Individual Traits, Personal Values, and Conflict Resolution in an Isolated, Confined, Extreme Environment

Jesper G. Corneliussen; Gloria R. Leon; Anders Kjærgaard; Birgit A. Fink; Noah C. Venables

BACKGROUND: The study of personality traits, personal values, and the emergence of conflicts within groups performing in an isolated, confined, and extreme environment (ICE) may provide insights helpful for the composition and support of space crews for long duration missions.

METHODS: Studied pre/post and over the 2-yr period of the investigation were 10 Danish military personnel deployed to stations in Greenland on a 26-mo staggered rotation. Subjects completed the NEO PI-R, Triarchic Psychopathy Measure, and Portrait Values Questionnaire, and participated in structured interviews. During deployment, questionnaires were completed biweekly and a cognitive function test once a month.

RESULTS: Personality findings indicated a generally well-adjusted group, above average in positive personality traits [Conscientiousness T-score = 59.4 (11.41); Agreeableness T-score = 54.4 (9.36)] and boldness. Personal values of benevolence and self-direction were highly rated. The decision when to "pick sides" and intervene during disagreements between group members was viewed as an important component of conflict resolution. There were no changes in positive/negative affect or cognitive function over the annual light/dark cycle.

DISCUSSION: The personal values of group members appear highly compatible for living in a small group ICE environment for an extended period. Disagreements between group members impact the functioning of the entire group, particularly in regard to decisions whether to support one of the individuals or let the argument run its course. Extended training in strategies for conflict resolution are needed in planning for future long duration missions to avoid fault lines forming within the group.

KEYWORDS: personality, personal values, conflict resolution, analog environment.

Corneliussen JG, Leon GR, Kjærgaard A, Fink BA, Venables NC. *Individual traits, personal values, and conflict resolution in an isolated, confined, extreme environment.* Aerosp Med Hum Perform. 2017; 88(6):535–543.

The optimal composition of crews for space missions continues to be a topic eliciting considerable attention.[2,16,29] The identification of salient individual and team factors, including personality characteristics and personal attitudes and values, becomes increasingly important as plans accelerate for long duration missions. Evaluation of interpersonal and task processes within a confined small group environment may also have application for space environments.

Confidentiality is a concern in the publication of astronaut personality and performance data. However, studies of polar expedition and work groups living and working for extended periods in isolated, confined, and extreme (ICE) environments can serve as one type of analog. Clearly, an analog is a simulation of specific aspects of the situation of interest and does not provide all of the components of the situation itself; in this case, the space environment. However, the ICE analog can provide relevant information on how small groups interact together while living and working in a confined and environmentally challenging situation, with limited contact with the outside world, and during periods in which there are limited possibilities for evacuation.

From the Department of Psychology, Aalborg University, Aalborg, Denmark, and the Departments of Psychology and Psychiatry, University of Minnesota, Minneapolis, MN.

This manuscript was received for review in November 2016. It was accepted for publication in March 2017.

Address correspondence to: Gloria R. Leon, Ph.D., Department of Psychology, University of Minnesota, Elliott Hall, 75 E. River Rd., Minneapolis, MN 55455; leonx003@umn.edu.

DOI: https://doi.org/10.3357/AMHP.4785.2017

Research on different types of expedition teams indicates that individuals engaging in these activities were high on traits related to achievement motivation, low on stress reactivity, and at average levels compared to population norms on risk taking tendencies.[13] The highly selected Danish military patrol teams operating in the Arctic were above average on the positive/adaptive NEO PI-R traits, and scored at average levels or below on neuroticism.[8] They also were high on a boldness factor, reflecting adventurous, fearless, and social poise characteristics. Assessment of polar work group personnel indicated that those judged notably well adapted in terms of psychological functioning, social adaptability, and work performance had high scores on the NEO-FFI Openness factor;[4] the best work performers among Antarctic winter-over personnel scored low on neuroticism, need for order, and achievement motivation.[19] High dominance traits in a two-member special forces expedition team was associated with strong disagreements on the strategies of the expedition, suggesting less than optimal characteristics in confined groups/dyads.[14]

The personal and social values of individuals confined for long duration periods requiring living in close proximity and performing tasks with great efficiency may also prove to be an important factor in selection and group processes. Assessment of a mixed gender group of astronauts indicated personal values of achievement, enjoyment, and self-direction in both male and female spacecrew.[28] Self-direction, universalism, and stimulation were the values most highly rated by polar military patrol teams.[8] A review of the personal values of diverse groups performing in extreme environments indicated consistency in the high valuation of self-direction, stimulation, universalism, and benevolence.[27] This particular combination suggests individuals who self-identify as valuing independence and challenges, but yet are highly engaged in feelings of one with nature and the universe, and concerns about the welfare of others.[26]

Compatibility of values appears to be highly important for optimal team member performance over extended missions.[1] In the Mars-105 simulation study, tensions occurred among team members viewed as dissimilar in values.[22] Over the course of the following Mars-500 study, emphasis on self-direction increased, while valuation of benevolence, stimulation, and tradition significantly decreased.[23] Crewmembers attributed group tension to individual differences in benevolence.

