

1 **Reported growth following mountaineering expeditions: The role of personality and**
2 **perceived stress**

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26 **Abstract**

27 Results from previous studies suggest that stressful environmental conditions such as
28 those faced on expedition may result in psychological growth. Building on previous research,
29 the present cross-sectional study examined the role of personality and perceived stress in
30 relation to post-expedition growth. Eighty-three participants who had completed a
31 mountaineering expedition responded to measures of stress, personality, growth, well-being
32 and resilience. Findings implicate perceived stress, and personality dimensions of
33 agreeableness and openness, in post-expedition growth. Growth was associated with well-
34 being but distinct from psychological resilience, highlighting the need to consider growth and
35 resilience independently. Present findings support the proposition that stressful expedition-
36 environments may promote positive psychological adjustment and identify factors that may
37 influence this change. Research is needed to delineate the impact of other variables, such as
38 coping, on changes that occurs during the post-expedition phase. Such research holds
39 relevance for maintaining health following immersion in extreme and unusual environments.

40 Keywords: Personality; Stress; Post-expedition Growth; Mountaineering; Expedition

41 **Introduction**

42 There are a number of inherent stressors associated with extreme environments, such
43 as hostile climates, cramped living spaces, lack of available life support and limited
44 communication with the outside world (Sandal, 2000). Despite these challenges, there is a
45 growing body of literature that suggests exposure to stress as a result of operating in extreme
46 environmental conditions can manifest in adaptive psychological responses and personal
47 growth (Kjaergaard, Venables, Leon, & Fink, 2013; Leon, Sandal, Fink, & Ciofani, 2011).
48 Such findings are consistent with the positive psychology orientation encouraged by Suedfeld
49 (2001, 2005), and based on the presumed ‘salutogenic’ (or health-enhancing) function of
50 challenging experiences (Antonovsky, 1987). Researchers conducting studies with diverse

51 populations, such as young adult expedition-goers (Stott & Hall, 2003), round-the-world
52 sailors (Kjaergaard, Leon & Venables, 2015), polar adventurers (Atlis, Leon, Sandal &
53 Infante, 2004; Leon et al., 2011), military personnel (Kjaergaard et a., 2013), Antarctic over-
54 winterers (Palinkas, 1986), and astronauts (Ihle, Ritsher & Kanas, 2006; Suedfeld, Brcic,
55 Johnson, & Gushin, 2012), have reported various forms of positive adjustment following
56 exposure to stress-inducing extreme environs. These findings contrast to the more traditional
57 pathogenic view of extreme environments, which focused on psychological and interpersonal
58 dysfunction experienced by personnel in such contexts (Steel, Suedfeld, Peri, & Palinkas,
59 1997; Suedfeld, 2001).

60 In an attempt to explain the positive adjustment reported in previous studies, scientists
61 focusing on psychological factors in extreme environment contexts have employed concepts
62 embedded in the post-traumatic growth (PTG) literature (Calhoun & Tedeschi, 2004). While
63 extreme environments are not by nature considered traumatic, they do provide a challenging
64 context that tests the personal resources of an individual and may result in enhanced feelings
65 of personal strength, appreciation of life, and possibilities for the future. It is important to
66 note that Calhoun and Tedeschi (1996; 2004) consider growth as a process of positive
67 adaptation that occurs following stressful and traumatic events, and emphasize a distinction
68 from psychological resilience. In contrast to growth, resilience is more related to avoiding,
69 warding off, and recovering from negative effects (Palinkas & Suedfeld, 2008). Although the
70 relationship between growth and resilience is debated (Lepore & Revenson, 2006) and
71 considered to be complex (Calhoun & Tedeschi, 2006), initial evidence does support the
72 distinction between the two variables (e.g., Levine, Laufer, Stein, Hamama-Raz, & Solomon,
73 2009). If resilience and growth are found to be independent constructs, this would highlight
74 the need to consider both variables when examining responses to stressful environments such
75 as expeditions.

76 According to Calhoun and Tedeschi (1996; 2004), there are several distinct changes
77 that characterize PTG. These include, (a) improved perceptions of personal strength; (b)
78 appreciation of life; (c) possibilities for the future; (d) relating to others; and (e) spiritual
79 awareness. Personal strength relates to an enhanced belief in one's capabilities and having the
80 resources needed to overcome challenging situations. Appreciation of life is associated with
81 a positive view of the world and understanding what matters in life. Possibilities for the
82 future refers to new opportunities that may not have presented themselves before
83 encountering the stressful experience. Relating to others is about understanding and
84 connecting with other people and spiritual awareness is being aware of and in touch with
85 religious matters. Despite a number of studies examining growth following immersion in
86 extreme conditions (e.g., Ihle et al., 2006; Kjaergaard et al., 2013), there has been little or no
87 attempt to assess the correlates (i.e., personality, stress, well-being, resilience) of growth after
88 returning from an extreme and unusual environment expedition.

