at individual colleagues in confinement or projected to the external investigators in an experimental situation have been fairly common in confinement and isolation research.

b)In the SAM two-man chamber the investigators found that the subjects maintained a high morale and demonstrated few emotional changes.

c)Lawton found that during the confinement period cohesiveness deteriorated steeply with a sharp rise beginning as the flight was about to end. In spite of this trend, personal emotional defenses were sufficient to maintain each individual's stability.

d)Flinn in one study and Tiller and Figur in another found that the significance of motivation and discipline as factors in masking the expression of hostility and resentment is obvious, but should not be relied upon to ensure success in a mission.

INTELLECTUAL CAPACITY

a)In the General Electric study significant performance decrements were observed during the simulation period as compared with a pre-simulation control run.

b)Hanna and Gaita found no performance decrement in complex arithmetical tasks during their 7-day space cabin simulation.

FACTORS WHICH CAN MODIFY TOLERANCE OF CONFINEMENT

a)Motivation and experience.

b)Activities and tasks during confinement.

c)Knowledge of duration.

d)Exercise and physical fitness.

e)Number of subjects confined.

CONCLUSIONS

In view of the 60 operational and experimental studies analyzed and reviewed, the physiological and psychological responses of the subjects in various confinement situations are discussed. Also discussed are some measures to reduce undesirable responses (in terms of modifying tolerance to confinement).

REFERENCES

FRASER, T.M. 1968.
Confinement and free-volume requirements.
Space Life Sciences 1(2/3):428-466.

PURPOSE

To review factors in influencing the aircrewman's capacity to perform useful work.

Topics covered:
a) Psychological selection and training of aerospace crews.

b) Characteristics of the human operator.

c) Psychologic effects of physiologic stress.

d) Psychologic factors in spaceflight.

SUMMARY OF REVIEW

I. Psychologic Selection and Training of Aerospace Crews

AIRCREW SELECTION PROGRAMS

a) Requirements for an effective selection program:

1) Pool of applicants must be larger than the number of jobs to be filled.

2) Job analysis must be available.

3) Candidates must vary in their ability to perform the job.

4) Procedures or tests which measure the variability to perform the job must be available.

b) Typical selection procedures:

1) A minimum level of education; frequently 2 years of college.

2) A test which measures equivalent achievement, emphasizing acquired information and general intelligence.

3) A battery of tests, each designed to measure a component of the job.

4) A battery of tests measuring both job components and special technical background factors.

5) A battery of tests with interest and personal history elements added.

6) A battery with psychomotor apparatus tests added,

7) A battery of tests supplemented by a short training and performance period, as for example 10 hours in light planes.

8) A special battery of tests, with results provided to a selection board.

c) An example of a good selection program: U.S. Air Force Requirements.

1) Air Force Officer Qualifying Test (AFOQT).

2) Commissioned officer.

3) Physical examination.

d) Special Selection Programs. A good example is the procedure used by the U.S. Air Force School of Aerospace Medicine in evaluating space flight candidates including NASA astronauts.

1) Intensive physical examination including psychiatric evaluations.

2) Tests of intelligence:
Wechsler Adult Intelligence Scale;
Miller Analogies Test;
Doppelt Mathematic Reasoning Test;
Minnesota Engineering Analogies Test.

3) Projective tests:
Rorschach Psychodiagnostic Test;
Thematic Apperception Test;
Draw a Person Test;
Bender Visual-Motor Gestalt Test.

TRAINING

a) Little substantial progress in the application of psychologic principles to flying training has been made since World War II.

b) Most training devices are designed to improve a pilot's performance rather than to measure it.

c) Although not applied to flight training as yet, programmed learning is a likely candidate for "ground school" phases.

II. Characteristics of the Human Operator

a) Operator delays and lags are a key area of concern in the use of man in complex systems.

b) Delays vary across sensory systems and can be substantial. For example, receptor delay is 15 times longer for visual than for auditory transduction, although this is offset by the ability of the visual system to process exceedingly complex inputs.

c) Central nervous system delays are the longest, the most variable, and therefore the least predictable.

d) Man may be described as fundamentally a single-channel sequential responder with a reasonably wide base and low sensitivity input-output capacity in relation to his cost and size.

III. Psychologic Effects of Physiologic Stress

a) Low levels of biodynamic stressors such as acceleration and vibration alter crew performance because they "load" the limbs and interfere with coordination.

b) Low levels of other stressors like hypoxia compromise crew performance by inducing fatigue.

c) Any stressor producing unpleasant subjective states and bodily discomfort or pain distracts an aircrewman and creates a situation in which a substantial possibility of poor performance exists.

d) Fatigue.

1) Performance becomes poorer during an extended period of work due to fatigue.

2) Fatigue causes disruptions in timing, losses in fine motor control, increased variability in performance, and a lowering of standards.

3) Tasks based on gross, discrete cues are more resistant to fatigue than tasks based on minute cues, in which vigilance and alertness are important.

4) Duty schedules containing programmed periods of rest can be carried out quite effectively for many hours.

5) Cumulative fatigue is the result of inadequate recovery from several successive periods of acute fatigue and appears gradually over several days or weeks. Performance effects are like those seen in acute fatigue, including poorer airmanship, and degraded management and judgment during flight. Impairment in motivation, emotional control and interpersonal relationships can develop.

e) Diurnal Effects

1) Diurnal variation is another factor involved in prolonged work. Losses in proficiency are generally found when operators have already been on duty for some time or when tasks are very demanding.

2) If the operator's performance is at normal levels and other primary stressors such as fatigue are not taking their toll, no significant diurnal effects are likely.

f) Work/Rest Schedules

The important factor with respect to work/rest schedules is the maximum time on duty. Duty schedules should not require continuous work to the point where significant fatigue effects occur.

g) Performance Upon Awakening

1) Having to work in a concentrated fashion after sudden awakening interferes with the capacity to perform effectively.

2) A few minutes of nonworking time when the crewman can devote himself exclusively to waking up offsets performance decrements.

h) Maintenance of Skill

In order to maintain an acceptable level of performance, Fitts suggests engineering the job to reduce overload and augment low-load conditions and then to train as frequently and intensively as possible.

i) Alterations in perceptions

Alterations in an aircrewman's perception of his surroundings are best characterized as undue narrowing of attention, inability to focus attention properly, or actual distortions of sensory input.

j) Other Problems

1) Such problems as irritation with routine operations, an increase in physical complaints, and interpersonal friction have been evident in small groups assigned to remote duty sites.

2) Aircrewman report significant losses in morale and job satisfaction due to the frustrations of unavoidable delays.

IV. Psychologic Factors in Spaceflight

a) Three psychologic problems were considered critical in the early days of manned spaceflight:

1) Gross disruptions in emotional status as a result of prolonged isolation and sensory deprivation.

2) Difficulties in neuromuscular function in the weightless condition.

3) The possibility of undefined performance disturbances related to prolonged exposure to radiation.

Experience has relegated these to problems of minor concern at least in relation to the lunar program.

b) Present psychologic problems are work/rest schedules and the relationship between work, fatigue and sleep.

1) This problem is concerned with how to arrange the duty day to provide sleep periods, housekeeping periods, and still provide coverage throughout the day, for many days in succession.

2) Ground-based studies have demonstrated that man can perform acceptably on schedules as unusual as 4 hrs. on duty, 2 hrs. off or even 2 hrs. on duty 2 hrs. off, but the sleep schedule which goes with this does not permit adequate recovery.

3) The subject of what constitutes adequate sleep and sleep deprivation are areas of concern today. (1971)

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Psychologic aspects of aerospace medicine.
In: H.W. Randel, ed. Aerospace Medicine, 2nd edition. The Williams and Wilkins Company, Baltimore, Maryland. pp. 565-585.

R-12
REVIEW/COMPOSITION OF GROUPS Haythorn, W.W.

PURPOSE

To present a systematic and selective review of research bearing on the hypothesis that the bahavior, compatibility and effectiveness of a group is dependent on a particular combination of individuals.

REVIEW OF CREW STUDIES

THE COMPOSITION OF GROUPS

a)The presence of others in the perceptual field of an individual affects his performance, but this effect depends on characteristics of the individual, the others, and the task.

b)The behavior of other people is a determinant of a subject's behavior. Individuals in groups composed of members with heterogeneous attitudes and values may be less subjected to the pressure to conform than individuals in homogeneously composed groups.

c)Individuals develop a complex set of needs, the satisfactions of which require particular kinds of relations with other individuals. On the whole, behavior conducive to effective leadership is clearly a function of the situation.

d)Inability of group members to get along frequently results in failure in achieving the group goals.

e)Socioeconomic level, educational level, intelligence and vocabulary all may be expected to relate to the ability of individuals to communicate with each other.

f)Differences in objectives among group members generate conflict which could result in not achieving the goal.

g)Group activity allows individuals with complementary skills to assist each other in attaining goals.

h)Every group has certain informal social skills that have to be played by individuals for the success of the group.

i)The behavior of the groups varies as a function of the personality characteristics of group members.

j)The personality of the leader significantly determines the group climate that develops.

k)Under some conditions, assembling groups on the basis of personal preferences produces more effective groups.

l)If a leader is to be effective, group members must have some confidence that he is seeking at least some of the same goals that they are seeking.

m)When dissimilar attitudes exist, pressures toward balance tend to generate interpersonal hostility or disliking.

n)Individuals homogeneous with regard to fundamental value systems relevant to the nature of their interaction tend to be more compatible than groups heterogeneous with regard to such values. In some situations, members of groups can to a degree complement each other's weaknesses.

o)Daily contact among persons with different outlooks and professional backgrounds provides mutual stimulation which results in higher research performance.

p)Crew morale is lower when leadership roles are limited to a few crew positions, but instructors give the crew a higher performance rating.

q)Crews in which relatively little informal interaction among crew members was reported were likely to have crew personal liking.

r)It is useful to consider compatibility in three dimensions:

1)Congruency vs. incongruency.

2)Complementary vs. non-complementary.

3)Competitive vs. non-competitive needs, values, and cognitive styles.

s)Interpersonal attractiveness and performance effectiveness must be distinguished in the composition of a group since the results for one are different from those for the other.

RELATION TO ISOLATION AND CONFINEMENT

a)Men that are required to function for long periods of time in narrowly confined spaces under great degrees of isolation from the rest of society are entirely dependent on each other for:

1)Social interaction.

2)Gratification of social needs.

3)Testing of social reality.

b)The boredom resulting from long periods of inactivity in the military system which places few demands on the operator for long periods of time tends to make individuals look to one another to provide necessary stimuli to counteract the performance and morale-degrading effects of monotony.

CONCLUSIONS

a)The literature survey finds that research supports the view that group composition significantly determines group member behavior; that both homogeneity and complementary hypotheses regarding the bases of compatibility and group effectiveness are tenable.

b)Group behavior is a function of the modal characteristics of the individual group members.

c)Group characteristics are directly dependent on individual member's characteristics and interpersonal relations among members.

REFERENCES

HAYTHORN, W.W. 1968.
The composition of groups: A review of the literature.
Acta Psychologica 28:97-128.

R-13
REVIEW/DESIGN OF CLOSED ECOLOGIES Haythorn, W.W.

PURPOSE

To identify some of the sources of psychological stress in isolated groups, and to point out their probable implications for systems design.

VARIABLES DISCUSSED

Stimulus reduction, social isolation, and interpersonal conflict are sources of stress which seem particularly noteworthy with regard to their implications for systems design.

a) Stimulus Reduction.

1) Under conditions of extreme stimulus reduction, a variety of perceptual and intellectual decrements, and various bizarre behaviors and experiences are reported.

2) Under less extreme conditions of stimulus reduction, reports of a reduction in motivation, morale, and performance have been reported.

3) Stimulus reduction effects accumulate over time.

b) Social Isolation.

Social need satisfaction and opportunities for social reality testing can be seriously impaired in small socially isolated groups. This can result in: a heightened sense of frustration; decreased accuracy and stability of self-concepts; and the development of invalid group norms.

c) Interpersonal Conflict.

1) Interpersonal conflict is heightened under conditions of isolation and confinement.

2) Minor irritations accumulate to the point of being major sources of tension.

3) The following factors contribute to interpersonal hostilities: lack of privacy; inability to establish and maintain territorial ownership; inability to find scapegoat outside group to displace aggression; and restricted opportunities to release tension through muscular activity.

CONCLUSIONS

The stress caused by the stimulus reduction, social isolation, and interpersonal conflict should be considered when designing any system for small groups for a long period of time. Possible implications for design are:

STRESS	CAN BE REDUCED BY:
1) Stimulus reduction	Stimulus enrichment proceedures: music visual stimuli (TV, movies) radio programs intellectual puzzles reading material choice of operation mode (automatic, manual)

2) Social isolation	Some degree of communication with outside world Crew size (at least 15) for long duration missions Reminders of larger cultural identity - insignia, labels and proceedures reflecting identity within larger group.
3) Interpersonal tensions	Provision of active recreation. Provision of privacy Identifiable boundaries between working areas. Identification of equipment as belonging to one crew position. Limiting necessity to share equipment and living facilities. Provision of ample space to permit men to maintain preferred distances from each other.