As the distance from Earth and the resulting communication time lag increases, Mars crews will become more autonomous from mission control. They also will need to rely on each other for social interactions rather than communicating regularly with family and friends. However, greater autonomy presents a significant challenge; group process studies indicate that interpersonal conflict and poor group cohesion have a detrimental influence on both work performance and well-being.[1] Findings of a decrease in cohesiveness, social support, and work performance in an international mixed profession group over the course of a 1-yr Antarctic stay points to the importance of maintaining adequate adaptation and performance in ICE environments.[18]

The influence of a challenging and potentially dangerous external environment is an additional factor to consider in terms of individual and team functioning over a long-duration period. Personnel living and working in the extreme cold and extended darkness of a high latitude Antarctic environment showed increases in depressive mood and interpersonal conflicts, and a decrement in work performance over the total dark winter-over period.[20] Disruption of the normal circadian sleep rhythm may occur as well, resulting in difficulties in falling asleep, and less deep sleep and dreaming.[17,20,24] The effects of total darkness on mood and cognitive function in the group studied in this investigation has application for a Mars mission in terms of dealing with the challenging and dangerous environment on the Mars planetary surface.

The overall focus of this 2-yr field study was to address some of the gaps in the literature on relationships between individual characteristics and values and group experiences in ICE environments. A specific aim was the assessment of the process of conflict resolution when disagreements occurred in a naturalistic rather than laboratory setting. A further aim was to examine the influence of the challenging polar environment on mood and cognitive functioning, with possible application for other types of extreme environments.

METHODS

Subjects

A total of 10 male Danish military subjects participated in this study. Subjects were deployed to Greenland on a staggered 1-yr rotation; therefore, approximately half of the group consisted of new members each year. Subjects ranged in age from 24 to 33 ($M = 27.4$, $SD = 2.46$); seven had a ninth/tenth grade education and three had graduated from gymnasium or a technical school. Three had served previously in the Middle East as part of the Danish NATO forces. Subjects volunteered for the Greenland assignment and were selected based on technical skills as well as psychological and medical evaluation. The recruitment requirement was that the individual had completed basic military training prior to the first selection round. In general, the selection procedure is a successive process commencing with physical strength measures, a cooperation task, and interviews. The next round includes psychological and intelligence testing, cooperation tasks, and further interviews. A group of 3–4 applicants are then selected for the "preschool," consisting of training in winter survival, first aid, and instruction on the heavy equipment used at the station. The final selection is made approximately 7 mo later.

The subject cohort in Year 1 consisted of two subjects who had completed 1 yr of service at Station Nord before entrance into the study, an additional three subjects who were on their initial assignment to Station Nord, and one to Mestersvig Station. The subject cohort in Year 2 consisted of the two Station Nord subjects, now in their second year of deployment, plus three newly deployed subjects to Station Nord, and one to Mestersvig. One subject participated only in the pre- and

postdeployment evaluations. One subject stopped participating in the on-site ratings after 9 biweekly intervals, a second after 5 intervals.

Procedure

Because of the staggered rotation of personnel to the Greenland stations and some rotation exigencies in terms of military needs, it was not possible to examine a group consisting of the same subjects over the 2-yr period of the study. Our strategy was to focus on the experiences of individuals within a group, enabling the aggregation of data from two small group samples. All subjects were chosen for Greenland service from the same overall subject pool; they were assigned to either one of two military stations with similar environmental and work conditions. Predeployment interviews, personality and values measures, and training on the WinSCAT cognitive measure were carried out in Denmark prior to departure. These procedures were repeated in Greenland for the subjects already there.

Over the course of their deployment, subjects independently completed the Weekly Rating Form on a biweekly basis and the WinSCAT once a month. Following each testing interval, data were transmitted via email to one of the investigators. Postdeployment debriefing interviews and personality/value measures were carried out in Denmark for those who completed their assignment after Year 1; debriefing interviews and personality/value measures were carried out in Greenland for the remaining subjects at the end of Year 2. For logistical reasons, the NEO PI-R was not repeated at the post-testing. Following the debriefing segment, two supervisors in Denmark were asked to rate the subjects in regard to overall social and work performance on a scale of 1 (best) to 5 (least good) to obtain an objective measure of performance.

The study was approved by the University of Minnesota IRB and the Danish military. Written informed consent of subjects was obtained. Forms were identified by subject code number and confidentiality was maintained. The data were not shared with the Danish military or any other group.

