



Relations between daily events, coping strategies and health during a British Army ski expedition across Antarctica

Document Version

Accepted author manuscript

[Link to publication record in Manchester Research Explorer](#)

Citation for published version (APA):

Smith, N., Keatley, D., Sandal, G. M., Kjaegaard, A., Stoten, O., Facer-Childs, J., & Barrett, E. (2020). Relations between daily events, coping strategies and health during a British Army ski expedition across Antarctica. *Environment & Behavior*.

Published in:

Environment & Behavior

Citing this paper

Please note that where the full-text provided on Manchester Research Explorer is the Author Accepted Manuscript or Proof version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version.

General rights

Copyright and moral rights for the publications made accessible in the Research Explorer are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Takedown policy

If you believe that this document breaches copyright please refer to the University of Manchester's Takedown Procedures [<http://man.ac.uk/04Y6Bo>] or contact uml.scholarlycommunications@manchester.ac.uk providing relevant details, so we can investigate your claim.



1 Relations between daily events, coping strategies and health during a British Army ski
2 expedition across Antarctica

3 Word count: 5934

4 Abstract

5 Expedition teams operating in Polar environments are exposed to a range of environmental,
6 psychological and social challenges. How a person responds to these demands has
7 implications for their physical and psychological health. In the present study, we examined
8 relations between the daily events encountered, coping strategies used and markers of
9 physical and psychological health in a team of six British Army soldiers (one serving and five
10 reservists) completing a 68-day ski-traverse of the Antarctic continent. In general, daily
11 reports indicated a largely adaptive response to the expedition. There were fluctuations in the
12 events encountered, coping strategies used, and experiences of physical and psychological
13 health throughout the endeavor. Reported daily events and coping strategies explained
14 variability in the positive and negative fluctuations of physical and psychological health.
15 Findings from this study can inform health decision-making of groups operating in Polar
16 environments, and others living and working under similar constraints.

17 *Keywords:* daily events, coping strategies, health monitoring, Antarctic expedition,
18 military

19

20

21

22

23 Relations between daily events, coping strategies and health during a British Army ski
24 expedition across Antarctica

25 Expedition teams operating in Polar environments face a range of physical hazards,
26 including severe temperatures, unrelenting terrain and unpredictable weather. There are also
27 psychosocial challenges. For instance, task demands can result in feelings of monotony and
28 boredom, sleep deprivation, fatigue and fear of injury. Proximity with others and separation
29 from friends and family can lead to feelings of interpersonal stress (Palinkas, 2003; Smith,
30 Kinnafock, & Saunders, 2017). While some people succumb to these task and environmental
31 demands and experience poor physical and psychological health (Wood et al., 2005), others
32 cope well and derive benefits from their expedition experience (Leon, Sandal, & Larsen,
33 2011; Palinkas & Suedfeld, 2008). Research on these different dynamics of stress, coping and
34 health in Polar settings can be used to understand and ensure the survival, performance and
35 optimal function of other expeditioners, as well as individuals and groups operating under
36 similarly challenging conditions (Smith & Barrett, 2018; Suedfeld, 2018).

37 Although researchers have previously examined the physical and psychological
38 function of Polar travelers (e.g., Anton-Solanas, O'Neill, Morris, & Dunbar, 2016;
39 Blackadder-Weinstein et al., 2019; Gifford et al., 2018; Leon, Sandal, Fink, & Ciofani, 2011),
40 few studies have explored the situational or day-to-day dynamics that may explain variability
41 in their experience. Studies conducted to date have rarely explored the interrelations between
42 the events encountered, the reaction to those events and the consequent impact upon physical
43 and psychological health (for exceptions, see Kahn & Leon, 1994 and Leon, Kanfer,
44 Hoffman, & Dupre, 1991). Knowledge of these relationships is crucial for monitoring
45 purposes, understanding when health might be at risk and for recommending strategies to
46 facilitate coping and optimize individual (and team) function. In the present study, we
47 address this gap in the literature by examining the relations between the daily events

48 encountered, coping strategies used and experiences of physical and psychological health in a
49 team of British Army soldiers completing an unassisted ski expedition across the Antarctic
50 continent.

51 The safe and successful completion of a Polar ski expedition is more likely when
52 individuals maintain a healthy physical and psychological state. This means staying
53 physically fit, by avoiding injuries and ensuring appropriate calorific intake, and regularly
54 experiencing positive mood and emotions (Palinkas & Suedfeld, 2008). Studies of Polar
55 expedition teams suggest that in general individuals do tend to maintain good levels of
56 physical and psychological health (Atlis, Leon, Sandal, & Infante, 2004; Blackadder-
57 Weinstein et al., 2019; Gifford et al., 2018; Leon, Sandal, Fink et al., 2011). Weekly ratings of
58 positive affect, for instance, tend to be scored higher than negative affect across time spent in
59 the field (see Leon, Sandal, & Larsen, 2011). Collectively, existing findings suggest a degree
60 of stability in Polar expeditioners' physical and psychological health. However, recent
61 evidence indicates that the stability observed in week-by-week or month-by-month
62 measurements may mask changes that occur at a more granular level (e.g., day-to-day; Smith,
63 2018). These changes may be affected by daily experiences such as getting injured, feeling
64 fatigued or lacking sleep (Anton-Solanas et al., 2016; Smith, Barrett, & Sandal, 2018). To
65 effectively support expeditioners, further research is needed to understand the situational
66 health changes they experience and the events that precede them.

67 In the past, diaries (e.g., Suedfeld, Shiozaki, Archdekin, Sandhu, & Wood, 2017) and
68 weekly reports (e.g., Leon, Sandal, Fink et al., 2011) from Polar expeditioners have provided
69 valuable data on expedition experiences. Expeditioners commonly highlight rewarding
70 aspects of their journeys, including enjoying the Polar environment (Atlis et al., 2004),
71 feeling a sense of camaraderie with team mates (Kjaergaard, Leon, & Fink, 2015), feeling
72 able to cope (Leon, Sandal, Fink et al., 2011b) and taking satisfaction from making progress

73 towards goals (Atlis et al., 2004). Such positive experiences are likely to stimulate more
74 positive emotions, foster team cohesion, engender a sense of control and build confidence,
75 thereby contributing to the safe and successful achievement of expedition goals (Suedfeld,
76 2001).

77 Despite expeditions often being marked by positive features, Polar expeditioners have
78 also referred to experiencing a range of harmful and threatening incidents during their travels.
79 This includes injuries and illnesses (Leon & Venables, 2015), poor weather conditions (Smith
80 et al., 2017), equipment loss and malfunction (Suedfeld et al., 2017) and experiencing tension
81 with teammates (Blackadder-Weinstein et al., 2019). Such negative events have been
82 associated with decrements in performance and health, including impaired decision-making
83 (Atlis et al., 2004), interpersonal conflict (Corneliussen, Leon, Kjærgaard, Fink, & Venables,
84 2017) and irritation and mood disruption (Leon, Sandal, Fink et al., 2011; Suedfeld et al.,
85 2017). It is these events, and associated health impacts, that may signal acute periods of risk.
86 If not effectively dealt with, such events could lead to mistakes and the eventual abortion of
87 an expedition or mission, or more serious consequences such as injury or death (Leon &
88 Venables, 2015).

89 How a person adjusts and copes with the challenges posed by the Polar environment
90 has been linked to a range of individual difference factors, such as personality, habitual
91 coping approaches and a person's current health status (Leon, 1991; Leon, Sandal, & Larsen,
92 2011; Sandal, Leon, & Palinkas, 2006; Sandal & Smith, 2017). In general, personality traits
93 linked to effective coping in Polar contexts include being higher than average on measures of
94 conscientiousness, agreeableness and openness, and being emotionally stable (Kjaergaard et
95 al., 2015; Leon, Sandal, & Larsen, 2011; Palinkas & Suedfeld, 2008). Habitual coping
96 approaches, including active problem-solving and using comforting self-talk, are broadly
97 considered to be adaptive for coping with extreme stress (Leon, Sandal, & Larsen, 2011).

