ADAPTATION TO EXTREME ENVIRONMENTS: PREDICTION OF PERFORMANCE

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This report summarizes a series of studies concerned with environmental and psychological factors related to adjustment or performance in isolated Antarctic groups. These studies were designed to provide support for the Navy's psychiatric assessment program and to aid in selection of suitable military and civilian applicants for service at Antarctic scientific stations. Possible sources and effects of stress in this type of confined environment are considered. Methods developed for the measurement of individual and group performance are described, and results of studies conducted to evaluate the predictive validities of biographical, clinical, and personality data are presented in detail. Studies of emotional and motivational changes during the long Antarctic winter and the relationships of such changes to occupational and social roles, psychological needs, and effective work performance are reported.

Introduction

The U.S. Navy has provided the principal logistic support for this nation's large-scale research efforts on the Antarctic continent over the past decade. The Bureau of Medicine and Surgery of the Navy has conducted a psychiatric assessment program to aid in selection of suitable military and civilian applicants for service at Antarctic scientific stations.

A previous report [66-4][1] has described the Antarctic research program, the Antarctic environment, distinctive features of the various stations, the composition of wintering-over parties, and the social background and psychological characteristics of Antarctic occupational groups, both Navy and civilian. The personnel requirements and selection process for Navy assignments were described in detail.

In the present survey, findings from more than twenty separate studies are summarized. The major focus of this review is upon methods for the measurement and prediction of performance at small Antarctic stations. The first section briefly considers possible sources and effects of stress in the Antarctic environment, and other sections deal in some detail with the development of measurement techniques and the analysis of results obtained from twenty-eight station groups in eight expeditions. Although primary attention is given to the smaller stations, data from larger station groups (primarily McMurdo) are reported as appropriate.

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[1]Report Numbers from the Project Bibliography listed in Appendix A. The reports cited give detailed information concerning the studies summarized in this review.

Sources and Effects of Environmental Stress

There is no doubt that prolonged isolation in a restricted environment places unusual stresses upon small groups. Precise knowledge concerning the sources and effects of stress in such a setting is lacking, however. The particular features of Antarctic station environments that are most productive of stress are not known with certainty, but data have been gathered from participants and from psychiatric examiners which are suggestive. It is known that reductions in physical activity and social stimulation inevitably occur in Antarctic groups. Our test data have shown that not only are individual emotional and motivational changes common, but that some deterioration in group harmony and cooperation also frequently takes place [63-16].

The major problem in the assessment of physiological and psychological responses to environmental stresses is that these responses are usually non-specific. A variety of behavioral changes may accompany specific stressful events, and it is seldom possible to infer the kind or degree of stress from changes in response alone. Obviously it would be impossible to measure all of the many environmental factors that might have significant effects upon physiological and psychological functions. We can only note, as best we can with our admittedly crude methods of observation, those environmental circumstances which are regularly associated with changes in work efficiency, social behavior, or subjectively reported emotional states.

Reactions of persons to variations in external stimulation are assumed to be related to their personality structures and past histories and probably involve exaggeration of characteristic adaptive mechanisms. If this assumption is true, it is more important for prediction to know the personality characteristics and behavior patterns of the individual than to know the particular kinds of stress that he will experience. A wide array of personality measures have been used in our Antarctic studies, and their relationships to performance criteria will be examined in later sections of this report.

A study was conducted of the relative stressfulness of Antarctic small station duty as perceived by psychiatric examiners for the Antarctic program [62-4]. Eleven different duty assignments were rated by psychiatrists and psychologists as being more, less, or equivalent in stress to Antarctic small station duty. These assignments were: Antarctic small station, astronaut training, underground intelligence, SAC alert flight crew, Underwater Demolition Training, jungle warfare training, DEW-Line small station, Marine Corps basic training, radar picket ship duty, nuclear submarine duty, Naval Academy training, and destroyer sea duty. In ranking the eleven duty assignments on the basis of the rating assigned to each by psychiatrists and psychologists, high agreement was revealed (Rho = .94, $p > .01$). For the psychiatrists, only

astronaut training and underground intelligence were seen as more stressful than Antarctic small station duty, while for psychologists, only astronaut training was more stressful. Thus, duty in Antarctica was perceived as generally more stressful than most other duty assignments with which comparisons were made. Comments given by the screeners to support their ratings of high stress included reference to the threat of death, the continuing need for being alert, being alone or with the same small group over prolonged periods of time, and having to cope with the unknown.

The final task for the screeners was that of describing what they considered to be the most stressful attributes of Antarctic small station duty. The content and analysis of these descriptions resulted in six general content areas described as follows:

1. Confined Isolation: Geographical, social and emotional remoteness with limited space and absence of an opportunity to withdraw or escape from the situation.

2. Continuous Presence of Same Associates: Continuous proximity of others with lack of interpersonal choice; knowing that one must get along with others.

3. Tension Control: Necessity of controlling aggressive and emotional impulses; inability to relieve anxiety; lack of heterosexual objects.

4. Boredom, Monotony: Sameness of physical surroundings, faces, work tasks, conversations; lack of stimulus variety.

5. Physical Hardship: Hard and heavy work; cold weather, darkness; certain food deprivations; having to work to attain minimal standards for health and safety.

6. Status Limitations: Status leveling, role overlap; lack of immediate status rewards.

In terms of other sources of information, such as post-winter interviews with station leaders and debriefings of visiting psychiatric teams, the clinical examiners probably overestimated the degree of stress typically experienced at small Antarctic stations; the sources and kinds of stress enumerated by clinicians generally tended to agree with appraisals by observers at the stations, however.

A study was conducted of sources of stress as judged by station members in one expedition. Wintering-over participants have reported that inadequacy of heat or light has not been a particular problem. Because water must be made from snow and ice with considerable expenditure of labor and fuel, water generally is in short supply, and personal cleanliness tends to become a serious concern to many individuals after several months of isolation. Food generally is abundant and of good quality and represents a major source of gratification, although shortages in certain food items may be present. Recreational facilities are generally reported to be inadequate and represent a significant problem to many individuals. Space is very limited, largely because of the enormous expense of heating living and working areas; crowding was considered a problem by about one-third of the station members. Fire was a constant concern to a large majority of the station

members. Worry about maintaining communication with family was expressed by many. The physical condition of the station and the need for improving facilities was of concern to many station members. Inadequacy of pay was a frequent complaint by naval personnel but not the civilians. Naval personnel receive no special compensation for duty in the Antarctic.

It is apparent that as a consequence of prolonged confinement and restriction in activities, many of the usual modes of dissipating emotional tensions are not available. Active sports, many common social diversions, and sexual outlets are not available. The Antarctic situation confronts group members with a number of problems that have no possibility of solution during the long winter confinement period. Men with strong needs for activity and achievement might be expected to suffer more in such an environment than men with lesser needs for mastery over the environment. Data supporting this hypothesis for Navy personnel will be presented in a later section.

Antarctic participants are typically confronted with an unusual combination of barriers, deprivations, and annoyances in the immediate environment. Certain individuals find this environment congenial, however; the absence of many usual social pressures perhaps counterbalances the mild hardships of life at remote stations for some participants. Of practical and theoretical concern are the individual differences in response, favorable or unfavorable, to such circumstances, particularly differences in work efficiency. Later sections of this report will present a review of efforts to measure personality characteristics and behavior patterns in this unusual and extreme situation.

The Development of Individual Performance Measures

This section is concerned with the development of performance measures for men wintering-over at small Antarctic stations. The majority of volunteers for Antarctic duty are initially acceptable from the point of view of physical, psychological, and occupational capabilities. The problem remains to select those individuals with the highest potential for effective performance at small stations. What, then, constitutes effective performance and how can it best be measured?

An examination of the stated purposes and goals of the participating organizations led to the assumption that work motivation and emotional stability were highly relevant to the aims of the Antarctic program. The scientific and operational tasks could not be accomplished without hard work and persistence in the face of many difficulties on the part of most participants; nor could the planned projects be accomplished if group members developed disabling or disruptive emotional symptoms.

The importance of another behavior area, social compatibility or likability, did not become fully apparent until empirical data from several stations clearly indicated its significance in evaluating overall individual competence. The general concept of effective individual performance over the entire year then appeared to be best approximated by estimates of adjustment in three behavior areas, emotional stability, task motivation, and social compatibility. None of these taken singly was sufficient to represent the concept: taken together these three components appeared to represent major aspects of the overall criterion.

Because the incidence of gross ineffectiveness, e.g., incapacity due to psychosis or psychoneurosis, was extremely rare and the rate of attrition for psychiatric or motivational reasons after selection was very low, such infrequent events could not provide an adequate criterion for differentiating performance. It was impossible to know in advance what tasks an individual would be expected to accomplish except in a broad sense and unpredicted events beyond an individual's control could disrupt planned achievement efforts. For these reasons and because different tasks were to be performed by the various station members, it was not feasible to establish a meaningful standard of performance applicable to all personnel. Furthermore, there was no practical way for an observer outside the station to monitor an individual's behavior. The only available source of information about an individual's performance over the entire year was from the station membership itself. It seemed reasonable that the station leaders (supervisors) and other station members (peer group) were capable of observing whether or not an individual was emotionally distressed, socially disruptive, or incompetent.

Preliminary data gathered during the IGY period, although incomplete, provided the following results: (1) significant agreement was found between station leaders and between supervisors and peers both within and between time periods, and (2) significant positive intercorrelations were found among evaluations of work, social adjustment, and overall effectiveness. It was concluded from these preliminary studies that station members could be reliably differentiated by peers and supervisors on the basis of their observed performance, individual performances tended to be consistent over time, and overall evaluations of performance reflected both work and social qualities of the individual [62-3].