REFERENCES

Haythorn, W.W. 1966.
Isolation, stress, and the design of closed ecologies.
Presented at the Human Factors Society Convention, Los Angeles, California, November 2-4, 1966.

R-14
REVIEW/INTERPERSONAL STRESS Haythorn, W.W.

PURPOSE

To review various studies concerning interpersonal stress.

CONFINEMENTS REVIEWED

Various kinds with various numbers of subjects in small groups.

REVIEW OF STUDIES

SOURCES OF INTERPERSONAL STRESS

a)Competitive needs of group members.

b)Incongruencies between need patterns.

c)Complementarity of need patterns.

d)Social isolation.

e)Lack of privacy.

A VIEW OF PERSONALITIES IN GROUPS

a)Personality is seen as a concept used to reference the organizing function in individual development.

b)With increasing freedom from physical threat, it is assumed that the individual becomes increasingly concerned with self-identity.

c)A higher level of differentiation and integration is shown by the individual who is primarily concerned with interpersonal relationships as these are expressed in affiliative, affectionate, group oriented behavior.

A STUDY OF ISOLATED DYADS

a)Social isolation was expected to be stressful. A pure test of this, however, was obtained only for hypothetically compatible dyads.

b)Interpersonal incompatibility was also expected to generate elevated levels of subjective stress and symptomatology. The expectation was confirmed.

c)Both sources of stress applied in hypothetically incompatible isolated dyads.

d)This study supported the general hypothesis that social isolation and interpersonal incompatibilities elevate subjective experiences of stress.

CONCLUSIONS

a)Social isolation and interpersonal incompatibilities produce high levels of subjective stress and isolation symptomatology.

b)The task of social psychologists is to identify the environment and group compositional situations which generate interpersonal stress.

c)Not much is known about group behavior under stress, for there have not been many longitudinal, intricate studies.

REFERENCES

HAYTHORN, W.W. 1970.
Interpersonal stress in isolated groups.
In: J.E. McGrath, ed. Social and Psychological Factors in Stress. Holt, Rinehart and Winston, New York.

PURPOSE

To review studies on the effects on performance of confining two or more people in a restricted area for a prolonged period of time as they pertain to the U.S. Army's interest in performance during and after prolonged confinement in armored vehicles.

CONFINEMENTS REVIEWED

a)Submarine.

b)Laboratory.

c)Fallout shelter.

d)Spaceflight simulation.

e)Antarctic.

REVIEW OF STUDIES

GROUP BEHAVIOR UNDER STRESS

a)Submarine-Kinsey confined 23 men together for 2 months. He evaluated group behavior with interviews, daily diaries, casual observation, and a structured questionnaire.

b)Laboratory - Lanzetta imposed threat on groups of three students doing a highly structured task. Threatened groups attached problems less forcefully, assertively, and actively than unthreatened groups. A second lab experiment by Lanzetta used four people working on a task. Both the observers and the participants saw the groups as less competitive, more cooperative, and more friendly under increased stress. The results from the above two studies are directly opposed to findings when groups are confined under high threat in real-life conditions.

c)Laboratory - Ruff studied confinement by placing five-man groups in a small compartment for 5 days. Three definite conclusions emerged: that different groups behave differently; that there is a great increase in interest in food; and that hostile feelings aroused by fellow crew members were not expressed overtly but in sarcasm, in comments in diaries, and on projective tests.

d)Simulated Shelter - Altman made auditory and visual observations of 30 people for 1 to 2 weeks. The observers found that agitation and tension were greatest just after the subjects entered the shelter and just before they left it.

e)Simulated Flight Chamber - Flinn reported that two subjects who were confined for 14-30 days showed only covert antagonisms, which they displaced toward monitoring personnel outside the chamber.

TASK PERFORMANCE

a)Simulated space-cabin - six men were confined for 7 days. They worked in pairs. Each member of the pair tested, scored, and timed the other's performance. The mean findings are: intellectual functions did not deteriorate; subjects performed as well on the seventh day as on the first; and variable performance on psychomotor tasks probably reflected boredom.

b)Simulated space capsule - Ormeston and Finkelstein confined subjects for 48 hours while measuring their performance on a variety of tasks. They found that 48 hours of close confinement had no effect on intellectual functioning.

c)Submarine - Weybrew confined 23 men for 50 days. He found that, although psychomotor or manipulative ability changed little, other variables did show changes.

d)Summary of Task Performance

1. Confined subjects' intellectual performance will not necessarily deteriorate, even though the environmental conditions are not optimum.

2. Confinement has little effect on tasks such as radar monitoring, vigilance, discrimination, problem solving, aerial-reconnaissance perception, rapid and accurate perception, form discrimination, tracking, and time estimation.

3. Confined subjects can perform complex tasks, if they are of particular interest to them, effectively for long periods. Variable performance on psychomotor tasks probably arises from boredom. Thus, simple routine tasks should be supplemented with more complex tasks which require higher-level behavior.

4. When perceptual and motor-skill performance did degrade during prolonged confinement, certain kinds of changes were characteristic:

   a)Omitting portions of simple tasks, or parts of complex perceptual-motor tasks. These omissions may indicate general inattentiveness or boredom.

   b)Approximation. The subject's responses became less accurate and his performance less precise, but they remained minimally adequate to meet the proficiency requirement of the task.

   c)Longer response time. This increase may be due to gross misjudgments of the passage of time or to general lethargy.

   d)Larger and more frequent errors.

   e)Queuing. The subject may delay responding during peak loads, then catch up during lulls.

   f)Lapses. Sometimes subjects' performance showed exaggerated variability.

   g)Stereotyped responses and movements, regardless of the stimulus. The subject may treat all stimuli as if they were equivalent.

   h)Filtering. Subjects may systematically omit certain categories of stimulation and response, according to some subjective priority scheme. Subjects frequently showed this filtering when stresses increased markedly.

   i)Operating controls unintentionally.

   j)Failing to detect and respond to stimulus changes.

PREDICTING ADJUSTMENT TO CONFINEMENT

a)Well adjusted men perform best and adapt most easily to confined situations.

b)Relatively few variables are systematically related to confinement adjustment. However, men who adjust to confinement better are older than 21, married, and have more than 2 years of Armed Force service.

c)The men who adjusted best to confined conditions at Antarctica had above average intelligence test scores, low interest in organized sports, high rating of ability to communicate, high rating of ability to cope with aggression, low rating on overt hostility, and less than a college education.

ANNOTATED BIBLIOGRAPHY

a)General Problems in Confinement, Isolation, and Sensory Deprivation.

b)Physical Environment of Confined Spaces.

c)Effects of Confinement.

d)Predicting Adjustment to Confinement.

CONCLUSIONS

a)When people are highly motivated, they can maintain effective working relationships during confinement.

b)People in confinement will undoubtedly develop feelings of resentment, but will displace most of the negative feelings towards outside sources.

c)As stress increases, individuals seem to make more effort to control interpersonal tensions.

d)The Army has highly specialized problems of confinement and isolation. Due to the unique character of the operational situations which may present themselves, few studies have been performed. Questions posed are, for example: what if, in a combat situation, one member of a tank crew decides to "drop-out" and what are the effects on the rest of the tank crew?

e)Because in simulated field studies subjects are aware of their roles, operational field studies produce more satisfactory data. Subjects know this is the "real thing" and are not controlled by factors such as the experimenter's expectations.

REFERENCES

HONIGFELD, A.R. 1965.
Group behavior in confinement: Review and annotated bibliography.
Human Engineering Laboratories, US Army, Aberdeen Proving Ground, Maryland.
116 pages. [Technical Memorandum 14-65]

R-16
REVIEW/PROTOTYPE MISSION TO MARS Kanas, N.A., and Fedderson, W.E.

PURPOSE

a)A literature search was made of isolated behavioral, psychiatric, and sociological problems to be expected on a future long duration space mission.

b)An attempt was made to draw conclusions pertinent to a prototype mission to Mars.

CONFINEMENTS REVIEWED

a)Short term space flights

b)Submarines.

c)Antarctic expeditions

d)Isolation chambers

e)Space flight simulators

f)Russian hypodynamic work

REVIEW OF STUDIES

Tests (Measurement of Psychological and Social Stress)

a)Psychophysiological Tests

Test	Psychic Correlate
Catecholamines (urine or blood)	inc. norepinephrine--anger inc. epinephrine--fear
ACTH or Adrenal Corticosteroid Levels (urine or blood)	inc. levels in stress
Protein-bound Iodine (serum)	inc. related to anxiety
Skin Resistance	dec. with arousal
Heart Rate	usually inc. in stress
Blood Pressure	variable
Respiratory Rate	inc. in fear or anger
EMG	related to motivation
EEG	alertness related to frequency

It appears that psychophysiological tests for stress measuring external stressors must also take into account internal stressors rooted in the personality of the subject.

b)Psychological Tests.

Perceptual Tests
1)Threshold
2)Flicker fusion
3)Perceptual speed
4)Perceptual retention
5)Attention
6)Discrimination

Motor Tests
Steadiness
2)Tracking
3)Coordination

Perceptual-Motor Tests
1)Reaction time

Cognitive Tests
1)Problem solving
2)Concept formation
3)Conditioning and learning

Personality Tests
1)Direct observation and interviewing
2)Self-ratings (e.g., MMPI, Edwards Personal Preference Schedule)
3)Projective Tests (e.g., Rorschach, TAT)

c)Social Tests

1)Direct Observations.
2)Bales Interaction Process Analysis.
3)Ranking Scales.
4)Interpersonal Projection Test.

RESULTS

1)Physical and physiological stressors are

a)weightlessness
b)circadian rhythms
c)hypodynamia

2)Psychological and social stressors are

a)low sensory input
b)lack of motivation
c)confinement
d)isolation
e)monotony
f)free time
g)unconscious conflicts
h)blocked drives
i)dangers and emergencies
j)interpersonal relationships
k)crew size
l)crew structure

3)Weightlessness can cause

a)physiological problems
b)some visual disorientation
c)irritability
d)nervousness
e)increased hostility

4)Disruption of circadian rhythm periodicities affects

a)sleep cycles
(difficulty sleeping)
b)work cycles
c)performance
(produces variations)

5)Hypodynamia results in

a)poor time estimates
b)irritability
c)negative behavior
d)headaches, nausea and dizziness
e)such physiological effects as:

1)weight loss
2)muscle atrophy
3)joint pains
4)cardiovascular difficulties

f)inability to think
g)depression

6)Low sensory input can cause

a)apathy
b)restlessness
c)tension, anger
d)anxiety
e)auditory and visual hallucinations
f)distorted time-sense
g)depersonalization
h)defects of body image
i)perceptual difficulties
j)inability to concentrate
k)a preoccupation with food and sex

These studies were performed mostly with individuals, but were felt to be pertinent to groups on a mission to Mars.

The author concludes that the conditions on a mission to Mars will not be quite so severe due to the addition of a buddy, the duty of monitoring instruments, and other various activities that astronauts have to perform.

7)In Antarctic confinement, isolation and monotony caused

a)disruption of sleep
b)apathy
c)tenseness
d)restlessness
e)complaining
f)irritableness
g)mistrust
h)uncooperativeness

8)In the Antarctic, monotony and boredom resulted in

a)widespred daydreaming
b)sensitivity
c)desire for a change
d)erroneous interpretation of familiar sounds
e)a tendency to choose those physically remote as companions for a future trip

9)In submarine studies it was found that

a)psychomotor efficiency coordination decreased slightly
b)psychological problems such as anxiety, depression, insomnia, and headaches occurred frequently

10)In space simulation studies it has been found that

a)tension existed between the men but they usually used displacement
b)minor perceptual problems appeared
c)monotony increased fantasy, reading or cat-napping
d)boredom produced some decrement in performance
e)fatigue increased

11)Generalizations concerning confinement, isolation and monotony

a)interpersonal stresses developed
b)three stages in this order seemed to develop:

1)anxiety
2)depression
3)anticipation

c)high levels of arousal (noise) or low levels (sleep deprivation) caused performance decrement

12)Sociological stresses

a)small groups restrict interpersonal contacts and produce tension more than large groups
b)if the informal structure deivates too far from the formal one, stress will develop
c)lack of social role (father) may produce stress

13)Personality traits that are important in selecting crew for long-duration space flights are

a)youth
b)single
c)good family history
d)few diseases
e)no serious injuries or stresses
f)college education
g)good at manual dexterity
h)active life
i)healthy home life
j)extreme moderation in the use of alcohol and tobacco
k)good appetite
l)normal sleep patterns

CONCLUSIONS

On a long-duration space mission, the three important stressors that the crew will have to deal with are:

confinement
isolation
monotony

The literature on Antarctic, submarine, and space simulation studies shows that behavioral, interpersonal, and psychiatric problems occur more frequently when these stressors are present than when they are not. But performance levels remain high enough to complete the mission if the men are so motivated. Reaction to isolation seems to follow three stages:

1)heightened anxiety
2)depression
3)anticipation

The final stage is particularly important for long space missions because of the presence of hostility, a decrement in performance, and adolescent behavior, which would interfere with required performance. Monitoring instruments and improperly used leisure time contribute to the problem of monotony, but this can be alleviated through such things as:

short work/rest schedules
improved selection of personnel based on personality variables
varying sensory input
inclusion of practical activity aboard a space mission such as music, reading, etc.