Station Description

Station Nord is located at 81°43′ latitude, Mestersvig Station at 72°14′ latitude. Both are within the Northeast Greenland National Park. The stations are Danish military outposts with a key function of maintaining Danish sovereignty of Greenland. Major activities at each station involve maintaining and keeping open a large gravel airstrip capable of handling large cargo planes, building maintenance, communication, and general support for scientists and other military units, primarily the Danish Sirius Patrol teams. Temperatures range from −45°C at the end of December to +8°C in July; total winter darkness is from mid-November to the end of January, total light from the third week in April until mid-August. Personnel are deployed for a 26-mo period, interspersed with a 3-wk summer holiday. Except for the busy summer season, five to six men are stationed at Station Nord, and two at Mestersvig Station. During the summer, typical of polar stations elsewhere, construction, maintenance, and scientific personnel are present; food, fuel, and other supplies are transported during this period via airplane. One or two short outside visits occur during the autumn period. In the past year, the Villum research station, Aarhus University, Denmark, was opened at Station Nord, bringing in male and female scientists for short periods during the spring and summer. The Station Nord personnel have access to email and are allowed periodic calls to family and friends in Denmark via satellite phone.

Measures

A standardized Danish version of the NEO PI-R was used in the study. Translation and back translation procedures were carried out to develop Danish language versions of the other personality and rating measures. The WinSCAT instructions were in English.

NEO PI-R. The 63-item Danish version of the NEO PI-R[3] assesses five independent personality traits: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. The factors assessed by the NEO-PI-R have been shown to have considerable cross-cultural stability.[15]

Triarchic Psychopathy Measure. The Triarchic Psychopathy Measure (TRI-PM)[21] is a 58-item inventory assessing Boldness, Meanness, and Disinhibition factors of psychopathy. Boldness denotes an interpersonal style of social dominance, adventure-seeking, and relative immunity from fear and stress while remaining calm in stressful and dangerous situations. Disinhibition denotes a propensity toward impulsivity and a lack of behavioral restraint. The Meanness (callousness) factor denotes cruelty and deficient empathy. Items corresponding to each scale are summed and then prorated so each scale ranges in value from 0 (low) to 1 (high).

Portrait Values Questionnaire. The Portrait Values Questionnaire (PVQ)[25,26] is a 40-item measure assessing 10 major distinct values and the perceived importance of these values. The value scales are as follows: Tradition, Universalism, Self-Direction, Simulation, Hedonism (Enjoyment), Achievement, Power, Security, Conformity, and Benevolence. Respondents rate on a 6-point scale how much this person is like him/her. The individual scales are scored by applying a correction for individual differences in response style. The mean of the raw score on each scale is "centered" by subtracting the mean score of the rankings on all 40 items. The discriminant validity of the 10 PVQ values across cultures has been demonstrated.[25,26]

Spaceflight Cognitive Assessment Tool for Windows. The Spaceflight Cognitive Assessment Tool for Windows (WinSCAT)[5] is a computer performance test consisting of five subtests assessing different cognitive functions. The Index of Cognitive Efficiency is a weighted score giving the four included tests equal weight. According to the experience of the test developers, the Index of Cognitive Efficiency scores typically range between 300 and 600 (Seaton, KA; personal conversation; September 24, 2016).

Weekly Rating Form. The 82-item Weekly Rating Form (WRF) has been used in previous expedition studies,[10–12] modified as needed for the specific circumstances of the Station Nord/Mestersvig environment and the questions addressed in this investigation. The individual sections are: Feelings and Emotions (Positive and Negative Affect Schedule; PANAS);[30] Symptoms of Depression (Patient Health Questionnaire; PHQ-9);[9] Environmental and Physical Factors; Positive and Negative Event Checklist; Coping Checklist; Strategy/Decision Processes; and Other Important Events. PANAS ratings range from 1 (not at all, very little) to 5 (extremely); PHQ-9 items are rated as "Over the last two weeks, how often have you been bothered by any of the following problems," ranging from 0 (not at all) to 3 (almost every day).

Predeployment interview. The predeployment interview is a 12-item semistructured interview assessing training experiences and expectations about deployment to Greenland.

Postdeployment debriefing interview. The postdeployment debriefing interview is a 60-item semistructured interview assessing in greater detail the research questions posed in this investigation. There was a particular emphasis on team interactions and decision processes, and possible changes in these factors over the course of the Greenland deployment.

Statistical Analyses

The overall approach was to use descriptive statistics (mean, SD) to assess the variables of interest, followed by repeated measures ANOVA or paired samples *t*-tests as appropriate (SPSS version 22). We did not conduct quarter analyses because the specific composition of the groups varied from one year to the next. However, the analyses on the mood and cognitive measures grouped according to light/transition/dark periods include all subjects in each of these conditions, enabling the assessment of possible changes over specific environmental conditions. The first WinSCAT test was not included in the analyses to avoid a possible learning curve on this measure. The Events and Coping items endorsed by each subject were analyzed by the percentage of time a particular item rating [either 1 (yes) or 2 (no)] was made in relation to the number of biweekly intervals in which the subject did a rating. Using this procedure, missing data were not presumed to be a lack of endorsement of an item.