98 Good pre-departure emotional health, characterized by high levels of positive affect, is also
99 likely to be protective of health when entering extreme settings (Maguen et al., 2008;
100 Wagstaff & Leach, 2015). While it remains important to examine how individual differences
101 affect adjustment and adaptation to extremes, dynamic factors such as the strategies that
102 individuals use to cope during an expedition are likely to be an immediate determinant of
103 their physical and psychological health (Palinkas & Suedfeld, 2008; Smith et al., 2018).

104 Coping strategies can be conceived of as either problem-focused or emotion-focused
105 (Lazarus and Folkman, 1984). Problem-focused strategies aim to resolve a stressful encounter
106 directly, whereas emotion-focused strategies are mobilized when a person appraises that
107 nothing can be done to change the situation. Common problem-focused strategies used by
108 Polar expeditioners include actively solving problems as they occur (Suedfeld et al., 2017)
109 and engaging in more effortful behavior (Blackadder-Weinstein et al., 2019). Emotion-
110 focused methods that are regularly endorsed include trying to relax (Leon, Sandal, Fink et al.,
111 2011b), emotion suppression (Wagstaff & Weston, 2014), sharing concerns and seeking
112 support (Blackadder-Weinstein et al., 2019; Devonport, Lane, & Lloyd, 2011), viewing the
113 situation in a positive way (Kjaergaard et al., 2015) and relying on humor (Corneliusson et
114 al., 2017).

115 Though there have been numerous studies on coping in Polar contexts, few have
116 focused on the situational determinants of the strategies that individuals use to regulate their
117 daily experience (Leon et al., 1991; Smith et al., 2017). Our understanding of the links
118 between the daily use of coping strategies at the point when a demand is faced and indicators
119 of physical and psychological health during Polar expeditions is thus limited. Results from a
120 study with an Antarctic mountaineering expedition team suggest that certain strategies, such
121 as positive reappraisal, may be effective for regulating the psychological experience
122 (Wagstaff & Weston, 2014). However, there is likely to be significant intra- and inter-

123 individual variability in how people cope. Indeed, other Polar researchers have suggested that
124 regulatory flexibility (the capacity to select the most appropriate coping strategies based on
125 the demand(s) faced; Bonnano & Burton, 2013) is likely to be needed to maintain
126 performance and health and to deal with the changing situational demands in these extreme
127 and unpredictable settings (Kjaergaard et al., 2015). Examining relationships between daily
128 coping strategies and physical and psychological health, while accounting for person-level
129 variations, will provide a more nuanced understanding of coping in these hazardous,
130 unremitting environments.

131 The overall aim of the current study was to examine the daily events encountered,
132 coping strategies used and markers of physical and psychological health during a Polar ski
133 expedition across the Antarctic continent. Primarily, we were interested in how daily events
134 and coping strategies impacted upon physical and psychological health. A secondary aim was
135 to explore how expeditioners adjusted to the environment and how the reported events and
136 coping strategies used changed over time.

137 **Method**

138 **The Expedition**

139 Participants were members of the South Pole Expedition Army Reserves 2017
140 (SPEAR17) expedition, an unassisted ski journey from Antarctica's Hercules Inlet to the
141 Ross Ice Shelf via the South Pole (approximately 1100 miles). During the expedition, the
142 team averaged 14.42 nautical miles (Range = 0 – 19.10 nm) and 9.16 hours skiing (Range = 0
143 – 11 hours) each day. On five days the team made no progress: because of illness (day 32),
144 taking on new supplies at the South Pole (days 41-43) and bad weather (day 62). At the South
145 Pole the team completed a dynamic risk assessment resulting in one team member

146 withdrawing from the expedition due to health concerns. The five remaining team members
147 continued, arriving at their final location and being picked up from the ice after 68 days.

148 **Participants**

149 The SPEAR17 team included six male members of the British Army (age range 26 –
150 47 years; *Mdn* = 32 years). The expedition leader was a career soldier with over 20 years of
151 service. The others were Army reservists: three medical doctors, a paramedic and a web
152 developer. All had experience of operating in challenging and demanding environments but
153 had varying degrees of expedition experience and exposure to Polar settings. The expedition
154 leader had previously completed a self-supported Polar ski expedition. Other team members
155 had participated in expeditions (ocean rowing) and endurance activities (ultramarathons) in
156 remote environments but had no previous experience of Polar ski expeditions.

157 **Procedure**

158 After institutional ethical approval, we provided members of the expedition with
159 information on the nature and purpose of the study. Given the small number of participants,
160 the unique route followed and the expedition's international profile, it was unrealistic to
161 conceal the identity of the expedition team. Therefore, as part of the research consent process,
162 expeditioners were asked to confirm that we could name the expedition under the proviso that
163 individual identities would be protected. All participants provided signed consent.

164 Approximately six weeks prior to leaving the UK for Antarctica, the first author visited the
165 team at one of their training camps and administered a multi-section pre-departure
166 questionnaire. As part of this pre-expedition meeting the team members were also briefed on
167 how to complete the structured daily diary that would be used to collect data during the
168 expedition. Once the expedition had started, team members were asked to complete one diary
169 entry at the end of each expedition day.

170 **Measures**171 **Pre-expedition questionnaire.**

172 **Personality.** Personality was assessed using the Big Five Inventory (BFI; John,
173 Donahue & Kentle, 1991). Expeditioners responded to 44 items tapping into five subscales of
174 personality: Conscientiousness (nine items; e.g., “does a thorough job”), Agreeableness (nine
175 items; e.g., “is helpful and unselfish with others”), Openness (ten items; e.g., “has an active
176 imagination”), Extraversion (eight items; e.g., “is talkative”) and Neuroticism (eight items;
177 e.g., “worries a lot”). Participants were asked about the extent to which each item was like
178 them and responded on a five-point scale ranging from 1 (disagree strongly) to 5 (agree
179 strongly). The psychometric properties of the BFI have been evidenced in previous research
180 (Soto & John, 2009).

181 **Typical coping strategies.** Coping strategies were examined using the Utrecht Coping
182 List (UCL; Schreurs, Tellegen, Van der Willige & Brosshot, 1988). The UCL includes 47
183 items reflecting seven subscales related to how a person generally copes with stress: Active
184 problem solving (seven items; e.g., “Making a direct intervention when problems occur”),
185 Palliative reactions (eight items; e.g., “Trying to relax”), Avoidance (eight items; e.g.,
186 “Giving in, in order to avoid difficult situations”), Social support (six items; e.g., “Sharing
187 one’s worries with someone”); Depressive reactions (seven items; e.g., “Isolating oneself
188 totally from other people”), Sharing emotions (three items; e.g., “Showing one’s annoyance”)
189 and Comforting cognitions (five items; e.g., “Telling oneself that things could be worse”).
190 When responding, participants were asked to think about how they react when confronted
191 with a problem and answer on a four-point scale ranging from 1 (seldom or never) to 4 (very
192 often). The UCL has demonstrated adequate validity and reliability in prior studies (Sandal et
193 al., 2018; Sandal, Endresen, Værnes. & Ursin, 1999).

194 ***Health and wellbeing.***

195 *Affect.* Affect was reported using the Positive and Negative Affect Schedule (PANAS;
196 Watson, Clark & Tellegen, 1988). The 20-item PANAS includes two subscales (ten items
197 each), one for positive affective states (e.g., interested, enthusiastic) and the other for
198 negative affective states (e.g., upset, scared). When completing the baseline pre-expedition
199 questionnaire, we added the stem “During the past month I have felt...” to each item.
200 Participants responded using a five-point scale ranging from 1 (very slightly or not at all) to 5
201 (extremely). The PANAS is widely used as a measure of affect and has shown good validity
202 and reliability in many studies (see Crawford & Henry, 2004).