REFERENCES

KANAS, N.A., and W.E. FEDDERSON. 1971.
Behavioral, psychiatric, and sociological problems of long-duration space missions.
Manned Spacecraft Center, Houston, Texas. 90 pages.
[NASA TM X-58067]

PURPOSE

a)To summarize the literature on the experimental investigation of problem solving by small groups.

b)To consider a broad range of factors which are known to affect group processes and to examine them as they relate to group problem solving.

REVIEW OF STUDIES

EXPERIMENTAL COMPARISONS OF INDIVIDUAL AND GROUP PROBLEM SOLVING

a)It appears that a variety of factors may affect the group product and account for its unique character as compared with a simple pooling of individuals.

b)These factors can be analyzed in terms of whether they affect:

1)The individual solutions, judgments, opinions, etc. which are available to be combined into the group product.

2)The actual combination or voting process in which individual contributions are "weighted" in some way to determine the final group outcome.

SOME SPECIFIC FACTORS AFFECTING GROUP SOLUTIONS

As compared with working alone, working before a passive audience or with other persons at the same task seems to have the following effects:

1)Greater quantity of work where physical outputs are involved, suggesting increased motivation to perform the task.

2)Lesser quantity or quality of work where intellectual processes or concentration are involved, suggesting that social stimuli are able to compete successfully with task stimuli.

3)Inhibition of responses and qualitative changes in work, which suggest that the person somehow "takes account" of others as he goes about his work.

4)Greater variations through time in his output, indicating the presence of periodic distractions and/or the effects of working under greater tension.

5)Evidence that these effects wear off as the person adapts to the social situation.

INDIVIDUAL MOTIVES IN RELATION TO GROUP GOALS

a)The interdependent relationship in which cooperation is rewarded seems to lead to strong motivation to complete the common task and to the development of considerable friendship among the members.

b)Group decision studies suggest that member acceptance of group goals is heightened by a goal setting procedure involving discussion and participation in selecting the goal.

TYPE OF TASK

Deutsch found a higher volume of interaction and greater attentiveness to one another's contributions on the human relations problem than on the puzzle problem, presumably because the solution to the former depended on consensus.

GROUP SIZE

The available investigations of group size and participation suggest that as size increases, the most active member becomes increasingly differentiated from the rest of the group, who become increasingly similar to one another in their participation output.

GROUP RELATIONS FACTORS

a)Friendship among members.

b)Communication.

c)Group standards.

d)Group majority.

e)Treatment of deviates.

f)Initial attitudes.

g)Status differences.

h)Leadership.

REFERENCES

Kelley, H.H., and J.W. Thibaut. 1954.
Experimental studies of group problem solving and process. Chapter 21.
In: G. Lindzey, ed. Handbook of Social Psychology, Vol. II. Addison-Wesley Publishing Company, Cambridge, Massachusetts. pp. 735-785.

R-18
REVIEW/HABITABILITY

Kubis, J.F.

PURPOSE

To review general principles which are applicable to habitability of space vehicles.

REVIEW OF STUDIES

a)Problems of habitability develop from habitat-tenant interactions.

b)As applied to spaceflight, proposed changes in the spacecraft or in the astronaut are subject to well-defined constraints of technological capability and human tolerances.

c)The spacecraft-astronaut interaction is compounded by a number of stresses rarely or never experienced by man before.

d)Habitability requirements vary, depending in the main on the goals and purposes of the spaceflight.

e)Considered globally, habitability involves four basic types of components: physical, physiological, psychological and social.

f)A system is considered habitable if man can function as man within its environmental confines. Whatever the goal of a space mission may be, the primary objective is to preserve man's integrity and his dignity.

REFERENCES

KUBIS, J.F. 1967.
Habitability: General principles and applications to space vehicles.
In: H. Bjurstedt, ed. Proceedings of the 2nd International Symposium on Basic Environmental Problems of Man in Space, Paris, France, June 14-18, 1965. Springer-Verlag, Vienna. pp. 399-427.

R-19
REVIEW/PROLONGED ISOLATION Levine, A.S.

PURPOSE

To point out the importance of research and information pertaining to small group interaction under conditions of confinement and isolation.

RESULTS

Experience in the Arctic, in the Antarctic and on submarines submerged for long periods of time has shown that:

a)Isolation is a much more significant stress factor than extreme cold or any other adverse environment.

b)Lack of sensory stimuli sometimes causes disturbances akin to insanity which are generally of a temporary nature.

c)Inactivity for long periods is demoralizing.

d)An area providing privacy for the individual is important.

e)A cardinal point in controlling stress in a group is to provide relief goals.

CONCLUSIONS/RECOMMENDATIONS

a)Problems and solutions can be identified by studying the composition of groups, living conditions, communications, and motivation.

b)A high level of training as a group is invaluable.

c)Psychiatric selection methods are effective in eliminating men who might experience severe emotional or mental disturbances during isolation.

d)Capable leadership can prevent stress from reaching the danger zone.

e)This research is needed because future weapon systems will involve small groups of men operating for extensive periods of time under conditions of both social and geographic isolation.

REFERENCES

LEVINE, A.S. 1965.
Prolonged isolation and confinement.
Navy - The Magazine of Sea Power 8(1):26-28, 44-45.

PURPOSE

a)To review a number of studies in the area of habitability.

b)To extract from these studies findings which are relevant to any long-term mission in confinement.

CONFINEMENTS REVIEWED

a)Underwater (Tektite, Sealab etc.)

b)Spaceflight.

REVIEW OF STUDIES

HABITABILITY - Definition

a)Fraser (1968) - Habitability describes the qualities of an environment with respect to the acceptability of that environment for man.

b)Johnson (1969) - The major elements of habitability are: 1)the environment (noise levels, lighting, temperature, etc); 2)architecture; 3)mobility, restraint and equipment handling; 4)food, its storage, preparation, serving, eating arrangements, and facilities; 5) clothing and personal accouterments; 6)personal hygiene; 7)housekeeping; 8)communication; 9)off-duty activity provisions.

c)Habitability depends on the interaction between the individual and the environment.

PHYSICAL FACTORS

a)The necessary crew volume requirements for long term missions have been established in earth-bound spacecraft simulations at from 350 to 700 cubic feet, but this requirement appears to be reduced by conditions of weightlessness.

b)Space should be provided for mission related tasks, vehicle management, biomedical support, storage areas, rest and off-duty time, dining and food management, personal hygiene, and privacy and territorial needs, but some of these areas may overlap.

c)Provisions should be made for mobility and restraint devices, suitable garments, light intensity and color, and noise control.

CREW STRUCTURE

The presently used military structure seems to be an effective and acceptable method of crew structure.

FOOD PREPARATION

a)Weber and Gatts (1969) - provided an excellent review of the considerations in developing a food service program for long missions. Concepts must be developed for cooking and baking equipment, so food will be as attractive and palatable as possible.

b)Preparation of food underwater presented some unique problems:

1)Frying of food is prohibited because of the release of acrolein.

2)Certain foods such as toast, when burned, release CO which, even in small concentrations, at high pressures can cause severe problems.

LEISURE TIME ACTIVITIES

a)Eberhard - summary of activity findings:

1)Men in confinement prefer work to free time.

2)There is a higher incidence of abnormal symptoms among men in confinement without adequate work opportunities than with those who have such opportunities.

3)Discretionary activities should depend upon the free choice of each crewmember.

4)Confined individuals create some free time activities of their own.

5)Off-duty time and activity patterns of isolated groups differ from those of the general population; furthermore, the activity patterns of the individuals in confinement change over time.

6)Talking, reading fiction, watching movies, and television are the most frequently performed activities by confined groups.

7)Men in confinement take almost twice as long to eat as men in the general population.

8)Exercise was a necessary but infrequently performed activity for all of the adults studied.

9)Interest in educational activities is highly individualistic; however, it is generally sought infrequently.

10)Individuals who regularly use religion, or those who do not, adjust best to confinement.

11)Activities such as painting, playing cards, chess and checkers, are relatively infrequently mentioned by most of the individuals studied.

12)Recreational facilities have historically been the source of significant morale problems for confined groups.

CONCLUSIONS

a)The crews involved in both space and undersea missions have been extremely work-oriented and have shown little inclination for any other activity, with the exception of sleep and self-maintenance. However, as mission lengths increase, so will the need for adequate leisure time activities.

b)Certain behavioral patterns among the crew in relation to mission support personnel have become evident during both space and undersea missions.

c)When provisions for personal needs, such as food preparation, waste management, hygiene, maintenance, warmth and privacy, fail to meet expected standards, they can become a cause of morale decline and performance degradation.

REFERENCES

PARKER, J.F., Jr., and M.G. EVERY. 1972
Habitability issues in long duration undersea and space missions.
BioTechnology, Inc., Falls Church, Virginia 52 pages.

R-21
REVIEW/DETERMINERS OF INTERPERSONAL CLIMATE

Rawls, J.R.

PURPOSE

The present effort involves a focused review of a selected group of problems that are believed to be peculiarly important under conditions of isolation and confinement, with particular interest in principles that have demonstrated effectiveness in the mitigation and management of these problems across situations.

REVIEW OF STUDIES

SOCIAL DISTANCE

a)Fitzgerald 1963 - found that self disclosure, as a dimension of social distance could be used to determine how close one person felt to another.

b)Taft 1958 - investigated differences between high, intermediate, and low tolerance subjects. Intolerant subjects appeared to be more pessimistic, ego-defensive and extrapunitive rather than impunitive. Tolerant subjects did not dwell on frustrating obstacles. They were ego-defensive as was the intolerant group but were more forgiving.

c)Photeadis and Begger 1962 - found that church participation was negatively correlated with social distance, whereas orthodoxy and extrinsic belief were not related.

d)Rao 1960 - found that the correlation between radicalism and "tough mindedness" was .39; between radicalism and social distance, .03; and between "tough mindedness" and social distance, .42.

SOURCES OF SOCIAL DISTANCE

a)Banton 1960 -
Social distance:
1)Resulted from person's negative attitude.

2)Reflected a lack of common interests and experiences.

3)Was characteristic of certain types of social relationships.

4)Was caused by self interest.

RELEVANCE TO LONG-DURATION SPACE FLIGHT

a)Social distance measures could seemingly be utilized to optimize interpersonal relations and maximize group effectiveness in a variety of ways.

b)Taro 1960 - concluded that the behavior of the leader is the most important factor in unit morale and effectiveness among isolated and confined groups.

IMPLICATIONS OF PERSONAL SPACE FOR LONG-DURATION SPACE FLIGHT

a)Pollack and Kiev 1963 - individual's modification in shape, area, or penetrability of personal space has been utilized as an index of his present clinical state.

b)Man's utilization of space appeared neither meaningless nor random, for spatial behavior has been shown to represent a means of communication as well as a modifier of behavior.

c)A large portion of the literature centered around two inquiries: (1) what factors directly influence personal space, and (2) what reactions occur to invasions of personal space?

INTERPERSONAL ATTRACTION

a)Haythorn and Altman 1967 - indicated that under conditions of isolation, good interpersonal relations were important to group productivity and effectiveness.

b)Wilkins 1967 - reported that in studies of groups in the Antarctic, interpersonal relationships occurred mainly between work partners; and, as smaller groups were investigated, the number of men chosen as off-duty associates also became smaller.

c)Isolation studies have shown that as length of time in isolation increased group cohesiveness decreased and then showed a sharp increase toward the end of the mission.

d)Similarity of attitude was an important factor in determining interpersonal attraction.

CONFLICT AND CONFLICT RESOLUTION

a)The following represent the constructive range of functions served by conflict:

1)Conflict results in the establishment of group norms.

2)Conflict clarifies objectives.

3)Conflict sets group boundaries by strengthening group cohesiveness and separateness.

4)Without conflict, accommodative relations would result in subordination rather than argument.

5)Conflict reduces tension and permits maintenance of social interaction under stress.

b)Theodorson 1962 - found that conflict in such groups may lead to either cohesion or disintegration.

c)Kinds of conflict:

1)Substantive and affective conflict.

2)Conflict of interest and conflict of values or belief.

d)Altman and Haythorn 1965-1967 - found that interpersonal compatibility within dyads was an important dimension of behavior in isolation.

e)Shepard 1963 - posed four means of resolving conflicts:

1)Suppression.

2)War.

3)Limited war.

4)Bargaining.

f)Douglas 1962 - analyzed psychologically the interaction of bargainers and mediator. Three stages in the mediation process were indentified:

1)Establishing the range.

2)Reconnoitering the range.

3)Decision - reading crises.

CONCLUSIONS

SOCIAL DISTANCE

It seems likely that social distance measures provide insights related to the optimization of interpersonal relationships through selection, crew composition, leadership style, group structure, spatial arrangement, crew scheduling, and capsule design.

