

The Relative Importance of Behavioral Issues During Long-Duration ICE Missions

JACK STUSTER, PH.D., C.P.E., CLAUDE BACHELARD, M.D., AND PETER SUEDFELD, PH.D.

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Previous studies of isolated and confined environments (ICEs) have been unable to assign relative priority to the many behavioral issues affecting participants. The current study analyzed psychologically relevant entries in the journals of nine leaders and physicians of French circumpolar expeditions. More than 100 specific themes emerged, distributed across 22 categories. Group Interaction was found to be the most salient of the categories, followed by Outside Communications, Workload, Recreation and Leisure, Medical Support, Adjustment, Leadership, Event, and Food. Substantial evidence of a third quarter phenomenon was found in all expeditions. Unexpectedly, shorter missions (69–180 d) generated more negative reactions than longer missions (230–363 d) and diaries from the sub-Antarctic stations were more negative than those from the Antarctic. The study provides quantitative bases for judgments concerning the relative importance of psychological issues.

Keywords: isolated environments, behavior, Antarctica, journals, psychology.

ALTHOUGH PEOPLE HAVE LIVED and worked in isolated and confined environments (ICEs) for countless generations, only within the past 4 decades has there been a scientific interest in the problems associated with human adjustment to those conditions. Many explorers were aware of the effects that isolation and confinement can have on crew adjustment and behavior, and implemented procedures to counter those effects. Following a highly disruptive psychotic episode among the U.S. Antarctic team preparing for the 1957 International Geophysical Year, psychological studies were conducted to study the stressors experienced in the Antarctic environment, to improve personnel selection, and to develop performance measures (2).

Since then, there have been many other studies of behavioral issues in Antarctica (e.g., 7,8,10,11,13,14,20,21). Several additional conditions characterized by long-duration isolation and confinement have been the objects of behavioral analysis. These include remote military outposts, submarines, saturation chambers, fishing vessels, and underwater habitats, to name a few (16,17,19).

Journals, Diaries, and Logs as Sources of Behavioral Information

Self-initiated diaries and official logs usually provide descriptive accounts of events in a chronological sequence, answering the implicit question, "And then what happened?" (6). This is precisely what behavioral

scientists would ask; the answers are provided within a narrative account, sometimes in great detail.

Riessman (12) suggests that the analysis of such narratives can transcend the limitations of traditional research methods for understanding social life. Further, reviewing diaries, logs, journals, and other archival sources is a less obtrusive and reactive method for obtaining information than either interviews or questionnaires. Archival materials are often the only sources of information, e.g., about the historic voyages of discovery and current expeditions in remote locations.

Anecdotal comparisons frequently are made among future space missions, Antarctic winter-over experiences, and the expeditions of the past. However, few attempts have been made to formally study relevant personal accounts. Johnson and Finney (4) analyzed Huntford's (3) account of the Amundsen and Scott race to the South Pole, and Mocellin and Suedfeld (9) performed content analyses of 13 original diaries maintained by polar explorers from the mid-19th to the early 20th centuries. Later, Johnson and Suedfeld (5) analyzed the content of diaries and correspondence written by early Arctic whalers and explorers. Finally, Stuster's (17) study of diaries and secondary accounts of expeditions resulted in the identification of several habitability principles and more than 200 specific recommendations for the design of equipment and procedures to facilitate human adjustment during future long-duration space missions.

The current study is based on the premise that the introspective accounts of ICE personnel can provide useful information about the factors that affect individual and group performance.

METHODS

Content analyses were performed on nine personal journals maintained for this purpose by leaders and

From the Anacapa Sciences, Inc., Santa Barbara, CA (J. Stuster); Territoire des Terres Australes et Antarctiques Françaises and Institut Françaises Pour La Recherche Et La Technologie Polaires, Paris, France (C. Bachelard); and University of British Columbia, Vancouver, BC, Canada (P. Suedfeld).

Address reprint requests to: Dr. Jack Stuster, Anacapa Sciences, Inc., P. O. Box 519, 301 E. Carrillo Street, Santa Barbara, CA 93101.

For more information about this study, please visit Dr. Stuster's web site at: www.anacapasciences.com.

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physicians at French remote duty stations in Antarctica and on small islands in the South Indian Ocean. The diaries were maintained during the 1993-1994 expedition as part of the International Antarctic Psychological Program (IAPP). In order to increase the useful content of the journals, the participants were first sensitized to the relevant behavioral and human factors issues and were encouraged to discuss those issues in their journals when warranted by events. The diaries were translated into English by Dr. Bachelard.