89 Findings from previous work suggest that the extent to which a person is likely to
90 report growth will be influenced by a variety of factors, which include the level of stress
91 experienced and an individual's personality characteristics (Paton, 2005). Indeed,
92 Shakespeare-Finch, Gow and Smith (2005) reported positive correlations between the Big-5
93 personality dimensions of extroversion, openness, agreeableness, and reports of PTG. Similar
94 relationships between PTG and personality have also been found in other clinical (Garnefski,
95 Kraaij, Schroevers, & Somsen, 2008) and non-clinical (Tedeschi & Calhoun, 1996)
96 populations, thereby highlighting the importance of considering dimensions of personality
97 when studying PTG.

98 Within extreme environment research, personality has often been a variable of interest
99 and is an important consideration when screening people to operate in challenging conditions
100 (Cardona & Ritchie, 2007; Palinkas & Suedfeld, 2008; Sandal, Leon & Palinkas, 2006). For

101 instance, the European and Russian Space Agencies and the National Aeronautics Space
102 Administration (NASA) screen applicants' personality prior to acceptance on to their
103 respective astronaut programs (Kanas & Manzey, 2008; Musson, Sandal & Helmreich, 2004).
104 The aim of this screening process is to remove candidates who are deemed unsuitable for
105 deployments in space.

106 In teams operating in challenging situations, a combination of high motivation
107 (instrumentality) and positive expressivity (interpersonal sensitivity) have been used to define
108 what is referred to as "the right stuff". The "right stuff" personality profile has been
109 associated with superior coping and performance in teams operating in stressful environments
110 such as aircrews (Chidester, Helmreich, Gregorich, & Geis, 1991), military units (Sandal, et
111 al. 1998), submarine personnel (Sandal, Endresen, Vaernes & Ursin, 1999), and astronauts
112 (McFadden, Helmreich, Rose, & Fogg, 1994). Further evidence also exists to indicate that
113 agreeableness, the extent to which a person is affable and able to work with others, may
114 contribute to performance in demanding situations such as space missions and astronaut
115 training (Rose, Fogg, Helmreich, & McFadden 1994). Instrumentality and agreeableness
116 (closely linked to positive expressivity) are very relevant to the present research, especially
117 given the importance of the study participants working with others to complete their
118 expedition objectives.

119 Personality profiling has also been popular with polar expedition groups and has been
120 used to assess a variety of individuals and teams operating in Arctic and Antarctic conditions
121 (Bishop, Grobler, Schjoll, 2001; Kjaergaard et al., 2013; Leon & Scheib, 2007; Sandal,
122 Bergan, Warncke, Vaernes, & Ursin, 1996). Findings from previous studies suggest that
123 individual characteristics such as high emotional stability, task ability, and social
124 compatibility predict optimal performance and adaptation during polar expeditions (Biersner
125 & Hogan, 1984; Mocellin, Suedfeld, Bernaldez, & Barbarito, 1991; Palinkas, Gunderson,

126 Holland, Miller, & Johnson, 2000). Further distinctions can be made between the types of
127 individual characteristics needed for optimum performance during different length
128 expeditions to the Polar Regions. The ideal personal characteristics for short-duration (<3
129 months) polar excursions are considered to be a high motivation to achieve, sense of
130 adventure, and low susceptibility to anxiety. In contrast, the individual characteristics ideal
131 for longer-duration stays and over-wintering are somewhat different and include amongst
132 others, being emotionally stable, introverted yet socially adept and not needing social
133 interaction (Palinkas & Suedfeld, 2008). The participants in the present study were typically
134 undertaking short-duration expeditions and optimal performance would be expected to fit
135 within the former profile.

136 Taken together, findings from military, space, and polar expedition research point
137 towards certain personality factors, such as agreeableness, motivation, and low neuroticism
138 (or anxiety susceptibility) that are expected to facilitate performance and adjustment in
139 extreme environments (Musson et al., 2004; Sandal et al., 2006). However, to date there has
140 been a limited attempt to examine the link between personality and adjustment (i.e., growth)
141 specifically during the post-expedition phase. Given the role of personality factors in
142 predicting performance and adjustment (Palinkas et al., 2000), and considering research
143 conducted in trauma-related settings (e.g., Shakespeare-Finch et al., 2005), we might also
144 expect the same personality factors to contribute to reports of growth on return from extreme
145 and stressful environmental conditions.