PERSONAL SPACE

Of paramount importance at this stage of development is the need for studies of personal space variables as they are related to conditions of isolation and confinement.

INTERPERSONAL ATTRACTION

It seems that interpersonal attraction between members of the space crew would be expected to lead to greater group unity and, consequently, to less interpersonal conflict.

CONFLICT

a)A number of group composition factors are associated with low incidence of conflict (e.g., proficiency in group activities, interpersonal compatibility, etc.).

b)Selection of the group should be on the basis of mutual attraction and common interest, attitudes, and goals, rather than on the individual's psychological profile per se.

REFERENCES

RAWLS, J.R., C.N. MCGAFFEY, R.E. TREGO, and S.B. SELLS. 1968.
Some determiners of interpersonal climate in relation to long-duration space missions: A review of constructs and research.
Institute of Behavioral Research, Texas Christian University, Fort Worth, Texas. 72 pages.

R-22
REVIEW/POLAR AND SUBMARINE ISOLATION Rohrer, J.H.

PURPOSE

a)To review the effects of polar isolation and submarine habitability as received in 12 pieces of literature.

b)To apply social and psychological material to living in a fallout shelter.

CONFINEMENT REVIEWED

First study: polar isolation
Second study: submarine

VARIABLES STUDIED

a)Anxiety

b)Boredom

RESULTS

POLAR ISOLATION

a)Persons exhibited psychiatric symptoms to which they were predisposed.

b)For some, increased anxiety resulted in aggression.

c)If there was a need for aid, anxiety motivation might have been channeled to this goal.

d)The effect of anxiety plus impersonality of a large group might lead to nuclear formal organization.

e)Increased anxiety resulted in headaches and sleeplessness.

SUBMARINE STUDIES

a)Anxiety was greatest when the subjects entered isolation.

b)There was a desire for communication with the outside world.

c)Social irritation was caused by:

humidity
temperature
ventilation inadequacies.

d)The attractiveness of food affected the group tolerance of isolation.

e)There was a greater amount of sleeping done in isolation.

f)Diversity for leisure time was required.

g)Anxiety was relieved through activity.

CONCLUSIONS

The author suggests that initial anxiety could be reduced by subjecting persons to functionally oriented and meaningful tasks, like "do-it-yourself kits." Two-way radio equipment relieves anxiety. Food should be attractive and environmental conditions should be pleasant.

REFERENCES

ROHRER, H.H. 1960.
Implications for fallout shelter living from studies of submarine habitability and adjustment to polar isolation.
In: G.W. Baker, and J.H. Rohrer, eds. Human Problems in the Utilization of Fallout Shelters. National Academy of Sciences, Washington, D.C. pp. 21-30.
[Disaster Study No. 12]

R-23
REVIEW/UNDERWATER

Schulte, J. H.

PURPOSE

To review each underwater study briefly in an attempt to predict future development in underwater exploration.

CONFINEMENTS REVIEWED

a)Genesis I, II.

b)Sealab, I, II.

c)Conshelf I, II and III.

d)Man in the Sea I and II.

REVIEW OF STUDIES

GENESIS I

a)Experiments conducted in 1962 evaluated the effects of three different gas mixtures on animals.

b)As a result of this series of experiments it was concluded that man could probably be exposed to a breathing mixture of 97% He and 3% O_2 at a pressure equivalent to 200 feet of sea water for prolonged periods of time without developing any deleterious effects.

GENESIS II

a)In 1962-1963 experiments on men conducted in a recompression chamber at ambient pressure and at a simulated 100 and 200 feet of sea water depth pressure.

b)One hundred physiological and psychological tests were performed daily on each subject. Only stress indicators were outside normal limits, due to the hazardous situation.

SEALAB I

In this study four men lived and worked at a depth of 192 feet for 11 days.

SEALAB II

Bond performed a field experiment in 1965 in which three groups of 10 men each descended to an underwater lab 205 feet below the ocean surface for consecutive periods of 15 days. Also, one man stayed submerged for the first 30 days.

CONSHELF I

a)In a 1962 experiment conducted by Cousteau, two men spent 1 week under 33 ft. of water breathing compressed air.

b)Physically and subjectively the men suffered no harmful effects from their excursions into the sea. No decompression was needed.

CONSHELF II

a)In a 1963 study directed by Cousteau, five men lived for a month at 36 feet underwater and two additional men lived 1 week at 90 feet before returning to the house at 36 feet. The two additional men breathed a mixture of air plus helium while at the depth of 90 feet.

b)No harmful effects from exposure were found.

R-23

CONSHELF III

a)Six men remained at a depth of 370 feet for a period of 3 weeks in a study conducted by Cousteau.

b)The men did not suffer any injuries or physical damage from the dive.

MAN IN THE SEA, PHASE I

a)In this study, a man spent about 24 hours at a depth of 200 ft. breathing a mixture of 97% He and 3% O_2.

b)Link estimated that is should normally require only 16-18 hours decompression from prolonged exposure to the pressure at 200 feet below the surface and 18 to 24 hours at 400 feet.

MAN IN THE SEA II

a)In a 1964 test conducted by Link, two men lived 2 days at a depth of 432 feet breathing 3.6% oxygen, 5.6% nitrogen, and 90.8% helium.

b)They did not suffer any apparent harmful effects.

REFERENCES

SCHULTE, J.H. 1967
Medical aspects of sustained underwater exploration.
Archives of Environmental Health 14:333-336.

PURPOSE

To review the results of various studies on the effects of confinement in a very specific and monotonous sensory environment on an individual alone or with small groups of people.

CONFINEMENTS REVIEWED

a)Antarctic

b)Submarine

c)Fallout shelters

d)Prison

e)Lab experiments

REVIEW OF STUDIES

I. HAYTHORN, ALTMAN and MYERS. (1965)
Study of subjects confined to a small room.
The purpose of this study was to attempt to match the personalities of pairs of men in order to facilitate their adaption to isolation.

Variables:
1. Composition of group
   a. need dominance
   b. need achievement
   c. need affiliation
2. Stress

Results:
1. A persisting emotional decrement was noted
2. Two of nine pairs terminated before the end of the period of confinement
3. There were serious outbreaks of hostility toward each other
4. The composition of the isolated pairs was a significant determinant of subjective response to the stress of confinement

II. TAYLOR. Prison Study. (1961)
The purpose of this study was to determine if personality deterioration is an effect of imprisonment.

Variables:
1. Personality deterioration
2. Cognitive efficiency
3. Motivation

Results:
1. Deterioration was not evident
2. Perhaps deterioration begins with cognitive function and then spreads to a change of attitude, outlook, motivation, and emotional orientation

III. RUFF, LEVY, and THALER. (1959)
Study of subjects confined to a small compartment.

Variables:
1. Behavior
2. Physiological effects
3. Objective and projective tests

Results:
1. A positive attitude toward each other was maintained
2. A trend toward regressive behavior was noted
3. Ego impairment occurred
4. Subjects were capable of more mature and flexible handling of certain conflict areas
5. Hostility was suppressed or denied

IV. GUNDERSON and NELSON. (1963)
Measured emotional reactions of scientists and naval personnel who experienced prolonged social isolation at stations in the Antarctic.

Variables:
1. Somatic symptoms
2. Emotional symptoms
3. Size of group
4. Satisfaction with Antarctic life
5. Affective and work relationships

Results:
1. Sleep disturbances
2. Depression
3. Headaches
4. Irritation
5. Sore muscles
6. An increased incidence over time of symptoms
7. Decline in
   a. work satisfaction
   b. social relationships
   c. group accomplishments
8. Size of groups have no relation to somatic and emotional symptoms

V. MULLIN. (1960)
Study was based on interviews of 85 scientific and Naval personnel, conducted at American Antarctic stations.

Variables:
1. Individual adjustment to the group
2. Sameness of the environment
3. Absence of usual sources of gratification

Results:
1. Headaches
2. Insomnia
3. Horseplay, loud complaining, and swearing
4. Lack of intellectual energy
5. Tension

VI. ROHRER. (1960)
A review of submarine habitability and adjustment to polar isolation.

Variables:
1. Size of group
2. Length of stay

Results:
1. Three phases of adjustment to polar isolation
   a. anxiety
   b. depression
   c. decrease in depression
2. Submarine habitability also revealed an initial anxiety
3. The larger the group, the fewer the disturbances

VII. ALTMAN, SMITH, MYERS, MCKENNA, and BRYSON. Fallout shelters. (1960)

Variables:
1. Temperature (varied)
2. Presence or absence of a trained leader

Results:
1. No serious psychological or social stress appeared
2. Trained leaders seemed to be beneficial, but not necessary
3. Emotional agitation and tension were high at start and end of confinement
4. A high degree of group cohesiveness was maintained

VIII. RASMUSSEN. Fallout shelters. (1963)

Variables:
1. Psychologic discomforts

Results:
1. Leading source of discomfort was lack of water for washing
2. The winter test revealed complaints about food
3. The summer test revealed numerous complaints about the temperature

CONCLUSIONS

a)The presence of other people in a small isolated group may provide meaningful and varied stimulation for a time, but prolonged confinement can minimize even this source of varied sensory input and result in a monotonous environment.

b)General effects of isolation:

1. Emotional impairment occurs
2. Not all groups show adverse effects to isolation
3. Intellectual functions might be impaired slightly

REFERENCES

SCHULTZ, D.P. 1965.
Effects of social isolation. Chapter VIII.
In: D.P. Schultz. Sensory Restriction: Effects on Behavior. Academic Press, New York. pp. 147-167.

R-25
REVIEW/SOCIAL SYSTEM MODEL Sells, S.B.

PURPOSE

A preliminary attempt has been made to compare the social system of the extended duration space ship with other types of social systems in order to obtain background material for further studies. The objective of this study was to define a set of criteria to determine the relevance of data obtained in various situations to the problems of isolation associated with spacecraft.

REVIEW OF THE STUDY

a)A set of characteristics to be considered in an isolated social system was established. They fell into seven general categories: objectives and goals; value systems; personnel composition; organization; technology; physical environment; and temporal characteristics. A total of 56 variables were classified under these general headings.

b)Eleven social systems, each involving isolation, confinement, and/or stress to a high degree, were selected for study.

c)Conditions of the 11 systems were compared to the conditions of an extended duration space mission according to the 56 characteristics referred to above. Similarity was designated by a three-point scale: two (highly similar to extended duration space ship situation), one (moderately similar), and zero (dissimilar).

d)The order of similarity from highest to lowest was submarines, exploration parties and expeditions, Naval ships, bomber crews, remote stations, POW groups, professional athletic teams, mental hospital wards, prison society, industrial work groups, and shipwrecks.

CONCLUSIONS

a)Because of the similarity of the social systems on submarines, exploration parties and Naval ships to that of the extended duration space ship, profitable historical studies of literature concerning these areas has been undertaken.

b)Significant research problems to the study of isolation and confinement in space include: the social system model; research design and methodology; astronaut selection and crew composition; authority; stress; training and preparation; motivation; privacy, personal possessions, personal space, and considerations of territoriality; conflict arousal and resolution; and communication.

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SELLS, S.B. 1966.
A model for the social system for the multiman extended duration space ship.
Aerospace Medicine 37(11):1130-1135.

SELLS, S.B. 1971.
Capsule society - new problems for man in space on long-duration missions.
In: Biotechnology (Proceedings of a conference held at Blacksburg, Virginia, August 14-18, 1967). National Aeronautics and Space Administration, Washington, D.C. pp. 221-233.

R-26
REVIEW/EFFECTS OF ISOLATION Sells, S.B., and Rawls, J.R.

PURPOSE

To review literature dealing with the effects of isolation on man's performance.

CONFINEMENTS REVIEWED

a)Submarines.

b)Arctic.

c)Antarctic.

d)Penthouse.

e)Other isolated situations.

REVIEW OF STUDIES

THE NATURE OF ISOLATION

a)The forms of isolation were generally distinguished as being social isolation, confinement, and sensory restriction.

b)The circumstances of isolation structure the significance of the situation to the individual. The factors defining these circumstances can be broken down in terms of motivation, goal orientation, preparation, duration, confinement, treatment, social condition, support conditions, and environmental variability.

EFFECTS OF ISOLATION

a)Social deprivation is a source of stress to the individual to the extent that it calls for modes of personal problem solving that are not available and for which suitable alternatives cannot be found.

b)The major issues for space mission planners are: 1)to select personnel least vulnerable to stress from social deprivation; 2)to program crew composition and on-board work and living experiences to provide maximal compensatory support for social needs of the crew.

c)Haythorn has emphasized the importance of compatible personalities in the limited social situation and has made a significant start in the quantitative study of the problem.

d)Gunderson reported that men with high affectional needs experienced problems with wintering-over situations in the Antarctic confinement.