RESULTS

The NEO PI-R findings indicated a generally well-adjusted group, although with individual differences as noted by the standard deviations on each factor. The Neuroticism factor score was below the standardization group average levels (T = 44.1, SD = 13.4); the relatively highest scores were on Conscientiousness (T = 59.4, SD = 11.4) and Agreeableness (T = 54.4, SD = 9.36). The NEO PI-R T-score profile of Subject #20, independently judged by external evaluators as having exhibited excellent social and work performance while in Greenland (mean rating = 1.5), was as follows: Neuroticism–30; Extraversion–59; Openness–53; Agreeableness–65; Conscientiousness–71. This pattern reflects a psychologically well-adjusted individual, showing an overall configuration of positive traits, and particularly high on conscientiousness and agreeableness (**Table I**).

The TRI-PM evaluation demonstrated high scores on the Boldness factor in combination with low scores on Disinhibition and Meanness, reflecting a group of adventurous individuals who are not prone to emotional dysregulation and callous behavior toward others. There were no significant differences on the TRI-PM comparing the pre- to the post-assessments. A high score

Table I. Personality Traits and Personal Values of Greenland Personnel Over the Deployment Period.

	GROUP (PRE)			
FACTOR/SCALE	**M**	**SD**	**CASE EXAMPLE**	
NEO PI-R+				
Neuroticism	44.1	13.4	30	
Extraversion	52.2	11.69	59	
Openness	52.4	6.99	53	
Agreeableness	54.4	9.36	65	
Conscientiousness	59.4	11.41	71	
	PRE		**POST**	
	M	**SD**	**M**	**SD**
TRI-PM++				
Disinhibition	0.23	0.13	0.19	0.04
Boldness	0.69	0.15	0.64	0.19
Meanness	0.22	0.12	0.19	0.89
PVQ+++				
Tradition	−1.01	0.50	−0.93	0.65
Universalism	0.18	0.54	−0.20*	0.74
Self-Direction	0.80	0.38	0.84	0.49
Stimulation	0.07	1.12	0.06	0.99
Hedonism	0.78	0.35	0.76	0.38
Achievement	−0.34	0.70	−0.43	0.98
Power	−1.41	0.89	−0.68***	1.03
Security	−0.27	0.56	−0.02	0.79
Conformity	0.50	0.53	0.37	0.53
Benevolence	0.61	0.62	0.48	0.51

N = 10.
NEO PI-R = NEO Personality Inventory-Revised; TRI-PM = Triarchic Psychopathy Measure; PVQ = Portrait Values Questionnaire.
* $P = 0.059$; *** $P < 0.001$.
+ Indicates *t*-scores; standardized score with mean 50, SD 10.
++ Scores range from 0 (low) to 1 (high).
+++ A correction for individual differences in response style is applied by "centering" the mean of the raw score on each scale by subtracting the mean score of the rankings on all 40 items.

on the Boldness factor and low scores on Disinhibition and Meanness also were noted for Subject #20 (Boldness Pre = 0.77, Post = 0.75; Disinhibition Pre = 0.1, Post = 0.17; Meanness Pre = 0.05, Post = 0.14).

The PVQ predeployment evaluation indicated self-identification with the following hierarchy of values: Hedonism (enjoyment), Self-Direction, Benevolence, and Conformity; the lowest value scores were Power, Tradition, and Achievement. At the post-evaluation, there was a significant increase in the Power value, although remaining in the least valued part of the hierarchy [$t(8) = -3.98$, $P = 0.004$]; the Universalism value exhibited a trend-level decline [$t(8) = 2.20$, $P = 0.059$]. However, the hierarchy of values remained relatively similar: high valuation of Self-Direction, Hedonism, Benevolence, and Conformity; low valuation of Tradition, Power, and Achievement.

The PANAS ratings were assessed for differences comparing Positive Affect (PA, M = 3.0, SD = 0.57) with Negative Affect (NA, M = 1.14, SD = 0.12) across the study period, which indicated PA was significantly higher than NA [$t(8) = 9.0$, $P < 0.001$]. There were no significant differences in PA or NA across the light/transition/dark periods: light period (PA, M = 2.99, SD = 0.61; NA, M = 1.18, SD = 0.17); transition (PA, M = 3.05, SD = 0.64; NA, M = 1.15, SD = 0.11); dark (PA, M = 2.91, SD = 0.68; NA, M = 1.10, SD = 0.12).

The PHQ-9 data were calculated as an overall score across the participation period for each subject and by light/transition/dark periods. The overall depression mean score = 1.99, SD = 0.16. The items rated were primarily sleep problems (49.26% positive endorsements) and fatigue, no energy (61.09% positive endorsements). There were no endorsements of cognitive symptoms such as negative feelings about oneself. Further, there were no significant differences in depression score comparing the light/transition/dark periods ($P = 0.104$) (light, M = 1.83, SD = 1.34; transition, M = 2.0, SD = 1.39; dark, M = 2.49, SD = 1.15). A comparison of the light and dark periods indicated a trend ($P = 0.067$) for a higher score in the dark period.

The Events ratings demonstrated that a high proportion of positive events was endorsed; "Feelings of camaraderie/closeness with a co-worker" (35%); "Satisfaction that I am able to cope with the challenges" (32.8%); "Satisfaction in making good progress today" (28.2%); and "Satisfaction that the equipment is working properly" (21.3%). The least rated items included "Feeling down/low because a co-worker is feeling that way" (0.5%); "Fear of being injured" (0.7%); and "Personal hygiene/wanting to be cleaner" (0.7%) (**Table II**).

