

ON THE ICE: INDIVIDUAL AND GROUP ADAPTATION IN ANTARCTICA

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This paper summarizes four decades of research on the social, psychological, and cultural issues facing men and women who spend the austral winter under conditions of prolonged isolation and confinement in the Antarctic. Analyses of data collected from over 1,100 Americans who wintered-over between 1963 and the present are used to make the case that the process of psychosocial adaptation to isolation, confinement and extreme physical conditions exhibits four distinct characteristics. First, it is seasonal or cyclical in that variations in mood appear to be associated with the altered diurnal cycle and psychological segmentation of the mission. Second, it is situational in that concurrent measures of personality, interpersonal needs, and coping styles are better predictors of depressed mood and peer-supervisor performance evaluations than baseline measures. This is because of the unique features of the station social and physical environments and the absence of resources typically used to cope with stress elsewhere. Third, it is social in that individuals belonging to crews with a clique structure report significantly more depression, anxiety, anger, fatigue, and confusion than individuals belonging to crews with a core-periphery structure. Finally, it is “salutogenic” in that depressed mood is inversely associated with the severity of station physical environment and the winter-over experience is associated with reduced subsequent rates of hospital admissions, both supporting the existence of a positive effect for individuals seeking challenging experiences in extreme environments.

Key words – stress, coping, adaptation, Antarctica, microcultures

Antarctica is the highest, driest, coldest, and windiest of the earth’s continents. Because it has no permanent or indigenous inhabitants, it has rarely been imagined by anthropologists as a place for conducting ethnographic research. Nevertheless, “The Ice,” as it is referred to by those who live and work there, has long been viewed as having enormous potential as a “natural laboratory for the social and behavioral sciences” (Shurley, 1974; Pierce, 1985). This potential lies in both the nature of the environment and the nature of those who struggle to live and work in this environment. As described by Stephen Pyne in his book, *The Ice: A Journey to Antarctica*:

The simplest of the world’s environments harbors the simplest of the world’s civilizations, one based almost exclusively on exploration. The pack ice and the veil of fog that perpetually shrouds the pack ward off human inquiry until renewed speculation about a tropical *terra australis* situated near the South Pole, a concept whose ancestry traces back to Greek geographers, inspired Great Britain to send Capt. James Cook to discover the facts. Antarctica thus began as an idea, and its discovery would be intimately connected to intellectuals and intellectual history. Its extraordinary isolation was not merely geophysical but metaphysical. The transition to Antarctic exploration demanded more than the power to overcome the energy gradients that surround The Ice: it demanded the capacity and desire to overcome Antarctica’s information gradient. The penetration of Antarctica thus required not only the development of special ships and steam power or aircraft, but suitable syndromes of thought. Antarctic exploration would be deliberate, not accidental. “No one comes here casually,” observed J. Tuzo Wilson, presiding over the International Geophysical Year. “It is a continent of extremes and of contrasts where there is no middle way.” (Pyne 1986:65).

Despite the harshness of this environment, humans have been living and working in the Antarctic for over 100 years. Since the International Geophysical Year of 1956-57, there has been a continuous presence on the ice in the form of small, isolated research stations, many of

which operate on a year-round basis. These stations comprise a collection of “microcultures” where adaptation to the isolation, confinement and extreme environmental characteristics that define The Ice may be seen as a process of negotiation between the needs of the individual and the needs of the social group. The cultural systems of Antarctic research stations are both the product of this negotiation and a set of rules that regulate this process.

The objective of this paper is to describe some of the lessons learned from the human experience in Antarctica, based on analyses of data collected over the past 45 years in the Antarctic in an effort to identify certain general characteristics of behavior and performance in ICE environments that are influenced to one degree or another by the microcultures of polar so-journers. These analyses were conducted under the auspices of a series of studies funded by the National Science Foundation and the National Aeronautics and Space Administration, intended to address the following: 1) the long-term health effects of individual and group adaptation to prolonged isolation and confinement in an extreme environment; 2) the social dynamics of small, isolated groups, and 3) the environmental, social, and psychological determinants of effective performance in isolated and confined environments.

ANTARCTIC MICROCULTURES

The first group of men to winter-over in Antarctica was the *Belgica* expedition of 1898-99. Currently, 18 nations operate 44 year-round stations, not to mention summer-only stations, numerous field camps, research vessels, and subantarctic stations. The variety in station size and design is reflected in the contrasts between two American stations, Amundson- Scott Station located at the South Pole, and McMurdo Station, located on Ross Island off the coast of Antarctica. Amundson-Scott Station consists of a number of modular one and two-story buildings located underneath a large metal dome or in adjacent archways. A summer camp consisting of wood-frame shacks, canvas-covered quonset huts, and new, pre-fabricated dormitory buildings is located nearby. The station serves as a base for scientific research in fields such as upper atmosphere studies, meteorology, seismology, glaciology, and astronomy. It also represents the "American presence" at the South Pole. During the past austral summer (November, 1999 – February, 2000), the station population reached a record high of 200 men and women, almost all of them either scientists and technicians supported by funds from the National Science Foundation or civilian contractors employed by Raytheon Polar Services Corporation who provide support services such as facility maintenance, construction, logistics, cooking, and communications. This past winter, there were 50 men and women who maintained the facilities in working order and monitored ongoing scientific research projects and data collection instruments.

McMurdo, by contrast, is much larger and possesses many of the same physical characteristics as a small town in Alaska or the Pacific Northwest. It is composed of a hodge-podge of buildings, constructed out of canvas, wood, and metal, that serve as dormitories, warehouses, bars, a church, fire station, recreational facilities, administrative offices, and scientific labs. The station serves as the administrative and logistical (transportation, supplies) center for the United States Antarctic Program. Members of McMurdo Station belong to a number of different organizations, including the administrative personnel who represent the National Science Foundation’s Office of Polar Programs, university-based scientists and technicians funded by NSF grants, Air Force Reserve officers and crew representing the New York Air National Guard, American and New Zealand army and air force personnel who work as

cargo handlers and pilots, and Raytheon Polar Services Corporation personnel who provide support services (administrative personnel, construction workers, tradespeople, technicians); and, to a smaller extent, scientific and support personnel from New Zealand's Scott Base located nearby. Until 1998, the U.S. Navy was responsible for construction, air transport, communications, weather forecasting, recreation, supplies, and food services. During the summer, as many as 1,100 civilian and military personnel live and work in McMurdo, while during the winter the population is reduced to approximately 200.