EFFECT OF CONFINEMENT

a)The close quarters, with incident status leveling, familiarity, reduction of privacy, enforced intimacy, absence of shelter from interpersonal conflict, and limited opportunity for recreational pursuits, presents numerous problems in relation to personal conduct, interpersonal interaction, leadership, organization, and group management.

b)Haythorn has observed a speeding up of the acquaintance process, marked by an accelerated rate of interpersonal information exchange.

c)Tendency to withdraw is a reasonable alternative and leads to breakdown of communication.

d)Isolated subjects in the UCLA Penthouse experiment actually staked out areas of exclusion from others and acted with marked hostility toward trespassers.

e)Mullin recorded observations frequently mentioned in the literature:
1)Group and individual tensions and irritations are ever present. The most important lesson a member can learn is he cannot afford to alienate himself from the group support.

2)A mechanism of displacement of hostility frequently observed is the tendency to direct anger, scorn, toward external competitors and superior authorities.

EFFECT OF SENSORY DEPRIVATION

a)The problem appears rather to involve "the same faces, the same surroundings, the same routines" over and over, accompanied by minimal physical mobility and activity.

b)Even a moderate amount of monotony can result in profound psychological effects.

MITIGATION MEASURES

a)Attention must be directed to the requirements of the on-board social system to provide a systematic and internally consistent framework for planning.

b)It appears that whatever produces greater crew competence, compatibility, and cohesiveness would also contribute to greater resistance to isolation effects.

CONCLUSIONS

a)In terms of military applications, until strong scientifically developed arguments for another approach can be offered, the recommendation is to follow the traditional pattern of leadership and social organization.

b)In the areas of crew control and interpersonal behavior, individual beliefs, traditions of service, and idiosyncratic preferences must be respected.

c)Significant contributions can be expected in planning and designing an amazingly comfortable and efficient habitation within which groups of 5-15 men could live and work on long duration space missions.

REFERENCES

SELLS, S.B., and J.R. RAWLS. 1968.
Effects of isolation on man's performance
In: W.B. Cassidy, ed. American Astronautical Society Science and Technology Series. Volume 20: Bioengineering and Cabin Ecology, American Astronautical Society, Tarzana, California. pp. 89-116.

R-27
REVIEW/SMALL GROUPS IN ISOLATION Smith, S.

PURPOSE

To glean useful facts and hypotheses and avoid unsubstantiated over-generalizations and careless conclusions from the literature on small groups in confinement.

CONFINEMENTS

a)Controlled laboratory isolated group experiments.

b)Isolated duty stations in the Antarctic and Arctic.

c)Submarine - service habitability and situation studies.

d)Experiments in fallout shelter occupancy.

e)Space-system tests and other aerospace assessments.

f)Manned space flight.

g)Experiments in man-in-the-sea.

h)Various reports of expeditions and explorations.

i)Accounts of sea voyages and disasters.

REVIEW OF STUDIES

I. Group Behavior
   A. Interpersonal Stresses
      1. Overt or covert interpersonal frictions frequently occur.
      2. Evidence of pronounced irritability, hostility, and personality conflicts.
      3. Interpersonal compatibility more important in very confined groups than in groups working in more enriched environments.
      4. A carefully selected group, well constituted in regard to compatibility, will likely avoid serious personal problems and conflicts.

   B. Group Interaction
      1. Communication and other interactive activities decline with time.
      2. Territoriality and privacy needs increase with time.

   C. Relationship with the Outside World
      1. Loss in performance feedback and consensual validation from outside sources has been observed.
      2. Meaningfulness and influences of society will probably diminish during lengthy periods of isolation.
      3. Displayed aggression and hostility often are directed at people or objects external to the group.
      4. Functioning of isolated groups was influenced by loss of information about outside events and the lack of important feedback from outside sources.
      5. Isolation and confinement seemed to foster a resentment for rules and regulations, and an unawareness of any need for legal structure or self-government.

II. Reactions to Confinement and Isolation

   A. Boredom and Monotony
      1. Results in widespread daydreaming and intense desire for a change.
      2. Particularly noticable after task program has been learned well enough for it to become routine.

   B. Motivation and Morale
      1. Highly motivated groups appear to endure isolation without serious problems, but this is time dependent.

2. Motivational drops were shown to be caused by poor leadership and conflicts between the subjects and outside agents.
3. There was a significant decline in personal motivation and hence group morale, but accompaniment with any performance decrement has not been reported.
4. The height of morale was shown to be an inverse function of imposed regimentation in one study.

C. Annoyances
1. Limited facilities for personal care
2. Monotonous diet; food annoyances
3. Crowded conditions
4. Behavior of others
5. Boredom
6. Internal friction and relations with staff
7. Resentment over rules
8. Sleeping problems
9. Odors and noise
10. Temperature and humidity

D. Symptomatology
1. An increase in emotional disturbances and symptomatic complaints during prolonged isolation were shown in spite of living condition improvement.
2. Symptomatology usually became apparent after an initial period of confinement and may lessen just before termination.
3. Symptomatic complaints were observed as follows:
   a. headaches
   b. nausea
   c. sleeplessness
   d. depression
   e. mood declines
   f. occasional compulsive behavior
   g. occasional psychomotor problems

III. Performance Data

A. Intellectual Functioning
1. There was very little evidence of serious shifts over time in intellectual functioning in short and medium term confinement and isolation.
2. There was no test evidence to confirm the decrements that so many persons <u>feel</u> really exist.

B. Perceptual and Motor Skills
1. Members of isolated groups generally seem to be able to maintain their abilities, and only a few instances of skill decrements were reported.
2. Experiments in longer periods of confinement may not hold when participation is more commonplace and routinized.

IV. Physiological and Biochemical Changes

A. In isolated groups, changes can result from:
1. Unresolved conflict and tension
2. Environmental stresses

B. In prolonged durations boredom may contribute to a lowered physiological state.

V. Individual Differences and Selection

A. Individual traits related to successful performance and adjustment are:
1. Work motivation
2. Emotional Stability
3. Social compatibility

B. Well Adjusted
1. Conscientious
2. Responsible
3. Accepts authority

C. Poorly Adjusted
1. Complaining
2. Fearful

3. Marginally concerned about work
4. Greater aggression
5. Less orderliness

D. Screening criteria and predictors which have been reported to be useful:
1. Consideration of past personal effectiveness and adequacy of adjustment to prior duty station.
2. Technical competition of the individual in regard to the nature of the mission.
3. High appropriately directed motivation.
4. Ratings of ego strength and adequacy of defense mechanisms.
5. Detection of personality problems which might be a demoralizing influence or a source of friction.
6. Evaluation of individual in terms of the group to which he will belong.

VI. Other Variables Affecting the Success of Groups in Confinement

A. Group Maintenance
1. Efficient group organization
2. Good leadership
3. Clear definition of objectives and methods
4. Adequate training
5. Effort to maintain good morale

B. Group Size
Must be studied in relationship to severity of isolation and duration of the mission.

C. Work-Rest Cycles

D. Habitat Design

E. Others
1. Privacy
2. Cultural awareness
3. Extent of audio contact from the outside world
4. Expectation as to the duration of confinement

CONCLUSIONS

Fewer problems exist for small groups in isolation than for individuals.

Three major stresses confronting isolated groups are:
Boring sameness of activity and environment as compared to the variability usually available.
Interpersonal dependence necessitating group members to find ways to get along with one another in spite of overcrowding and unfavorable conditions.
Lack of usual sources of emotional gratification and release.

Interpersonal problems are present, particularly in lengthy confinement along with boredom due to unchanging environment.

Interpersonal problems have been shown to be more serious among incompatible groups.

Group members tend to withdraw from one another and from group activities during lengthy confinement and display increased territoriality for areas and possessions.

Aggressive hostility is frequently directed away from the group, perhaps representing useful scapegoating.

Loss of relevant feedback from parent society may be a problem during very long confinement.

Test data are lacking to substantiate many aspects of performance, intellectual effectiveness and perceptual-motor activity did not decline during short-term confinement.

Selection for participation in group confinement must include group considerations in addition to conventional individual criteria.

REFERENCES

SMITH, S. 1969.
Studies of small groups in confinement.
In: J.P. Zubek, ed. Sensory Deprivation: Fifteen Years of Research.
Appleton-Century-Crofts, New York. pp. 374-485.

R-28
REVIEW/EMOTIONAL REACTIONS Solomon, P.

PURPOSE

a)To discuss the role of motivation in the emotional reactions of a space traveler.

b)To analyze the more dangerous emotional reactions caused by space travel, with a view toward their unconscious derivations.

REVIEW OF STUDIES

MOTIVATIONS

a)Aggressive - directed toward attaining goals.

b)Defensive - directed toward avoiding failure; it is here that the chief problems with personnel may be expected.

EMOTIONAL REACTIONS

a)Psychological reactions to danger involve the intellect and emotions.

b)Personnel for space travel should choose persons that are likely to employ their intellect consistently in an emergency.

c)Every man has a breaking point.

d)Factors that can play an important role are: physical fatigue, sleeplessness, hunger, thirst, discomfort, illness, danger, lack of a strong leader, solitude or poor morale in the group, monotony and boredom, and uncertainty in an emergency.

e)Individuals need continuous meaningful contact with the outside world.

f)The presence of another subject causes less serious mental aberrations.

g)In assessing an individual's ability to withstand the stress of sensory deprivation a person's unconscious reactions should also be studied...a person might have deep seated problems that might not be revealed in psychiatric tests a candidate for space should be put through sensory deprivation experiments... if he can't stand this he should not be able to participate in space travel.

h)During the course of space travel there should be communication constantly between astronauts and earth monitors and astronauts and family if possible.

i)Astronauts should be given plenty of work to do.

j)At least two men should be together to avoid inactivity, monotony and boredom.

REFERENCES

SOLOMON, P. 1961.
Motivations and emotional reactions in early space flights.
In: B.E. Flaherty, ed. Psychophysiological Aspects of Space Flight (Symposium on Psychophysiological Aspects of Space Flight, Brooks Air Force Base, Texas, 1960). Columbia University Press, New York. pp. 272-277.

R-29
REVIEW/SENSORY DEPRIVATION Suedfeld, P.

PURPOSE

a)To review the literature on isolation, confinement, and sensory deprivation.

b)To develop taxonomy and unifying theory relating degree of motivation to performance.

REVIEW OF STUDIES

a)Long-duration space flight implies a certain amount of monotony, isolation, confinement, and sensory deprivation.

b)Performance and motivation are related curvilinearly (e.g., high performance at moderate levels of motivation and low performance at both high and low levels of motivation).

c)Interpersonal relationships in group isolation situations are related to dimensions such as duration, conditions, tasks, authority, and group status.

d)In view of the existing literature on sensory deprivation, simple, well-learned, behaviors show the highest improvement rate, while complex, unfamiliar tasks show the highest impairment rate.

CONCLUSIONS

The relationship of motivation to both interpersonal relationships and task performance can be applied to the various facets of long-duration space flight.

REFERENCES

SUEDFELD, P. 1968.
Isolation, confinement, and sensory deprivation.
Journal of the British Interplanetary Society 21:222-231.

R-30
REVIEW/SUBMARINE CREW EFFECTIVENESS Weybrew B.B.

PURPOSE

a)To integrate literature on factors affecting performance of submarine crew-members during prolonged cruises.

b)To delineate the unique, stress-inducing aspects of the submarine environment which require unique adaptation processes by each submarine crew member.

c)To describe the psychological and psychophysiological "make-up" of the carefully selected submariner in terms of specific adaptation resources.

d)To integrate the research findings pertaining to the changes in morbidity patterns and in psychological and physiological stress indicators observed during prolonged submergence - all as they relate to overall submarine crew effectiveness.

CONFINEMENT REVIEWED

Submarines

REVIEW OF STUDIES

STRESS-INDUCING FEATURES

a)There is growing evidence that headaches, irritability and depression observed during protracted submergence may be the result of restricted muscular activity and stimulus invariance rather than the result of the reduced level of stimulation per se.

b)Two other perceptual factors may affect submarine effectiveness: lateral esophoria and time perception in the direction of increased positive.

c)Revitalized ambient atmosphere.

d)Threat of hyperbaric and reduction exposure.

e)Interruption of diurnal periodicity.

f)Sustained effort, sleep deprivation and fatigue.

SUBMARINE CREW CHARACTERISTICS

a)Input population included 4500-5800 enlisted men (18.5 yrs. average age) and 320-450 officers (22 yrs. average age).

b)Test score cutoffs for the Arithmetic and Mechanical Aptitude Tests were set at or about 75th percentile for the Navy as a whole.

c)All men volunteered for submarine service.

d)Psychiatric screening criteria use was the Personal Inventory Barometer (PIB), which provides an emotional stability score and a depression score.

INDICES OF SUBMARINER EFFECTIVENESS

a)Vigilance - the significance of the problem appears to have been recognized but the results appear to be equivocal as to the severity of the effects of long exposure to these conditions.

b)Psychological performance:

1)Faucett and Newman 1953 - suggested that the observed decrements in performance may have been due to deteriorating motivation rather than to any direct effect on the experimental conditions upon psychomotor processes.

2)Johnson 1971 - following a brief learning period the curve of mean scores plotted by week submerged reached a plateau, holding consistent or at least showing no decrement, for the duration of the 8-week missions.

3)Wilken 1969 - in a study involving 360 FBM patrols, 192 psychiatric cases were reported, 136 of which were described as anxiety reactions, resulting in 69 sick days, most of which were accrued by one man.