The mean highest percentage of coping mechanisms endorsed to deal with stressors were: "Kept a positive attitude. Humor, joking around, having fun." (26.9%); "Thought of something pleasant, good times to come." (24.5%); and "Tried to figure out how to solve the problem that's bothering me." (24%). The least endorsed methods were: "Cried" (0.3%); "Prayer" (0.4%); and "Negative Feelings about myself." (0.6%) (**Table III**).

The WinSCAT Index of Cognitive Efficiency scores were assessed as a summary measure of cognitive function. The overall mean score = 404.9, SD = 84.89. This score is within the range found for subjects assessed in space-related settings. There were no significant differences in scores comparing the light/transition/dark periods (light, M = 414.51, SD = 105.08; transition, M = 398.42, SD = 79.56; dark, M = 401.79, SD = 84.61).

Table II. Mean Percentage of Significant Events Endorsed Over the Course of Deployment.

ITEM	%*
Problems with gear and equipment	16.4
Feeling of camaraderie/closeness with a coworker	35.0
Concern about the well-being of a coworker	2.8
Enjoyment of the Arctic environment	28.7
Concern about how effective my coworkers and I are working together	7.0
Feeling down/low because a coworker is feeling that way	0.5
Tension or argument with a coworker	9.4
Satisfaction in making good progress today	28.2
Satisfaction that equipment is working properly	21.3
Satisfaction that I am able to cope with the challenges	32.8
Concerns about the effectiveness or safety of decisions I made today	0.8
Fear of being injured	0.7
Worried about family, friends	4.0
Loneliness, homesickness	11.1
Personal hygiene (wanting to be cleaner)	0.7
Lack of privacy, time for myself	14.2
Worried about encountering bad weather	3.9

* Mean percentage of rating periods in which a particular item was endorsed.

Table III. Mean Percentage of Coping Mechanisms Endorsed Over the Course of Deployment.

ITEM	%*
Told myself, "take it one day at a time. Live with it, accept it."	8.9
Kept my feelings to myself.	14.6
Discussed task concerns with a coworker.	17.2
Discussed personal/emotional concerns with a coworker.	3.0
Tried harder. Pushed myself to do my best, told myself I can do it.	15.7
Prayer. (For God or others)	0.4
Saw the situation in a very positive way, what I'm learning and getting out of it.	21.6
Kept a positive attitude. Humor, joking around, having fun.	26.9
Cried	0.3
Relaxed, meditated, listened to music, daydreamed.	9.0
Kept the goal in sight. Thought about finishing the assignment and why I am here.	14.3
Thought of something pleasant such as good times to come.	24.5
Tried to figure out how to solve the situation that's bothering me.	24.0
Negative feelings about myself.	0.6
Negative feelings about a coworker.	9.0
Yelled, stomped, threw things around.	1.5

* Mean percentage of rating periods in which a particular item was endorsed.

Interview Excerpts

Understanding the experiences of the subjects through "their own voices" provides a perspective that supplements the quantitative data obtained. These excerpts encompass comments from each of the subjects and indicate motivations for applying for service in an ICE environment, positive experiences, the nature of the conflicts experienced and the effects on the overall group, conflict resolution, and personal insights on relating to others over an extended period.

The predeployment interviews indicated that a number of subjects viewed the primary motivation for their 26-mo

deployment to the Arctic as an opportunity for personal growth and insight.

"Discover new facets of yourself. Friendships for life."

"Both human, professional and intellectual….to learn from previous mistakes… to become a better craftsman…. to feel that I have learned something academic."

"How to find myself…I would like to find out what I appreciate at home through what I didn't have/find at Station Nord."

The primary motivation indicated (in retrospect) in the postdeployment interviews for volunteering for Station Nord involved strivings for self-efficacy and learning new skills.

"To test myself; to experience a lot of new things."

"To work with 5 or 6 guys on their own without any help from the outside. If you don't know how, you have to fix it anyway."

"Something special to do that not everyone gets to do. Very competitive, it makes you feel very special, gives you the responsibility to do it well."

Positive experience topics related to group camaraderie, the peacefulness of the environment, and satisfaction in work accomplishments were evident.

"The people you meet and the friendships that are made."

"The holidays, Christmas and New Years. We were only 6 guys up here, so we had some days off, relaxed, enjoyed ourselves…a nice Christmas dinner."

"The peace up there, to eat together without telephones. It leads to better conversations, you have more eye contact."

"That it worked so well. There were less minor problems than I expected."

"Arriving here and applying what I had learned and had been working for to get here."

"That I put my own touch on (the station). I did my work and tried to get a bit out of it as well."

"When the sun came out."

Differences of opinion during Year 1 centered on decisions regarding when and how to resolve conflicts.