203 *Wellbeing.* We examined pre-expedition well-being using the Subjective Vitality
204 Scale (SVS; Ryan & Frederick, 1997). The SVS includes seven items that indicate the extent
205 to which a person feels alive and vital (e.g., I have energy and spirit). To each item, we added
206 the stem “In general, in everyday life...”. Participants were asked to respond using a seven-
207 point scale ranging from 1 (Not at all true) to 7 (Very true). The SVS has shown acceptable
208 psychometric properties when used as a measure of well-being (Bostic, Rubio, & Hood.,
209 2000).

210 *Mood.* The Centre for Epidemiologic Studies Depression Scale-Revised (CESD-R;
211 Eaton, Muntaner, Smith, Tien, & Ybarra, 2004) was used as a baseline assessment of mood.
212 The CESD-R includes 20 items targeting nine different depression symptom groups (e.g.,
213 Concentrating – “I had trouble keeping my mind on what I was doing”; Sadness – “I felt
214 depressed”). The total CESD-R score is used by clinicians to categorize mood disruption and
215 depression according to varying levels of severity. We added the stem “During the past
216 month...” to each item and participants provided a rating on a four-point scale ranging from 1
217 (Rarely or none of the time/less than 1 day) to 4 (Most or all the time/5 – 7 days). Scores

218 lower than 16 suggest there are no clinical issues. Total scores above 16 may indicate signs of
219 mood disruption and mental health difficulties. The CESD-R has been demonstrated as a
220 valid and reliable measure of mood disruption and depression in previous work (Van Dam &
221 Earleywine, 2011).

222 **Daily experience.** Each participant used a structured diary to record their daily
223 experiences during the expedition. The diary included 66 items tapping into perceptions of
224 health and fitness, events experienced and coping strategies used. Diary content was based on
225 a version of the diary used in several published expedition studies (Atlis et al., 2004; Leon,
226 Sandal, Fink et al., 2011; Smith et al., 2018). To minimize their weight, we worked with the
227 team to integrate the rating form into their general-purpose expedition diaries.

228 Three single-item indicators were used to rate physical and psychological aspects of
229 health: scaled questions on fitness (i.e., how physically fit you feel), exertion (i.e., how hard
230 you are working) and perceived stress (i.e., current level of stress). Daily affect, assessed via
231 the 20-item PANAS, was used as the primary measure of psychological health. The
232 occurrence of positive and negative experiences during the day was recorded on a 24-item
233 rating checklist. A 19-item coping strategy checklist, derived from work with military
234 personnel (Ben-Porath, Leon, Rinehart, Gupton, & Sineps, 1991), was used to examine the
235 methods team members used to cope.

236 The diaries took approximately five minutes to complete at the end of each expedition
237 day. We received completed daily diaries from five of the six team members. We did not
238 receive a diary from the team member who had to withdraw from the expedition and his daily
239 reports are not included in our analysis.

240 **Data analysis**

241 Although consent was provided to name the expedition being studied, we have taken
242 measures to protect individual participants' identities. Data is presented at the team level to
243 ensure anonymity but range and standard deviation scores are meaningful and indicative of
244 team member individual differences.

245 Descriptive statistics (Mean, SD, Range, Min., and Max.) were computed for all
246 questionnaire subscales and the three single-item indicators (fitness, exertion, stress) in the
247 daily diary. The resulting values were used to create a pre-expedition profile and to examine
248 day-to-day fluctuations in and interrelations between expeditioners' reports of health.
249 Responses to the event and coping checklists were treated as categorical (e.g., event
250 encountered yes = 1 or no = 0). Separately, each of the events encountered and coping
251 strategies reported during the expedition were summed to create an overall frequency rating.

252 A series of linear mixed models (LMMs) were tested to examine the interrelations
253 between fluctuations in the daily events reported, coping strategies used and indicators of
254 physical and psychological health (fitness, exertion, affect and stress). We considered LMMs
255 the most appropriate form of analysis given the nested data structure (311 daily diary entries
256 nested within 5 participants). This approach allowed us to examine interrelations between
257 variables while controlling for person-level variability. LMMs have previously been used
258 effectively in other small sample extreme environment studies (e.g., Basner et al., 2014;
259 Smith et al., 2018).

260 Finally, we used standardized residual scores and chi-square analyses (Clarke &
261 Crossland, 1985; Keatley, 2018) to examine how the events reported and coping strategies
262 used changed during the expedition and whether these changes were greater or fewer than
263 would be expected by chance alone. Given there was a natural midpoint in the expedition
264 (arriving at the South Pole on day 41), which also coincided with a major event (a team

265 member leaving the expedition), we used this as an anchor point to contrast the psychological
266 experience in the first and second half of the journey.

267 **Results**

268 Pre-expedition survey information is presented in Table 1. Expeditioners reported
269 higher scores on conscientiousness and agreeableness, and lower scores on neuroticism when
270 compared to a general population sample (Nofle & Robins, 2007). Variation was observed in
271 extraversion scores (Min = 2.50; Max = 4.50). All team members reported a tendency to use
272 problem-focused techniques and comforting cognitions when dealing with stress. All
273 demonstrated good pre-departure emotional health (positive affect scores higher than
274 negative affect scores), high levels of subjective wellbeing and low mood disruption and
275 depression (scores <16). One participant had lower positive affect and wellbeing scores and
276 higher mood disruption. This participant reported issues related to sleep difficulties during
277 the assessment period, which is likely to account for their slightly different profile.

278 Daily diary data suggest that the team members generally maintained good overall
279 physical and psychological health throughout the expedition (see Table 2). Perceived fitness
280 ($M = 6.95$; $SD = 1.14$) and exertion ($M = 3.98$; $SD = 1.03$) scores were moderate. Positive
281 affect remained high ($M = 4.03$; $SD = 0.69$) and negative affect low ($M = 1.10$; $SD = 0.20$)
282 across the expedition period. Reports of perceived stress were low on average ($M = 0.88$; SD
283 $= 1.34$). Interrelations between daily markers of physical and psychological health are
284 presented in Table 2. Perceptions of fitness were positively correlated with positive affect.
285 Exertion, negative affect and stress were all positively correlated. Fitness was negatively
286 correlated with negative affect and stress and positive affect was negatively correlated with
287 negative affect and stress.

288 The most frequently reported events and their relation to physical and psychological
289 health are presented in Table 3. Expeditioners regularly reported feelings of being able to
290 cope, camaraderie with teammates, enjoying the environment and satisfaction in making
291 progress. Daily reports of being able to cope, enjoying the environment, making progress and
292 equipment working were associated with feeling physically fit, higher levels of positive
293 affect, lower negative affect and lower reports of stress.

294 Although recorded less frequently, participants also reported harmful and threatening
295 events including muscle and joint pain, lack of sleep, problems with gear and fear of injury.
296 Muscle and joint pain, fear of injury, loneliness, headaches and tension with teammates were
297 associated with lower reports of fitness, increased ratings of exertion, lower positive affect,
298 higher negative affect and higher stress scores.

299 The most frequently reported coping strategies and their associations with physical
300 and psychological health are presented in Table 4. Expeditioners regularly reported writing a
301 journal, thinking of something pleasant, keeping the goal in sight, maintaining a positive
302 attitude and using humor and trying to see the situation in a positive way. There were no
303 reported instances of outright arguments, but participants did report having negative feelings
304 about the self and others and having to discuss personal and task concerns. Daily reports of
305 coping strategies, such as trying to have pleasant thoughts and seeing the situation in a
306 positive way, were associated with higher scores of positive affect and lower perceptions of
307 stress. Writing in a journal, prayer, discussing task concerns and having negative feelings
308 about the self were associated with lower ratings of fitness, lower positive affect, higher
309 negative affect and higher perceived stress scores. Reports of relaxing and meditating were
310 linked to lower ratings of negative affect. Trying to take it one day at a time and solve
311 problems were associated with elevated perceptions of stress.