CONCLUSIONS

The optimal quality of the submariners' adjustment results from first, the comprehensiveness of the medical and psychiatric screening procedures designed to identify poor adjustment risks for the service. Secondly, motivation patterns must be tied to the selection procedure.

REFERENCES

WEYBREW, B.B. 1971.
Submarine crew effectiveness during submerged missions of sixty or more days' duration.
U.S. Naval Submarine Medical Center, Submarine Base, Groton, Connecticut.
22 pages.
[Report No. 686]

R-31
REVIEW/SUBMARINE PSYCHOLOGICAL PROBLEMS Weybrew, B.B.

PURPOSE

To identify and delineate the most important areas of submarine psychology which will formulate a theoretical model for future research in applied psychology.

REVIEW OF STUDIES

TIME PERCEPTION IN SUBMARINES

a)Underestimation of task-filled intervals.

b)Overestimation of void intervals. Individual differences in time estimation may be predictive of adjustment to submergence.

SOCIAL MOTIVATION

a)Behavior directed toward satisfying needs for status, affiliation and prestige.

b)Slightly motivated by desire to be with "good fellows", "better class of men", etc.

CONFORMITY MOTIVATION

Willingness to take orders from superiors is a trait of most officers and enlisted men.

ROLE BEHAVIOR AND GROUP STRUCTURE

a)Group cohesiveness is a function of role behavior ascribed to the group.

b)Crew members whose roles are clearly delineated maintain more favorable attitudes during submergence.

c)Low discrepancy between self-perceived roles and ascribed roles correlate highly with high group morale and leadership.

LEADERSHIP

a)Crew morale is related to leader's ability to delegate authority and the number of personal contacts with other officers and men.

b)Successful leadership is characterized by factors relating to:

1)Drive.

2)Aptitude for submarine service.

3)Stable career orientation.

c)Leader's preference for members of group is transparent to group members themselves.

VIGILANCE

a)Tendencies toward the following were noted:

1)Reduced alertness.

2)Inability to concentrate.

3)Reduction in excitation level as cruise progressed.

b)Daily measures of critical flicker frequency thresholds indicated no significant change in visual sensitivity.

c)Perceptual spans for numbers and letters showed no decrement.

d)Monotony was coincident with reduced excitation level and consequently lowered vigilance.

PSYCHOMOTOR PERFORMANCE

a)Any decline is probably due to deteriorating motivation rather than any direct effect on psychomotor processes.

b)Trend toward increased muscular tension during cruise has not been shown to be related to performance.

SUBJECTIVE INDICES

a)As subjective tension increased, subjects had more difficulty sleeping.

b)Interpersonal irritability increased.

c)Headaches increased both in frequency and severity.

d)Good adjustment was observed on days when land falls are approached.

e)Adjustment was most favorable on Sundays and least favorable on clean-up days.

ASSESSMENT OF ADJUSTMENT POTENTIAL

a)Assessment of abilities.

b)Assessment of personality traits.

c)Aptitude assessment.

d)Motivation assessment.

e)Assessment of over-all adjustment status.

f)Psychophysiological assessment.

CONCLUSIONS

Suggestions for research focus resulting from review are as follows:

a)Selection methodology is needed that will emphasize positive factors contributory to resilient psychological health as well as negative factors related to behavioral disorders.

b)Development of new multivariate techniques of collecting predictor data are needed.

c)Assessment of initial motivation and the problems of maintaining optimal motivation during extended missions should be investigated.

d)Development of operational criteria is needed which will reliably indicate individual differences in the changes in the quality of adjustment as a function of time for prolonged missions.

REFERENCES

WEYBREW, B.B. 1963.
Psychological problems of prolonged marine submergence.
In: N.M. Burns, R.M. Chambers, and E. Hendler, eds. Unusual Environments and Human Behavior - Physiological and Psychological Problems of Man in Space. Macmillan Company, New York. pp. 87-125.

R-32
REVIEW/FALLOUT SHELTER SYMPOSIUM Baker, G.W., and ROHRER, J.H.

PURPOSE

a)To discover the requirements for getting shelters built in our contemporary society.

b)To identify and analyze the wide range of human problems that would be encountered in general adoption and use of fallout shelters.

PRESENTATIONS AT SYMPOSIUM

The following studies from the symposium that were concerned with the social and psychological effects of isolated groups.

Study I: Rohrer, J.H. Implications for Fallout Shelter Living from Studies of Submarine Habitability and Adjustment to Polar Isolation.
Rohrer suggests that the size of the group and duration of the stay affect a person's adjustment in an isolated group. He has applied the findings from submarine habitability and polar isolation to suggest some speculations concerning the results of the initial anxiety to be expected in shelters:
1. Persons who are predisposed to psychiatric symptoms will exhibit them and create management problems.
2. Increased anxiety will result in increased aggression which will be displaced.
3. Increased anxiety will result in headaches and sleeplessness.

Study II: Biderman, A.D. The Relevance of Studies of Internment for the Problems of Shelter Habitability.
Biderman attempts to relate information regarding internment of military, civilian, and political war prisoners to the problems of fallout shelter living. He suggests some physiological and psychological results of isolation that might pertain to shelter habitability.
1. A possible threat from depressive reactions and disinvolvements.
2. Organic and other effects of deprivation (hunger and other deprivational conditions) included:
   a. short temper
   b. infantilism
   c. projection
   d. failing memory
   e. shortened attention span
3. Distress and discomfort caused by:
   a. inactivity
   b. boredom
   c. monotony
4. Sexual deprivation is rarely reported as a major source of distress.
5. Some individuals adapt to an isolated environment by being:
   a. active
   b. aggressive
   c. adaptive
   Others adapt by being:
   a. passive
   b. withdrawn
   c. maladaptive
6. A great many individuals lose the ability to cope with the physical environment.

Study III: Miler, D.C. Some Implications for Shelter Living Based on a Study of Isolated Radar Bases.
Miller's study examined the impact of isolation on morale and human relations problems. Some findings are:
1. Leisure problems will emerge.
2. Apathy and lassitude will increase unless there is a vigorous work and recreational program.
3. The more isolated the shelter, the greater the extent of personal problems.
4. Inclement weather which limits out-of-door activity is detrimental to mental outlook.
5. There is much restlessness.

Study IV: Vernon, J.A. Generalizations from Sensory Deprivation to Fallout Shelters.
Vernon's generalizations from studies of sensory deprivation to fallout shelters are:
1. Hallucinations may occur.
2. Persons may become sensitive to pain.
3. There may be a loss of some motor performance while in the shelters.
4. Shelterees might tend to sleep a lot.
5. Fallout shelters are likely to produce stress in individuals.

Study V: Murray, E. J. Adjustment to Environmental Stress in Fallout Shelters.
A number of psychological adjustment problems might arise from individuals being confined to fallout shelters:
1. Physiological deprivations (lack of food and water, poor air circulation, and overcrowding) can produce:
   a. irritable feelings
   b. poor social and emotional adjustment
   c. a deterioration in moral standards
2. Overcrowding may cause:
   a. decreased efficiency
   b. depression
   c. irritability
3. Depression and fatigue can result from physiological deprivations.
4. Noise in confinement may cause:
   a. irritability
   b. fatigue
   c. aggression
5. Overall stress will be produced by the conditions.
6. A great deal of frustration is produced. Common reactions to frustration might be:
   a. aggression
   b. depression
   c. regression
   d. withdrawal

REFERENCES

BAKER, G.W., and J.H. ROHRER, eds. 1960.
Symposium on human problems in the utilization of fallout shelters.
National Academy of Sciences, Washington, D.C.
[Disaster Study #12]

R-33
REVIEW/NATO SYMPOSIUM

Forgays, D.G., Wilkins, W.L., et al.

PURPOSE

To provide a summary of present knowledge of how man adjusts, individually or in groups, to situations of isolation, whether physical or social, purposeful or accidental.

FORMAL PRESENTATIONS

a)John P. Zubek and Paolo Bonaiuto - provided reviews of the measured effects of sensory and perceptual deprivation in behavior.

b)Ernest Haggard - reported on the adjustment of isolated Norwegian farmers.

c)Eric Gunderson - Discussed the adaptation of scientists and sailors in the wintering-over groups at Amundsen-Scott Station at the South Pole, Byrd Station and the other Antarctic posts.

d)Paul D. Nelson - considered the phenomenological features of isolation, emphasizing that the natural course of human life involves man in a diversity of group contexts under a wide variety of environmental conditions.

e)R.W. Radloff - discussed the usefulness as well as the reliability of such measures as: effects of underwater isolation, as in the cases of Tektite and Sealab.

f)Paul Fraisse - reported results of experiments in caves with particular emphasis on how perception of time is distorted and sleep affected by a long period of monitored life in a cave.

g)W.W. Haythorn - reported on the studies of dyads at NMRI involving interactions of two-man groups under conditions of great restriction of personal space. He pointed out that, although there were unrewarding features of isolation, like tedium stress and unreality stress up to a reaction of claustrophobia, there were possible rewarding features as well, such as a positive sort of contemplation and satisfaction following a period of self-appraisal on which explorers and monks have reported.

h)Dr. Irving Altman - presented ecological aspects of the experience of isolation and a consideration of the dynamics of social penetration.

i)S.B. Sells - considered the taxonomy of man.

j)Walter Wilkins - determined implications of the study of man in isolation for understanding behavior.

REFERENCES

FORGAYS, D.G., and J.M. LEVIN. 1969.
Man in isolation and/or enclosed space: Report of activities of NATO Symposium in Rome, Italy, October 20-24, 1969.
University of Vermont, Burlington, Vermont. 14 pages.

WILKINS, W.L. 1970.
NATO symposium on man in isolation and/or enclosed spaces.
European Science Notes 24(3):88-89.

R-34
REVIEW/NASA SYMPOSIUM

Office of Manned Space Flight
National Aeronautics and Space Administration
Washington, D.C.

PURPOSE

To review what effects the factor of confinement will play in manned space flights of long duration.

PRESENTATIONS AT SYMPOSIUM

Contents and Findings

I. An overview of confinement as a factor in manned space flight (*T.M. Fraser. Lovelace Foundation for Medical Education Research, Albuquerque, New Mexico).
   A. The behavioral response to confinement may take the form of hostility or frustration toward the environment, experimenters, or the other subjects.
   B. With multi-man groups, cliques can form.
   C. Although the group appears to function well, covert hostilities may emerge later.
   D. A number of studies and findings are briefly reviewed.

II. Social emotional considerations in confined groups (*W.W. Haythorn. Naval Medical Research Institute, National Naval Medical Center, Bethesda, Maryland).
   A. Isolation and confinement are stressful to small groups of men, even when the confinement situation is physically comfortable and safe.
   B. Dyad research has revealed a high rate of mission aborts when the variety of tasks required of subjects is reduced and when their expectations of the duration of confinement are increased.
   C. The stresses of stimulus reduction, isolation, and confinement can be alleviated through a process of stimulus enrichment.

III. Crew station design and volume requirements (*W.E. Federsen. Crew Systems Division Manned Spacecraft Center, Houston, Texas).
   A. Review of aspects of space station design known to impair performance.
   B. Recommendations for additions and improvements.

IV. Work-rest schedules under conditions of long-term performance (*W.D. Chiles. Training Research Division Behavioral Sciences Laboratory, 6570th Aerospace Medical Research Laboratories).
   A. Adjustment to circadian rhythms should be a factor in long-term scheduling or work-sleep periods.

V. Preventive and remedial measures related to crew activities and performance (*R.M. Patton. Human Performance Branch, Ames Research Center, Moffett Field, California).
   A. Review of problem areas and suggested approaches to solving problems related to crew activities and performance.
   B. The problems areas covered are: selection; training; and inflight measures.

VI. Operational evaluations of the confinement problem (*M.A. Grodsky. Man-Machine Engineering Department, The Martin Company, Baltimore, Maryland).
   A. Discussion of possible effects of long duration confinement on space crews and means of evaluation concerning mission - and system-oriented tasks.

VII. Human factors in a confined operational environment - Sealab (*J.W. Miller. Engineering Psychology Branch, Office of Naval Research, Washington, D.C.).
   A. Divers underwater were significantly more fearful and aroused than on the surface prior to submersion.
   B. Age and maturity were the only characteristics associated with being chosen as a leader. Performance, fear, arousal, gregariousness, and choice as a peer were not related to leader choice.
   C. There was no increase in the homogeneity of emotional responses over time.
   D. Self-reported fear and arousal were significantly correlated with performance criteria. The more frightened and aroused divers showed inferior performance.

E. First-born and only children were more frightened and had poorer performance than later-borns.
F. Failure of an individual to share group activities and social behavior was associated with higher levels of reported stress and inferior performance.