The first step in the content analysis was to define the inventory of behavioral issues with design and procedural implications for future ICE missions. The process began with 17 issues listed to provide guidance to the diarists. Additional issues were added to the list during the review. During this Level 1 analysis, Drs. Stuster and Bachelard reviewed the relevant entries and allocated them to the various categories. Entries that involved more than one category were also assigned to a secondary category. All diary entries and associated data then were entered into formatted, computer-based spreadsheets. Data fields included for each entry are: a) Diarist Name (coded); b) Role (M for medical officer; L for station leader); c) Mission Day (0-363 maximum); d) Category 1 (the primary category of behavioral issues to which the entry was assigned); e) Category 2 (the secondary category of behavioral issues to which the entry was assigned, if relevant); f) Page (the page number of the diary on which the entry can be found); g) Entry (the English translation of the diary entry); and h) Positive/Negative (whether the entry is positive, negative, or neutral in tone).

Next, the passages within each of the issue areas were reviewed and assigned to emerging themes. Passages could be assigned to more than one theme within an issue area. All categorization was performed by the same investigator to ensure that the same categories and criteria were used throughout the process. Equivocal or problematic passages were identified and set aside for later review. Drs. Suedfeld and Karine Weiss of the University of Paris participated during this task to ensure that the process was free of investigator bias. Dr. Weiss independently rated and categorized the diary entries and found compatible results and conclusions, which validated the original classifications.

The product of the content analysis was a relational database containing passages organized by primary behavioral issue. It might be useful to imagine the database as a large, multi-dimensional matrix that contains the relevant comments of the diarists. The conceptual matrix permits simple quantification of comments regarding the various categories of behavioral issues, as well as quantification of themes within a primary issue area.

RESULTS

The data were assembled into a master database containing 1810 entries. Simple sorts and tallies then were performed to characterize the database and to help plan further analyses. The durations of the various expeditions ranged from a 69-d Antarctic traverse to nearly 1 yr on a remote island. The number of entries per day

TABLE I. CATEGORIES RANKED BY TOTAL NUMBER OF ASSIGNMENTS.

	Primary	Secondary	Total
Group Interaction (GI)	330	275	605
Outside Communications (OC)	315	58	373
Workload (W)	169	180	349
Recreation & Leisure (RL)	226	101	327
Medical Support (MS)	217	55	272
Adjustment (AD)	138	134	272
Leadership (L)	160	68	228
Event (E)	71	22	93
Food Preparation (FP)	43	47	90
Organization/Mgt. (OM)	17	59	76
Equipment (EQ)	20	45	65
Sleep (S)	30	19	49
Safety (SA)	29	14	43
Personnel Selection (PS)	6	20	26
Waste Management (WM)	9	3	12
Internal Communications (IC)	6	4	10
Exercise (EX)	3	7	10
Habitat Aesthetics (HA)	8	1	9
Hygiene (HY)	5	2	7
Personal Hygiene (PH)	4	0	4
Privacy/Personal Space (PP)	1	3	4
Clothing (C)	3	0	3
Totals	1810	1117	2927

ranged from a low of 0.34 by a physician during a 230-d expedition on an island station, to a high of 2.86 by a physician during the 69-d traverse. Diaries were maintained by the expedition leaders and expedition physicians at four remote duty stations; a ninth diary was maintained by the physician who served on the 69-d Antarctic traverse. The latter diary was omitted from some of the analyses because the traverse conditions were very different from those at the stations.

Because of the large number of behavioral categories, the small number of diarists, and individual differences among them, it was judged to be inappropriate to subject the data to inferential tests of significance.

Category Analysis

A total of 22 categories of relevant behavioral issues emerged from the analysis. All entries were assigned to a primary category; 62% were also assigned to a secondary category. The combined database was sorted by categories and the entries in each category were counted. The numbers of primary and secondary assignments for each category are presented in Table I; the categories are listed in descending order of number of relevant entries.

Group Interaction was the most frequently assigned category. The content matrix, a summary of primary and secondary category assignments, shows that for the 330 entries assigned to Group Interaction, the most frequent secondary category was Adjustment ($n = 53$), followed by Recreation & Leisure ($n = 51$). For the 226 entries assigned to Recreation & Leisure as the primary category, the most frequent secondary category was Group Interaction ($n = 90$). It must be noted that the numbers of entries assigned to Medical Support and Leadership categories probably were influenced by the sample of diarists, which was limited to expedition physicians and leaders.

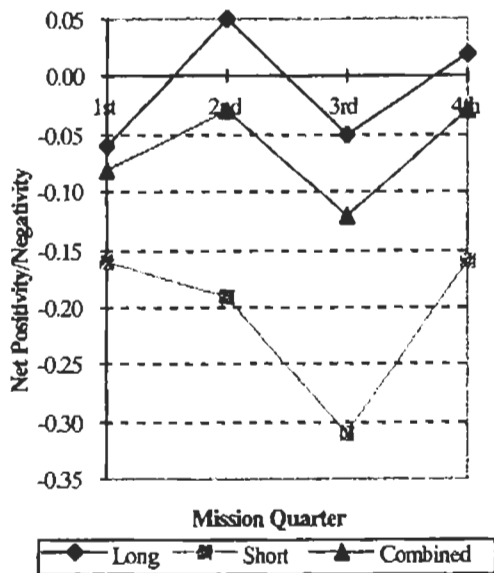


Fig. 1. Overall: long vs. short duration and all missions combined.