During the expeditions of 1960 through 1962 new types of supervisor and peer evaluations were developed and data were obtained from members of seven small stations [63-5]. Two procedures were devised to obtain supervisor evaluations: (1) independent ratings of all members by the two station leaders on a series of trait scales, and (2) independent rankings of all station members in the order in which the supervisor would select them to serve with him again in the

Antarctic. Peer group members provided two types of evaluations: (1) nominations of station members which best fit certain behavior descriptions, such as "easiest to get along with," and (2) rankings or nominations of station members in terms of which men they would choose to serve with again in the Antarctic. The item pertaining to the selection of station members with whom one would want to return to the Antarctic was common to evaluation data from all seven stations. This item, among all of those studied, was considered to be the most meaningful general index of effective performance. From responses on the "return with" item, subjects within each station were ranked separately on supervisors' and peers' evaluations; ranks were converted to T-scores (mean = 50, standard deviation = 10) in order to provide comparable measures across stations of different size. A composite criterion score reflecting the combined peer and supervisor estimates of overall performance, then was obtained by averaging the T-scores from the two independent sources. Reasonably good agreement or reliability was found between supervisors and among peers on the "return with" item. Also, the average correlation (agreement) between combined supervisor and total peer evaluations over the seven stations was .63. The substantial agreement between the two methods of estimating overall performance was encouraging in view of the fact that raters were untrained and often inexperienced, and groups varied in size, composition, and physical environment.

The next phase of the research involved an effort to identify a limited number of psychological factors which could account for a large portion of the variance in the general performance criterion. In addition to ranking all members at the seven stations, two supervisors at each station independently rated all personnel on 21 behavior traits. Eleven of these traits (likability, emotional control, acceptance of authority, industriousness, achievement motivation, motivation towards group, attitude towards project, happiness, alertness, job satisfaction, and self-confidence) were selected in terms of non-redundancy and rater reliability for a factor analysis. An additional item, peer nominations for "best friend" or "easy to get along with," was included in the analysis.

Two factors accounted for 82% of the variance. One was a general factor and the other was a bipolar factor with social-emotional attributes loading in one direction and task-oriented attributes loading in the other. The rotated factor structure was such that three pairs of items emerged as meaningful concepts; the items in each pair differed in content from the other two. The three factors consisted of the following item-pairs: (1) emotional control and acceptance of authority, (2) industriousness and achievement motivation, and (3) likability (from supervisor ratings) and friendship-compatibility (from peer nominations). These factors clearly represented

the three components of overall performance hypothesized to account for effective performance at small Antarctic stations.

The next procedure was to determine the relationship between the three factors and the composite criterion based upon averaged supervisor and peer rankings. Scores representing the three factors were obtained by averaging T-scores for the two items in each cluster.

The multiple correlation between all three clusters and the combined criterion was .89; the highest possible multiple correlation using various combinations of individual items was slightly less, .84. The importance of the social compatibility cluster was apparent when multiple correlations were obtained between pairs of clusters and the criterion. By removing the social compatibility cluster, the value of R was reduced to .75.

A final analysis was that of determining the extent to which the three clusters were consistent in their relationship with the criterion for different station groups and for military and civilian personnel. The values of R were .90 and .87 for military and civilian personnel, respectively. Comparing station groups, R values ranged from .76 to .93, but the median value of R was .88. The three clusters, then, appeared to have about the same multiple relationship with the criterion for different groups of personnel.

In summary, the greatest amount of criterion variance was accounted for by the three trait clusters of emotional stability, task motivation, and social compatibility. The addition of other characteristics to these clusters, for example, attitudes toward job and project, did not improve the multiple relationship.

The next phase of the research involved obtaining criterion scores for new groups of subjects [65-6]. Supervisor ratings and peer nomination data were collected from personnel at eight small Antarctic stations over a two-year period. Stations ranged in size from 12 to 35 men. Criterion data consisted of independent ratings by two station leaders on a set of behavior traits and peer nominations on several of the same or comparable traits. Scores were derived on each supervisor cluster by averaging ratings from both supervisors over all items and both administrations. Members at each station were ranked on the average rating for the cluster, and these ranks were converted to T-scores in order to render the cluster scores comparable across stations.

Measures of the three trait areas by the two methods, supervisor rating and peer nominations, were intercorrelated separately for the two expeditions. Results are shown in Table 1. All intercorrelations of trait clusters within and between methods are presented; internal consistency reliabilities are estimated for each of the measures. The correlation coefficients underlined in the Table indicate that there was substantial agreement in measuring the three behavior areas by

Table 1

Intercorrelations for Different Methods of Measuring Three Performance Areas[a]

	E_1	T_1	S_1	E_2	T_2	S_2
First Year						
Supervisor (N = 64)						
$Emotion_1$	(72)[b]					
$Task_1$	12	(56)				
$Social_1$	47	29	(61)			
Peer (N = 75)						
$Emotion_2$	59[c]	10	42	(80)		
$Task_2$	29	45	30	53	(78)	
$Social_2$	38	32	48	64	60	(63)
Second Year						
Supervisor (N = 64)						
$Emotion_1$	(75)					
$Task_1$	66	(60)				
$Social_1$	78	52	(76)			
Peer (N = 64)						
$Emotion_2$	48	53	40	(73)		
$Task_2$	47	64	33	64	(83)	
$Social_2$	39	43	51	57	53	(82)

[a]All coefficients are Pearson correlations averaged over stations; N = 64 for all correlations except for the first year Peer sample where N = 75.

[b]Estimated supervisor reliabilities in parentheses are based upon weighted averages of inter-rater correlations over stations corrected by the Spearman-Brown formula; estimated peer reliabilities are based upon averaged split-half reliabilities over stations corrected by the Spearman-Brown formula.

[c]Underlined values in diagonals represent convergent validities for two methods of measuring the same traits.

the two methods, but it is apparent that the three concepts overlapped considerably in the minds of the raters as can be seen by the high intercorrelations among cluster scores within a given method.

The results indicated that reliable measurement of important behavior characteristics is practicable in the Antarctic environment and that the concepts measured are meaningful to untrained observers. The three performance scores described above and two others -- leadership ability and overall effectiveness -- have been utilized as criterion measures in a series of studies to test the validities of biographical data, personality ratings by psychologists and psychiatrists, and

personality inventories for Antarctic selection. The results of these studies are described in the following sections.

Prediction of Individual Performance

The difficulties of measuring performance or adjustment at Antarctic stations were evident from the discussion in the previous section. Although reasonable reliability and stability of interrelationships were demonstrated for the performance measures developed for small Antarctic stations, it must be emphasized that these measures are fallible estimates, largely based upon subjective judgments, and influenced to some degree by particular value systems of station leaders and unrecognized or perhaps unpredictable environmental factors. With these limitations of the criteria in mind, we proceed to the description of validity studies utilizing biographical information, psychiatric evaluations, and personality inventories obtained in the psychiatric assessment program.

Biographical Predictors. An individual's life history and present status are generally viewed as appropriate sources of data from which to predict future behavior. The ease of obtaining this information, its reliability, and patent face validity make personal history data an inevitable part of personnel assessment programs. The validity of biographical variables for the prediction of adjustment or performance, however, cannot be assumed but must be demonstrated for each particular setting in which such information is to be used.

Because the military and civilian groups differed in work roles, social and educational backgrounds, and methods of selection, validity studies have been conducted separately for the two groups. Primary attention is given to Navy participants in the Antarctic operations in the analyses to follow. Results for civilian participants are cited where available and appropriate.

Several months prior to their deployment to the Antarctic, subjects completed a biographical questionnaire that elicited information concerning military status and history, interests and hobbies, family and educational background, and pre-military vocational experience. Performance measures were derived from evaluations by station supervisors and peers as described in the previous section.

The first analyses to be considered were based upon peer evaluations collected from both small stations (15 to 40 men) and large stations (80 to 100 men) during the period of the IGY (International Geophysical Year) [65-7]. A second set of data -- independent ratings by two supervisors -- was obtained over a two-year period from Navy personnel at the large permanent base at McMurdo Sound [64-22].

While the IGY data generally were not productive of significant relationships, age, and rank (pay grade) were highly discriminating ($p > .001$) with respect to the peer criterion. Years of naval experience and marital status (married) also were found to be positively related to performance. In addition, low frequency of worship and a large amount of reading (of books and magazines) were related to the positive pole of the peer criterion.

In the second sample (McMurdo Sound), age, rank, years of experience and marital status (married) were found to be significantly related to the supervisor criterion -- each relation being in the same direction as that for the peer criterion in the IGY groups. Frequency of worship, however, was not found to be significantly related to the McMurdo performance criterion (as it had been related to the IGY criterion). Several other variables that characterized an individual's personal and social background, namely, education, education of parents, urban-rural residence, and number of siblings, did not prove discriminating with respect to the supervisor rating criterion. Finally, two composite scores which had been derived from a number of separate personal history questionnaire items were included in the analysis for the McMurdo sample. First, an activities score was developed on the basis of an individual's participation in sports, clubs, hobbies, and reading activities. Second, a delinquency-truancy index was constructed from items pertaining to arrest, expulsion from school, running away from home, and being frequently truant from school. Both the activities score and the delinquency-truancy index were found to be significantly related to performance.