312 Daily variability was observed in physical and psychological health during the
313 expedition. A wide range of scores were provided for fitness (Range = 7; Min = 2; Max = 9),
314 which coincided with team member injuries. There was a marked increase in stress and
315 negative affect and decrease in positive affect around day 41, which was when the team
316 reached the South Pole.

317 Time changes in the events experienced and coping strategies used are reported in
318 Table 5. Lacking privacy, sleep deprivation, muscle and joint pain, concern for teammate
319 wellbeing and concerns over team effectiveness were reported more often than would be
320 expected by chance in the first half and less often than would be expected by chance in the
321 second half of the expedition. In contrast, gear problems, fear of injury and loneliness were
322 reported less than would be expected by chance in the first half and more than would be
323 expected by chance in the second half of the expedition. Alongside these changes, individuals
324 also reported enjoying the environment and being able to cope more often in the second half
325 compared to the first half of the expedition.

326 Expeditioners reported using task immersion, active problem-solving and discussing
327 personal and task concerns more in the first than second half of the expedition. Individuals
328 were also more likely to report keeping feelings to themselves, having negative feelings about
329 themselves and having negative feelings about others in the first compared to second half of
330 the expedition. In contrast, expeditioners were more likely to report taking the expedition one
331 day at a time in the second compared to first half of the expedition.

332 Discussion

333 The present study focused on events encountered, coping strategies used and
334 experiences of physical and psychological health during a successful military ski-expedition
335 across Antarctica. Findings suggest that team members had a largely positive experience.

336 However, daily fluctuations in indicators of both physical and psychological health **were**
337 **observed. These fluctuations were** predicted by the daily events encountered and coping
338 strategies used. The withdrawal of one of the **team members** at the South Pole was a
339 particularly **difficult period** and resulted in less positive and more negative **reports of** physical
340 and psychological health. After overcoming this difficulty, the remaining individuals
341 appeared to function well and successfully completed their ski traverse. **Study results** offer
342 new insight into the situational experience of expeditioners operating in extreme Polar
343 environments and factors that might influence their safety, health and wellbeing.

344 **Pre-expedition profiles suggest that the expeditioners** were well-adjusted for
345 adaptation to extreme and stressful settings (Leon, Sandal, Fink et al., 2011; Palinkas &
346 Suedfeld, 2008; Sandal & Smith, 2017). The configuration of personality traits (high
347 agreeableness, high conscientiousness and low neuroticism) and typical ways of coping (high
348 active problem-solving, high comforting cognitions) are in keeping with findings of other
349 Polar and extreme environment research (Leon, Sandal, & Larsen, 2011; Leon, Sandal, Fink
350 et al., 2011; Kjaergaard et al., 2015; Sandal et al., 2006). These individual difference factors
351 are likely to contribute to **resilience** and protect physical and psychological health when
352 operating under conditions of chronic stress (Lazarus, 1991; Maguen et al., 2008; Sandal et
353 al., 2006).

354 **In common with results from similar Polar expedition studies, we found positive**
355 **affect generally higher than negative affect across the entire expedition period (Blackadder-**
356 **Weinstein et al., 209; Kjaergaard et al., 2015; Leon, Sandal, Fink et al., 2011).** Daily reports
357 of physical and psychological health were correlated (e.g., higher fitness scores were
358 associated with lower reports of negative affect), highlighting the interdependency of the
359 physical and psychological experience. **Variability observed in expeditioners' daily reports of**

360 **health underlines** the value of day-to-day monitoring of people in extreme settings (Smith et
361 al., 2018).

362 **Daily events and physical and psychological health**

363 **Reported positive experiences** (e.g., enjoying the environment, feeling able to cope
364 and taking satisfaction from progress) were associated with more adaptive physical and
365 psychological health responses. In extreme Polar environments, nourishment of physical and
366 psychological health is likely to help individuals and teams maintain their performance under
367 conditions of chronic stress (Driskell, Salas, & Driskell, 2018; Wagstaff & Leach, 2015). The
368 pattern of relationships observed in the present study may be explained by theories of human
369 motivation. For example, self-determination theory (SDT; Deci & Ryan, 2000; Vansteenkiste
370 & Ryan, 2013) suggests that individuals will function optimally and experience better health
371 when their basic psychological needs for autonomy, competence and relatedness are met.
372 Being able to cope and taking satisfaction from **making** progress should generate feelings of
373 autonomy and competence, **which, according to SDT, would then** result in adaptive health
374 responses (Goemaere, Vansteenkiste, & Van Petegen, 2016).

375 **As expected, negative experiences, even those rated infrequently, had an adverse**
376 **impact upon health and wellbeing. This is consistent with previous research that suggests**
377 **diverse negative experiences are likely to have a greater impact upon group dynamics,**
378 **performance and health than positive experiences, despite the latter being more common**
379 **(Wagstaff & Weston, 2014; Wood, Hysong, Lugg, & Harm, 2000). In particular, reports of**
380 **loneliness** predicted multiple **negative health responses, suggesting that isolation and**
381 **separation** from established social networks **in expedition environments** (even when part of a
382 cohesive expedition team) can have a **damaging impact on** health (Smith & Barrett, 2018).

383 **In contrast to positive events, negative events** are more likely to thwart an individual's
384 basic psychological needs for autonomy, competence and relatedness (Goemaere et al., 2016;
385 Vansteenkiste & Ryan, 2013). **Loneliness, for instance, is likely to thwart a person's sense of**
386 **relatedness. While, muscle and joint pain is likely to impair task performance and hinder**
387 **progress, thereby frustrating autonomy and competence. The frustration of the psychological**
388 **needs has recently been linked to a range of adverse health responses in isolated and extreme**
389 **teams and may explain the health impact of negative events in the present work (Goemaere et**
390 **al., 2016).** Interestingly, individuals who were not experiencing pain but were nevertheless
391 concerned about the effectiveness of teammates might have experienced an increased sense
392 of competence because of taking on additional responsibility (in the present case, taking
393 weight from another team member's pulk) and therefore having an increased status within the
394 team. This may explain why concerns for teammate wellbeing were associated with higher
395 perceptions of fitness.

396 **Coping strategies and physical and psychological health**

397 **Bonnano and Burton (2013) suggest that how a person copes** will depend on the
398 context, the repertoire of strategies **they have** available and whether these strategies are, or
399 have previously been, effective for mitigating experiences of stress. In the present study,
400 writing a journal was the most frequently reported coping strategy used by team members.
401 Journal-keeping on Polar expeditions has a long history (Mocellin & Suedfeld, 1991).
402 Creating a narrative of the experience, documenting important milestones and encounters and
403 recording private thoughts about the expedition is likely to serve multiple coping functions,
404 offering an outlet to vent frustration and fill time during periods of low activity. Participants
405 also reported emotion-focused coping strategies, **such as** focusing on positive thoughts,
406 keeping a positive attitude, using humor and trying to see the situation in a positive way.
407 **Such approaches are likely to** help individuals deal with persistent and largely uncontrollable

408 issues (e.g., lack of sleep, muscle pain) faced in Polar settings (Kjaergaard et al., 2015; Leon,
409 Sandal, & Larsen, 2011). Avoidance coping approaches (e.g., keeping feelings to self) may
410 help avoid arguments and minimize tension in small interdependent expedition teams
411 (Corneliussen et al., 2017; Smith et al., 2017; Wagstaff & Weston, 2014). However,
412 overreliance on avoidance strategies could potentially result in less functional communication
413 and cooperation between members of a team and have an overall adverse impact on team
414 performance (Sandal et al., 2006).

415 Pleasant thoughts and seeing the situation in a positive way were associated with
416 higher positive affect scores. Such emotion-focused strategies help people identify the
417 enjoyable and satisfying aspects of an experience by distracting them from unpleasant
418 features and re-focusing attention on areas that are more agreeable (Folkman & Morowitz,
419 2004). Techniques including writing a journal, prayer, active problem solving and discussing
420 concerns were associated with less adaptive health responses, including lower fitness, lower
421 positive affect and higher stress scores. Coping approaches such as problem-solving and
422 discussing task and personal concerns may be mobilized in response to specific stressful
423 events, which may explain these associations.