SOCIAL AND ENVIRONMENTAL STRESSORS IN ANTARCTICA

Although these stations are designed to provide protection from the harsh environment, a measure of physical comfort, and insure a continuous year-round presence on the ice, the men and women who inhabit these stations are subjected to a number of stressors that may be grouped into three categories--Isolation, Confinement, and Environment (ICE). Between the months of February and August at McMurdo and February and October at the South Pole, the stations are physically isolated from the outside world with darkness and weather conditions preventing travel to and from the continent. Station members are separated from family and friends back home and consequently experience varying degrees of emotional deprivation. Personal crises such as the death of a family member, financial difficulties, or deterioration of marital relations become magnified by the separation and distance between the individuals involved. Winter-over crews often experience some level of tension or conflict with external organizations and agencies, usually due to interference with established station routines, delays in the arrival of replacement personnel or supplies, or problems with communication which result from the disruption at times by environmental conditions and the frequent misinterpretation of the meaning or intent of certain messages.

The flip side of the isolation from the outside world is the confinement or lack of isolation within the station itself. During fieldwork conducted at McMurdo and South Pole stations in 1988 and 1989, informants complained that the lack of privacy and constant gossip that pervaded the community had a negative influence on social relations, especially relations between men and women. Consequently, as much as 60% of one's leisure time is spent alone in a dorm room (Carrere et al., 1991). However, there is little separation between work and leisure because living and working spaces are in close proximity to one another (in some cases, like the firehouse at McMurdo, the winter-over crew live and work in the same building and are confined there six days each week due to the nature of their assignment), and one interacts with the same group of individuals in both sets of activities. This constant interaction also creates a potential for increased social conflict between workers and supervisors, co-workers, cliques, or people with conflicting personalities. Removing oneself from tense social situations during the winter is not a viable option. Travel outdoors for even brief periods in order to escape this confinement is restricted by the extreme cold, darkness, and policies designed to promote safety and reduce the risk of accidental injuries.

Finally, the environment itself poses a significant stressor despite the improvements in living conditions at either station. Residents of research stations must contend with high altitude (especially at the South Pole which is situated 2835 meters above sea level), extreme light-dark cycles, very low humidity, exposure to extreme cold when working outdoors, and the absence of viral and bacterial agents during the winter. Among the physiological responses to these environmental conditions are a complete absence of Stage IV sleep as well as sizable reductions

in the amount of Stage III and REM sleep, a disruption of circadian rhythms, dyspnea, arterial hypoxia, headaches, hypocapnia, erythrocytosis, mild alkalosis, suppression of the immune system, and disruption of thyroid function (Guenter et al., 1970; Reed et al., 1986).

Nevertheless, winter-over crewmembers report that the isolation and confinement are more difficult to live with than the extreme environmental conditions. This is attributed to the separation from usual sources of support located in the United States and the relative difficulty in obtaining emotional support from other station members. When examined within the social and environmental context of an Antarctic microculture, the perceived absence of social support during the winter-over period may be seen as contributing to a condition known as the "winter-over syndrome" (Strange and Youngman, 1971). This syndrome is characterized by varying degrees of depression; irritability and hostility; insomnia; and cognitive impairment, including difficulty in concentration and memory, absentmindedness, and the occurrence of mild hypnotic states known as "long-eye" or the "Antarctic stare." These symptoms have been observed to increase over time, peaking at mid-winter, and then declining during the third quarter of winter-over duty, only to increase again at the end of the winter-over period. These symptoms were first reported by Frederick Cook (1900), the polar explorer and anthropologist who served as physician aboard the *Belgica*. Since that time, they have been evident in almost every expedition. Most winter-over personnel at both stations experience these symptoms to various degrees. During the 1989 winter season at McMurdo, for instance, 64.1% of the winter-over crew members interviewed reported some problem with sleep over the winter; 62.1% reported feeling depressed; 47.6% reported feeling more irritable than usual; and 51.5% reported difficulty with concentration or memory (Palinkas, 1992). For the most part, these symptoms are relatively mild and do not severely impair performance. However, approximately 5% of winter-over personnel experience symptoms that fulfill DSM criteria (American Psychiatric Association, 1994) for a psychiatric disorder and are severe enough to warrant clinical intervention (Palinkas et al., 1995; Palinkas, Glogower, et al, in press). Although these rates are no higher than what might be experienced in the general population in the United States, they are noteworthy in that these men and women are required to undergo psychiatric screening prior to the austral winter. Those with a history of psychiatric disorders, current symptoms of psychosocial distress, or considered to be at risk for a psychiatric disorder and/or poor performance on The Ice are disqualified from winter-over duty. Even among those who fail to meet DSM diagnostic criteria, The Ice tends to magnify seemingly trivial events and symptoms, transforming what would be viewed as mundane or unimportant in any other environment into something that is problematic and significant under conditions of isolation and confinement.

CHARACTERISTICS OF BEHAVIOR AND PERFORMANCE

Our efforts to understand the winter-over syndrome in particular and the human experience in Antarctica in general have revealed four principles of behavior and performance in isolated and confined environments. Under these conditions, behavior and performance is likely to be seasonal or cyclical, situational, social, and "salutogenic". Each of these principles is described in greater detail below.