"…all the small things because the big things we are pretty much agreed about. Sometimes you don't resolve them because you have to pick the big fights, not the small ones…When people have an opinion and another guy has an opinion and you can't find a solution. You can't do anything about it."

"…After 6 months you get to know the others routines and you know what they like and don't like so we make it work that way. If it was something important then we would discuss it and come to an agreement. If we couldn't find a solution we just agreed that we had different opinions and that was just the way it was. Sometimes just ignore it if it is a small matter. But people are different so there will be some differences."

Disagreements during Year 2 centered on the differences of opinion/conflicts between two of the subjects who were assigned to work together based on their complementary skills. The effects on the group were as follows:

"It has irritated the other guys up here quite a bit. When you are as few and isolated as we are, it affects the rest of the group. People have taken sides, me too, but I kept it to myself…others might get involved in the argument…. But when part of the group has a disagreement and it goes on for more than a few hours I think everyone gets affected. You need to address the issues. If you don't do that people will quite quickly drift apart."

Picking sides became an issue:

"Most of the times (they) have figured it out themselves, and then the people who picked sides didn't make a big deal out of it afterwards."

"When people have had enough of the arguing…just let them work it out by themselves….People would just go off to their own work areas."

(Station leader comments). "I try to stay out of it and just not pick a side. And then if one of them has a valid point in the discussion and it is a work related thing, I would back that person. Not by excluding the other one, but telling them why that would be a good way to solve the issue."

Perceptions of work efficiency recognized individual differences.

"All the guys have different rhythms in their working…See it mostly in the winter time because we are so close together."

Comments regarding teamwork and personal relationships showed insights about how a small group can effectively work together.

"Solidarity regarding work. Everybody does it together. The work goes fast. Feel the solidarity in the task."

"If we are fed up with each other, then teamwork is difficult and you don't like the others. Then the tasks don't get solved properly."

"Honesty, and that you have to address the conflicts before they escalate…that you have to talk to the specific person directly."

"Having self-awareness and empathy. Being able to reflect whether it is you or your co-worker who is wrong if things don't work."

"Are here to work together, not necessarily to be friends."

"That you can be two different personalities but still be able to work together. You might not be socializing a lot but you still help each other out and respect each other."

"We didn't talk about personal things but we were good at keeping conversations going - even if we had had a quarrel. We were good at doing things together where we found a level where we both could join."

Conversely, one subject highly valued a close personal relationship.

> *"Saturday evenings where we had a few glasses of red wine. Those evenings we spoke about things you only talk to close friends about."*

Boredom was related to times when conflicts might arise.

> *"When we are bored, it is not so good. So it is important to always have something to do."*

> *(Winter darkness) "It was boring. In spite of doing the same every day, little things can make the day special. You must find the little cheerful things yourself."*

> *"You have to enjoy the time off. If the spare time works then the work routines become better."*

In the view of the subjects, applications for space related to communication issues and tolerance:

> *"Honesty is important, and being able to communicate and get along. It is really important to be courteous and polite to each other."*

> *"To be tolerant when you live so close together and do not see other people. Irritations must be dropped, otherwise you cannot sleep. You must have a conversation during mealtimes, or it becomes too weird."*

> *"You must be tolerant with people's eccentricities…nobody is alike, everybody is different."*

> *"The possibility to shut out (find privacy). Possibly a room for reflection, where you can have privacy and it gets respected."*

DISCUSSION

The findings of this study indicate a hardy group of individuals, highly motivated to test themselves and experience the challenges of living for an extended period in a harsh and confined environment. The positive experiences noted centered on aspects of group camaraderie, satisfaction in work performance, and enjoyment of the Arctic environment.

The subjects' personality profiles demonstrated traits similar to the findings from a study of Danish military special forces teams in the Arctic: low in neuroticism, higher than the standardized mean on all positive factors, high on boldness, and low on disinhibition and meaness.[8] This trait configuration was particularly notable on the NEO PI-R and TRI-PM profiles of the subject judged to have performed in an excellent manner throughout the course of his deployment. In our view, a predominance of positive personality traits, including boldness (adventure seeking, social poise, emotional resiliency), and a low propensity for callous and emotionally dysregulated behavior appear to be an excellent combination for optimal functioning in certain ICE environments, as long as these factors are not at the extreme of the trait dimension. For astronaut selection, it may be more productive to focus on overall positive psychological adjustment rather than searching for specific "right stuff" traits among this configuration.