424 Time-based changes

425 A notable example of the temporal changes in events, coping and health is the marked
426 increase in negative affect and perceived stress and reduction in positive affect upon reaching
427 and after leaving the South Pole. The expedition leader decided that a team member who was
428 struggling with his physical health should not continue beyond the South Pole. This meant
429 that the team had to carry on without one of their comrades. The change in health reports at
430 this time may reflect this loss as well as the reality of facing several more weeks of physical
431 effort and isolation with a diminished team. During this difficult period, team members

432 tended to rely on emotion-focused techniques, including **summoning up** pleasant thoughts,
433 trying to keep the goal in sight, maintaining a positive attitude and seeing the situation in a
434 positive way. The expedition leader, who was responsible for the safety of the group, also
435 reported using problem-solving strategies, discussing task concerns and keeping feelings to
436 himself. These techniques may have helped him explain and rationalize his decision to
437 withdraw the struggling team member.

438 In the second half of the expedition participants generally reported fewer concerns,
439 suggesting that the team actually became more comfortable with the task and environmental
440 demands (Sandal, Bergan, Warncke, Værnes, & Ursin, 1996; Smith et al., 2018). **Changes in**
441 **the type of events and coping strategies reported may also reflect the team becoming more**
442 **functional after the withdrawal of the struggling team member. Negative events commonly**
443 **reported later in the expedition included** having problems with gear, which was starting to
444 break due to overuse, and fearing injury, maybe due to fatigue and prolonged exertion.
445 **Reports of loneliness increased, although** reports of camaraderie with teammates also rose
446 from the first to the second half of the trip, indicating that loneliness may be more likely to be
447 caused by separation from friends and family than by issues within the expedition team.

448 **Our results emphasize coping as a dynamic process.** Early in the expedition, as the
449 team was adjusting to the environment, individuals were more likely to cope by restricting
450 their emotional sharing and by using more active strategies, such as task immersion, active
451 problem solving and putting in more effort. Restricting emotional sharing, particularly during
452 the early phases of an expedition, may be due to concerns about over-burdening teammates,
453 which has **previously been observed in other isolated** Polar groups (Leon, Sandal, & Larsen,
454 2011). **After adjusting to the environment,** reliance on active problem-focused coping
455 approaches reduced. In the second half of the expedition, individuals used more **positively**
456 **framed** emotion-focused techniques, **for instance, ‘trying to see the situation in a positive**

457 way', 'taking it one day at a time' and 'keeping the goal in sight'. Such approaches help
458 motivate people towards their goals and foster a sense of control and competence by
459 providing small but regularly achievable targets, which should help maintain a sense of
460 purpose during long, repetitive and arduous expeditions (Smith et al., 2017).

461 **Limitations**

462 Daily data from the individual who withdrew from the expedition at the South Pole
463 was not available for analysis. Their data, particularly their reports of events and use of
464 coping strategies, would have added to our understanding of the psychosocial processes of
465 interest to the present work. Although difficult to study in situ, the psychosocial factors
466 underpinning individual and team failures in extreme expedition settings warrant further
467 attention (Leon & Venables, 2015).

468 Small sample sizes are common in the extreme environment literature and remain a
469 challenge, including in the present study. We made efforts to address this by adopting an
470 intensive sampling procedure. Although repetitive sampling can sometimes lead to response
471 fatigue, the daily variability we observed in the expeditioner scores suggest that this was not
472 an issue in our study. Nevertheless, the small number of participants does necessitate caution
473 when considering the generalizability of these findings to other individuals and groups
474 operating in extreme settings.

475 From a conceptual and methodological perspective, we still need to unpack the
476 antecedents and outcomes of daily expedition events and coping strategies. The question stem
477 we used for the event and coping checklists ("identify the events you experienced during the
478 day/identify the methods you used to cope during the day") was worded in a way that meant
479 responses logically preceded reports of physical and psychological health ("how do you feel
480 right now?"). However, because the diary was completed at only one time-point and

481 responses to all items were provided concurrently (i.e., events and coping were reported at
482 the same time as health), we cannot be certain of the direction of the observed relationships.
483 Separating reports of events and coping strategies from the end-of-day reports of health,
484 perhaps by collecting responses at several points throughout an expedition day, would help to
485 **determine** the role of events and coping strategies as antecedents of health. Asking
486 expeditioners to report on their **perceptions of the** effectiveness of coping strategies used
487 would advance our understanding of regulatory flexibility and the dynamic nature of effective
488 coping in extreme settings (**Bonnano & Burton, 2013**).

489 **Implications for practice**

490 **If certain events and coping strategies contribute to more positive physical and**
491 **psychological health responses, finding ways to promote or train these methods could**
492 contribute to **expeditioner resilience** (Maguen et al., 2008; Tice, Baumeister, Shmueli, &
493 Muraven, 2007). **Findings** might also inform dynamic risk assessments in the field. For
494 instance, if an expedition leader is aware of how a person is likely to react following certain
495 daily events, and the health responses that accompany their selected coping methods, they
496 might choose to reassign tasks, adjust individual and team goals, make efforts to optimize
497 team interactions, or, in the worst case, call for help.

498 **Conclusions**

499 The present study extends prior work by offering a more contextualized view of the
500 expedition experience. Specifically, we identify relations between daily events encountered,
501 coping strategies used and their links to physical and psychological health in an extreme
502 expedition **context**. **Understanding daily experiences is** critical to providing effective support
503 and informing the design of appropriate health countermeasures for individuals and teams
504 operating in environmental extremes.

505 References

- 506 Anton-Solanas, A., O'Neill, B. V., Morris, T. E., & Dunbar, J. (2016). Physiological and
507 Cognitive Responses to an Antarctic Expedition: A Case Report. *International Journal*
508 *of Sports Physiology and Performance*, *11*, 1053-1059.
509 <http://dx.doi.org/10.1123/ijsp.2015-0611>
- 510 Atlis M. M., Leon G. R., Sandal G. M., & Infante M. (2004). Decision processes and
511 interactions during a two-woman traverse of Antarctica. *Environment and Behavior*, *36*,
512 402-423. <https://doi.org/10.1177/0013916503262217>
- 513 Barnes, C. M., & Hollenbeck, J. R. (2009). Sleep deprivation and decision-making teams:
514 Burning the midnight oil or playing with fire? *Academy of Management Review*, *34*, 56-
515 66.
- 516 Basner, M., Dinges, D. F., Mollicone, D. J., Savelev, I., Ecker, A. J., Di Antonio,
517 A.,...Sutton, J. P. (2014). Psychological and behavioral changes during confinement in
518 a 520-day simulated interplanetary mission to mars. *PLoS ONE*, *9*. doi:
519 [10.1371/journal.pone.0093298](https://doi.org/10.1371/journal.pone.0093298)
- 520 Blackadder-Weinstein, J., Leon, G. R., Norris, R. C., Venables, N. C., & Smith, M. (2018).
521 Individual Attributes, Values, and Goals of an All-Military Women Antarctic
522 Expedition. *Aerospace Medicine and Human Performance*, *90*, 18-25. DOI:
523 <https://doi.org/10.3357/AMHP.5248.2019>
- 524 Ben-Porath, Y., Leon, G. R., Rinehart, J., Gupton, H., & Sineps, M. (1991). Variation and
525 covariation among personality, stress, coping, and mood. *Paper presented at the 99th*
526 *Annual Meeting of the American Psychological Association*, San Francisco, California.