Seasonal Characteristics

Longitudinal assessments of behavior and performance in the Antarctic reveal certain patterns that suggest an influence of various features of the physical and psychosocial environment. For instance, analyses of data collected between 1963 and 1974 revealed a significant increase in winter-over syndrome symptoms from early to late winter (Palinkas et al., 2000). A review of data collected from personnel who spent the austral winter at Palmer, McMurdo and South Pole Stations in 1991 revealed a significant increase in the prevalence of subsyndromal seasonal affective disorder from late austral summer to mid-winter (Palinkas et al., 1996). A comparison of personnel at Palmer (64⁰45'S) and South Pole (90⁰S) Stations revealed significant differences in measures of seasonally-related depressive symptoms at mid-winter (July/ August) and late winter (October) (Palinkas et al., 1996). Cold temperatures that confine personnel indoors and restrict outdoor activity may account for differences in symptoms between stations, but not for differences between summer and winter symptoms observed at all three stations since these stations vary with respect to the degree of confinement and temperature during the winter. When viewed collectively, therefore, these results suggest that behavior in Antarctica is influenced by patterns of exposure to daylight associated with time of year and latitude.

A second pattern that appears to be circannual in nature was observed in a cohort of 22 men and women participating in a study of cold-related changes in thyroid function and its effect on mood. Profile of Mood States (POMS; McNair et al., 1992) Total Mood Disturbance scores showed an effect of time over the 12 months of Antarctic residence with a sine distribution and two peak values above the mesor, one in November and one in July, as well as a trough below the mesor in March (Palinkas, Reed et al., in press). This circannual pattern is almost identical to the seasonal variation in serum TSH levels in the placebo group of study participants during the 1996-97 season (Reed et al., in press).

A third pattern that appears to be seasonal in nature is related more to the experience of isolation and the seasonal round of activities than to the experience of cold and darkness. An analysis of deviations from the mean POMS Total Mood Disturbance scores at the South Pole during the austral winters of 1991 to 1994 based on a nonlinear iterative least squares model revealed a significant difference in the second half of the winter (July – October) compared to the first half (March – June) (Palinkas et al., 2000).

The association between depressive symptoms and time of year and latitude are consistent with studies of individuals in the general population that suggest an increased risk of Seasonal Affective Disorder and subsyndromal seasonal affective disorder with increasing latitude and decreased exposure to bright light during the winter months (Kasper et al., 1989; Potkin et al., 1986; Rosen et al., 1990). The circannual patterns of change in total mood disturbance and serum TSH levels support an association between cold-related changes in thyroid function in Antarctica, referred to as the Polar T₃ Syndrome, and the mood symptoms of the Winter-Over Syndrome (Palinkas et al., 1997; Palinkas, Reed et al., in press). These patterns are not confined to the winter months but occur during an entire year of exposure to an ICE environment. The increase in total mood disturbance scores and symptoms of confusion-bewilderment after the mid-point of winter isolation found at the South Pole suggest the existence of a “third quarter phenomenon” among personnel in isolated and confined environments (Bechtel and Berning, 1991). This phenomenon appears to be more psychosocial than environmental in nature and is independent of mission duration. It results from the realization that the mission is only half completed, and that a period of isolation and confinement equal in length to the first half remains. In this instance, the elevation in mood scores remains

relatively constant throughout the second half (i.e., third and fourth quarters) of the austral winter.

Situational Characteristics

There is a long tradition of research on individual characteristics that predict for optimal performance and high adaptability to ICE environments (Gunderson, 1974, Rose et al., 1994; Sandal et al., 1996). The object of these investigations has been to identify characteristics that might be used to “select-in” individuals most likely to adapt to such environments. However, our analyses of the human experience in Antarctica suggests that there are few, if any, traits that serve as useful predictors of performance during the austral winter. For instance, a previous study of 119 men and women who spent the 1989 austral winter in Antarctica found that while several features of personality characteristics, coping methods and resources, and social resources were associated with concurrent measures of depressive symptoms, the only baseline measures that were significantly associated with late winter depressive symptoms were pre-deployment depressive symptoms and satisfaction with social support (Palinkas and Browner, 1995). Furthermore, of these two predictors, pre-deployment level of depressive symptoms was the only significant independent predictor of late winter depressive symptoms. These results suggested that baseline measures of personality, stress and coping are weak prospective predictors of behavior and performance during the winter because such performance is influenced more by the conditions of isolation and confinement than by stable traits of individuals (Carver and Scheier, 1994; Holahan and Moos, 1987). These conditions include the stressors (e.g., isolation, confinement), and the limited availability of re-sources necessary to cope with these stressors. Likewise, methods and resources used to cope with stressful situations prior to deployment in Antarctica may not be effective in coping with isolation and confinement in Antarctica because they are situation-specific and not generalizable from one social environmental context to another, particularly when that context is an ICE environment.

A similar prospective study of the 657 men who overwintered at 8 different stations in Antarctica between 1963 and 1974 found that military crewmembers received significantly higher combined peer-supervisor evaluations of task ability, social compatibility, and overall performance than their civilian counterparts. Being married was a significant independent predictor of leadership. Many of the personality traits and interpersonal needs were significant predictors of predictors in the expected direction. For example, a high level of boredom expressed at screening was inversely associated with task ability, emotional stability, social compatibility, and overall performance. The desire for optimism in friends was a significant independent predictor of emotional stability and social compatibility. Peer-supervisor assessments of crewmember leadership were positively associated with the need to control others and inversely associated with self-reports of absentmindedness. However, other traits and characteristics were also associated with these performance measures, but not in the expected direction. For instance, the need for order was inversely associated with emotional stability and leadership, while the need for achievement was inversely associated with social compatibility. A desire for efficiency in friends was inversely associated with emotional stability. High levels of motivation were inversely associated with evaluations of leadership, and a desire for affection from others was inversely associated with task ability, emotional stability, social compatibility, and overall performance (Palinkas et al., 2000).

The low need for achievement and orderliness, affection from others, and efficiency in friends may reflect characteristics uniquely suited to ICE environments. Under conditions of

isolation and confinement, the ability to satisfy a need for achievement and order is often restricted by the environment itself. Individuals wishing to complete projects on schedule become frustrated at delays in communication with the outside, constant equipment failure, or absence of necessary supplies (Palinkas, 1992). Prior to the advent of computerized inventory control systems, it was often quite difficult to locate necessary equipment and supplies on station, even when such materiel was physically present. Crewmembers who adapt best to such situations are those who adjust their expectations to fit the reality of the situation (Palinkas, 1991a). Adjustment of expectations to meet the reality of the situation may also account for the inverse association between a desire for efficiency in friends and emotional stability. Similarly, the ability to satisfy a desire for affection from others is limited by a perceived need among all crewmembers to create their own personal space in a confined setting. The willingness to display friendship and offer emotional support to other crewmembers is often counterbalanced by a perceived inability to offer effective support and a fear of being burdened by the problems of others that are similar in nature to one's own problems (Palinkas, 1992).