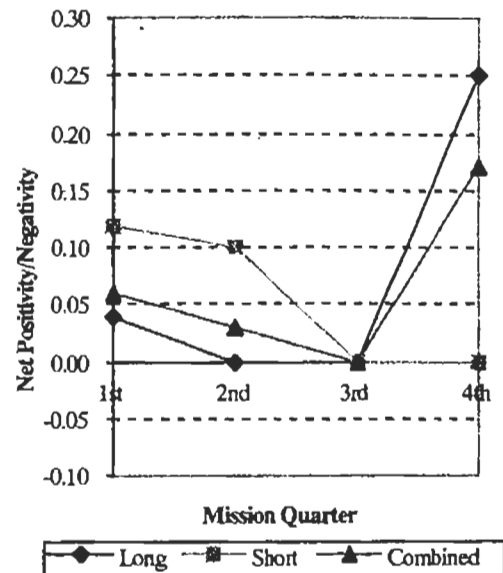


Fig. 2. Group interaction: long vs. short duration and all missions combined.

Because mission duration varied from 69–363 d, the database was divided between the three missions with a maximum duration of 180 d (“short duration”) and the six missions with a minimum duration of 230 d (“long duration”). The purpose of separating the shorter and longer missions was to identify any effects attributable to mission duration. Each mission was divided into quarters; the category assignments in each quarter were tallied, then combined with the corresponding quarters of all other missions in each of the two derivative data sets. The purpose of dividing each diary into quarters was to identify any changes over time.

Positive-Negative Analysis

Each diary entry was assigned a code to indicate whether the statement was neutral, positive, or negative in tone or content. All entries were reviewed and the codes assigned during the same session in an attempt to maximize the consistency of the code assigning process. The numbers in the three categories then were tallied, and proportions calculated, by quarter, for all missions. A metric defined as Net Positivity/Negativity (NPN), was calculated by subtracting the proportion of negative entries from the proportion of positive entries. Three sets of positive-negative analyses were performed: a) long vs. short duration missions; b) Antarctic vs. insular bases; and c) physicians vs. leaders.

Positive-Negative Analysis: Long vs. Short Duration Missions

Fig. 1 illustrates the results of the positive-negative analysis for all diaries combined, and for the short- and long-duration missions separately. The patterns of NPN were similar across mission quarter for entries within the long and short mission durations. However, shorter missions were characterized by substantially greater negativity, especially during the third quarter of the

missions. This finding appears to support hypotheses of a third quarter phenomenon (1).

The proportions of positive, negative, and neutral diary entries were calculated for each behavioral category, on the assumption that the relative frequency of positive and negative entries is influenced by fundamental characteristics of the categories. Both primary and secondary category assignments were included in this analysis. Fig. 2 illustrates the results of the positive-negative analysis for entries with either primary or secondary assignments to Group Interaction. There was a similar pattern of positive but declining values, for both long- and short-duration missions, with the exception of a substantial positive spike in the final quarter of the long-duration missions.

Fig. 3 shows similar NPN for Outside Communications during the first and fourth quarters of all missions.

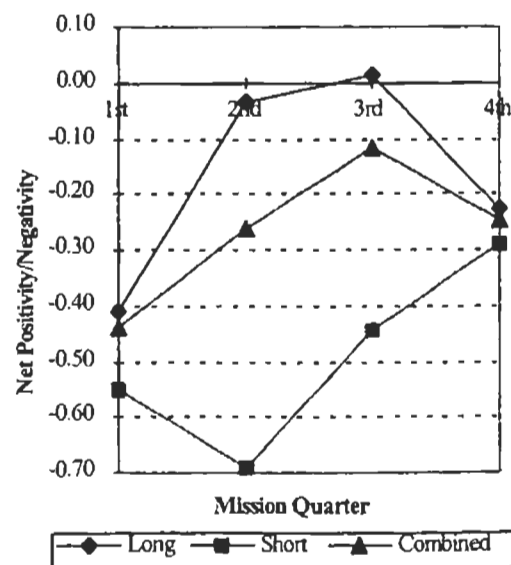


Fig. 3. Outside communications: long vs. short duration and all missions combined.

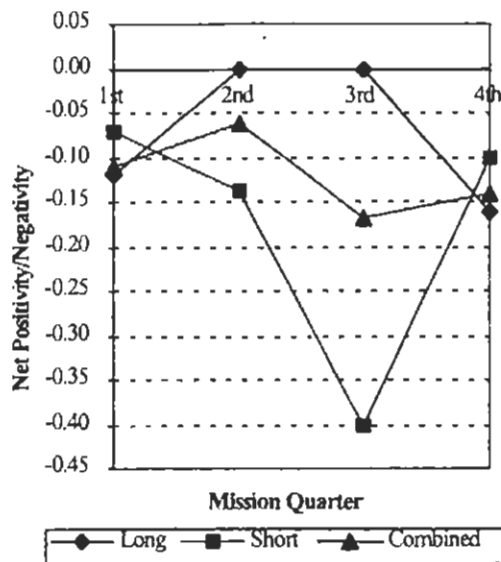


Fig. 4. Workload: long vs. short duration and all missions combined.