- 527 Bonanno, G. A., & Burton, C. L. (2013). Regulatory Flexibility: An Individual Differences
528 Perspective on Coping and Emotion Regulation. *Perspectives on Psychological
529 Science*, 8, 591–612. <https://doi.org/10.1177/1745691613504116>
- 530 Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the Subjective Vitality Scale
531 using structural equation modelling. *Social Indicators Research*, 52, 313- 324.
532 doi:10.1023/A:1007136110218
- 533 Clarke, D. D., & Crossland, J. (1985). *Action systems: An introduction to the analysis of
534 complex behaviour*. London: Methuen
- 535 Corneliussen, J. G., Leon, G. R., Kjærgaard, A., Fink, B. A., & Venables, N. C. (2017).
536 Individual Traits, Personal Values, and Conflict Resolution in an Isolated, Confined,
537 Extreme Environment. *Aerospace Medicine and Human Performance*, 88, 535-543.
538 doi: 10.3357/AMHP.4785.2017
- 539 Crawford, J. R., & Henry, J. D. (2004). The Positive and Negative Affect Schedule
540 (PANAS): Construct validity, measurement properties and normative data in a large
541 non-clinical sample. *British Journal of Clinical Psychology*, 43, 245–265.
542 <https://doi.org/10.1348/0144665031752934>
- 543 Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and
544 the self-determination of behavior. *Psychological Inquiry*, 11, 227-268.
545 doi:10.1207/S15327965PLI1104_01
- 546 Devonport, T., Lane, A. M., & Lloyd, J. (2011). Keeping Your Cool: A Case Study of a
547 Female Explorer’s Solo North Pole Expedition. *Wilderness & Environmental Medicine*,
548 22, 333-337. doi: 10.1016/j.wem.2011.07.003

- 549 Driskell, T., Salas, E., & Driskell, J. E. (2018). Teams in extreme environments: Alterations
550 in team development and teamwork. *Human Resource Management Review*, 28, 434-
551 449. <https://doi.org/10.1016/j.hrmr.2017.01.002>
- 552 Eaton W. W, Muntaner C, Smith C, Tien A, Ybarra M. (2004). *Center for Epidemiologic*
553 *Studies Depression Scale: Review and revision (CESD and CESD-R)*. In: Maruish ME,
554 ed. *The Use of Psychological Testing for Treatment Planning and Outcomes*
555 *Assessment*. 3rd ed. Mahwah, NJ: Lawrence Erlbaum; 363-377
- 556 Folkman, S., & Moskowitz, J. T. (2004). Coping: Pitfalls and promise. *Annual Review of*
557 *Psychology*, 55, 745-774. DOI: 10.1146/annurev.psych.55.090902.141456
- 558 Fletcher, D., and Sarkar, M. (2013). Psychological Resilience. *European Psychologist*, 18,
559 12–23. doi: 10.1027/1016-9040/a000124
- 560 Gifford, R. M., O'Leary, T., Cobb, R., Blackadder-Weinstein, J., Double, R., Wardle S.
561 L., ... Woods, D. R. (2018). Female Reproductive, Adrenal, and Metabolic Changes
562 during an Antarctic Traverse. *Medicine & Science in Sports & Exercise*, 51, 556-567.
563 DOI: 10.1249/MSS.0000000000001803
- 564 Gloria, C. T., & Steinhardt, M. A. (2016). Relationships Among Positive Emotions, Coping,
565 Resilience and Mental Health. *Stress & Health*, 32, 145-156. DOI: 10.1002/smi.2589
- 566 Goemaere, S., Vansteenkiste, m., & Van Petegem, S. (2016). Gaining deeper insight into the
567 psychological challenges of human spaceflight: The role of motivational dynamics.
568 *Acta Astronautica*, 121, 130-143. <https://doi.org/10.1016/j.actaastro.2015.12.055>
- 569 John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory Versions 4a and*
570 *54*. Berkeley: University of California, Berkeley, Institute of Personality and Social
571 Research.

- 572 Kahn, P. M., & Leon, G. R. (1994). Group climate and individual functioning in an all-
573 women Antarctic expedition team. *Environment and Behavior*, 26, 669–97.
574 <https://doi.org/10.1177/0013916594265004>
- 575 Keatley, D. A. (2018). *Pathways in crime: an introduction to Behaviour Sequence Analysis*.
576 London: Palgrave MacMillan.
- 577 Kjaergaard, A., Leon, G. R., & Fink, B. A. (2015). Personal Challenges, Communication
578 Processes, and Team Effectiveness in Military Special Patrol Teams Operating in a
579 Polar Environment. *Environment and Behavior*, 47, 644-666.
580 <https://doi.org/10.1177/0013916513512834>
- 581 Lazarus, R. S. (1991). *Emotion and adaptation*. New York: Oxford University Press.
- 582 Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.
- 583 Leon, G. R. (1991). Individual and group process characteristics of polar expedition teams.
584 *Environment and Behavior*, 23, 723-748. <https://doi.org/10.1177/0013916591236005>
- 585 Leon, G. R., & Venables, N. C. (2015). Fearless Temperament and Overconfidence in an
586 Unsuccessful Special Forces Polar Expedition. *Aerospace Medicine and Human*
587 *Performance* 86, 567–570. doi: 10.3357/AMHP.4256.2015
- 588 Leon, G. R., Sandal, G. M., & Larsen, E. (2011). Human performance in polar environments.
589 *Journal of Environmental Psychology*, 31, 353-360.
590 <https://doi.org/10.1016/j.jenvp.2011.08.001>
- 591 Leon, G. R., Kanfer, R., Hoffman, R. G., & Dupre, L. (1991). Interrelationships of
592 personality and coping in a challenging extreme situation. *Journal of Research in*
593 *Personality*, 25, 357-371. [https://doi.org/10.1016/0092-6566\(91\)90027-N](https://doi.org/10.1016/0092-6566(91)90027-N)

- 594 Leon, G. R., Sandal, G. M., Fink, B. A., & Ciofani, P. (2011). Positive experiences and
595 personal growth in a two-man North Pole expedition team. *Environment and Behavior*,
596 43, 710-731. <https://doi.org/10.1177/0013916510375039>
- 597 Levine, S., & Ursin, H. (1991). What is stress? In: Brown, M.R., Koob, G.F., Rivier, C.
598 (Eds.), *Stress- Neurobiology and Neuroendocrinology*. Marcel Dekker, New York, NY.
- 599 Maguen, S., Turcotte, D. M., Peterson, A. L., Dremsa, T. L., Garb, H. N., McNally, R. J., &
600 Litz, B. T. (2008). Description of risk and resilience factors among military medical
601 personnel before deployment to Iraq. *Military Medicine*, 173, 1–9.
- 602 Mocellin, J. S. P., & Suedfeld, P. (1991). Voices From The Ice: Diaries of Polar Explorers.
603 *Environment & Behaviour*, 23, 704-722.
- 604 Nofle, E. E., & Robins, R. W. (2007). Personality predictors of academic outcomes: Big five
605 correlates of GPA and SAT scores. *Journal of Personality and Social Psychology*, 93,
606 116-130. doi:10.1037/0022-3514.93.1.116
- 607 Ntoumanis, N., Edmunds, J., & Duda, J. L. (2009). Understanding the coping process from a
608 self-determination theory perspective. *British Journal of Health Psychology*, 14, 249-
609 260. DOI: 10.1348/135910708X349352
- 610 Palinkas, L. A. (2003). The psychology of isolated and confined environments:
611 Understanding human behavior in Antarctica. *American Psychologist*, 58, 353-363.
612 <http://dx.doi.org/10.1037/0003-066X.58.5.353>
- 613 Palinkas, L. A., & Suedfeld, P. (2008). Psychological effects of polar expeditions. *Lancet*,
614 371, 153-163. DOI: [https://doi.org/10.1016/S0140-6736\(07\)61056-3](https://doi.org/10.1016/S0140-6736(07)61056-3)