Social Characteristics

Our analysis of the role of interpersonal needs and social support in the behavior and performance of Antarctic winter-over crewmembers revealed a paradox. On the one hand, social support is important to these men and women. This was reflected in the significant inverse associations between satisfaction with support and concurrent and prospective measures of depressive symptoms (Palinkas and Browner, 1995). However, these measures include satisfaction with support received from individuals who are not fellow crewmembers, i.e., family and friends back home. With respect to other crewmembers, an repeated measures analysis of variance of personnel who spent the austral winter at the South Pole between 1992 and 1994 revealed a significant decline in the extent to which individuals asked others for advice or provided advice to others (Palinkas et al., 2000). Although this decline appears to be associated with a corresponding increase in mean POMS Total Mood Disturbance scores, this association is not significant.

However, this is not to say that social interaction is relatively unimportant in the Antarctic. Use of multidimensional scaling of data collected from pile sorts of crewmember categorization of the structure of the winter-over crews at the South Pole during the same three-year period revealed three distinct patterns. The first pattern was a clique structure in which crew members identified three distinct subgroups, based on areas of the station each subgroup usually spent most of their leisure time: 1) the "Biomed" group; 2) the "Library" group; and 3) the "Bar" group. Each group had a membership of five individuals. There were an additional six individuals who were not a part of any group. The second pattern was a core-periphery structure. In this structure, most (n=16) crewmembers strongly identified themselves as members of the same group (the core), followed by five additional members who maintained close ties with the core but were somewhat more independent (semiperiphery); and six individuals who were more independent in their social interactions (periphery). The third pattern was a clique-core/periphery hybrid in which a relatively unified group contains identifiable subgroups.

A comparison of mood scores over the course of the austral winter by means of a repeated measures analysis of variance revealed a significant difference among the three crew structures with respect to tension-anxiety, depression, and anger-hostility. The crew characterized by a clique structure exhibited significantly higher levels of tension-anxiety,

depression and anger than the crew characterized by the core-periphery structure throughout the entire winter. The POMS scores of the crew characterized by the hybrid structure fell somewhat in between those of the other two crews. The three crews also differed significantly with respect to the amount of support given to fellow crewmembers over the course of the winter (Palinkas et al., 2000).

These results suggest that individual behavior and performance is indeed influenced by crew dynamics and patterns of interaction, but not by the degree of support obtained from fellow crewmembers. A previous study of the 1989 winter-over crew of McMurdo (Palinkas and Johnson, 1990) revealed that station members who scored low on measures of emotional stability and supervisor/clinician evaluations of individual performance were not socially isolated. This finding was in contrast to the numerous studies that have documented an association between depression and a decrease in size of social networks and amount of received social support (Cohen and Wills, 1985; Lin and Ensel, 1984). The lack of an association may be interpreted as evidence of the tolerance of depressive symptoms on the one hand (Cravalho, 1996), and the limited use of other crewmembers to cope with stress on the other hand, largely because these crewmembers are facing the same stressors (Palinkas, 1992). Hence, an important distinction must be made between social dynamics as a stressor and social support as a mediator of the stress-performance relationship. Behavior and performance in ICE environments is social from the stand-point that impaired social interaction may be responsible for decrements, but that individuals adapt to such environments by refraining from a reliance upon their fellow crewmembers for support.

Salutogenic Characteristics

The fourth characteristic of behavior and performance in ICE environments is that it is “salutogenic.” A term coined by Aaron Antonovsky (1979), salutogenic was intended to convey the idea that under certain conditions, stress could actually be beneficial and health-promoting, and not simply “pathogenic” or destructive to health and well-being. These conditions have been identified as “flow experiences” by Csikszentmihalyi (1975) in which individuals seek out challenges and obtain increased self-esteem and self-efficacy by successfully meeting these challenges.

The human experience in the Antarctic provides numerous instances of individuals who have had such flow experiences with salutogenic results. Our analysis of the data collected since 1963 uncovered two particular sources of evidence suggesting that some individuals, at least, exhibit improvements in performance and well-being during extended periods of isolation and confinement in extreme environments. The first source of evidence was obtained from an examination of mood disturbances during early and late winter among the 657 men who overwintered between 1963 and 1974. Symptoms of the winter-over syndrome (depression, irritability, insomnia, cognitive impairment) were inversely associated with the altitude, latitude, and mean annual temperature of the stations where individuals spent the austral winter (Palinkas, 1991b). However, when these symptoms were separated into sleep related and non-sleep related categories, an interesting pattern emerged. Complaints of disturbed sleep (difficulty falling asleep or staying asleep, waking up at night, feeling tired during the day) were positively associated with the severity of the station physical environment in early winter, but not in late winter. In other words, the winter-over personnel in this cohort had somehow managed to adapt to the characteristics of the physical environment, thereby minimizing the impact of this environment on their sleep patterns. On the other hand, other symptoms (feeling blue, lonely,

annoyed or irritated, critical of others, uneasy or worried, nervous or tense, and unable to concentrate) were *inversely* associated with severity of the station physical environment at both early and late winter. In other words, the more severe the physical environment, the fewer mood disturbances that were not sleep-related (Palinkas, 1991b; Palinkas et al., 2000).

Further analysis of these individuals revealed three patterns of mood disturbance: 1) an increase in symptom scores from early to late winter (63.0%); 2) no change in symptom scores (8.5%); and 3) a decrease in symptom scores (28.4%). When compared with individuals who exhibited an increase in symptom scores, the only personality traits or interpersonal needs associated with a decline in symptom scores were a low need to include others, a low need to be included by others, and a low need to express affection to others (Palinkas et al., 2000).