However, long-duration missions increased on this measure in the second quarter and declined in the fourth, while the short-duration missions declined in the second quarter and increased in the fourth. Outside Communications entries were predominantly negative in tone or content during both the long and short missions. Fig. 4 shows similar patterns for the Workload category as shown for Outside Communications in Fig. 3. First and fourth quarter values were about the same for long and short duration missions. However, long-duration missions increased in NPN in the second quarter and declined in the fourth; short-duration missions again performed in the reverse, and again with greater overall negativity.

Figs. 5 shows similar patterns during the long- and short-duration missions for entries assigned to Recreation & Leisure. Recreation & Leisure includes the most

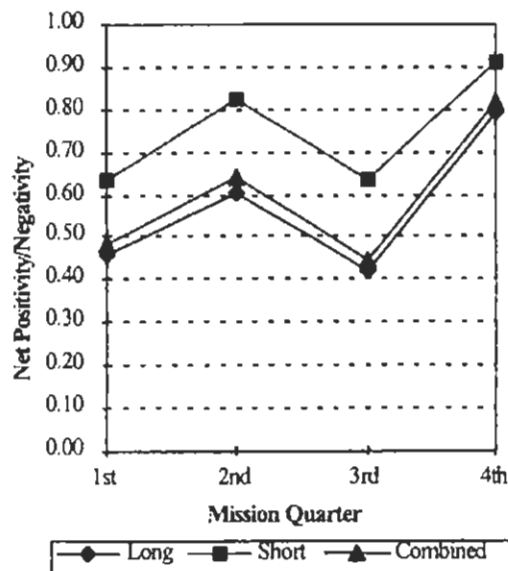


Fig. 5. Recreation and leisure: long vs. short duration and all missions combined.

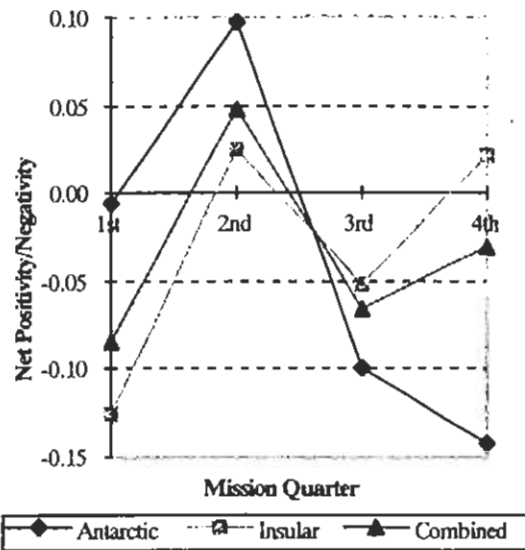


Fig. 6. Overall: Antarctic vs. insular stations and all missions combined.

positive values of all, reflecting the importance of this category to ICE personnel.

Positive-Negative Analysis: Antarctic vs. Insular Stations

Positive-negative analyses were performed comparing diaries from the three insular stations to those from the Antarctic base to identify differences attributable to environmental conditions. Although all four bases are located in remote and hostile environments, the harshness of the environment and degree of isolation are greater at the Dumont d'Urville base than at any of the insular stations. In addition to more extreme weather in Antarctica, Dumont d'Urville is visited by ship only twice each year, during the austral summer, whereas ships stop at the insular stations almost monthly. The diary maintained by the physician on the 69-d traverse from Dumont d'Urville was excluded from this analysis because of the uniquely arduous conditions.

Fig. 6 presents the results of the overall positive-negative analysis, comparing all Antarctic base diary entries to the diaries maintained at the insular bases. The patterns are similar, with the exception of a positive spike in the fourth quarter of the insular missions and a continued decline in NPN during the fourth quarter at the Antarctic base. Fig. 7 presents the results of the positive-negative analysis for entries assigned to the primary and secondary categories of Group Interaction. There are two distinct patterns. NPN increased during the second quarter at the Antarctic base, then declined precipitously during the third quarter and continued to decline into the fourth quarter. A steady increase in NPN was exhibited by the diaries from the insular bases. It is important to note that NPN values were substantially more positive at the Antarctic base than the insular bases during the first two mission quarters, and remained more positive during the third quarter despite the sharp decline.