146 In summary, the aim of the present study was to build on previous research examining
147 growth following an extreme environment expedition (e.g., Kjaergaard et al., 2013; 2015).
148 Specifically, in the current study we tested the relationship between PTG and correlates,
149 including stress, personality, well-being, and resilience. In line with previous findings, we
150 expected expedition-goers to report perceptions of growth. We expected growth to be

151 positively related to well-being but not related to the distinct construct of resilience (Levine et
152 al., 2009). Finally, we anticipated that stress and personality would account for changes in
153 reported growth. It was expected that dimensions of personality consistent with the “right
154 stuff” (e.g., agreeableness, conscientiousness, openness) would be predictive of post-
155 expedition growth.

156 **Method**

157 **Participants**

158 In total, 83 mountaineering participants (Male = 72; Female = 11) were involved in
159 the present study. On completion of data collection, 93 expedition-goers had fully completed
160 the survey. After screening for expedition-type, 10 non-mountaineers were eventually
161 removed from the analysis resulting in the finally sample of 83 mountaineers. The final
162 sample had a mean age of 42.54 years ($SD = 16.50$ years), had participated in at least 1, and
163 up to as many as 40 expeditions ($M = 7.55$), and on average had completed their most recent
164 expedition 28 months ago ($SD = 48$ months). Of the participants, 31 were single, 42 were
165 married, 2 separated, and 8 co-habiting. In addition, 35 of the participants reported having
166 children. The study was approved by the University ethics committee prior to being
167 undertaken and all participants provided informed consent before taking part.

168 **Measures**

169 **Post-expedition growth.** To assess reports of post-expedition growth the 21-item
170 Post-traumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996) was used. The PTGI
171 assesses 5 dimensions of growth, including personal strength, appreciation of life,
172 possibilities for the future, relating to others, and spiritual matters. There were 4 items for
173 personal strength (e.g., “*knowing I can handle difficulties*”), 3 items were used to assess
174 appreciation of life (e.g., “*an appreciation for the value of my own life*”), 5 items used for
175 possibilities (e.g., “*new opportunities are available which wouldn’t have been otherwise*”), 7

176 items for relating to others (e.g., “a sense of closeness with others”) and 2 items for spiritual
177 matters (e.g., “a better understanding of spiritual matters”). Participants were asked to
178 consider the extent to which they experienced change in relation to their last expedition.
179 Responses were provided on a 6-point scale, ranging from 0 (*I did not experience this*
180 *change*) to 5 (*I experienced this change to a very great degree as a result of my expedition*).
181 The PTGI has been used in previous expedition research and demonstrated acceptable
182 validity and reliability (Ihle et al., 2006; Kjaergaard et al., 2013). In previous work, alpha
183 coefficients for the PTGI subscales range from .77 to .97 (Ihle et al., 2006). Reliability
184 coefficients for the PTGI and other scales used in the present study are presented in Tables 1
185 and 3.

186 **Subjective vitality.** To examine participant well-being the Subjective Vitality Scale
187 (SVS; Ryan & Frederick, 1997) was administered. The SVS contains 7 items tapping into the
188 extent to which a person feels alive and vital (e.g., I have energy and spirit). To answer each
189 of the questions, participants were provided with the stem “Since returning from my last
190 expedition, in general in everyday life...” and responded using a 7-point scale ranging from 1
191 (*Not at all true*) to 7 (*Very true*). The SVS has been used extensively in previous research
192 across a variety of domains and has been shown to be a valid and reliable indicator of well-
193 being (Bostic, Rubio & Hood, 2000). Bostic et al. indicate typical alpha coefficients for the
194 SVS range between .80 and .89.

195 **Resilience.** The Brief Resilience Scale (BRS; Smith et al., 2008) was used to assess
196 expedition-goers’ reports of resilience. The BRS contains 6 items tapping into one dimension
197 of resilience (e.g., “I tend to bounce back quickly after hard times”). Participants were
198 provided with the stem “Since returning from my last expedition, in general in everyday
199 life...” and asked to respond to each item using a 5-point Likert scale from 1 (*Strongly*
200 *disagree*) to 5 (*Strongly agree*). The BRS provides an assessment of resilience as an outcome

201 and offers information on the ability of a person to bounce-back consistent with the definition
202 with the PTG literature (Windle, Bennett & Noyes, 2011). Smith et al. (2008) reported
203 acceptable levels of internal reliability for the BRS in four independent samples with
204 Cronbach alpha scores ranging from .80 - .91.