- 615 Pennebaker, J. W. (1997). Writing About Emotional Experiences as a Therapeutic Process.
616 *Psychological Science*, 8, 162–166. [https://doi.org/10.1111/j.1467-](https://doi.org/10.1111/j.1467-9280.1997.tb00403.x)
617 [9280.1997.tb00403.x](https://doi.org/10.1111/j.1467-9280.1997.tb00403.x)
- 618 Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality
619 as a dynamic reflection of well-being. *Journal of Personality*, 65, 529-565.
620 doi:10.1111/j.1467-6494.1997.tb00326.x
- 621 Sandal, G. M., & Smith, N. (2017). Individual resilience. In T. Sgobba, B. Kanki, J-F.
622 Clervoy & G. M. Sandal (Eds.), *Space Safety and Human Performance* (pp. 20-30).
623 Cambridge, MA: Butterworth-Heinemann.
- 624 Sandal, G. M., Leon, G., & Palinkas, L. A. (2006). Human challenges in polar and space
625 environments. *Environmental Science and Biotechnology*, 5, 281-296.
- 626 Sandal, G. M., van der Vijver, F., & Smith, N. (2018). Psychological hibernation during
627 overwintering in Antarctica. *Frontiers in Psychology*. doi: 10.3389/fpsyg.2018.02235
- 628 Sandal, G. M., Endresen, I. M., Vaernes, R., & Ursin, H. (1999). Personality and coping
629 strategies during submarine missions. *Military Psychology*, 11, 381-404.
630 doi:10.1207/s15327876mp1104_3
- 631 Sandal, G.M., Bergan, T., Warncke, M., Værnes, R.J. & Ursin, H. (1996). Psychological
632 reactions during polar expeditions and isolation in hyperbaric chambers. *Aviation Space*
633 *and Environmental Medicine*, 67, 227-234
- 634 Schreurs, P. J. G., Tellegen, B., Van der Willige, G., & Brosshot, J. F. (1988). *Utrecht*
635 *Coping List: Handbook*. Lisse, Belgium: Swets & Zeitlinger

- 636 Smith, N. (2018). Relations between self-reported and linguistic monitoring assessments of
637 affective experience in an extreme environment. *Wilderness and Environmental*
638 *Medicine, 29*, 61-65. DOI: <https://doi.org/10.1016/j.wem.2017.08.023>
- 639 Smith, N., & Barrett, E. C. (2018). Psychology, Extreme Environments, and Counter-
640 terrorism Operations. *Behavioral Sciences of Terrorism and Political Aggression, 11*,
641 48-72. <https://doi.org/10.1080/19434472.2018.1551916>
- 642 Smith, N., Barrett, E. C., & Sandal, G. M. (2018). Monitoring daily events, coping strategies
643 and emotion during a desert expedition in the Middle East. *Stress & Health, 34*, 534-
644 544. DOI: doi: 10.1002/smi.2814
- 645 Smith, N., Kinnafick, F., & Saunders, B. (2017). Coping Strategies Used During an Extreme
646 Antarctic Expedition. *Journal of Human Performance in Extreme Environments, 13*, 1-
647 10. DOI: 10.7771/2327-2937.1078
- 648 Soto, C. J., & John, O. P. (2009). Ten facet scales for the Big Five Inventory: Convergence
649 with NEO PI-R facets, self-peer agreement, and discriminant validity. *Journal of*
650 *Research in Personality, 43*, 84-90. doi:10.1016/j.jrp.2008.10.002
- 651 Suedfeld, P. (2001). Applying positive psychology in the study of extreme environments.
652 *Journal of Human Performance in Extreme Environments, 6*, 21-25. doi:10.7771/2327-
653 2937.1020
- 654 Suedfeld, P. (2012). Extreme and Unusual Environments: Challenges and Responses. In S. D.
655 Clayton (Ed). *The Oxford Handbook of Environmental and Conservation Psychology*.
656 Oxford Handbooks Online. DOI: 10.1093/oxfordhb/9780199733026.013.0019

- 657 Suedfeld, P., Shiozaki, L., Archdekin, B., Sandhu, H., & Wood, M. (2017). The polar
658 exploration diary of Mark Wood: a thematic content analysis. *The Polar Journal*, 7,
659 227-241, DOI: 10.1080/2154896X.2017.1333327
- 660 Tice, D. M., Baumeister, R. F., Shmueli, D., & Muraven, M. (2007). Restoring the self:
661 Positive affect helps improve self-regulation following ego depletion. *Journal of*
662 *Experimental Social Psychology*, 43, 379–384.
663 <http://dx.doi.org/10.1016/j.jesp.2006.05.007>
- 664 Suedfeld, P. (2018). Antarctica and space as psychosocial analogues. *REACH: Reviews in*
665 *Human Space Exploration*, 9-12, 1-4. <https://doi.org/10.1016/j.reach.2018.11.001>
- 666 Van Dam, N. T., & Earleywine, M. (2011). Validation of the Center for Epidemiologic
667 Studies Depression Scale—Revised (CESD-R): Pragmatic depression assessment in the
668 general population. *Psychiatry Research*, 186, 128–132.
669 <https://doi.org/10.1016/j.psychres.2010.08.018>
- 670 Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic
671 psychological need satisfaction and need frustration as a unifying principle. *Journal of*
672 *Psychotherapy Integration* 23, 263-280. <http://dx.doi.org/10.1037/a0032359>
- 673 Wagstaff, C. R. D., & Leach, J. (2015). The Value of Strengths-Based Approaches in SERE
674 and Sport Psychology. *Military Psychology*, 27, 65-84.
675 <http://dx.doi.org/10.1037/mil0000066>
- 676 Wagstaff, C. R. D., & Weston, N. J. V. (2014). Examining Emotion Regulation in an Isolated
677 Performance Team in Antarctica. *Sport, Exercise, and Performance Psychology*, 3,
678 237-287. DOI: 10.1037/spy0000022

- 679 Watson D, Clark L. A, & Tellegen A. (1988). Development and Validation of Brief Measures
680 of Positive and Negative Affect: The PANAS scales. *Journal of Personality and Social*
681 *Psychology*, 37, 395-412. <http://dx.doi.org/10.1037/0022-3514.54.6.1063>
- 682 Wood, J., Hysong, S. J., Lugg, D. J., & Harm, D. L. (2000). Is it really so bad? A comparison
683 of positive and negative experiences in Antarctic winter stations. *Environment and*
684 *Behavior*, 32, 84-110. <https://doi.org/10.1177/00139160021972441>
- 685 Wood, J., Schmidt, L., Lugg, D., Ayton, J., Phillips, T., & Shepanek, M. (2005). Life,
686 survival, and behavioral health in small closed communities: 10 years of studying
687 isolated Antarctic groups. *Aviation, Space and Environmental Medicine*, 76 (S6), B89-
688 93.

689 Table 1

690 *Descriptive statistics on pre-departure individual differences*

	Category	Variable	Mean	SD	Range	Min	Max
Pre-expedition	Personality	Extraversion	3.75	.74	2.00	2.50	4.50
		Agreeableness	4.06	.54	1.22	3.56	4.78
		Conscientiousness	4.28	.49	1.44	3.44	4.89
		Neuroticism	1.75	.52	1.50	1.00	2.50
		Openness	3.68	.43	1.20	3.20	4.40
	Coping Strategies	Active Problem Solving	3.19	.41	1.00	2.57	3.57
		Palliative Reactions	2.29	.38	.88	1.88	2.75
		Avoidance	2.00	.52	1.38	1.13	2.50
		Social Support	2.22	.48	1.17	1.67	2.83
		Depressive Reactions	1.33	.21	.52	1.14	1.67
		Sharing Emotions	2.11	.50	1.33	1.33	2.67
		Comforting Cognitions	3.27	.45	1.00	2.80	3.80
		Health & Wellbeing	Positive Affect	4.32	.71	1.80	3.20

Negative Affect	1.52	.31	.80	1.00	1.80
Wellbeing	5.43	.44	1.29	4.57	5.86
Mood (Depression)	5.33	4.89	12.00	.00	12.00