A second piece of evidence suggesting some form of positive adaptation to the characteristics of the physical environment is derived from a comparison of the seasonally-related depressive symptoms experienced among personnel who over-wintered at McMurdo and South Pole Stations in 1991. Although we noted earlier that S-SAD is positively associated with station latitude, mean Hamilton Depression Rating Scale (HDRS) scores and seasonally-related depressive symptom (SAD-SIGH) scores of personnel at McMurdo in 1991 were significantly higher than the respective scores of personnel at South Pole the same year (Palinkas et al., 1996).

Third, when viewed within the context of the stress-illness paradigm, the winter-over syndrome is interpreted as the inevitable consequence of the stress associated with the prolonged isolation and confinement, apparent absence of social support, and extreme environmental conditions of the Antarctic winter. However, despite the potential degradation to health and performance associated with more severe forms of the winter-over syndrome, the Antarctic winter-over experience does not appear to have any adverse long-term effects. In fact, exposure to such stress may actually confer some long-term health benefits. Using medical and service history records as well as screening data obtained from volunteers to the Operation Deep Freeze Program between 1963 and 1974, the subsequent first hospital admissions of 328 enlisted Navy men who actually wintered-over at six small Antarctic research stations were compared with those of a control group of 2,396 Navy winter-over volunteers who were assigned elsewhere because of the limited number of available winter-over assignments (Palinkas, 1986). All of these individuals were evaluated by screening teams, each consisting of a clinical psychologist and psychiatrist, and found to be medically and psychologically qualified for winter-over duty. Both groups were followed for a maximum of 15 years with an average follow-up of 5.4 years (6.1 years for the winter-over group, 5.3 years for the control group). The study found that the winter-over personnel experienced 20% fewer total first hospital admissions subsequent to their return from Antarctica than the control group during the same period. The winter-over group also displayed significantly fewer first admissions in selected International Classification of Disease Adapted for Use in the United States, Eighth Revision (ICDA-8) diagnostic categories such as neoplasms (73% fewer admissions); endocrine, nutritional, and metabolic diseases (60% fewer admissions); diseases of the musculoskeletal system (44% fewer admissions); and nonsignificant declines in admissions for mental disorders (36% fewer admissions) and accidental injuries (27% fewer admissions) (Palinkas, 1986).

Taken altogether, these results suggest that extreme environments generate positive forms of adaptation in certain individuals, particularly those with a low need for social interaction. While not all individuals obtain such an experience, these results suggest prolonged exposure to an ICE environment does not necessarily produce pathogenic consequences. On the contrary,

certain individuals are likely to acquire significant psychological benefits or flow experiences from such environments.

CULTURE AND COPING

Individual Coping and Group Adaptation

These four characteristics of behavior and performance in the Antarctic exist within a collection of normative and pragmatic rules and traditions of adaptation to prolonged isolation and confinement that comprise a cultural system. When station personnel first arrive in the Antarctic, they represent a collection of culturally heterogeneous individuals with different social backgrounds, occupational assignments, attitudes, and values. However, each station gradually develops a cultural system of its own. This process was described by Admiral Byrd (1930:208) in the following passage:

It was wonderful to observe how the characters of men and situations evolved. If one drew apart occasionally contrasts that would have passed unnoticed stood out sharply, and it was surprising to observe how certain men, normally ignored, had come into their own. There was a subtle reorganization of values. And yet when one was immersed in it, there seemed to be little change, after all. What one saw depended on where one stood. For in a very short time the fact of living in crowded quarters, under the pall of the winter night, became the normal existence, and what had gone on before a rather confused and unusual memory.

These microcultures change from year to year as personnel rotate in and out of stations; nevertheless, the cultural systems of certain stations retain a certain amount of continuity from one year to the next. These cultural systems are a product of several different features of the human experience on the ice. One such feature is the history of that experience with its record of successes and failures. The legacies of Scott and Amundson, of Byrd and Siple, remain as part of the cultural heritage of Antarctic scientific and support personnel. The ubiquitous plaques, memorials, and historical sites in or near each station serve as a constant reminder of that tradition. In addition to representing a compendium of lessons learned and institutions designed to mitigate the psychosocial and environmental stressors, that tradition also reinforces certain values relating to survival, self-striving, exploration, deprivation, and physical adventure.

Processes contributing to group cohesion and the adoption of certain norms of behavior that foster individual adjustment and group adaptation also underly the development of station microcultures. For instance, areas such as lounges, galleys, and exercise rooms, where differing groups interact, are typically subject to rules that prevent friction between the groups. Expressions of this norm include the no dirty dishes rules in mess halls or "no outdoor boots" rules that prevent visitors from adding to the residents' housework by tracking in dirt and mud.

The behaviors of station members are also governed by and evaluated in terms of other norms including cooperation, hard work, and a disdain for rash or foolhardy behavior or excessive consumption of alcohol. Within each station from one year to the next, a high value is typically placed on certain qualities such as self-sufficiency, decisiveness, intelligence, the ability to work alone, good communication skills, assertiveness, and independence (Palinkas, 1992; Taylor, 1987).

Station microcultures also provide a set of rules that govern gender and class relations. Since men and women work in many of the same occupations (e.g., heavy equipment operators, mechanics, plumbers, general field assistants, and inventory control clerks) and are required to perform similar tasks (e.g., housekeeping duties, manning firefighting details, filling the snow

melts), status inequality between men and women is less evident than is the case in the outside world. Socioeconomic status is based primarily on education and occupation with Navy or Air Force officers and civilian scientists at the top of the hierarchy, senior enlisted military and civilian supervisory personnel in the middle, and junior enlisted personnel and civilian manual laborers at the bottom. However, the station microculture minimizes the potential for social conflict resulting from the display of socioeconomic status in a variety of ways. For instance, although officers and scientists earn higher wages than enlisted personnel and manual laborers, these wage differentials rarely become apparent, much less transformed into indicators of social status, because there are very few venues to spend money in Antarctica during the winter (the purchase of alcohol being a notable exception), and most winter-over personnel view the experience as an opportunity to save money since their room and board expenses are assumed by the United States Antarctic Program. Socioeconomic status differences are also obscured by the fact that leaders and followers alike perform many of the same tasks.