To summarize, results for the IGY and McMurdo samples indicated significant predictive validities for biographical items pertaining to occupational experience and general maturity. Evidence of past delinquent behavior was found to be associated with less effective Antarctic performance, while an index of avocational interests and activities was found to be positively related to the supervisor criterion in the McMurdo sample.

During a five-year period, biographical and criterion data were obtained from members of fifteen small stations [65-7]. The total sample was divided into two series of stations, representing the first three years and the last two years of the study. In addition to evaluations of overall performance (by supervisors and peers combined), criterion scores representing emotional stability, task motivation, and social compatibility were utilized.

Age was found to be positively and linearly related to the emotion and the overall criteria in the first series of small stations -- a result that paralleled the results for the large stations. In the second series of stations, a significant relationship was found between age and the overall criterion, but this relationship was non-linear because the middle age group

(24-30 years) scored lowest on the criterion. A disproportionate number of older men, however, were in the superior performance category.

Rank proved to be discriminating in both series of groups. In the first series, second class petty officers scored lower than did the men in all other categories (unrated men and third class men, first class petty officers and chiefs) on the social criterion; in the second series, second class and higher petty officers scored low on the social criterion. In the second series, second class petty officers also scored much lower than did men in other grades on the emotion and overall criteria.

Naval experience was found to be significantly related to one criterion measure only -- the overall criterion in the second series. The middle experience group (4 to 10 years) was lowest on this criterion.

Frequency of worship was found to be discriminating for both samples. Individuals reporting low attendance at organized worship scored highest on the emotion criterion in both series.

Interest in hobbies was found to be related negatively to the social and the overall criteria in the first sample and negatively related to the emotion criterion in the second.

The activities score (based upon club membership, sports participation, and hobbies) was available only for the first sample. It related significantly to three of the four criteria in a negative direction, a direction opposite that obtained for large station personnel.

The delinquency-truancy index, available only for the first series, proved discriminating for the emotion and overall criteria in the same direction as that found in the earlier studies.

A number of the biographical items did not relate significantly to any of the criterion measures in either of the small station samples. These variables were education, marital status, parents' marital status, rural-urban residence, changes of residence, region of residence, and family size.

It was notable that the cluster of variables which pertained to avocational interests and activities (i.e., variables such as clubs, hobbies, reading, and sports) was strikingly different in its relationship to performance in the two settings. At the small stations, where opportunities for avocational activities are very limited, preferences for such activities were found to be negatively correlated with adjustment. At the larger stations, where recreational and social activities are more varied and more readily available, participation in avocational activities was found to be positively correlated with the performance criteria.

Another shift in the significance of particular categories of information occurred with respect to the frequency of worship item. In the IGY period, a clearly linear and negative

relationship was found between frequency of worship and the peer criterion. For the small station, a non-linear relationship was present in that both the "never" and "regular" attendance categories were found to be associated with superior performance, while individuals reporting irregular attendance scored lower on the emotion criterion. This result implies that persons firmly committed to attendance or to non-attendance at organized worship adjusted better than others at the small stations.

The fact that many life history or status characteristics are non-discriminating with respect to Antarctic performance emphasizes the fact that the use of biographical data does not offer an easy answer to personnel assessment in this setting. There is nothing in our data to contradict the proposition that the Navy man who would be effective at the large Antarctic base, McMurdo, is likely to be the individual who would be effective in other duty assignments. Important qualifications must be added for the men assigned to small stations, however. Rank and experience do not have a simple positive relationship to performance, and personal needs for avocational activities have an important meaning for the small station environment that is different from that of the large station.

A separate study was conducted of relationships between biographical attributes and emotion, task, and social criterion scores for civilian personnel from seven small stations [64-4]. The scientists and meteorology or weather personnel were treated as separate groups.

Among the weather personnel, age and job experience were correlated with the task and emotion criteria. The same finding was obtained earlier among Navy personnel. Neither of these two variables was positively correlated with performance among scientists, except for a moderate positive relationship between job experience and the emotion criterion. Education was more important among the scientists than among the weather personnel. For both the weather and science personnel, being married and attending church seemed positively, though not in each case significantly, related to performance. Similar to the findings among military personnel, frequent reading and much avocational activity tended to be unfavorable for the weather personnel, but this was less so for the scientists. Urban-rural residence presented conflicting relationships with the criteria for the two civilian groups, urban residence being negatively correlated with the task and social criteria for weather personnel and positively correlated with the emotion and social criteria for the scientists. Urban residence tended to be positively related to the emotion criterion for all groups, Navy included. Also, a positive correlation was observed between family size and task performance for all groups, although not significant in each case. The results for the military and for the two civilian groups indicated that the attributes are not equally effective as predictors of performance among all occupational subgroups. Specific biographical attributes relevant to performance for each occupational group must be identified.

Psychiatric Evaluations. Plans for satellite space stations, lunar colonies, and undersea communities call attention to the increasing demands upon psychiatrists and psychologists to aid in the selection of personnel for tasks and environments about which relatively little is known. Conducting psychiatric evaluations of Antarctic volunteers presented similar problems. Although more knowledge has been disseminated about living conditions in the Antarctic than about those on the moon, it is reasonable to assume that most of the clinicians involved in this assessment program had received little information concerning details of everyday life in the Antarctic. Because the wintering-over personnel cannot be evacuated once the winter sets in, it was obvious that a major objective of the screening process should be that of eliminating the potential psychotic or seriously disturbed individual. But within the population of healthy volunteers, the psychiatrists and psychologists were expected to predict potential adjustment levels. To do this with relatively little information about Antarctic life situations, with no personal experience in the Antarctic, and with no feed-back on their previous evaluations was a manifestly difficult task.

A study was conducted to identify some of the assumptions held by psychiatrists and psychologists who examined candidates for Deep Freeze and to determine the extent to which such assumptions were shared by the screeners [62-4]. Twenty examiners were paired so that one psychiatrist and one psychologist worked together throughout the screening program as a team. Each team screened approximately 20 candidates. Screening one candidate at a time, the psychiatrist interviewed the candidate for approximately one-half hour, and the psychologist, during another period of time, administered the Rorschach to the candidate. Upon completion of the assessment period for each applicant, the psychiatrist and psychologist independently evaluated the individual on each of nine specific adjustment areas and one overall adjustment scale, using a 5-point rating system. To determine the extent to which each psychiatrist and psychologist pair agreed on their general evaluation of each candidate, the two sets of ratings for each candidate were pooled into two summed scores, then, the scores were correlated for each screening team. Agreement (correlation) between psychiatrists and psychologists ranged in value from .38 to .82, all correlations being significant beyond the .10 of confidence. The average correlation between psychiatrists and psychologists was .60. Thus, overall agreement between these clinicians was quite high.

The psychiatrists and psychologists also ranked 11 personality traits and defense mechanisms from most to least unfavorable for successful adjustment in a small Antarctic station setting. Significant agreement was obtained within each group of screeners. Because there was significant agreement among psychiatrists and among psychologists, the average rank order of the traits and

mechanisms was determined for psychiatrists as a group and psychologists as a group. A rank order correlation of .88, significant beyond the .01 level, revealed high agreement between psychiatrists and psychologists. The rank order of traits and mechanisms from most unfavorable to least unfavorable for the two groups combined was: paranoid, psychopathic, dissociative, phobic, somatizing, withdrawing, masochistic, schizoid, obsessive-compulsive, rationalizing, and repressive.

In summary, the Deep Freeze examiners of this study held similar assumptions about relevant personality characteristics and agreed substantially in global predictions of Antarctic adjustment.

Two further studies were undertaken of agreement in personality evaluations made by psychologists and psychiatrists. In the first, agreement achieved by experienced clinicians in rating personality characteristics of Navy volunteers under four different screening conditions was studied. In the second study, an effort was made to identify characteristics of clinicians and factors in the situation that were favorable or unfavorable for agreement.

In predicting personal adjustment and on-the-job effectiveness in unusual settings, personality characteristics as well as intellectual and technical abilities must be taken into account. Psychiatrists and psychologists in military settings are routinely called upon to assess strengths and weaknesses of healthy individuals. The reliability of such personality evaluations is of serious concern because predictions and decisions based upon them can seriously affect human lives. It is obvious that clinicians often differ among themselves in their impressions of personality characteristics and dynamics. To what factors in the clinicians or in the situation can we attribute such disagreement?

In the first phase of the reliability study, each of 719 Navy Deep Freeze volunteers was independently examined and rated on nineteen personality traits and adjustment predictions by a psychiatrist and clinical psychologist [64-9]. Rating items consisted of common adjectives or brief sentences descriptive of personality traits.

Rorschach examinations were used by the psychologists as a source of information for the first year's sample of ratings. Trait ratings were filled out shortly after the administration of the Rorschach. A clinical interview and a biographical questionnaire were utilized as the source of clinical data during the second year. Psychiatrists relied upon interviews and biographical information both years.

Approximately one-half of the military personnel were assessed at special screening centers each of the two years of the study. The other half were examined at four naval hospitals by professional staff members in the psychiatric services of those hospitals. Almost all of the

pairs of clinicians from the hospitals had previously worked together, but only a few of the clinicians at the special centers had ever worked together.

Pearson correlation coefficients which reflected agreement between judges were generally significant but uniformly low, indicating that the judges could not agree with high consistency in evaluating specific personality attributes. Agreement was generally lower over the nineteen traits under the condition of different assessment methods used by psychologists and psychiatrists (Rorschachs versus interviews) as opposed to the condition of both clinicians using the same methods (interviews). In the other comparison, clinicians who were not experienced in working together agreed about as well as clinicians who regularly worked together.