The personal values held by group members may also facilitate their adaptation to ICE environments. The subjects in this study tended to self-identify and show stability over time with values of hedonism (enjoyment), self-direction, and benevolence. This hierarchy of values is consistent with the challenge of their situation in terms of valuing enjoyment of life, independent thought, and enhancing the welfare of other people one is in contact with.[25,26] The value of benevolence, related to feelings of camaraderie within a group, may be particularly important for facilitating a small group of people to live together in a confined environment for an extended period. For example, in the Mars-500 study, participants attributed tension within the group to individual differences in the valuation of benevolence.[23] Of interest, benevolence was one of the lowest rated values prejourney in an expeditioner who completed a 260-d solo sailing voyage, although he showed a consistent increase in benevolence valuation from prejourney up to the final 6-mo follow-up.[7]

The lower importance of stimulation and universalism values in the current group appears adaptive for living in a confined environment for an extended time, particularly during the darkness period. The decline in universalism at the postevaluation may reflect a constriction of interest in the outside world because of living in the limited physical area of the station. In a related manner, the increase in the power value over time reflects a greater interest in social recognition, possibly from a larger group.[25]

Along with the personality traits and attitudes expressed in a particular environment, the environment itself has an influence on behavior. One such factor in the current study was the periods of total darkness and light. However, over the course of the deployment, positive affect was significantly higher than negative affect. The predominance of positive affect also was demonstrated comparing the light, transition, and darkness periods, which was not moderated by the light/dark cycle. Overall, depression symptoms were moderate and primarily related to sleep problems and fatigue, although there was a trend for higher scores during the dark period. In addition, changes in the light/dark cycle had no significant effect on cognitive functioning. These findings suggest that individual resilience characteristics may override some of the detrimental effects of particular environmental conditions such as constant daylight or darkness for extended periods.

The events subjects rated as occurring with relative frequency indicated well-functioning groups; positive events reflected camaraderie among coworkers, positive feelings of self-efficacy, satisfaction in one's work performance, and enjoyment of the environment. The coping mechanisms used to deal with stressors also were highly adaptive; cognitive strategies included finding a meaning in the difficult situations one is dealing with, keeping a positive attitude, and focusing on problem solution.

The interview excerpts provide insights into how the group dealt with disagreements among members and conflict resolution. While the emotional climate of the group was generally positive, a theme that emerged was deciding when a

disagreement was important enough to "pick a fight," or just allow the particular situation to resolve itself. Disagreements between two of the members clearly had an impact on the others in the group. In a confined and isolated environment, this situation could prove highly detrimental to the functioning of the entire group, potentially resulting in fault lines in the group if other members consistently choose to side with one individual over the other.[2] In our view, the importance of deciding when to ignore an issue or when to address the particular disagreement is a significant aspect of conflict resolution that requires specific training prior to assignment to an ICE environment.

Comments about other aspects of group functioning centered on work vs. personal relationships. Preventing boredom was indicated as necessary for avoiding conflict within the group. Acknowledgment and toleration of the eccentricities of others also was seen as essential for optimal personal and work relationships. Several subjects noted the importance of solidarity in working together, although indicating that a close working relationship did not necessarily transfer to a close personal relationship. The importance of adequate communication in terms of balancing the disclosure of personal information to team members was noted in a study of Danish military patrol groups.[6]

This field study has several limitations in terms of group composition. The group was all men; thus, generalizations to mixed gender or all-female groups need to be made with caution. As in other investigations of polar work groups, the subjects studied were not comparable to astronauts/cosmonauts in academic and professional level; however, the experience of living and working in an ICE environment is a consistent factor across these studies.

Because of the staggered rotation, it was not possible to maintain a group composed entirely of the same members over the 2-yr duration of the investigation. Also, two of the subjects were deployed at another Greenland station. Therefore, our aim was to gain a better understanding of the performance of individuals within the group, rather than focusing on an ongoing group process. Further, we examined particular aspects of group processes such as conflict resolution to obtain insights regarding functioning in other types of ICE environments, including space.

In conclusion, an overall configuration of positive personality traits, along with boldness (adventurous), appears to be highly adaptive for long duration performance in an ICE environment. The personal value of benevolence likely facilitates group camaraderie, which in turn facilitates optimal work performance. Extended training in conflict resolution, with an emphasis on strategies for when/if to intervene in other group members' disagreements, also should be helpful for enhancing overall group functioning.

ACKNOWLEDGMENTS

We gratefully acknowledge the help of Torben Eriksen and Helle Christiansen in translating, and Marie Troelsgaard in conducting the interviews. The excellent support of the Danish Arctic Command and the UVG (Educational and Logistics Section) during all stages of this project was invaluable.

Authors and affiliations: Jesper G. Corneliussen, B.A., M.A., Department of Psychology, Aalborg University, Aalborg, Denmark; Gloria R. Leon, M.S., Ph.D., Department of Psychology, and Birgit A. Fink, B.A., and Noah C. Venables, M.S., Ph.D., Department of Psychiatry, University of Minnesota, Minneapolis, MN; and Anders Kjærgaard, B.A., M.A., Danish Defence, Copenhagen, Denmark.