Positive-Negative Analysis: Physicians vs. Leaders

As is evident from Figs. 1 through 7, the differences between long- and short-duration missions, and the

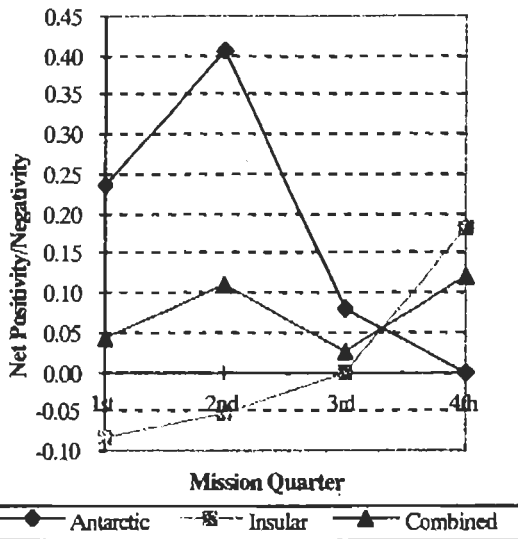


Fig. 7. Group interaction: Antarctic vs. insular and all missions combined.

differences between Antarctic and insular bases, can be characterized as differences in degree; that is, the patterns of change are similar, although on some measures there are differences in absolute values. However, comparisons of the diaries of physicians and leaders found distinctly different NPN values and patterns of change. Fig. 7, the overall comparison of all primary category assignments, shows the general pattern for the main behavioral categories. NPN increased for physicians in the second quarter (overall and in five of the seven main categories), but decreased for leaders (overall and in five of the seven categories). During the third quarter, physicians' diaries exhibited lower NPN overall and in six of the seven main categories, compared with the leaders' increased NPN overall and in six of the seven main categories. Apparently, the experiences of physicians and leaders were very different, at least as measured by the positive-negative analysis of diary entries. The data suggest that physicians experienced a third-quarter phenomenon, whereas leaders tended to experience their decline during the second quarter of their mission.

Positive-Negative Analysis: Overall

The overall results of the three sets of positive-negative comparisons are summarized in Table II. The table presents the proportions of diary entries coded as positive, negative, and neutral, and the NPN derived from

TABLE III. POSITIVE VS. NEGATIVE ANALYSIS OF DIARY ENTRIES BY BEHAVIORAL CATEGORY.

Category	Proportions of Entries in Each Category		
	Positive	Negative	Neutral
Group Interaction (GI)	0.46	0.50	0.04
Outside Communications (OC)	0.31	0.54	0.15
Workload (W)	0.31	0.29	0.40
Recreation & Leisure (RL)	0.78	0.11	0.11
Medical Support (MS)	0.14	0.66	0.20
Adjustment (AD)	0.50	0.46	0.04
Leadership (L)	0.39	0.43	0.18
Event (E)	0.42	0.49	0.09
Food Preparation (FP)	0.53	0.42	0.05
Organization/Management (OM)	0.06	0.82	0.12
Equipment (EQ)	0.00	1.00	0.00
Sleep (S)	0.10	0.83	0.07
Safety (SA)	0.11	0.48	0.41

those values, for each of the comparison categories in the three sets of analyses. The highest proportions of positive entries were in the long-duration missions (0.420), and the highest proportions of negative entries came from the short-duration missions (0.526).

Table III shows that nine of the behavioral categories listed had overall proportions of positive or negative entries of at least 0.50. Categories with predominantly positive entries were Recreation and Leisure, Food Preparation, and Adjustment. The relatively high proportions of positive entries reflect the importance of enjoyable recreation and food in ICEs and the successful adjustment of the individuals who participated in the expeditions described by the diarists.

Behavioral categories with predominantly negative entries were Equipment, Sleep, Organization-Management, Medical Support, Outside Communications, and Group Interaction. The relatively high proportions of negative entries in these categories reflect the high incidence of equipment malfunctions in extreme environments, inevitable misunderstandings with management, problems involving communications with the outside world, and the fact that most medical events (i.e., treatment of injury or illness) were categorized as negative. The proportion of negative entries concerning sleep is in response to crowded conditions and shift work, as well as the well-known Antarctic insomnia. The proportions of positive and negative entries concerning Group Interaction, along with the high total number of entries, suggest the extraordinary importance of this category.

TABLE II. OVERALL RESULTS OF THE POSITIVE-NEGATIVE ANALYSIS.

	Proportion of Diary Entries					
	Duration		Location		Role	
	Long	Short	Antarctic	Insular	Physicians	Leaders
Positive	0.420	0.316	0.398	0.410	0.408	0.404
Negative	0.435	0.526	0.427	0.452	0.461	0.417
Neutral	0.145	0.157	0.176	0.137	0.132	0.179
Net Pos/Neg*	-0.015	-0.210	-0.029	-0.042	-0.053	-0.013

*Net positivity/negativity = Positive - Negative proportions.