Ratings were more reliable for the overall effectiveness items than for specific traits. Psychologists' ratings were significantly less favorable and showed more variance in the first year (Rorschachs) than in the second year (interviews). In the second reliability study, 35 clinician teams, each composed of a psychologist and a psychiatrist, rated more than 700 Navy and civilian Antarctic candidates on the same nineteen items described previously [64-18]. Teams were ranked with respect to average reliability coefficients for three overall effectiveness ratings, then grouped into three levels or categories of agreement -- high, medium, and low. Teams were similarly classified with respect to average reliability coefficients over sixteen specific personality traits. Teams also were ranked and grouped with respect to sums and differences on a number of other variables, and these were related to the agreement variables by chi-square tests. These independent variables were: professional experience, Deep Freeze experience, favorability of ratings, dispersion of ratings, deviation from modal profile, agreement between profiles, and agreement in trait values. Additional measures were constructed to reflect degrees of similarity or difference between clinicians on the above variables.

Fifteen of the 35 teams achieved reliability coefficients for the overall effectiveness item exceeding .50; thus, many of the teams were able to agree substantially on global predictions of adjustment. For the same teams, agreement on specific personality attributes generally was much lower, averaging .30. Considering all rating items, the general level of agreement was low, although there were wide differences among teams.

Few of the characteristics of the clinician teams were found to be significantly related to inter-rater reliability. Clinicians who rated unfavorably and who had relatively little dispersion in their ratings agreed best with other clinicians in making global evaluations. Similarity in recent professional experience also favored agreement. For reliability on specific traits, similarity in type of professional experience, amount of similarity of deviation from modal rating

profiles, and agreement on the relevance of traits were most important. It was evident, however, that relatively little of the variance in team agreement was explained by these team characteristics.

The foregoing studies revealed that the reliability of clinical ratings generally was low, but agreement varied with the assessment condition. In this section, studies of the validity, or predictive value, of clinical evaluations for the Antarctic setting will be reviewed. The validity of judgments based upon clinical methods, such as interviews or projective tests, has been persistently questioned over the past 15 years. Meehl (1954), in summarizing research on the accuracy of clinical judgments more than a decade ago, suggested that such predictions often are in error because the clinician typically does not know what weights to give the various items of information nor how to combine them efficiently.

In spite of the admitted weaknesses of clinical methods, the interview continues to be the preferred technique for assessing personality. In many situations more efficient techniques simply are unknown or are not available. Whatever clinical methods are utilized, however, validity cannot be assumed but must be demonstrated for that particular setting.

The next series of studies was concerned with relationships between clinical ratings and the performance criteria developed for Antarctic stations [65-14]. Assessment conditions differed in terms of three factors: amount of variance in the performance criterion, methods of clinical appraisal, and the amount of standardization of instructions to examiners. The possible effects of the different assessment conditions upon the validities achieved in the Antarctic setting were evaluated.

As described previously, each candidate for Antarctic service is examined and rated independently by a clinical psychologist and psychiatrist on a rating schedule containing a series of personality traits and adjustment predictions. Different rating schedules were employed in the several studies reported. Personality variables in all rating schedules were common traits represented by adjectives or phrases descriptive of personality and presumably relevant to adjustment in small groups.

Joint psychologist-psychiatrist ratings of overall effectiveness which were utilized in both IGY expeditions were substantially related to supervisors' performance evaluations. These results were reported by Nardini, Herrmann, and Rasmussen (1962).

In the second of the two IGY expeditions, independent ratings by psychologists and psychiatrists were correlated with supervisor and peer criterion scores from four station groups. The individuals studied in this expedition varied considerably in the quality of their performance compared with later expeditions, both in terms of range of occupational experience and in terms

of actual adjustment difficulties reported by participants and leaders.

It was anticipated that each clinician might contribute uniquely to the prediction of adjustment based upon these largely independent sources of information (Rorschach and interview). Table 2 indicates that this was not the case; only the psychiatrists' ratings based upon interview data contributed to the validity of the clinical assessments. Psychologists' ratings proved discriminating on only one trait, while psychiatrists' ratings were significantly related ($p < .10$) to the supervisor criterion on five items. Psychiatrists' ratings were discriminating with respect to the peer evaluation scores on seven items. These significant correlations were all in the expected direction and in combination provided consistent evidence that psychiatrists' judgments based upon interviews were predictive of performance in the Antarctic setting under conditions of large variation in performance.

Table 2

Correlations of Clinical Ratings with Performance Criteria: First Rating Schedule[a]

	Psychologist		Psychiatrist	
Item	Supervisor	Peer	Supervisor	Peer
Likable	03	-01	00	27[b]
Prefer to Work With	16	05	17	15[b]
Direction of Hostility (Others)	-13	-09	-11	-04
Assertive-Passive	12	02	09	00
Tense-Relaxed	04	-03	12[b]	14[b]
Self reliant-Dependent	-04	-10	-03	-19[b]
Hostile-Friendly	26[b]	13	39[b]	17[b]
Modest-Boastful	-07	-04	-15	-07
Self denying-Self indulgent	-02	01	25[b]	-09
Withdrawn-Sociable	03	09	04	13
Adaptable-Rigid	-06	-10	-30[b]	-31[b]
Overall Evaluation	17	03	24[b]	23[b]
N	76	158	76	158

[a]Values are Pearson correlations; decimals are omitted.

[b]Values are significant ($p < .10$, two-tailed test).

The next series of clinical predictions studied were those for members of eight small stations (14 to 26 men) in three expeditions subsequent to the IGY. Navy personnel on these expeditions were more highly selected in terms of experience and past performance than had been the case in previous years; in addition, a higher percentage of candidates (10 to 15%) were disqualified for psychiatric reasons during the screening process. This greater selectivity served to raise the general quality of performance and to reduce its variance, thus making predictions more difficult.

Results of the clinical evaluations made in this phase of the study were consistently negative. All ratings and scores were correlated with supervisor and peer evaluations comparable to those used earlier. Neither the general evaluation scores for individual clinicians nor the scores based upon joint ratings were significantly related to the criteria. It was concluded that for the small stations of these three expeditions, the two clinician groups, either separately or jointly, were unable to predict performance evaluations in the field.

Clinical ratings similar to those described above also were available for Navy personnel assigned to the large Antarctic base at McMurdo Sound over a two-year period. Performance evaluations were obtained from the medical officer and executive officer of the station in both expeditions in the form of a 5-point scale ranging from "unacceptable" to "outstanding" performance. These independent ratings were averaged to obtain an overall criterion estimate. Joint psychologist-psychiatrist predictions of performance on the same 5-point scale ("unacceptable" to "outstanding") were correlated with the criterion scores in both expeditions. Separate psychologist and psychiatrist ratings were available only for the second of the expeditions. Because the work and social environment at the large McMurdo Station was quite different from that experienced at the smaller stations and more similar to that of a typical Navy base, it was of special interest to compare the validity of clinical predictions for the more "normal" environment of the large station with that achieved at the smaller stations. At the same time, the quality (criterion) range was somewhat greater at the larger station because of a number of less experienced men were accepted and selection standards generally were lower than for the small stations

For the two expeditions ($N = 194$), the joint clinical predictions correlated significantly with the supervisor criterion ($r = .19$, $p < .06$). In the second, expedition, independent ratings by the psychologists and psychiatrists were summed to provide general evaluation scores for each group. The psychologists' evaluations (based upon Rorschach examinations) were not significantly correlated with the supervisor criterion while the psychiatrists' scores (based upon interviews) were significantly correlated with the criterion ($r = .26$, $p < .05$). None of the 12 specific trait ratings made by the psychologists was significantly related to the criterion. Significant clinical prediction, therefore, was achieved for the large station environment but only by the psychiatrist examiners using the interview procedure.

In the most recent studies of this series, Navy and civilian members of eight small station groups (12 to 35 men) during two expeditions were clinically examined prior to deployment to the Antarctic and were evaluated on-the-job by station supervisors and peers. Performance variance was relatively small within this sample. Rorschach examinations again were used by the psycholo-

gists as a primary source of information in the first of the two expeditions. In the second expedition, however, a semi-structured clinical interview and a biographical questionnaire were utilized by psychologists as sources of clinical data. Psychiatrists relied upon clinical interviews and biographical information both years. Clinical assessment procedures also differed over the two-year period in that examiners were much better informed about the screening task the second year. At the second screening, clinicians were given more detailed information concerning rating procedures, trait definitions, the population to be screened, Antarctic station life, relevant personality attributes, and typical work and social roles of participants. As reported in a previous section of this report, improved inter-rater reliability was present under the revised assessment conditions of the second year.

Criterion measures were global performance evaluations by supervisors and by peers. Ratings made independently by the two station leaders (military and civilian) were averaged to provide an overall performance estimate for each participant; peer nominations of "best man" in terms of overall performance provided the second criterion measure.

In the first of the two expeditions, correlations between clinicians' ratings and criteria were uniformly low and the number of significant values did not exceed chance. Significant predictive validities were obtained for most of the clinical ratings in the second expedition. Results are shown in Table 3. Five items which were not discriminating for either criterion were omitted from the Table. Psychologists' ratings on six items were significantly related to the supervisor criterion, and ratings on three items were significantly correlated with the peer criterion in the expected direction. Psychiatrists' ratings on 10 of the 14 items were significantly correlated with the peer criterion; none of the psychiatrists' ratings were correlated with the supervisor criterion, however. Overall, though correlations were low, a number of significant relationships beyond chance expectation were attained by both groups of clinicians under conditions of low criterion variance, appraisal by interviews, and relatively thorough instructions to examiners.