REFERENCES

1. Bell ST, Brown SG, Abben DR, Outland NB. Team composition issues for future space exploration: a review and directions for future research. Aerosp Med Hum Perform. 2015; 86(6):548–556.
2. Bezrukova K, Jehn KA, Zanutto EL. Do workgroup faultlines help or hurt? A moderated model of faultlines, team identification, and group performance. Organization Science. 2009; 20(1):35–50.
3. Costa PT, McCrae RR. NEO PI-R. Professional manual. Odessa (FL): Psychological Assessment Resources; 1992.
4. Grant I, Eriksen HR, Marquis P, Orre IJ, Palinkas LA, et al. Psychological selection of Antarctic personnel: the "SOAP" instrument. Aviat Space Environ Med. 2007; 78(8):793–800.
5. Kane RL, Short P, Sipes W, Flynn CF. Development and validation of the Spaceflight Cognitive Assessment Tool for Windows (WinSCAT). Aviat Space Environ Med. 2005; 76(6, Suppl.)B183–B191.
6. Kjærgaard A, Leon GR, Fink BA. Personal challenges, communication processes, and team effectiveness in military special patrol teams operating in a polar environment. Environ Behav. 2015; 47(6):644–666.
7. Kjærgaard A, Leon GR, Venables NC. The "right stuff" for a solo sailboat circumnavigation of the globe. Environ Behav. 2015; 47(10):1147–1171.
8. Kjærgaard A, Leon GR, Venables NC, Fink BA. Personality, personal values and growth in military special unit patrol teams operating in a polar environment. Mil Psychol. 2013; 25(1):13–22.
9. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001; 16(9):606–613.
10. Leon GR, Atlis MM, Ones D, Magor G. A one-year three couple expedition as a crew analog for a Mars mission. Environ Behav. 2002; 34(5):672–700.
11. Leon GR, Kanfer R, Hoffman RG, Dupre L. Interrelationships of personality and coping in a challenging extreme situation. J Res Pers. 1991; 25(4):357–371.
12. Leon GR, Sandal GM, Fink BA, Ciofani P. Positive experiences and personal growth in a two-man North Pole expedition team. Environ Behav. 2011; 43(5):710–731.
13. Leon GR, Sandal GM, Larsen E. Human performance in polar environments. J Environ Psychol. 2011; 31(4):353–360.
14. Leon GR, Venables NC. Fearless temperament and overconfidence in an unsuccessful special forces polar expedition. Aerosp Med Hum Perform. 2015; 86(6):567–570.
15. McCrae RR, Allik J, editors. The five-factor model of personality across cultures. New York: Kluwer Academic Publisher; 2002.
16. Musson DM, Sandal GM, Helmreich RL. Personality characteristics and trait clusters in final stage astronaut selection. Aviat Space Environ Med. 2004; 75(4):342–349.
17. Natani K, Shurley JT, Pierce CM, Brooks RE. Long-term changes in sleep patterns in men on the South Polar Plateau. Arch Intern Med. 1970; 125(4):655–659.
18. Nicolas M, Bishop SL, Weiss K, Gaudino M. Social, occupational, and cultural adaptation during a 12-month wintering in Antarctica. Aerosp Med Hum Perform. 2016; 87(9):781–789.
19. Palinkas LA, Gunderson EK, Johnson JC, Holland AW. Behavior and performance on long-duration space flights: evidence from analogue environments. Aviat Space Environ Med. 2000; 71(9, Suppl.): A29–A36.
20. Palinkas LA, Houseal M, Rosenthal NE. Subsyndromal seasonal affective disorder. J Nerv Ment Dis. 1996; 184(9):530–534.

21. Patrick CJ. Operationalizing the triarchic conceptualization of psychopathy: preliminary description of brief scales for assessment of boldness, meanness, and disinhibition. [Unpublished manual.] Tallahasee (FL): Florida State University; 2010.
22. Sandal GM, Bye HH. Value diversity and crew relationships during a simulated space flight to Mars. Acta Astronaut. 2015; 114:164–173.
23. Sandal GM, Bye HH, van de Vijver FJR. Personal values and crew compatibility: results from a 105 days simulated space mission. Acta Astronaut. 2011; 69(3–4):141–149.
24. Sandal GM, Leon GR, Palinkas LA. Human challenges in polar and space environments. Rev Environ Sci Biotechnol. 2006; 5(2):281–296.
25. Schwartz SH. Value orientations: measurement, antecedents and consequences across nations. In: Jowell R, Roberts C, Fitzgerald R, Eva G, editors. Measuring attitudes cross-nationally – lessons from the European Social Survey. London: Sage; 2006:169–204.
26. Schwartz SH, Melech G, Lehmann A, Burgess S, Harris M. Extending the cross-cultural validity of the theory of basic human values with a different method of measurement. J Cross Cult Psychol. 2001; 32(5):519–542.
27. Smith N, Sandal GM, Leon GR, Kjærgaard A. Examining personal values in extreme environments: revisiting the question of generalizability. Proceedings of the 67th International Astronautical Congress (IAC); 26–30 September 2016; Guadalajara, Mexico. Paris (France): International Astronautical Federation; 2016.
28. Suedfeld P, Legkaia K, Brcic J. Changes in the hierarchy of value references associated with flying in space. J Pers. 2010; 78(5):1411–1436.
29. Ursin H, Etienne JL, Collet J. An Antarctic crossing as an analogue for long-term manned spaceflight. ESA Bull. 1990; 64:44–49.
30. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. J Pers Soc Psychol. 1988; 54(6):1063–1070.