The social identity of station members is another feature of station microcultures. Winter-over crews express their unique experiences and distinguish themselves from summer support "tourists" by means of specially designed patches, caps, t-shirts, and jackets. Activities such as the annual "Penguin Bowl" football game held at Williams Field or the initiation rituals associated with a certain station such as the Three Hundred Club (where crewmembers sit in a sauna at 200°F and then run outside to -100°F temperatures clad only in boots) at South Pole Station provide for station personnel, summer support and winter-over alike, a set of experiences that both define them as a group and distinguishes them from friends and family back home.

Coping and Control

As with any cultural system (Hallowell, 1955), station microcultures are a product of a fundamental relationship between man and nature and the need of humans to impose a cultural sense of order and meaning to an otherwise chaotic and unintelligible or unfamiliar environment. It is within the context of these meaning systems that we are led to understanding the role of Antarctic microcultures in coping with the stresses of prolonged isolation and harsh environmental conditions. This role is articulated in Colby's (1987) model of anthropological well-being which links the concept of "adaptive potential," defined in terms of adaptivity, altruism, and creativity, to the prediction of illness and health. According to Colby, adaptivity and its component conditions, efficacy and diversity, constitute a basic condition of ecological survival in both biological and cultural evolution. In the latter instance, "efficacy in the actions of a group must be accompanied by a diverse repertoire of cultural patterns (and the cognitive schemas to produce them)..." (1987:881).

At first glance, it would seem that efficacy is represented in the meaning systems of Antarctic research station microcultures as control while diversity is represented as different resources and strategies to cope with the conditions of isolation, confinement, and extreme environmental conditions and thus exercise some measure of control over these conditions. It is perhaps because there is so little opportunity to exercise control that it becomes a salient feature of life in Antarctica. Certain elements of the winter-over experience, like the physiological effects of the high altitude at South Pole station or the effect of prolonged darkness on mood and sleep patterns, are interpreted as being beyond the control of individual crewmembers. Because of the severe imbalance in the sex ratio (1 woman : 6-8 men at South Pole and 1 woman : 4-5 men at McMurdo) women are perceived to exercise greater control than men in developing intimate social relations with members of the opposite sex and obtaining emotional support from

these relationships. Other elements of the experience are perceived as being subject to the control of outside agencies and authorities. For instance, during the psychological debriefings of winter-over personnel conducted in 1989, many of the Navy Seabees complained of the fact that they lacked a clearly defined "mission" in Antarctica. Policy decisions made by National Science Foundation administrators in Washington and agreed to by U.S. Navy authorities resulted in a transfer of many of the public works functions formerly performed by Navy Seabees to the civilian contractor. Navy Seabees were forced to rely upon the good will of their civilian counterparts to obtain tools, supplies, workspaces, and equipment. Although relations between the Navy and civilians were quite good, this dependence was perceived by this segment of the Navy winter-over crew as placing them in a subordinate position and depriving them of a measure of control over their jobs in particular and their lives in general.

Because of these constraints on the exercise of control at both the group and the individual levels, many of the symptoms of the winter-over syndrome may be interpreted as resulting from a perceived lack of control over the social and physical environment. Thus, underlying the occasional conflict between Navy and civilian personnel was the Navy perception that civilians lacked self-discipline, had no respect for authority or the "chain of command," and (perhaps somewhat enviously) had too much autonomy--in other words, were uncontrollable. Civilians, on the other hand, resented the rigid authoritarian system of the Navy which imposed unnecessary rules and regulations and interfered with the autonomy they were used to back home--in other words, was too controlling.

The perceived lack of control also contributes to symptoms of fear and anxiety, resulting from events that directly affect individual crewmembers but that indirectly impact the entire community. A few years ago, for instance, a few members of the McMurdo Search-and-Rescue (SAR) team left town for a weekend trip up the slopes of nearby Mt. Erebus. Unfortunately, they failed to notify anyone of their departure since it was a violation of established safety procedures, and bad weather delayed their return to McMurdo. When they did return, they were effectively ostracized from the community for having put themselves in a hazardous situation and potentially endangering other, less qualified, station members who would have been forced to mount a search and rescue effort on their own. In another instance, a few winter-over crewmembers expressed a sense of fear and anxiety resulting from a co-worker's near fatal accident when her tractor fell through the ice into the waters of McMurdo Sound. The accident made them profoundly aware of the tenuous nature of their own existence on The Ice where even a momentary lapse in self-control or control over the environment can result in death.

Many winter-over personnel attribute the symptoms of the winter-over syndrome to the inability of winter-over crewmembers to control events back home, particularly events involving loved ones. It is not uncommon, for instance, for one or two crewmembers to receive a "Dear John" letter from their spouse, often precipitating episodes of depression, anxiety, and insomnia. In other instances, the inability to control events back home may lead to more severe consequences as explained by the medical officer of one winter-over crew:

We did send two people out (at winfly) because of the problems they were having with their families back home. They were both having a hard time dealing with the situation here. You're isolated. It's frustrating. You can't do much down here. You don't really know what's going on. So it kind of wore on them and they became vegetables, basket cases by the time they were able to get out of here. They weren't too functional. They had poor attention spans, poor memory; they just weren't too functional. Both individuals were to that extent. In fact, we had to shuffle jobs because they just weren't performing as they should. I talked to both of them, but there's not a lot you can do here because they're stuck in a situation you can't do a lot about, and you just have to try to cope with it and get the hell out of here.