When psychologists' and psychologists' ratings for each year were combined to provide for reliable estimates of personality traits and these were correlated with a combined supervisor-peer criterion, none of the combined trait ratings were significantly correlated with the composite criterion on the first expedition while six combined clinical rating items were significantly correlated with the criterion in the second expedition. These results again provided evidence of more effective prediction under the assessment conditions of the second expedition.

In the selection of men with suitable personality qualities for particular jobs and in the

Table 3

Correlations of Clinical Ratings with Performance Criteria: Second Rating Schedule[a]

Item	Psychologist		Psychiatrist	
	Supervisor	Peer	Supervisor	Peer
Aggression	-30[b]	-08	-10	-26[b]
Emotional Control	20	18	13	28[b]
Direction of Hostility (Self)	31[b]	21[b]	03	09
Acts Out (Impulsive)	-20	-08	-15	-23[b]
Likable	11	-02	04	23[b]
Modest	23[b]	08	-02	17
Conforming	33[b]	30[b]	17	10
Hostile	-17	00	-08	-21[b]
Excitable	-19	-09	-02	-25[b]
Orderly	08	21[b]	-10	-14
Paranoid	-21[b]	-16	-17	-23[b]
Overall	07	-03	04	26[b]
Peers[c]	15	00	14	28[b]
Leaders[c]	21[b]	08	00	21[b]
N	61	61	61	61

[a]Values shown are Pearson correlations; decimals are omitted.

[b]Values are significant ($p < .10$, two-tailed test).

[c]Predicted "acceptance by peers" and predicted "acceptance by station leaders."

prediction of future emotional and social adjustment, the clinicians' methods of personality assessment should be expected to contribute significantly to effective personnel decisions if examiners are given adequate information concerning the assessment task. The clinical psychologist and hospital psychiatrist, unlike the academic psychologist who can insist that he is only concerned with general laws of behavior, are specifically trained to apply their knowledge of general principles to individual cases. While everyone in daily life has observed the disastrous effects of placing the "wrong" personality or incompatible personalities in particular work or social situations, it has proved very difficult to develop systematic and reliable principles to guide the judgments of those responsible for making important personnel assignment decisions. Limited evidence was developed in the foregoing studies that significant predictive validities can be attained under particular assessment conditions but not others; much remains to be done to establish a sound basis for clinical evaluation as a predictive instrument for Antarctic performance.

Ample justification has been provided for the abandonment of the Rorschach technique in this setting. From the consistent lack of validity in the psychologists' judgments, based upon this method over several years, it can only be concluded that this type of projective instrument is of

little or no utility in the Antarctic assessment program.

A flexible interview technique on the other hand provided positive, though weak, validities, even when examiners were poorly informed about the environment for which they were predicting. When the clinicians were provided with more detailed knowledge of rating procedures, assessment objectives, and the Antarctic environment the best results were achieved. A major implication of the studies thus far is that special instruction and training for clinical examiners are worthwhile.

Examination of the item content which contributed to prediction of Antarctic adjustment in these studies suggests that control (or lack of control) of hostile and aggressive impulses has special significance in the small, closed group setting. Hostile-friendly in the first rating schedule and aggression, emotional control, direction of hostility (against self), conforming, and paranoid in the second were among the stronger predictors. Special attention directed to this area in the assessment interview is indicated.

Correlates of Performance: A Summary

A large number of biographical and psychological variables, including ratings by clinical examiners, have been correlated with criterion scores for Navy enlisted men at small stations. In preceding sections, the development of methods for the measurement and prediction of performance has been detailed, and the consistency of relationships for biographical and clinical rating data over several expeditions has been evaluated. In this section correlational relationships between screening variables and small station performance criteria for Navy men in the three most recent expeditions will be summarized to provide a contemporary outline of the attributes that characterize successful Navy men at Antarctic small stations.

The salient results for each of the five major performance criteria will be described, and correlations will be shown separately for the total Navy enlisted group and the group composed predominantly of Construction Battalion (Seabee) personnel. The latter group consists of men with the following ratings: Builder (BU), Utilitiesman (UT), Construction Electrician (CE), Electricians Mate (EM), Equipment Operator (EO), Construction Mechanic (CM), Engineman (EN), and Constructionman (CN). Differences in magnitude of the correlations for the two groups indicate that certain characteristics are more relevant for performance in one Navy occupational subgroup than in another.

Emotional Stability. Results for this criterion are summarized in Table 4. None of the experience variables (age, length of naval service, and pay grade) were significantly correlated with this criterion, nor were any other personal history items except hobbies. The number of

hobbies checked as "Liked" was a discriminating variable for the total Navy group, but not for the Seabee group alone. This result was highly consistent with earlier small station studies which indicated that expressed interest in hobbies and social activities was negatively related to performance. Preferences for four specific hobbies were significantly related to the criterion. Interest in reading books was an equally unfavorable indicator for Seabees and other Navy men while disliking movies was discriminating only for Seabees. Neutrality toward two hobbies, i.e., neither strongly liking nor disliking "Working on Hotrods" and "Hiking or Camping," was positively correlated for the all Navy group but not for Seabees.

Table 4

Correlates of Performance: Emotional Stability

Predictors	All Navy	Seabees Only
Hobbies:		
Number of Hobbies Liked	-22*	-13
Movies (Disliked)	17	41*
Books (Liked)	-29*	-31*
Hotrods (Neutral)	25*	18
Hiking/Camping (Neutral)	23*	03
Clinical Evaluation:		
Excitable	-22*	-13
Personality Scales:		
Motivation	-19*	-18
Confidence in Medical Care	-21*	35*
Attitude Inventory Items:		
I prefer the job I will have on this expedition to any other job I can think of.	-29*	-27*
I like other people to tell me how well I've done on a difficult job.	27*	11
The success or failure of the Antarctic expedition will depend as much on me as on anyone else.	-27*	-18
The harder the job, the better I like it.	-20*	-28*
Hard (Self-Description)	19*	33*
Conforming (Self-Description)	13	32*
N	106	58

*Product-moment correlations significant beyond .05 level.

A clinical evaluation score (the psychologist and psychiatrist examiners' ratings summed) for "Excitable" predicted in the expected direction for the total Navy enlisted group.

Expression of extremely positive attitudes toward the Antarctic expedition, that is, high Motivation and Confidence in Medical Care scores, was negatively correlated with the Emotional

Stability criterion. High scores on the FIRO-B Wanted Affection Scale (Schutz, 1958) tended to be negatively correlated with the emotional adjustment criterion, although not significantly. Responses at the positive extreme on three attitude inventory items, "I prefer the job I will have on this expedition to any other job I can think of," "The harder the job, the better I like it," and "The success or failure of the Antarctic expedition will depend as much on me as on anyone else," were predictive of poor emotional adjustment while a positive response to one item, "I like other people to tell me how well I have done on a difficult job," was a favorable indicator for the total Navy group. Seabees considered emotionally well-adjusted by their small station associates characterized themselves as "Hard" and "Conforming."

Task Motivation. Table 5 presents results for the Task Motivation criterion. None of the personal history items except hobbies were significantly correlated with this criterion. Preferences for specific hobbies tended to have weak but significant relationships for the total Navy group only; liking popular music (.19) and disliking to work on hotrods (-.20) were significantly correlated with the criterion.

Table 5

Correlates of Performance: Task Motivation

Predictors	All Navy	Seabees Only
Hobbies:		
Popular Music (Liked)	19*	16
Hotrods (Disliked)	-20*	-18
Clinical Evaluations:		
"Acts Out"	-23*	-20
Paranoid	-19*	-23
Acceptable to Peers	20*	18
Personality Scales:		
Motivation	-20*	-28*
Attitude Inventory Items:		
I enjoy returning to a problem which I have consistently been unable to solve.	-18	-29*
Most of the men who go to the Antarctic will probably wish they had stayed in the U.S.	20*	28*
I like for people to offer help when I'm having difficulty.	-25*	-28*
I like to keep records of continuous details or events.	-15	-27*
Hard (Self-Description)	19*	24
N	108	60

*Product-moment correlations significant beyond .05 level.

Three clinical evaluation items, "Acts Out," Paranoid, and Acceptable to Peers, predicted in the expected direction for the total Navy group. High expressed motivation for the expedition was negatively correlated with Task Motivation in the Antarctic as measured by supervisor and peer evaluations.

Four attitude inventory items proved discriminating for the Seabee group. High agreement with the item "Most of the men who go to the Antarctic will probably wish they had stayed in the U.S." was positively correlated with Task Motivation for both groups. Agreement with three items was negatively correlated with this criterion for Seabees: "I enjoy returning to a problem which I have consistently been unable to solve," "I like for people to offer help when I'm having difficulty," and "I like to keep records of continuous details or events." Navy men -- particularly Seabees -- who were rated hard-working and industrious in the Antarctic tended to describe themselves as "Hard."