Thematic Analysis

Diary entries were assigned to themes within each major behavioral category. Not all entries could be assigned to an emergent theme, and relatively few entries were assigned to two themes. Partial results of this analysis for the four most salient categories are presented in Table IV, beginning with Group Interaction, the category with the greatest number of diary entries. The numbers of category assignments and examples of entries for all 22 behavioral categories are included in the table. Comprehensive tables for all 22 categories were prepared.

DISCUSSION

Previous studies have not provided objective evidence for any ordering of priorities among the many psychological issues that must be considered when designing procedures and equipment for long-duration ICE missions. Suedfeld (18, p. 249) voiced the concern of behavioral scientists and perplexed aerospace engineers when he commented that a particular study, "... does not communicate judgments about the relative importance of the various problems, so the reader is often left wondering about what design or preparation or intervention goals should have priority if one has to make choices, as one often does because of restrictions of time, space, payload capacity, personnel, funds, and so forth." The current study provides an opportunity to identify the relative importance of the behavioral issues, if one accepts the seemingly reasonable assumption that the frequency with which an issue or category of issues is mentioned in diaries reflects its importance to the diarists.

Additional guidance about the processes of adaptation to isolated and confined environments can be found in the results of the positive-negative analyses. It is the experience of individuals in isolation and confinement that is central to the current study. In this regard, it is important to note that the sample of diarists was restricted to expedition leaders and physicians; no technicians or scientists participated. Although the sample is not representative of all expeditioners, the research provides clear indications about behavioral issues and adaptive processes from the perspectives of two key roles. Despite this limitation, the current study provides quantitative data for judging the relative importance of the various issues to individuals living and working in remote ICEs.

Implications of the Category Analysis

The total numbers of primary and secondary category assignments provide a list of issues in the relative order of their salience and inferred significance. These totals confirm the extraordinary importance of issues related to group interaction, previously suggested by qualitative research and the personal accounts of ICE personnel. The Group Interaction category received 330 primary and 275 secondary assignments, for a total of 605 diary entries, nearly twice the number assigned to the second-ranked category, Outside Communications. The next 6 categories have far fewer entries than Group

Interaction, and are separated from each other by an average of only 25 entries, forming a continuum in apparent salience. The numbers of entries, and the presumed importance of the issues, decline precipitously beyond the seven most frequently assigned categories.

Implications of the Positive-Negative Analyses

The positive-negative analyses suggest that mission duration, environmental conditions, and role in the group influence the tone and content of diary entries. Differential responses to differences in these factors might reasonably be expected, but the results were contrary to the usual expectations.

Long vs. Short Duration

Comparison between long- (230–363 d) and short- (69–180 d) duration missions showed that shorter missions were characterized by greater negativity in the overall comparison and for all of the main behavioral categories except Recreation & Leisure and Leadership. The patterns of change in NPN experienced during the long and short missions were similar; but NPN values for shorter missions were more negative, and substantially more negative for certain categories such as Workload and Outside Communications. Because the effects of stress tend to be cumulative, most behavioral scientists have assumed greater negativity (lower NPN values) during longer missions. The current results, however, show that shorter missions can generate greater negativity, most likely in response to tighter work schedules, overly optimistic goals for the relatively brief time spent at the remote base, and problems arising from communications with the outside world. An alternative explanation is that there is a critical period for accomplishing good adjustment to ICE conditions and fewer people in the shorter missions are there long enough to achieve it.

Location

The insular missions were described in slightly more negative terms than the missions conducted in Antarctica, despite the greater isolation and more extreme weather at the Dumont d'Urville station. Again, one might reasonably expect that the greater isolation and more severe environmental conditions in the Antarctic would result in greater negativity; this expectation is met only by the Workload and Adjustment categories. A sharp third-quarter decline in the Workload NPN in the Antarctic diaries corresponds with the austral winter and the resulting decline in work tempo at Dumont d'Urville.

The lower NPN values for entries in the Adjustment category reflect the cumulative effects of mission duration, dipping sharply in the third quarter and remaining low through the end of the mission. Despite the pronounced negativity in some categories in the Dumont d'Urville diaries, the overall comparison of the Antarctic and insular stations is affected by the relatively low NPN values for entries assigned to Group Interaction during the first and second quarters at the insular stations. These negative values are largely at-

TABLE IV. MAIN THEMES OF DIARY ENTRIES BEHAVIORAL CATEGORY.