The observation that a sense of control over the environment is related to the symptoms of the winter-over syndrome might be interpreted in light of the findings of other studies that have identified control as a moderator in the stress-illness relationship. A study of men who had experienced ischemic strokes (Adler et al., 1971) for instance, found that the stroke typically occurred in a general situation in which the individual felt that he was no longer in control of his environment. Studies that have applied Rotter's (1966) notion of locus of control have generally found that individuals with an external locus of control are at greater risk for physical and psychological disorders than individuals with an internal locus of control (Johnson and Sarason, 1978; Seligman, 1975). Other studies have indicated that persons with an internal locus of control derive greater benefits from social support when confronted with stressful life events than persons with a more external orientation (Lefcourt et al., 1984; Sandler and Lakey, 1982). The concept of mastery used by Pearlin and Schooler (1978) also includes notions of control, as does the concept of potency used by Ben-Shira (1985) and Kobasa's (1979) concept of hardiness.

Moreover, the uneven distribution of efficacy and diversity within the winter-over group might account for differences in psychological symptom patterns among crewmembers observed in earlier studies. Scientists, by virtue of their research, are often able to work in an independent and autonomous manner. Navy enlisted personnel, on the other hand, are subject to military rules and regulations while on The Ice, must obey the orders of superior officers, and are perceived and perceive themselves as being subordinate to the scientists by virtue of their role as "support personnel." Earlier research has demonstrated that it is the enlisted personnel who experience the most severe symptoms of the winter-over syndrome (Doll and Gunderson, 1971).

Therefore, from the perspective of an etic definition of coping and adaptation, the symptoms of the "winter-over syndrome" represent a failure to cope with the limitations on efficacy (control) and diversity. However, there are two specific problems with this conclusion. First, from the perspective of the group's own (emic) definition of adaptation, these symptoms represent a typical and perhaps even effective form of coping. Take, for instance, the phenomenon of cognitive disorientation, manifested in the "Antarctic stare." As explained by one informant: "I wonder if that is almost not a defense mechanism when people are not getting along, not happy, isolating themselves from everyone else." Similarly, the irritability and conflict exhibited by winter-over personnel, referred to by Pierce (1991) as "microaggressions," are seen by crewmembers as a normal response to unreasonable "orders from the outside world, differences in lifestyles, differing preferences for such things as music, and conflicts over the use of an exercise facility" (1991:126). As part of the structure and function of a group's etiquette (1991:127), these microaggressions operate to manage social conflicts, preventing them from erupting into full-blown explosions.

Second, the notion of control itself means different things to different segments of the winter-over crew. For civilian scientists and support personnel, control means autonomy and independence. For military personnel, control means order and subordination to a command structure. Personnel who perceive themselves to be powerless because they cannot exercise control or autonomy in either a social or a psychological sense have the greatest difficulty in adjusting to the demands imposed by the Antarctic environment. These individuals are less likely to adapt to the prolonged isolation and extreme environmental conditions than individuals who either have control or autonomy by virtue of their work assignments (i.e., civilian scientists of technicians), their gender (i.e., women who, by virtue of their small numbers, are more likely than men to obtain emotional support in an intimate social relationship) or who have a low need for autonomy and a high need to relinquish responsibility for control over their lives (i.e., enlisted Navy personnel) (Palinkas, 1991a).

This relationship between powerlessness, coping and illness has been found in other cultural systems as well. Key to the lifestyle incongruity hypothesis articulated by Dressler (1985) is that a major stressor affecting upwardly mobile persons in the context of modernization is the disruption of a sense of control over access to economic resources necessary to fulfill rising expectations. Similarly, Kleinman and Kleinman hypothesize that "persons who are at greatest risk for powerlessness and blocked access to resources are most likely to somatize" (1985: 475).

Coping and Compromise

Given this emic perspective on the symptoms of the winter-over syndrome and what control means in a context where there are limited opportunities to exercise control over the social and physical environment in Antarctica, the idea that control acts as a moderator between stress and illness provides an incomplete and unsatisfactory answer to the problem of how men and women cope with the isolation, confinement, and environmental conditions of the austral winter and derive some long-term health benefits from this effort. Rather, the human experience in Antarctica suggests that adaptation is essentially a compromise in which the results are seldom the "most-best," but rather a "least-worst" as Alland (1987) describes it, representing solutions to conflicting priorities (Moran, 1982). These conflicting priorities are represented in the microcultures of Antarctic research stations by the needs of the individual and the needs of the group. The individual adapts by increased self-reliance, autonomy, and utilization of available social networks for support. During this adaptation, a change in the behavior of individuals is evident. Oliver (1991), for instance, found a decrease in psychopathology and an increase in self-actualization during the winter in her study of a winter-over crew at McMurdo. A study of men who wintered-over at two New Zealand stations found them to be more self-reliant, self-sufficient, and practical after the winter than they had been before (Taylor, 1987). These same traits have been identified in other studies as key personality characteristics which moderate the effects of stressful life events on health and well-being (Antonovsky, 1979; Kobasa, 1979; Ben Shira, 1985) and may be the characteristics which enable these men and women to cope with other stressful conditions or events upon their return to the United States, thereby reducing their long-term risk for stress-related illness and disease.

The group, on the other hand, needs a certain amount of cooperation and conformity among its members and adapts by organizing a group of autonomous, self-sufficient individuals into a collective whole for the purpose of maintaining the continuity of the station itself. This organizing process occurs in three stages; in the first stage, the group is open to interaction among all members. Some pairs form as two persons find common interests and backgrounds. The second stage is marked by the formation of cliques, based on age and authority, occupational status and station responsibilities, religious beliefs, recreational activities, and extent of substance use. The third stage is one of coalescence where the entire group organizes around a social core (Palinkas, 1989; Natani and Shurley, 1974). This coalescence is evident during mid-winter airdrop when mail and new supplies are delivered or during fires and other station emergencies where crewmembers are forced to work together for their mutual survival (Natani and Shurley, 1974). It is most noticeable at the end of the winter-over period when replacements arrive. There is an almost universal sense of resentment at the outsiders who invade the station and disrupt or criticize established routines. These outsiders also provide a focus for displaced anxieties over having to once again become part of the larger society (Palinkas, 1989).