Social Compatibility. A number of attributes were significantly correlated with the Social Compatibility or likability criterion, particularly for the Seabee group. Results are summarized in Table 6. Pay grade was negatively correlated with social popularity as judged by supervisors and peers. Having a parent deceased related positively to likability for total Navy while being the youngest child was significantly related for Seabees. Among preferences for hobbies, only dislike for building models was significantly related to the criterion; liking popular music tended to be positively related for Seabees, but was not significant. None of the clinical evaluations were significantly correlated with the criterion; the clinicians' prediction of being "Acceptable to Peers" most nearly approached significance. This finding was consistent with earlier studies which indicated that clinicians were unable to predict social popularity.

Personality scales and attitude items were the best predictors of Social Compatibility scores. The Achievement Need Scale was inversely correlated with the criterion for Seabees (-.43), and four attitude inventory items from the same scale were significantly correlated for the Seabee group: "I like to stick to a job when everyone else has given up on it" (-.44), "The harder the job the better I like it" (-.41), "I like to assume total responsibility for things" (-.30), and "I like to stick with a job even when I am making no progress" (-.31). The Confidence Scale was negatively correlated with the criterion for Seabees, and the Motivation Scale was negatively related for both the total Navy and Seabee groups. The Decisiveness Scale, composed of six self-descriptive traits, Decisive, Obedient, Handy, Alert, Orderly, and Self-improving, also was negatively related for both the total Navy and Seabee groups. The Friend Description Optimism Scale, consisting of five traits preferred in close friends — Optimistic, Uninhibited, Curious,

Table 6

Correlates of Performance: Social Compatibility

Predictors	All Navy	Seabees Only
Personal History:		
Pay Grade	-24*	-31*
Parent Deceased	21*	19
Youngest Child	18	32*
Hobbies:		
Models (Disliked)	20*	31*
Personality Scales:		
Achievement	-18	-43*
Confidence (Medical Care)	-11	-28*
Motivation	-24*	-27*
Decisive	-22*	-32*
Optimism	-24*	-22
Wanted Affection	-21*	-19
Attitude Inventory Items:		
I prefer the job I will have on this expedition to any other job I can think of.	-15	-27*
I very often recopy notes or records in order to make them neater.	21*	10
Most of the men who go to the Antarctic will probably wish they had stayed in the U.S.	30*	35*
My job in the Antarctic will be important enough to justify my spending such a long time there.	-18	-26*
I like to stick to a job when everyone else has given up on it.	-14	-44*
I like other people to tell me how well I've done on a difficult job.	22*	10
The harder the job, the better I like it.	-25*	-41*
I like to assume total responsibility for things.	-20*	-30*
I like to stick with a job even when I am making no progress.	-26*	-31*
Accept Discipline (Self-Description)	-13	-32*
Decisive (Self-Description)	-28*	-31*
Hard (Self-Description)	15	33*
Argumentative (Self-Description	19*	22
Tactful (Self-Description)	-17	-30*
N	109	60

*Product-moment correlations significant beyond .05 level.

Frank, and Studious, and the FIRO-B Wanted Affection Scale were negatively correlated with Social Compatibility in the total Navy group. Furthermore, the socially likable Seabee describes himself as "Hard" and indicates that "Accepts Discipline," "Decisive," and "Tactful" do not apply to him.

In summary, the salient characteristics of the socially well-adjusted Seabee are: low pay grade, youngest child, low achievement needs, moderate or low expressed motivation for the expedition, emotionally self-sufficient, possibly pessimistic, and a self-picture of being somewhat indecisive, rebellious, tough, and tactless.

Leadership Ability. Compared with results for the social compatibility criterion, an entirely different set of traits was found to characterize successful leaders at small stations. Of all attributes studied, naval experience was most highly related to this criterion. There were many additionally significant correlates, most of them unrelated to experience.

Table 7

Correlates of Performance: Leadership Ability

Predictors	All Navy	Seabees Only
Personal History:		
Years of Service	34*	49*
Hobbies:		
Number of Hobbies Liked	-23*	-25
Painting, Drawing (Neutral)	20*	19
Hotrods (Neutral)	34*	23
Cards (Neutral)	33*	34*
Clinical Evaluations:		
Emotional Control	32*	17
Flexible	29*	25*
Alert	21*	09
Excitable	-28*	-20
Persevering	26*	16
Orderly	27*	15
Likable	31*	29*
Conforming	21*	09
"Acts Out"	-21*	-28*
Overall Effectiveness	34*	24
Acceptable to Peers	82*	21
Attitude Inventory Items:		
Most of the men who go to the Antarctic will probably wish they had stayed in the U.S.	24*	28*
Being part of an Antarctic expedition will be the highlight of my career.	-29*	-18
I like to keep records of continuous routine details or events.	-27*	-35*
Accepts Discripline (Self-Description)	19*	19
Slow (Self-Description)	-15	-33*
N	110	60

*Product-moment correlations significant beyond .05 level.

The "Number of Hobbies Liked" score was negatively related to leadership. Even more striking, however, was the relationship between neutrality toward certain activities (painting or drawing, working on hotrods, playing cards) about which group opinion may be sharply divided, and leadership scores. Apparently, the successful leader should not have strong opinions nor take sides on controversial group issues.

Many of the clinical evaluations were significantly related to Leadership Ability for the total Navy group; most highly correlated were Overall Effectiveness, Acceptable to Peers, Emotional Control, and Likable. For the Seabee group, only Likable, "Acts Out," and Flexible were significantly correlated.

The relevant personality traits for leadership as seen by clinicians are remarkably similar to those judged by station supervisors and the men themselves to characterize more effective leaders: emotional control, flexibility, and greater interest and concern for the problems of individual station members [63-9].

The only personality scale that approached a significant relationship with the criterion was Wanted Affection, which again tended to be negatively correlated with performance.

Attitude items that were significantly correlated suggested moderate or low motivation for the expedition and dislike for orderliness.

In contrast to results for the Social Compatibility criterion, the item "Accepts Discipline" was positively related to the Leadership criterion while a self-rating of "Slow" was negatively related.

Overall Effectiveness. A number of screening variables were significantly related to the Overall Effectiveness criterion which represents a general performance appraisal by supervisors and peers.

Being the oldest child was negatively correlated with the criterion for the total Navy group as was "Number of Hobbies Liked." Dislike for assembling models as a hobby was positively related to the criterion, particularly for Seabees.

Ratings of paranoid tendencies were significantly correlated with Overall Effectiveness; none of the other clinical evaluations reached significance.

Scores on the Motivation, Confidence, and Wanted Affection were inversely related to the criterion.

Results for the Attitude items tended to parallel those for the other criteria. It seems fitting that the successful Seabee at small, isolated stations describes himself as "Handy" and "Conforming."

Combinations of Predictors: Because low predictive validities generally are obtained with single predictors and these predictors are intercorrelated, multiple linear regression methods were employed to determine the best and most economical combinations of predictors for each of the five major criterion measures. Personal history data, clinical rating variables, and personality inventory items and scales were included in regression analyses against the Emotion, Task.

Table 8

Correlates of Performance: Overall Effectiveness

Predictors	All Navy	Seabees Only
Personal History:		
Oldest Child	-23*	-21
Hobbies:		
Number of Hobbies Liked	-21*	-04
Models (Disliked)	21*	38*
Clinical Evaluations:		
Paranoid	-14	-27*
Personality Scales:		
Motivation	-19*	-20
Confidence (Medical Care)	-21*	-24
Wanted Affection	-21*	-12
Attitude Inventory Items:		
The people in charge of the Antarctic expedition will do all they can to see that we are well-cared for.	22*	23
I prefer the job I will have on this expedition to any other job I can think of.	-26*	-33*
Most of the men who go to the Antarctic will probably wish they had stayed in the U.S.	22*	22
I like other people to tell me how well I've done on a difficult job.	21*	11
Handy (Self-Description)	17	32*
Conforming (Self-Description)	17	27*
N	108	59

*Product-moment correlations significant beyond .05 level.

Social, Leadership, and Overall criterion scores. These analyses provided regression coefficients for small sets of predictors which together gave the most efficient prediction by linear methods for each criterion. Combinations of six to nine predictor variables yielded multiple correlations with the five criteria ranging from .64 to .75 in a sample of Navy personnel drawn from two expeditions. Emotion, Task, and Leadership criterion scores for a new sample of military personnel in another expedition were significantly predictable from the regression weights based upon the previous sample. New and more stable regression weights were computed from a three-year military sample for use in the psychiatric screening program. Other information, such as past performance marks and intelligence (GCT) scores, can be added to strengthen the present prediction equations.

Because of the greater range of quality in the entire applicant population as compared with

wintering-over personnel, the prediction equations now available should provide useful discriminations when applied to the total population screened. Men in a particular occupational group can be rank ordered in terms of predicted performance at small stations based upon scoring weights for relatively few predictor items.

Emotional Changes

One measure of emotional status used extensively in Antarctic studies consists of supervisors' ratings and peer nominations which reflect "emotional stability." Scores based upon such supervisor and peer evaluations have served as one of our principle performance criteria at small stations. The rationale for and development of this measure was described in a previous section.

Another measure of emotional status is based upon the subject's responses to symptom questionnaires. Such questionnaires have been administered to members of several expeditions on two or more occasions during the wintering-over period in order to assess levels of and changes in emotional distress. Individual differences in the incidence of symptomotology are clearly of relevance and importance in evaluating adaptation to the Antarctic environment. Studies concerned with measurement of emotional symptoms under conditions of confinement and restricted activity in the Antarctic will be reviewed in this section.