Theme	Number of Entries	Example
Group Interaction		
Interpersonal conflict	40	Open conflict among physiologists; a fax war. Also, Conflict between radio operator and power crew has misunderstandings and exaggeration; I try to moderate. Also, B threatened to stop his greenhouse work because the leader would not excuse him from [kitchen duty].
Celebration/special meal brings us together	36	Birthday Saturday; food not so good, but good atmosphere. [Many similar in RL and FP]
Teamwork/solidarity	31	The expeditioners show much solidarity.
Group discussion	31	Ardent discussion re environmental issues.
Not fitting in	28	T still is isolated, but trying to do his best. Also, C is not well-accepted by the others.
Problems with crew-relief/switchover	20	New crew cannot feel at home until previous mission personnel depart.
Fitting in	18	The Italians are integrated and learning French.
No, or resolved, interpersonal conflict	14	Most of the crew are making big efforts to cope with the bad habits of others and tolerate them. Also, B apologized to the leader [for the greenhouse dispute] and gave him a special gift.
Trivial issues are exaggerated	14	I have words with P about a fax and realize I am giving too much importance to this issue.
Withdrawal from the group	13	D stays apart, bad mood, and will not participate in planning Midwinter celebration. Also, There is a tendency for retirement within oneself.
Outside Communications		
Receive replacement personnel or visitors	61	The ship has gone; at last I can read my mail.
Receive information from outside	50	Life at the station was quieter when there were fewer visits. Also, Received good wishes from HQ and Pres. Clinton—a grand honor for us.
Receive mail or fax from friends or family	31	I receive a fax from my son and a drawing from my daughter.
I write, fax, or telephone to friends or family	25	I am writing to friends partly because I have the time, but also because I need to write.
Angry or confused by message from HQ	25	What HQ is asking is unrealistic; they don't understand the conditions here; I had been warned of this, but didn't expect the problem to be so big.
Good news or pleasant message from home	19	I receive good news from my wife; we are exchanging telexes regularly.
Bad news or unpleasant message from home	16	Received fax re death of G's father; I must inform him and look after him. Also, Very unpleasant phone conversation with my wife; I realize I am on the other side of the world.
Workload		
Work described	52	Performed duty planning; not many problems. Also, Everyone is working on inventories. Also, Performed administrative work and reviewed reports. Also, Prepared equipment for the traverse. Also, I am on duty at the power station tonight.
Teamwork/cooperation/communal tasks	43	I help the glaciologist dig a pit—good exercise! Also, I help the meteorologist launch a weather balloon. Also, My turn to clean common areas, help prepare and serve food, and wash dishes.
High workload or too much work	18	I am overloaded with work; I was not expecting that. Also, So much work—and they say the doctor has nothing to do—not true! Also, Time is running quickly; I cannot cope with all that I have to do. Also, I instructed overloaded personnel to periodically leave the station for short walks.
Lack of teamwork or conflict about work	17	There are tensions re communal duties; the quantity of work is unequal.
Work is good or enjoyable/making progress	17	I am happy after a good day of hard work. Also, The hospital is more and more operational; I am pleased with that. Also, We did a good job of organizing the waste department.
Recreation and Leisure		
Special meal, celebration, or party	38	Birthday party: good meal, good wines, good cigars, good celebration! Also, Bastille Day: mock judgments (I am first to the guillotine). Also, For Midwinter, each expeditioner is preparing a gift for another (selected by lot).
Physical activity/sports	31	Skiing on the ice shelf. Also, Table tennis tournament. Also, Volley ball matches played in "la bon humer."
Excursion away from the station	27	The walk was difficult physically, but emotionally intense; we encountered the adventure. Also, I went out for three days—very pleasant; when out, I am me again. Also, As the weather is very bad, my excursion will be difficult, but I will do anything to go and get some oxygen.
Short walk from the station	21	Morning promenade with the doctor.
Videos/films	20	Three movies on same night, interrupted by onion soup, dinner, cakes; a success! Also, Bat Night, complete with two Batman films.
Group service as recreation	16	F is in charge of group photo; took four times! Also, A new newspaper is published; less aggressive and offensive.
Enjoying the view as recreation	15	The view through the window is wonderful; it is always a pleasure to look at it.
Cards, board or group games	14	Playing cards in the bar is a good way to get to know the people better.
Hobbies	13	Some greatly enjoy tending the vegetable garden, which supplements our meals.

tributable to problems arising from frequent visits to the stations by scientists and others who are not a part of the main expedition. As one diarist wrote, "*Quand il n'y avait pas de bateau, c'était plus tranquille. . .*" (Life in the station was quieter when there were fewer [visits by] ships). In contrast to life at the insular stations, weather, ice, and distance limit access to the Dumont d'Urville station, and insulate the expedition from the perturbations of frequent visits from the outside world.

Physicians vs. Leaders

The diaries maintained by physicians were more negative in their tone and content than those of leaders, which largely is attributable to the decision to code medical treatments as negative. The proportions of positive entries were about the same for physicians and leaders (0.408 and 0.404, respectively). There is a striking difference in patterns of change (but not in absolute NPN values) between physicians and leaders. It appears that the experiences of physicians and leaders at remote duty stations are vastly different when measured unobtrusively over time by content analysis.