CONCLUSIONS

Mission conditions affecting responses to confinement:

1. Physical Environment
   a. Gravity
   b. Environmental pressure
   c. Environmental composition
   d. Temperature-humidity
   e. Sanitation
   f. Food-water
   g. Medical treatment
   h. Environmental stability
   i. Environmental pollution
   j. Sound levels
   k. Radiation effects
2. Sensory-Motor Limitations
   a. Reduced depth perception
   b. Reduced kinesthetic and vestibular stimulation
   c. Monotonous stimulus environment
   e. Reduced functional area
3. Psychological environment
   a. Personal danger
   b. Command structure
   c. Interpersonal relations
   d. Privacy
   e. Flexibility of mission
   f. Communication problems
4. Crew tasks
   a. Active as opposed to passive vigilance tasks
   b. Variety of tasks
   c. Extent and capability of ground support
   d. Sensory equipment
   e. Guidance and control requirements
5. Crew size
   a. One man
   b. Two to four
   c. Five or more
6. Diurnal work cycles
   a. Work-rest cycle
   b. Sleep-wakefulness
   c. Amount of pre-flight training and adaptation
7. Individual differences
   a. Adequacy of selection procedures

REFERENCES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. 1966.
The effects of confinement on long duration manned space flights (Proceedings of the NASA Symposium, November 17, 1966).
Office of Manned Space Flight, NASA, Washington, D.C. 53 pages.

R-35
REVIEW/SMALL MILITARY GROUP CONFERENCE Sells, S.B.

PURPOSE

To review problems relating to the performance of isolated military groups in stressful environments. To study situations similar to those in Arctic isolated groups.

VARIABLES STUDIED

a)The three general areas investigated were:
1. ecological factors and stress
2. group structure and group dynamics
3. personnel aspects of group performance

b)The most important variables considered were:
1. performance
2. depression
3. perception
4. adjustment
5. morale
6. boredom
7. interaction

RESULTS

a)Inactivity, boredom, and monotony increase distress and discomfort. This is more relevant for well-fed persons, who have surplus energy beyond that required for existence, than for starved, exhausted persons.

b)In the 7-day confinement experiment performance efficiency on psychomotor tasks decreased; on tests of judgment and learning reasoning it did not decrease.

c)People who have trouble with authority were more prone to trouble in confinement.

d)In confinement for 36 hours in tank-type respirator experiment - all subjects showed impaired ability to concentrate, distortions in time judgment, and degrees of anxiety. Half had delusions, illusions, and hallucinations.

e)Decreased activity enhances depression.

f)Separation from valued stimuli - wives, friends, home - causes worry and depression.

g)Perceptual distortions and hallucinations seem most related to lack of patterning or absence of order or meaning.

h)When men function as a team, instead of a disorganized mob, they have more strength, skill, stress tolerance and stamina.

i)Most maladjustment in confinement in Alaska related to dissatisfaction with military provision for family, lack of interesting things to do, inadequate social outlets. This led to low morale.

j)Good leadership positively correlated with high morale.

k)Though initial Attitude and Group Behavior Scales indicated adjustment in a group isolated for 12 months at South Pole Station, further study revealed resentment and dislike among group members.

l)Youngest men received lowest adjustment station and performance ratings.

m)Lack of communication concerning purpose of mission, role designations, importance of work, correlates highly with low morale.

n)Individual job satisfaction and morale positively affects group integration and cohesiveness.

o)Small groups with good integration are potentially effective groups.

REFERENCES

SELLS, S.B. 1961.
Tri-service conference on research relevant to behavior problems of small military groups under isolation and stress.
Texas Christian University, Fort Worth, Texas 273 pages.

R-36
REVIEW/ISOLATION AND SENSORY DEPRIVATION Burns, N.M., and Kimura, D.

PURPOSE

To bring together the relevant features from several studies on confinement and isolation with particular emphasis on the application of this data for further research.

METHOD

Literature dealing with the following subjects was surveyed:

a)Pertinent animal experiments.

b)Controlled studies in which humans were confined and/or isolated.

c)Personal reports on the effects of confinement, isolation, and extreme hazard.

REVIEW OF STUDIES

a)Early explorers coped with their aloneness and the monotony of their surroundings by making a conscious effort to control their own thought processes, to rigidly structure their work day, and to draw into themselves for added stimulation and interest.

b)Early explorers experienced: fear, monotony resulting in reduced overall mental efficiency, feelings of depersonalization, and hallucinations.

c)The degree of hazard present and the way in which the isolates perceive the hazard affect the response to the situation.

d)Both very high and very low amounts of sensory input result in disorganization on a central level. A lack of sensory input not only results in a lack of specific sensory data reaching the cortex, but also deprives the cortex of the influence it normally receives from the brain stem.

e)When personal concepts of temporal congruity and logical analysis are disrupted (as by sleep loss), the frequency of misperceptions increases.

f)Monotony and a lack of patterning do not provide adequate cues to the individual and also fail to provide the essential nonspecific input on which the cortex depends for normal functioning.

g)Early sensory deprivation and restriction interfere with the emergence of normal patterns of perception and response.

h)Studies suggest a tentative relationship between stimulus change and sensory deprivation. Organisms attempt to maintain a given level of arousal. Level of arousal varies within and between species and is dependent upon: 1)the total of the organism's prior experience and 2) the strength of momentary stimulus events that preceded exposure to the present stimulus configuration.

i)An organism's behavior in confinement or isolation can be interpreted as an attempt to maintain some level of arousal.

j)Isolation - confinement environments remove the consensual validation to which we are accustomed and on which we are dependent in a normal unrestricted environment.

CONCLUSIONS

a)An adequate theoretical framework for handling the concepts involved in the areas of isolation and confinement will depend on the utilization of data that have already been accumulated in a number of ancillary areas, including: childhood separations, critical age studies, effects of early environment, psychopharmacology and the behavioral effects of hallucinogenic agents, biological rhythms, and time estimation.

b)A thorough engineering study must be conducted of pilots' sensory and motor capabilities under changing conditions of acceleration, and equipment must be designed accordingly.

c)Emphasis must be placed on the selection and training of crews.

d)Group cohesiveness and team effectiveness under stress will assume new importance in future space missions.

REFERENCES

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R-37
REVIEW/HUMAN FACTORS IN SPACE FLIGHT

Space Science Board, National Research Council, National Academy of Sciences Washington, D.C.

PURPOSE

To survey the following behavioral, psychological, physiological, and medical factors of manned space missions of 1 to 2-year duration in order to assess whether man's participation is possible and feasible and to make recommendations for future research.

a)Physiological and Medical Factors.

b)Physical Factors.

c)Sensory, Perceptual, and Motor Factors.

d)Motivation, Cognition, and Sleep-Work Factors; Central- and Autonomic-Nervous-System Indices.

e)Skilled Performance.

f)Subjective States.

g)Group Processes and Interpersonal Interaction.

h)A Social System Approach to Long-Duration Missions.

i)Human Factors and Operational Requirements.

METHOD

At NASA's request, the Space Science Board undertook a study of the behavioral, psychological, physiological and medical factors of manned space missions.

a)A Steering Committee was organized to survey the above factors and to identify specialists to write about these factors.

b)The papers written were incorporated into this report by the Steering Committee.

c)Since spaceflight biomedical and behavioral measurements have been few (as of the preparation of this report, 1970-1971), analogies were sought in the literature. Investigations of confinement and isolation were drawn on, these included studies of social isolation (laboratory experiments), underwater habitats, submarines, Antarctic and Arctic stations, simulated fallout shelters, and space studies.

MAJOR RECOMMENDATIONS MADE AFTER SURVEYING FACTORS

I. Ground-based research and subsequent inflight research with men and animals should cover the full range of physiologically deconditioning factors:

a)Understanding of course of deconditioning over two years.

b)Deconditioning mechanisms and consequences.

c)Validation of effective countermeasures.

d)Inflight research to include only definitive experiments that cannot be performed on ground.

e)Cautious, conservative incremental approach with man.

f)Possible use of human surrogates, especially primates, which will remain in space for long-duration studies in man-tended orbital stations.

g)Unmanned animal flights to investigate discrete problems.

II. Long-duration ground-based investigations of immediate and cumulative effects of high Z particles should be undertaken:

a)As soon as facilities are available.

b)Provided that interim studies support the present hypothesis concerning the nature and severity of this hazard.

c)In order to develop proper protection against the effects of high Z particles.

III. Research concerning the long-term effects on man of isolation, confinement and sensory restriction in conjunction with other stresses is critically needed.

a)Research should emphasize the following:

1)Cognitive functioning including EEG changes.

2)Maintenance of performance and retention of skills.

3)Sleep and work/rest cycles.

4)Group processes.

5)Allocation of tasks.

6)Perceptual and motor skills.

b)The following methodological approach is recommended - observation and measurement from shorter operational missions must be analyzed for relevance to longer-term missions, such as:

1)Training exercises in simulators should be utilized as sources of data bearing on crew performance over long periods of time.

2)Long-term simulator studies and other field studies should provide useful sources of data.

3)Laboratory studies are essential to clarify relationships among variables.

4)Computer and mathematical modeling efforts seem warranted and necessary in order to synthesize information obtained through empirical research.

c)Forms and systems of measurement to be used:

1)Four system levels important to research on microsocieties are:

Physiological
Psychological
Task performance
Interpersonal

2)On each system level measurement may take four forms:

Subjective report
Observations
Trace measurements
Archival measures

d)Substantive research questions:

1)Sources of CNS changes noticed in prolonged periods of comparative monotony.

2)Effect of training and conditioning on long-term physical adaptation and maintenance of performance.

3)The role of interpersonal compatibility in mitigating social withdrawal and encapsulation.

4)The role of leadership in maintaining adjustive interpersonal relationships.

5)The effect of expectations or "set" on experimental results.

IV. Techniques must be available to measure physiological, psychological and performance status inflight and to provide early indications of potentially serious situations:

a)Precise measurement of higher level performance.

b)Tests for psychological and/or psychiatric problems.

c)Emphasis on principles of noninterference, automotive and monitoring for critical deviations in biological parameters that best predict reductions in well-being.

V. Requirements for life support and safety, optimal habitability and comfort, and operational efficiency should be incorporated early into spacecraft engineering. Man's physical, psychological, behavioral, and interpersonal requirements must be considered in the design of the spacecraft and the mission.

a)Habitability must be improved regarding capsule volume, configuration and noise as they relate to work, mobility, recreation and sleep.

b)Broad research programs and close coordination among engineers, life scientists and human factors experts will be necessary.

VI. Elements of the long-duration mission should be viewed as portions of a totally integrated and mutually reinforcing system. Systems analyses approval should be advantageous in providing a common frame of reference for interdisciplinary planning and implementation. Elements of long-duration mission include:

a)Temporal factors - preflight, inflight, postflight.

b)Engineering factors - spacecraft and its internal environment, new technology.

c)Operational factors - ground support, mission control, space mission.

d)Scientific factors - inflight experiments, preparation and completion, medical care, ground-based resources.

e)Human factors - ground crew and flight crew and their relationships.

VII. Crew composition and selection criteria should be considered matters of first importance.

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Space Science Board, National Research Council, National Academy of Sciences, Washington, D.C. 272 pages.

R-38
REVIEW/ISOLATION, CONFINEMENT, GROUP DYNAMICS Kubis, J.F.

PURPOSE

To review studies on the dynamics of groups isolated and confined for periods up to 1 year.

CONFINEMENTS REVIEWED

1)Arctic

2)Antarctic

3)Submarines

4)Spaceflight Simulation

5)Underwater Habitats

REACTIONS OF INDIVIDUALS TO ISOLATION AND CONFINEMENT

Arctic

Individuals confined for 2-12 months showed decrements in performance and morale due to lack of privacy and social stimuli.

Antarctic

1)Individuals confined for 4-12 months developed symptoms of some or all of the following:

a)Anxiety

b)Boredom

c)Daydreaming

d)Depression

e)Hostility

f)Irritability

2)In one case, an increase in work activity helped alleviate the symptoms.

Submarine

1)Individuals confined for up to 60 days exhibited some or all of the following traits:

a)Boredom

b)Daydreaming

c)Desocialization

d)Headaches

e)Insomnia

f)Irritability

2)These symptoms were on occasion caused or increased by a lack of space and a high carbon dioxide atmosphere.

Spaceflight Simulation

1)In studies which followed both extensive selection procedures (physical, intellectual and emotional) and intensive training in "social sensitivity", subjects:

a)Maintained high motivation and morale

b)Improved performance

c)Established good interpersonal relations

d)Evidenced no decrements in psychomotor or cognitive functions.

2)In a 30-day simulation study carried out after random selection and no training, interpersonal stress was evident and although cognitive and psychomotor functions were not impaired subjects were:

a)Hostile

b)Irritable

c)Dissatisfied by the food

d)Unhappy about lack of privacy

3)In another 30-day simulation confinement which only included technical training, two 5-man crews alternated work/rest schedules of 4 hours on/4 hours off. Although subjects achieved high performance levels, they were:

a)Fatigued

b)Bored

c)Irritable

Underwater Habitats

The dangerous environment of the Sealab II experiment led each person to depend more on others and fostered cohesion.

Group Dynamics

1)As confinement continues, an informal or functional group structure will develop from the formal structure.

2)Members will easily perceive where teammates stand regarding popularity and power and may choose an emotional leader, ("father figure") in addition to the formally designated leader.