It has long been known that reductions in the intensity or variety of external stimulation from normal levels may have profound effects upon thought and behavior. Hebb (1949), in his experimental work on what he called perceptual isolation, suggested that monotonous sensory stimulation produces a disruption of the capacity to learn or even to think. Kubzansky and Leiderman (1961) in a critique of experimental work on sensory deprivation stated that studies thus far indicated that the absence of stimulation makes the individual less efficient and induces strong affective states which are associated with marked changes in motivation. Varied environmental stimulation, then, seems to be vital in maintaining the efficiency and stability of behavior.

Wheaton (1959) reported that there is no adequate information on the role of individual personality factors in ability to resist effects of confinement or social isolation, and, secondly, that at present there are no experimental data dealing with group interaction under conditions of prolonged isolation.

Questionnaires indicating the presence and intensity of a variety of common somatic and emotional symptoms were administered to a number of Antarctic groups on three occasions during each of two years of the IGY [63-13]. These data provided evidence concerning the effects of group isolation and confinement upon affective states, emotional symptoms, and somatic reactions

in terms of subjective responses over intervals of several months. The questionnaires were administered by medical officers assigned to each of several Antarctic groups. The first testing took place before the beginning of the Antarctic winter, the second testing occurred at mid-winter, after three to four months of isolation, and the final testing took place at the end of the winter period. Responses were given on a 4-point scale: No Complaint, Slight, Moderate, and Severe Complaints. The measure of symptom incidence used for comparisons was the percent of persons reporting some degree of complaint.

Size of station did not appear to be an important factor in incidence of emotional and somatic complaints. There was no consistent trend during the IGY indicating that small, medium, or large stations exhibited a proportionately higher incidence of symptoms.

The earlier of the two IGY expeditions reported more emotional and physical difficulties. When the total incidence of the various symptoms was compared for the two years, nine items differed significantly, and eight of them were higher in the first expedition.

The most prevalent symptoms at mid-winter in both expeditions were sleeping disturbances (difficulty falling asleep or staying asleep, waking up at night, and feeling tired during the day) and depression (feeling blue, feeling lonely). Headaches, feeling easily annoyed or irritated, and soreness of muscles also were reported frequently both years. Use of alcohol or medicine for symptomatic relief was infrequently reported; however, one large station was an exception (26%).

Table 9 shows the incidence of symptoms reported by all respondents from the two expeditions at three time periods. Symptoms were grouped into clusters based upon similarity of content. Questionnaire items which consistently had low incidence, negligible variation over time, or no apparent relation to the clusters were not included in the Table.

A general trend toward an increased incidence of symptoms over time is evident in Table 9. All of the symptoms except one were reported by a higher percentage of respondents at mid-winter than at pre-winter testing during both years.

Changes in specific symptoms from pre-winter to mid-winter were evaluated by means of the sign test in which positive and negative changes on the 4-point response scale were tabulated. Significant changes are indicated in Table 9 by means of "a" or "b" placed between the percentage values for the first and second test administrations. Only those subjects who were tested on both occasions were used for this analysis.

In the first expedition, the following symptoms showed significant shifts toward increasing severity from pre-winter test administrations: difficulty in falling asleep or staying asleep,

Table 9

Incidence of Common Symptoms in Antarctic Groups at Three Time Periods (Percentages)

Item		Expedition I			Expedition II		
		1st	2nd	3rd	1st	2nd	3rd
Sleep Disturbances:							
Difficulty falling asleep or staying asleep		34[a]	72	54	31[a]	51	49
Waking up at night		31[a]	58	49	22[a]	42	38
Depression:							
Feeling blue		34[a]	56	42	18[a]	35	34
Feeling lonely		28[b]	37	35	24[a]	39	37
Feeling people were watching or talking about you		8	11	11	4[a]	20	12
Preferring to be alone[c]		21[b]	28	21			
Being quiet and sad at parties					16[b]	21	24
Aggression:							
Feeling easily annoyed or irritated		35[b]	49	46	19[a]	27	34
Feeling critical of others		35[b]	49	[illegible]			
Finding others short-tempered or unkind		14[a]	30	39			
Burning up with anger					4[a]	14	17
	N	112	177	130	98	168	90
Anxiety:							
Sudden fright for no apparent reason		4	7	8	2[a]	10	14
Bad dreams		6[b]	18	20	8	11	9
Nervousness and shakiness under pressure		14	18	22	15	19	27
Feeling uneasy without knowing why		14	22	17	8	17	20
Sudden noises making you jump					16[b]	32	30
Difficulty in making up your mind					8	19	19
Somatic Complaints:							
Headaches		24[b]	41	43	31	31	31
Pains in the heart or chest		16	19	20	9[b]	15	18
Pains in lower part of back		20[b]	31	32	20	21	28
Nausea or upset stomach		19	23	19	26[a]	32	38
Itching		12	15	13	17[b]	27	27
Unable to use eyes because of pain					8[b]	11	11
	N	112	177	130	98	168	90

[a]Significant change at the .01 level.

[b]Significant change from 1st to 2nd administrations at the .05 level by the binomial sign test.

[c]Administered in only one of the two expeditions.

waking up at night, bad dreams, feeling blue, feeling lonely, easily annoyed or irritated, feeling critical of others, headaches, feeling tired during the day, and pains in lower back. There was a decrease in the severity of the soreness of muscles complaint reflecting the fact that the large

amount of heavy physical work characteristic of the pre-winter period was no longer a necessity.

In the second expedition, the most marked changes occurred in the same items that differed significantly from pre-winter to mid-winter in the first expedition, that is, items pertaining to sleep disturbances, depression, and irritability. Except for the sleep disturbance items, changes in severity tended to be more frequent and of larger magnitude in the second expedition, due perhaps to the fact that levels of symptom incidence in the first expedition were relatively high at the outset.

It seems clear that emotional disturbances and symptomatic complaints tend to increase in healthy subjects exposed to the prolonged restricted stimulation of the Antarctic situation. Generally, the subjective symptoms reported by Antarctic groups resemble the diffuse pattern of symptoms often observed under conditions of laboratory manipulation in "sensory deprivation" experiments. Those symptoms appear psychologically unpleasant and presumably would have a deleterious effect upon work effectiveness and social adjustment. This assumption was supported by significant correlations between symptom scales -- Anxiety, Depression, Aggression, and Insomnia -- derived from clusters of similar items, and attitude scales -- Motivation, Usefulness, and Group Compatibility -- administered near the end of winter during one IGY expedition. Increases in anxiety, depression, or irritability among even a few members of a small, closed group present a definite threat to group harmony and effectiveness.

Additional studies of symptom incidence have been conducted during the past two Antarctic expeditions. Because Antarctic living and working conditions generally have improved since the IGY period, it was anticipated that symptom incidence might show some decrease in the current studies. This expectation was not realized as shown by the results in Table 10. The incidence of symptoms was consistently higher for members of recent expeditions as compared with members of the IGY expeditions. In Table 10 percentages are presented separately for military and civilian participants, and the results reveal that the Navy men much more frequently reported symptoms near the end of winter for all items except two, "inability to concentrate" and "feeling critical of others." These data indicate that occupational role has an important effect upon susceptibility to emotional symptoms in this environment. Results for attitudinal and motivational changes, reported in the following section, are highly consistent with these occupational differences in emotional changes.

Utilizing symptom scales which reflected the number and degree of emotional disturbances reported by the individual, it has been possible to identify various psychological correlates of emotional changes among Antarctic participants. The four symptom scales mentioned previously --

Table 10

Incidence of Symptoms in Recent Antarctic Groups at Two Time Periods (Percentages)

	Military		Civilian	
	Early Winter	Late Winter	Early Winter	Late Winter
Feeling blue	68	82	64	48
Difficulty sleeping	58	83	52	48
Easily annoyed	68	87	69	76
Feeling lonely	64	70	52	48
Nervous and tense	46	71	45	52
Waking up at night	44	67	31	24
Inability to concentrate	36	49	33	58
Uneasy or worried	46	53	33	36
Feeling tired during the day	74	78	52	61
Critical of others	54	77	64	88
N	80	78	42	33

Anxiety, Depression, Aggression, and Insomnia -- were correlated with a large number of biographical, personality, and performance measures available on IGY personnel. Early winter, mid-winter, and end of winter symptom scale scores were significantly correlated with independent symptom check-list records accumulated by station leaders (including a medical officer). Two scores were derived from the check lists: Medical Complaints and Emotional Changes. These relationships are shown in Table 11 for mid-winter and end of winter symptom scale scores.

Table 11

Correlations between Symptom Scales and Symptom Check List Scores

	Symptom Check List Scores (Station Leaders)			
	Medical Complaints		Emotional Changes	
Symptom Scales (Self Report)	Mid-Winter	End of Winter	Mid-Winter	End of Winter
Anxiety	31[a]	46	48	27
Depression	25	10	36	35
Aggression	25	14	47	23
Insomnia	36	29	21	22
Number of Cases	56	52	56	52

[a]Pearson correlation coefficients; decimals are omitted. All values greater than .27 are significant ($p < .05$).

The presence of symptoms at mid-winter was predictable from several screening variables. Anxiety and Depression scale scores obtained during psychiatric screening were significantly correlated (.39 and .44, respectively) with the same scales administered at mid-winter. The Need Achievement and Need Dominance scales of the Edward's Personal Preference Scale administered at

screening were negatively correlated (-.29) with the Depression Scale administered at mid-winter while the Need Abasement Scale was positively correlated (.41) with the same scale. Age had low negative correlations with Depression (-.24) and Aggression (-.25) scores at mid-winter. A psychiatric evaluation rating, representing the combined judgment of a psychiatrist and a psychologist examiner, had modest correlations in the expected direction with the Anxiety (-.41), Depression (-.28), and Aggression (-.48) scales administered at early winter but was negligibly correlated with those scales at mid-winter and end of winter.