The negotiation between individual and group needs hangs on a delicate balance between the normative and pragmatic rules that comprise the cultural system. For instance, one is expected to maintain a certain amount of autonomy and independence from the social group; yet too much autonomy or independence can result in ostracism and conflict. One must be socially compatible yet not overburden station members with problems relating to isolation and confinement that all members experience. One is expected to adhere to the safety rules and regulations such as the filing of footplans when leaving the station, yet some crewmembers either blatantly ignore these rules or find ways to skirt them in order to escape from the confinement of the community and enjoy the pristine wilderness if only for a few hours at a time.

To illustrate how this negotiation operates in the Antarctic microcultures, let us examine the following two case studies:

Case No. 1

John was a 34-year old man who worked as a mechanic in the vehicle repair facility in McMurdo. John was married and had two children back home. Prior to the closing of the station for the winter, John received a "Dear John" letter from his wife that led him to suspect that she was having an affair with another man. This threw him into a severe depression that lasted for several weeks and necessitated some intervention on the part of the winter-over medical officer. During this period, John became withdrawn and his work began to suffer, subjecting him to the criticism of his co-workers for failing to complete assigned projects. Eventually, John resolved his problem by saying "to hell with it" and initiating a relationship with one of the female crewmembers. Both his mood and his work performance showed a marked improvement and he became more outgoing socially. This relationship lasted throughout the winter and was then terminated by John as he eagerly prepared to rejoin his wife and family.

Temporary relationships between male and female crewmembers are a common and accepted part of the winter-over experience. Although John's relationship was not widely approved by the winter-over crew as a whole because it violated the normative rule that this form of coping behavior should not be exercised by married men or women, it was tolerated because it met the individual's immediate need (to depend upon someone to cope with the isolation) and because it produced an improvement in John's performance at work. Thus, although the extra-marital affair may have been viewed as maladaptive back in the United States, it was seen as a pragmatic means for coping with the unique circumstances of the Antarctic physical and social environment.

Case No. 2

Chris was a 29-year old member of the winter-over crew at McMurdo. During the winter, Chris was known to his fellow crewmembers as the "mystery man of McMurdo" because relatively few people saw him or interacted with him over the course of the entire winter. In fact, a fellow crewmember came up with the idea of designing and selling a t-shirt, a popular activity in Antarctica, on which was inscribed the words: "I saw Chris." Chris never ate in the galley with the other crewmembers and never participated in station-wide social or recreational activities. This isolation was made possible by the fact that Chris worked the night shift at his workstation and could eat and sleep there when he wasn't working.

In the United States, such behavior might have been interpreted as maladaptive and perhaps symptomatic of some form of psychopathology. However, those men and women who worked with Chris described him as pleasant, funny, and remarkably free of the symptoms of the winter-over syndrome. More-over, Chris' decision not to interact with the majority of the winter-over crew was accepted by the group as a whole, and while this decision was regarded as odd or unusual, it was not perceived in the same manner as another fellow crewmember who would consistently show up late for work or not show up at all because of a drinking problem. This was because Chris was regarded as a good worker who did his job well while the performance of the other individual was adversely affected by his self-imposed isolation and his alcohol abuse.

Although both cases demonstrate a relatively successful compromise between individual and group needs in coping with the stress of isolation, confinement, and extreme environmental conditions, there are a number of variables that threaten this delicate balance. They include the restrictions placed on individual and group behavior by the physical environment or by external authorities (U.S. Navy, civilian contractor, National Science Foundation); characteristics of the individual such as the lack of flexibility or motivation, poor or inappropriate coping strategies such as excessive drinking when under stress, and poor leadership; and characteristics of the group such as the social, cultural and occupational differences which distinguish military and civilian personnel at McMurdo and science and support personnel at South Pole Station. Failure to negotiate individual and group needs then results in poor job performance, conflict between social cliques, ostracism of deviant members who fail to adhere to group norms, and low morale and increased psychological symptomatology. An example of the consequences of this failure is found in the following case study:

Case No. 3

At 19 years of age, Phil was the youngest member of the winter-over crew at South Pole Station, having been hired as a "last-minute" re-placement to work as a meteorology technician. Phil identified himself as the station clown and was proud of his practical jokes on other crewmembers. However, the remainder of the winter-over crew saw Phil as lazy, self-centered, and immature. They rarely saw him performing his duties because Phil was one of the few crewmembers able to "free cycle" which meant that he could stay awake or sleep as long as he liked just as long as he continued to launch weather balloons on schedule. This was a source of irritation to the station manager and to his supervisor who always found him to be asleep whenever they needed him for other duties. By mid-winter, Phil became ostracized from the group and was only marginally involved in a few of the many cliques that formed over the course of the winter. The ostracism only served to spur Phil into more frequent and dramatic forms of practical joking that only reinforced the group's largely negative perceptions of him. In an effort to cope with the social ostracism and criticism of his work, Phil turned to his supervisor for counseling and advice. However, his supervisor felt he had no time to act as the boy's father and told him he needed to deal with his problems on his own. By the end of the winter, Phil reported feeling depressed, irritable and unable to sleep. His work performance steadily deteriorated over the course of the winter.

Isolation from family and friends in the larger society is a hardship that all winter-over crewmembers must face, but isolation from other crewmembers is particularly stressful.

Phil's ostracism from the winter-over crew was a consequence of his failure to negotiate his own needs with the needs of the group. His attempts to cope with the disapproval of the group by constant practical joking and by seeking a father-son relationship with his supervisor were interpreted as evidence of poor coping skills in a microculture that demands maturity and self-sufficiency. Although he was able to work independently, Phil was perceived by the rest of the crew to spend more time sleeping than working, thus violating the microculture's norm of hard work.

CONCLUSION

The human experience in Antarctica is noteworthy in that the ice reflects and refracts four distinct characteristics of human behavior that are influenced in distinct ways by the microsocieties that comprise the cultural system of the polar sojourner. The human experience in Antarctica suggests that behavior and performance in ICE environments is seasonal or cyclical, situational, social, and salutogenic. These four characteristics are influenced in important ways by the microcultures of Antarctic research stations in ways that enable individuals and groups to achieve a compromise in their desire to cope with the stress of living in an environment characterized by isolation, confinement and extreme physical conditions in the face of limited, if any, control over such an environment.

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