691

692

693

694

695

696

697

Pre Proof

698 Table 2

699 *Relations between daily markers of physical and psychological health*

	Mean	SD	Range	Min	Max	Fitness	Exertion	Positive Affect	Negative Affect	Stress
Fitness	6.95	1.14	7.00	2.00	9.00	1				
Exertion	3.98	1.03	4.00	1.00	5.00	-.02	1			
Positive Affect	4.03	0.69	3.30	1.70	5.00	.55**	.09	1		
Negative Affect	1.10	0.20	1.40	1.00	2.40	-.43**	.16**	-.50**	1	
Stress	0.88	1.34	10.00	0.00	10.00	-.26**	.15*	-.36**	.75**	1

700 *Note: * p <.05; ** p<.01*

701

702

703

704

705

706

707 Table 3

708 *Frequency scores and linear mixed models predicting physical and psychological health from daily events reported*

Health Indicator	Total	Fitness		Exertion		Positive Affect		Negative Affect		Stress	
		Est.	Sig.	Est.	Sig.	Est.	Sig.	Est.	Sig.	Est.	Sig.
Event Reported	reports										
Able to cope	230	.76**	<.01	-.05	.72	.23**	.01	-.11**	<.01	-.99**	<.01
Camaraderie with teammates	223	-.14	.49	.23	.21	-.19	.07	.03	.42	.20	.38
Enjoyed the environment	221	.20	.13	-.03	.81	.27**	<.01	-.02	.34	-.33*	.02
Satisfied in making good progress	205	.16	.19	.11	.33	.26**	<.01	-.06**	.01	-.13	.34
Muscle and joint pains	163	.00	.99	.51**	<.01	-.04	.49	.05*	.01	.33*	.01
Equipment was working	115	.02	.88	-.12	.37	.15*	.04	-.03	.21	-.35*	.03
Lack of sleep	102	-.08	.59	.42**	<.01	.03	.70	.00	.87	.08	.48
Had gear problems	97	.00	.98	.04	.72	.07	.28	.00	.98	.04	.77
Feared injury	75	-.32*	.02	.03	.79	-.14*	.04	-.03	.20	-.14	.38
Hygiene concerns	73	.61*	.03	.30	.22	.00	1.00	-.05	.29	-.11	.72
Teammate wellbeing concerns	72	.18	.21	.40**	<.01	-.03	.63	-.03	.24	-.13	.40

Loneliness	53	-.36*	.04	.18	.26	-.10	.28	.10**	<.01	.60**	<.01
Worried about bad weather	50	.15	.36	-.32*	.02	.04	.61	.01	.65	-.24	.17
Worried about friends or family	49	-.39	.07	-.24	.21	-.08	.48	.07	.07	-.14	.56
Lacked privacy	32	.00	.99	.03	.86	.13	.23	-.10**	.01	-.39	.10
Team effectiveness concerns	31	.47*	.03	-.27	.15	-.04	.74	-.02	.68	-.13	.58
Headache	13	-.59*	.03	.06	.80	-.27*	.05	.05	.31	.23	.43
Tension with teammates	12	-.01	.98	.38	.13	-.15	.31	.12*	.02	.11	.35
Worried about safety decisions	6	.62	.11	.24	.48	.36	.07	-.02	.82	-.94*	.03
Down/stressed because teammate is	6	-.27	.54	.30	.43	-.18	.41	.02	.77	.22	.65

709 *Note: * p <.05; ** p<.01*

710

711

712

713

714

715

716 Table 4

717 *Frequency scores and linear mixed models predicting physical and psychological health from coping strategies used*

Coping Strategy	Health Indicator	Fitness		Exertion		Positive Affect		Negative Affect		Stress	
	Total reports	Est.	Sig.	Est.	Sig.	Est.	Sig.	Est.	Sig.	Est.	Sig.
Wrote in a journal	292	-.30	.24	-.19	.38	-.39**	<.01	.02	.57	.17	.48
Thought about something pleasant	268	.23	.21	.30	.06	.24**	.01	-.02	.48	-.25	.16
Kept the goal in sight	231	-.19	.27	.24	.09	-.15	.07	.03	.23	.25	.12
Kept a positive attitude, used humor	231	.05	.14	.20	.10	.06	.39	.01	.61	.04	.78
Saw the situation in a positive way	221	.12	.47	-.01	.95	.30**	<.01	-.05	.08	-.51**	<.01
Relaxed or meditated	197	.32	.07	-.18	.23	.01	.95	-.09**	<.01	-.33	.06
Took it one day at a time	177	.18	.22	.16	.22	-.12	.10	.03	.22	.56**	<.01
Immersed self in the task	146	.10	.47	.22	.06	.06	.40	-.01	.64	.05	.69
Tried harder	145	-.22	.24	.39*	.02	.17	.06	-.05	.09	-.26	.18
Kept feelings to self	115	-.35	.09	-.07	.59	-.03	.65	.02	.35	.09	.49
Tried to solve problems	92	-.10	.47	.20	.08	-.05	.41	.03	.25	.33*	.01

Discussed task concerns	91	-.09	.55	-.10	.39	-.08	.26	.05*	.04	.24	.09
Prayer	72	-.84*	.04	-.48	.17	-.73**	<.01	.38**	<.01	1.79**	<.01
Had negative feelings about teammate	60	.26	.10	-.05	.72	-.05	.50	-.01	.75	.03	.84
Discussed personal concerns	31	-.39*	.04	.13	.43	.05	.58	.03	.31	.13	.49
Had negative feelings about myself	27	-.35	.09	.54**	<.01	-.23*	.02	.12**	<.01	.94**	<.01
Cried	4	-.74	.12	1.00*	.01	-.29	.22	.05	.54	-.17	.72
Yelled	0	0	.	0	.	0	.	0	.	0	.

718 *Note:* * $p < .05$; ** $p < .01$

719

720

721

722

723

724

725 Table 5

726 *Indicator wave analysis demonstrating change in events and coping strategy use between 1st and 2nd half of expedition*

	Events				Coping strategies		
	1st	2nd	Δ		1st	2nd	Δ
Able to cope	-.30	.40	+	Wrote in a journal	-.60	.90	+
Camaraderie with teammates	-.30	.40	+	Thought about something pleasant	-.20	.30	+
Enjoyed the environment	-.70	1.0	+	Kept the goal in sight	-1.00	1.40	+
Satisfied in making good progress	-.40	.50	+	Kept a positive attitude, used humor	-.60	.80	+
Muscle and joint pains	1.00	-1.3	-	Saw the situation in a positive way	-1.00	1.30	+
Equipment was working	.40	-.60	-	Relaxed or meditated	-.30	.40	+
Lack of sleep	1.40	-1.90	-	Took it one day at a time	-.90	1.20	+
Had gear problems	-1.80	2.50	+	Immersed self in the task	1.40	-1.90	-
Feared injury	-.70	.90	+	Tried harder	.30	-.40	-
Hygiene concerns	-.10	.20	+	Kept feelings to self	.50	-.70	-
Teammate wellbeing concerns	2.50	-3.50	-	Tried to solve problems	1.20	-1.70	-

Loneliness	-.90	1.30	+	Discussed task concerns	.20	-.30	-
Worried about bad weather	-1.10	1.50	+	Prayer	-.50	.70	+
Worried about friends or family	1.20	-1.60	-	Had negative feelings about teammate	.90	-1.30	-
Lacked privacy	1.70	-2.40	-	Discussed personal concerns	.10	-.30	-
Team effectiveness concerns	1.90	-2.60	-	Had negative feelings about myself	.40	-.50	-
Headache	.50	-.70	-	Cried	.20	-.30	-
Tension with teammates	.40	-.60	-	Yelled	.00	.00	
Worried about safety decisions	.00	.00					
Down/stressed because teammate is	1.00	-1.40	-				

727 *Note:* Numeric values are standardized residual scores. + indicates an increase from 1st to 2nd half of expedition and – indicates decrease from 1st
 728 to 2nd half of the expedition