In recent expeditions, further data have been gathered concerning performance and personality correlates of self-reported symptoms. An overall symptom score obtained near the end of the winter period for Navy personnel in one expedition correlated in the expected direction with Emotional Stability (.39) and Overall Effectiveness (.32) scores derived from supervisor ratings and peer nominations. These results indicated significant relationships between self-reported symptomatology and performance evaluations by associates. The same symptom scale had a low positive correlation (.23) with a measure of job dissatisfaction at the end of winter. Symptom scores tended to be positively correlated with the SIV Leadership Scale and the FIRO-B Wanted Affection Scale and negatively correlated with the SIV Conformity Scale and a scale which expresses preferences for rebellious, argumentative, etc., traits in close friends [66-12].

Symptom changes have been shown to be importantly related to other indicators of adjustment and performance in Antarctic groups, and they appear to be predictable in some degree from knowledge of attitudes, values, and personality traits.

Attitude Measurement

Another aspect of behavior that is highly relevant to evaluations of performance is the individual's motivation for and satisfaction with his Antarctic assignment. Task motivation is one of the principal components of performance as measured by supervisors' ratings and peer nominations. The individual's own report of his attitudes toward his job and situation is another pertinent source of data for evaluation of success in adaptation.

Studies of motivation and satisfaction have been concerned with two general areas of attitude measurement: (1) changes in task motivation or job satisfaction measured by questionnaires during the winter period at Antarctic stations and the correlates of these changes, and (2) measures of motivation for the Antarctic assignment derived from questionnaires administered at the psychiatric screening and the relationships of these motivational measures to later performance.

Thus, part of the research objective was to measure the ability of Antarctic groups to maintain effective work motivation and positive social attitudes during many months of isolation from

the outside world. A series of studies was conducted to identify a small number of attitude dimensions which could meaningfully represent important aspects of individual and group functioning in Antarctic groups. Factor analysis was used to reduce a large number of heterogeneous test items to a few major scales, and this process was repeated a number of times.

Ten homogeneous item clusters were developed for preliminary studies in two IGY expeditions, and attitude changes during the winter period were measured for six small station groups [63-16]. A new inventory, the Opinion Survey, was constructed from items included in the ten earlier scales. This inventory was administered to new groups at three Antarctic stations twice during the winter period. Attitude changes again were measured. The results corroborated earlier findings that scales reflecting group harmony and efficiency showed considerable change in the direction of deterioration.

Intercorrelations among the ten item clusters suggested the presence of a few major factors. Factor analyses were undertaken of the earlier Attitude Study and Group Behavior Description inventories in an effort to determine the underlying factor structure of the attitude domain represented. Responses from two administrations of each inventory in each of two expeditions were factor analyzed, producing eight separate analyses and replicating results for each inventory over samples and over situations. Samples for these analyses ranged from approximately 85 to 150 subjects [65-11].

In all administrations of the Attitude Study inventory a large factor appeared which reflected motivation for and satisfaction with the Antarctic assignment. Additional significant factors emerged in one or another of the four administrations, but none were represented consistently on more than two occasions. In both first administrations of the Group Behavior Description inventory, two similar major factors appeared, one encompassing the group compatibility and teamwork concept and the other group achievement and efficiency. At the second administration (end of winter period) in both years, however, these two factors merged into one very large factor with two or three small additional factors absorbing the remaining content. Further analyses were required to establish the stability of the group compatibility and group accomplishment factors.

The new Opinion Survey inventory was administered to three stations on two occasions during the winter and responses were factor analyzed for each occasion. The first and largest factor in both administrations was that pertaining to group compatibility, teamwork, and pride in group. This factor was essentially the same as the major factor previously obtained and left little doubt that liking for one's associates, cooperation, and esprit de corps were very important aspects of Antarctic station effectiveness as perceived by participants. Internal consistency

reliability of this scale based upon item intercorrelations was estimated to be about .88.

The second factor to emerge in both analyses was concerned with motivation for and personal satisfaction with the Antarctic assignment. This factor also had been anticipated from results of earlier studies; the effects of boredom assumed slightly more importance and items reflecting feelings of personal usefulness less importance than in previous analyses. The internal consistency reliability of this scale was estimated to be about .83, based upon the item intercorrelations.

The third factor common to the two analyses was concerned predominantly with awareness of and feelings about the achievement of station members as a group. This factor was labeled Group Accomplishment. The internal consistency reliability of this scale was estimated to be about .75.

The simplicity and economy of the factor structures attained was gratifying, and the consistency of factors from one occasion to another was encouraging and appeared to reflect the appropriateness and meaningfulness of the questionnaire content to the participants. The three factors identified -- group compatibility, motivation, and group accomplishment -- logically represent important aspects of individual and group life and are highly relevant to the goals of the Antarctic program.

In earlier studies using the ten item clusters, attitude changes were studied in nine groups from three Antarctic expeditions. Of the attitude scales, the Group Compatibility and the Group Achievement scales most frequently showed significant changes from early winter or mid-winter to the end of winter. Six of the nine groups showed significant changes in mean scores on these two scales. These results suggested general agreement among station members at most stations that group harmony and efficiency declined during the winter months. Scores on the Motivation and Usefulness Scales, however, showed less consistent changes indicating that only parts of groups felt that their own attitudes toward the assignment had deteriorated.

Motivational changes were studied in three recent expeditions using essentially the same Motivation Scale derived from the series of factor analyses described above and a closely related measure, labeled the Usefulness Scale. These two scales taken together represent a number of important facets of motivation towards and satisfaction with the Antarctic assignment. Results are presented in Table 12. While changes for the civilian group were negligible, significant changes occurred in an unfavorable direction on both scales for military personnel. It seems clear that stability of job motivation or satisfaction in the Antarctic setting is related to occupational role.

An empirical scale was constructed to predict job satisfaction scores at the end of winter.

The Job Satisfaction Scale consisted of a composite of the Motivation and Usefulness scale items. The item content of the predictor scale strongly suggests that need for achievement or accomplishment is negatively correlated with Job Satisfaction. For example, the item "I would like to accomplish something of great significance" correlated -.59 with the Job Satisfaction Scale in one expedition. Further evidence for this relationship is provided by the fact that the Opinion Survey Achievement Scale administered at the psychiatric screening correlated -.37 with Job Satisfaction scores of Navy men at the end of winter.

Table 12

Changes in Motivation and Usefulness Scores for Military and Civilian Groups

	Military				Civilian			
	Early Winter		End of Winter		Early Winter		End of Winter	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Motivation	22.9[a]	6.8	25.6	6.9	15.9	5.3	15.7	6.0
Usefulness	11.8	4.5	14.0	5.0	11.4	2.8	11.7	3.2
Number of Cases	103		103		45		45	

[a]High scores represent low Motivation or Usefulness; changes for military personnel are in the direction of lower motivation and feelings of usefulness.

One possible indicator of future performance, which is often given considerable weight in selection, is the applicant's expressed motivation for the job. It would seem obvious that positive attitudes toward an assignment, particularly a difficult one, would be desirable, if not essential. Motivation, however, is known to be much more complex than simple statements of intention or purpose. Empirical studies of attitude items and scales, therefore, are essential to establish the validity, or lack of it, for prediction of performance and satisfaction in Antarctic assignments. Such studies have been carried out during several Antarctic expeditions, and relationships with specific criteria have been reported in previous sections. A brief review and summary is presented here in order to reemphasize these relationships.

Motivation scores obtained at psychiatric screening generally have had negligible or low negative relationships with performance criteria. In one IGY expedition, the screening Motivation Scale, representing positive attitudes toward the assignment, correlated -.28 and -.29, respectively with overall supervisor and peer evaluations. In a Navy sample drawn from three recent expeditions, a similar screening Motivation Scale correlated -.19, -.20, -.24, and -.19,

respectively, with Emotion, Task, Social, and Overall Effectiveness criterion scores based upon combined supervisor and peer evaluations.

Expressed motivation at screening was found to be unrelated to motivation or satisfaction at the end of winter in two expeditions. In one expedition, positive motivation or satisfaction at the end of winter was correlated significantly with only one of the five major criterion scores, namely, Emotional Stability.

Expressed positive motivation then is not a reliable indicator of present or future effective behavior in the Antarctic setting; in fact, very high motivation scores appear to have negative implications for performance. It seems plausible that those individuals with the most favorable and perhaps unrealistic expectations toward Antarctic service might be most easily disappointed in the experience.

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APPENDIX A

Deep Freeze Project Bibliography[a]

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[a]All reports published under Research Tasks MR005.12-2004, Subtask 1, and NF 022.01.03-9001.

Report No.	Author(s) and Title
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13. ABSTRACT

This report summarizes a series of studies concerned with environmental and psychological factors related to adjustment or performance in isolated Antarctic groups. These studies were designed to provide support for the Navy's psychiatric assessment program and to aid in selection of suitable military and civilian applicants for service at Antarctic scientific stations. Possible sources and effects of stress in this type of confined environment are considered. Methods developed for the measurement of individual and group performance are described, and results of studies conducted to evaluate the predictive validities of biographical, clinical, and personality data are presented in detail. Studies of emotional and motivational changes during the long Antarctic winter and the relationships of such changes to occupational and social roles, psychological needs, and effective work performance are reported.

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