Positive-Negative Overall

Net positivity/negativity shows the overall difference between the Antarctic and insular bases to be small (-0.029 vs. -0.042 , respectively). The overall difference in this metric between physicians and leaders also is small (-0.053 vs. -0.013 , respectively), despite different (mostly opposite) patterns of change. The overall differences between Antarctic and insular bases and between the experiences of physicians and leaders are small, particularly when compared with the difference in overall NPN between the long- and short-duration missions (-0.015 vs. -0.210 , respectively). Some of this difference is attributable to the special conditions of the arduous, 69-d traverse (included as a short-duration mission in this analysis), and some to the negative reaction of one physician to a change in staffing plans. The results clearly show that the short-duration missions were described more negatively, overall, than the long-duration missions.

Implications of the Thematic Analysis

Reviewing the entries within each category led to the identification of specific themes or clusters of entries concerning similar topics. Themes were labeled as they emerged from the review of diary entries; there were no a priori expectations concerning themes, and no theme was imposed on the data set. The more than 1800 entries were assigned to 22 behavioral categories; from these, 113 themes emerged. The number of themes to emerge from each category ranged from a low of 1 to a high of 17; generally, more entries in a category resulted in more emergent themes. Implications of the thematic analysis are provided below only for the most salient behavioral category.

Group Interaction

It is instructive, and a bit disturbing, to note that "Interpersonal Conflict" is the most frequent theme to

emerge from the most frequently assigned category of behavioral issues. The salience of this theme is particularly noteworthy because these expeditions were considered to be relatively harmonious. The instances of interpersonal conflict mentioned by the diarists are not terribly serious, nor were any a threat to safety or mission success. However, the number of instances reported and the amount of attention devoted to them in the diaries suggests that interpersonal conflict was both relatively frequent and of great concern to the diarists.

It is equally instructive to note that the second, third, and fourth highest-ranked themes within the category of Group Interaction all refer to activities that imply getting along with each other, rather than to conflict. "Celebration/special meal brings us together," "Teamwork/solidarity," and "Group discussion" contain entries that describe camaraderie in social exchange and cooperation in work. There are more references to "Not fitting in" than to "Fitting in," which reflects the emphasis on getting along with each other, and in this way, the salience of the incidents. This interpretation is supported by the larger numbers of references to "Teamwork/solidarity" and "Spirit is good/high morale" than to "Lack of cooperation/teamwork" and "Spirit is bad/low morale."

Johnson and Suedfeld (5) found that Arctic explorers and whalers attempted to reconstitute a part of their home while they were isolated in the Arctic. In this attempt, they engaged in activities that were similar to accustomed activities. The celebration of special occasions is, in part, an expression of the tendency to create a bit of familiar home life when living and working in isolation and confinement. Events and special celebrations are mentioned 200 times in the diaries, and most of these entries are positive in tone. The French expeditioners celebrated numerous occasions: birthdays, religious and national holidays, special theme dinners, feasts and parties, and sometimes no pretext except to break the monotony of their routine. The event most frequently mentioned is Midwinter, an occasion unique to the polar regions. All of the diarists wrote about it except the two who were not present at Midwinter. Midwinter is discussed in psychological terms only six times; among these entries, five are negative in tone because the diarists were reminded of the long time remaining in the missions. Other negative midwinter entries concerned either the preparation for the feast, or the feast itself, in which some individuals did not want to participate.

National and religious holidays appear 47 times. Among these holidays, Christmas and New Year's Eve are the most salient celebrations. They are always mentioned if diarists were in Antarctica at this time. The few negative entries were linked to homesickness, especially at Christmas time, which is a traditional family feast (for instance, one diarist wrote: "Christmas is the first recall of our isolation from people we love"). Also, each month, a party and/or special dinner was held to celebrate the birthdays among the crew during the month, sometimes with handmade gifts.

The salience of "Problems with crew relief/switchover" and "Trivial issues are exaggerated" confirms the

results of previous research and operational experience. Crowded conditions, disruption of work schedules, and ambiguity concerning roles all occur when new personnel share an ICE with those who are being relieved. Similarly, the tendency for remote duty personnel to exaggerate trivial issues beyond reasonable proportions has been elevated to a principle of habitability. The current analysis suggests that these topics should be of particular concern to mission planners and the designers of remote duty habitats.

Many of the entries concerning interpersonal conflict describe incidents that occurred between members of subgroups within the expedition. Generally, support personnel believe that scientific staff do not fully appreciate their contributions to the expedition, so they complain about their work and ridicule the scientists. There have been conflicts between ships' personnel and civilians onboard since the earliest explorers included scientists in their expeditions. The formation of subgroups is a natural phenomenon and can contribute to individual adjustment, if not permitted to develop to the extreme. The main subgroups at the French remote duty stations were: a) support personnel; b) military personnel on temporary assignment; and c) scientific staff.

CONCLUSIONS

This research identifies the behavioral issues associated with long-duration isolation and confinement and places the issues in order of importance, using quantitative means. Study results provide clear indications of the priority that should be placed on the various behavioral issues to prepare for isolation and confinement, such as long-duration orbital missions, and lunar and planetary expeditions.

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