3)The effective leader must perform well and support the emotional and social needs of his crew in order to achieve correspondingly high levels of performance and cohesion.

4)A mild degree of stress produces optimal performance; too little stress produces little or no motivation.

5)In a monotonous boring environment, cohesion will decline; in a dangerous interdependent environment, it will increase.

RECOMMENDATIONS

1)To counteract boredom, change and rotation or work assignments, work companions, and project responsibilities should be programmed into the flight schedule.

2)Some leadership functions should be delegated to and rotated among crew members.

3)Selection of astronaut teams should focus on identifying effective crews rather than individuals.

4)More research needs to be done to match homogeneous vs. heterogeneous characteristics that lead to optimal compatibility and performance.

5)Broad understanding of oneself and others must be included as an essential part of the training process.

6)Isolation and confinement impose a strain on group structure, induce severe pressures on leadership, and threaten group integrity.

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R-39
REVIEW/PSYCHOLOGICAL ASPECTS OF SPACEFLIGHT

Kubis, J.F., and Mclaughlin, E.J.

PURPOSE

To examine the involvement of psychological considerations in selection of astronauts, in their training, and in their behavior during actual space flight.

SUBJECTS

Thirty-two candidates selected from a pool of 500 names. All were:

a)Qualified jet pilots with over 1500 hours of flying time.

b)Graduates of test pilot school and under 40 years of age.

c)Highly intelligent and in excellent physical condition.

PROCEDURES

a)Upon completion of all physiological, psychological and biochemical tests at the Aerospace Medical Research Laboratory, the primary group of astronauts was selected by the Candidate Evaluation Committee.

b)Each received technical and psychological training to develop his confidence and regulate his anxiety.

c)During flight, effects of weightlessness and other stresses were assessed, physiologically and psychologically.

RESULTS

a)Stresses associated with short-term space flight produced no significant deterioration of visual acuity or spatial orientation.

b)Most astronauts maintained good emotional reactions, though some irritability was experienced on one 14-day mission.

c)Performance was maintained at a high level and adaptability and decision making processes were in evidence.

CONCLUSIONS

a)Psychological stability is the most important consideration in evaluating a candidate. His intelligence, maturity and motivation must be assessed.

b)Excellent physiological performance is a secondary consideration.

c)Although the impact of short-term space flight on man's body and brain have been assessed, it is now necessary to plan confinement experiments for future space flights which may last one year or more.

d)It is expected, from reviewing long-term confinement studies in the Antarctic and on submarines, that anxiety, irritability, sleep disturbances, depression and hostility will develop among crew members in prolonged

spaceflight unless determinations of compatibility are carefully established.

e)Behavioral and performance norms, gathered under comfortable, gravity-oriented conditions, will not be applicable in the weightless state and can only be measured by observations of crew members in actual space flight. For experimental purposes an orbiting space laboratory should be put into operation as soon as possible.

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R-40
REVIEW/ISOLATION AND CONFINEMENT Rasmussen, J.E.

PURPOSE

To review insights into human behavior in isolation and/or confinement as demonstrated by material developed since the last NATO Symposium on Man in Isolation and/or Enclosed Space held in Italy in 1969.

REVIEWS STUDIED

a)ZUBEK, J.P. Behavioral and physiological effects of prolonged sensory and perceptual deprivation: A review.

Zubek reports on sensory deprivation and its resulting perceptual aberrations. Lack of sensory stimuli also increases an individual's susceptibility to propaganda, impairs his cognitive functioning and slows occipital alpha frequencies. Measures to counteract effects of sensory deprivation include physical and mental exercises and special training for isolation conditions.

b)FRAISSE, P. Temporal isolation, activity rhythms, and time estimation.

Fraisse reports on temporal isolation, biorhythmicity, and time estimation. Circadian rhythms tend to remain stable but subjects consistently underestimate time intervals.

c)HAGGARD, E.A. Some effects of geographic and social isolation in natural settings.

Haggard studies the behavior of children raised in Norway's remote mountain farms. Children thus reared show greater interfamily heterogeneity and display different behavioral characteristics than urban children.

d)GUNDERSON, E.K.E. Individual behavior in confined or isolated groups.

Gunderson writes of adverse effects of confinement/isolation on emotional equilibrium, motivation and effectiveness based on studies carried out in the Antarctic.

e)NELSON, P.D. The indirect observation of groups under confinement and/or isolation.

Nelson analyzes confined and/or isolated groups, their stuctures, behavior, goal patterns, cultures, and effectiveness.

f)RADLOFF, R.W. Naturalistic observations of isolated experimental groups in field settings.

Radloff has conducted 6 years of research on saturation diving groups. Since divers regard continuous observation as a safety factor, psychologists can study their behavior unobtrusively and without negative reactions.

g)HAYTHORN, W.H. The miniworld of isolation: Laboratory studies.

Haythorn reviews laboratory studies of social isolation. He concludes that the major stresses of isolation and confinement are stimulus reduction, limited space, privacy, and mobility, non-gratification of needs, and interpersonal incompatibility. He recommends further investigations into the cognitive and aesthetic needs of small isolated groups.

h)ALTMAN, I. An ecological approach to the functioning of socially isolated groups.

Altman studies group adaptation, management of conflict and facilitation of positive interpersonal exchange. He finds that time and physical scales become telescoped, events proceed rapidly, and interpersonal tolerance is low. Early and effective group structure formation is critical for the later cohesiveness of the group.

i)DE MONTMOLLIN, G. Concepts and strategies of research on groups in isolation: Comments on Altman's approach.

De Montmollin agrees with Altman and emphasizes the necessity of managing, rather than just understanding, the psychological life environment of isolated groups. Programs should be developed and tested to provide training in interpersonal relationships, in individual and collective adaptation to confinement, and in common goal sharing among subjects who already have strong individual motivation.

j)SELLS, S.B. The taxonomy of man in enclosed space.

Sells presents the thesis that a taxonomy of man in isolation and/or confinement requires the analysis of these situations in terms of a social system model. Effects of social isolation, confinement and sensory restriction cannot be disentangled from the highly interdependent social system contexts in which they occur, and indications are that these vary significantly among classes of social systems.

k)WILKINS, W.L. Isolation research: The methodological context..

Wilkins provides an overview of research presented at the 1969 NATO Symposium. (See R-33 in this report)

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R-41
REVIEW/SYMPOSIUM - TEAM PERFORMANCE IN ISOLATED ENVIRONMENTS

Sells, S.B.

PURPOSE

To investigate the effects of conditions of isolation on team performance.

CONFINEMENTS REVIEWED

Study I - Mount Everest climbing expedition of 18 men

Study II - Scientific stations in Antarctica with 8 to 26 men

Study III - Comparison of Sealab II findings with reports of adjustment in similarly stressful environments.

PRESENTATIONS AT SYMPOSIUM

Study I

EMERSON, R.M., and J.T. LESTER. Reflections on Mt. Everest.

Discussed ideas related to the subject of team performance in isolated environments utilizing data collected in the 18-man Mount Everest Expedition of 1963 of which both authors were members.

EMERSON, R.M. Group performance in remote environments.

a)Discussed some of the effects of the level of group autonomy on the group's structure.

b)If an autonomous group was not overstaffed, it tended to assume an equalitarian structure, both in reward distribution and in the decision making process.

c)A non-autonomous, initially equalitarian group, with outside resource or reward inputs, will soon evolve into a power hierarchy. (Power derives from outside the group, while authority stems from performance within the group.)

d)An autonomous group has problems of authority to deal with, but one which is non-autonomous has power and authority problems to deal with.

LESTER, J.T. Accommodation and expression in remote environments.

a)Described interpersonal relationships from the dialectic between the necessity to accommodate oneself to another and the apparent necessity to express or assert oneself in relation to another.

b)Normative forces lead to a sense of community; self-expressive forces lead toward a sense of individuality. In any enduring interpersonal relationship, a balance must be reached between the affirmation of shared norms and the affirmation of individuality in relation to those norms.

c)Infractions of shared norms may be viewed as examples of correcting imbalances between accommodation to norms and individual self-direction.

d)Many balancing maneuvers will be unavailable on prolonged space flights, which may be set off by establishing more flexible norms and allowing for more freedom of self-expression.

Study II

GUNDERSON, E.K.E. Group compatibility in restricted environments.

a)Investigated the antecedents and correlates of group compatibility to improve understanding of the determinants of group effectiveness. Summarized studies of group compatibility conducted at scientific stations in Antarctica.

b)Social attractiveness, while difficult to assess, may be an important concept in the prediction of group compatibility.

c)Wide variation in attitudes and personality needs were detrimental to group harmony and cooperation.

d)Both formal and informal group structures were positively related to group compatibility, but an intermediate level of formality in group structure was associated with group incompatibility.

Study III

RADLOFF, R. Costs and rewards in exotic environments.

a)Introduced a conceptual model useful in considering performance in and adjustment to exotic environments.

b)The model consists of a cost-reward matrix, where the desirability of a situation depends on having rewards (whether subjective or objective) greater than costs.

c)Implications of model:

1)Later groups in exotic environments will experience poorer outcomes than pioneering groups, since rewards may be expected to decline faster than costs as more groups enter exotic environments.

2)Costs will be relatively stable and rewards will be relatively unstable for groups in exotic environments.

d)For a maturing system, the analysis implies that:

1)In a maturing system more attention should be devoted to substituting for rewards which have disappeared and maximizing potential available rewards rather than on minimizing costs, because costs are relatively stable and rewards are labile.

2)Rewards available to later groups in exotic environments will differ from the rewards available to pioneering groups.

3)Caution should be exercised against overly optimistic expectations of performance in later groups derived from an analysis of the behavior of earlier groups.

4)Rewards for later groups will be derived from personal and peer group relations rather than from recognition received from society at large and from the sub-culture.

5)Since rewards will depend on the peer group, it emphasizes the role of leadership in creating an atmosphere in which rewards can be maximized from qualities intrinsic to the situation as discussed by Sells.

6)Attention should be derived toward selection of men who are able to maximize the rewards of the situation as it exists.

REMARKS ON SYMPOSIUM

VINACKE, W.E.

a)Laboratory research is valuable in establishing theoretical tenets and empirical techniques in social psychology and in shaping field research.

b)There should be a two-way interchange between field and laboratory studies.

SAUCER, R.T.

The greatest challenge today facing the behavioral scientist involved in manned spaceflight is to be able to select crew members with outstanding emotional health and selected mental attributes.

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SELLS, S.B. (Chairman) 1968.
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Institute of Behavioral Research, Texas Christian University, Fort Worth, Texas.
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Trego, R.E., and Sells, S.B.

PURPOSE

To search and review all literature which relates individual characteristics to successful adjustment to isolation and confinement.

CONFINEMENTS REVIEWED

POLAR ENVIRONMENTS

a)Psychiatric screening can predict performance effectiveness as well as prevent selection of subjects prone to mental disorders.

b)Emphasis was placed on the adequacy of the individual's defense mechanisms.

c)Friction in a group is created by people who are inflexible, demanding, overly sensitive or narcissistic.

d)A positive correlation exists between a man's job effectiveness and his level of compatibility with others in the group.

e)"Control (or lack of control) of hostile and agressive impulses has special significance in the small, closed group setting."

f)The Rorschach technique is not useful as an adjustment predictor.

g)Biographical and demographic data are not accurate predictors of successful adaptation.

h)Positive correlations exist between age and emotional composure while negative correlations exist between age and measure of motivation.

SUBMERSIBLE ENVIRONMENTS

a)Few background variables were related to attitude changes during and following submergence.

b)Age and maturity were the only criteria for choice of leader.

c)Tests defining Verbal Comprehension and Speed-in-Spatial Orientation Factors "may have considerable value in predicting the quality of a person's adjustment to the confinement, frustration and other stresses of submarine living."

LABORATORY AND SIMULATOR ENVIRONMENTS

a)Individual differences in stimulus demand should be investigated as part of the selection process.

b)"Good adjustment is associated with flexibility, low sociopathy and ability to be aggressive and angry, yet not hostile."

c)Relationships between pain endurance tests and personality scales yield no significant coefficients.

CONCLUSIONS

a)Good adjustment can be related to:
1)Age and level of maturity
2)Absence of history of delinquency or infraction of established regulations
3)Low level of need for avocational activity

4)Low in impulsiveness.
5)Having feminine interests.
6)Well-organized in thought and performance.
7)Accepting of a dependency situation.

b)Poor adjustment can be related to:
1)Rural background.
2)Frequent sick calls.
3)Single status.
4)Low frequency of worship.
5)High scores on Psychopathic Deviate and Hypomania but a low on Ego Strength.

c)Individuals who have performed successfully in prior isolation and confinement tests will most likely perform well in space flight.

d)To appraise and predict performance, multiple predictor tests and criteria have become standard in selection; predictions, however, are not always accurate, best results being obtained by examiners using a flexible interview technique to receive maximum information.

e)Self-selection data have proven useful in determining a subject's motivation.

f)Previous research on selection has concentrated too much on isolating negative factors rather than on identifying positive factors contributing to resilient psychological adjustment to prolonged hazardous duty.

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