205 **Stress.** A single item was used to assess participants' perceptions of how stressful
206 their expedition experience was. A scale based on the Borg (1982) system was used to
207 capture perceptions of stress. Participants were given the stem "how stressful was the
208 expedition listed above?" and asked to respond on a scale from 0 (*least it could possibly be*) –
209 100 (*most it could possibly be*) in terms of how stressful they found the expedition
210 experience. Single item measures of stress have shown good construct, content and predictive
211 validity in previous psychological studies (Elo, Leppanen & Jahkola, 2003; Salminen,
212 Kouvonen, Koskinen, Joensuu, & Vaananen, 2014) and have also been utilized in past
213 extreme environment research (Kahn & Leon, 2000).

214 **Personality.** The 44 item Big Five Inventory (BFI; John, Donahue & Kentle, 1991)
215 was used to assess the five personality traits of agreeableness, conscientiousness,
216 extraversion, openness and neuroticism. There were 9 items to assess agreeableness (e.g., "I
217 am someone who likes to cooperate with others), 9 items to assess conscientiousness (e.g., "I
218 am someone who does a thorough job"), 8 items for extraversion (e.g., "I am someone who
219 has an assertive personality"), 10 items for openness (e.g., "I am someone who is original and
220 comes up with new ideas") and finally 8 items for neuroticism (e.g., "I am someone who is
221 depressed, blue"). Participants were given a series of statements and asked to consider the
222 extent to which did or did not apply to them. A 5-point Likert scale ranging from 1 (*Disagree*
223 *strongly*) to 5 (*Agree strongly*) was used to respond to each item. The BFI has demonstrated
224 reliability and validity in previous research and showed convergence (Soto & John, 2009)
225 with the NEO personality inventory (Costa & McCrae, 1992) used in previous extreme

226 environment research. In prior work, Soto and John (2009) have reported acceptable internal
227 reliability scores for the BFI with coefficients ranging between .81 - .88.

228 **Procedure**

229 A cross-sectional retrospective design was employed in the study. Data were collected
230 using an online questionnaire that was completed in English and contained items related to
231 demographics, expedition characteristics and the variables under examination. Indices of
232 reliability for each of the study variables can be seen in Tables 1 and 2. Prospective
233 participants were contacted online via a number of mailing lists and pre-existing networks
234 within the mountaineering and expedition community. After reading the information letter
235 and criteria for inclusion, individuals were asked to provide consent. Following consent,
236 participants completed the different sections of the online questionnaire in relation to their
237 most recent expedition. In total, the questionnaire took approximately 20 – 30 minutes to
238 complete.

239 Initially, the survey was promoted to all forms of expedition (e.g., mountaineering,
240 trekking, polar). However, on completion of data collection the convenience sample collected
241 were mainly mountaineers. Therefore, to be included in the study participants had to have
242 completed an alpine/mountaineering expedition lasting a minimum of 7 days. For the
243 purposes of this study an expedition was defined as a human powered journey between 2 or
244 more locations (i.e., from basecamp to a targeted[s] peak), which is consistent with how an
245 expedition is defined by the Royal Geographical Society in the UK.

246 **Data Analysis**

247 Aggregated scores for each of the questionnaire subscales were computed and
248 descriptive statistics presented alongside background information on the expeditions. To
249 examine the role of group size, expedition duration and expedition experience, variables were
250 dichotomized. For group size, participants were categorized into individual/small group ($N =$

251 1 – 4) and larger group ($N = 5+$). Expedition duration was considered shorter if the journey
252 lasted between 1 – 4 weeks and longer if the trip was 5 weeks+. If the participants had
253 completed 1 – 4 expeditions they were considered less experienced and those who had
254 completed 5+ trips were coded as more experienced. Coding the variables in such a way
255 resulted in roughly equal group sizes. Parametric assumptions were checked before
256 employing paired samples t-tests to examine differences in growth according to the coded
257 variables. As multiple t-tests were conducted, a Bonferroni adjustment was applied to the
258 probability (i.e., $.05/3 = .017$) value thereby reducing the chance of rejecting the null
259 hypothesis in error. Bivariate correlations were then computed between study variables
260 before running a hierarchical multiple regression analysis. Based on the initial t-tests and
261 correlational analysis, we controlled for expeditions completed and elapsed time since
262 completion in the first step. In Step 2, stress was included as a predictor before adding
263 personality dimensions to the regression model in Step 3. At each stage, the amount of
264 variance was explained and the standardized regression weights assessed for significance.

265 Results

266 The location of the expeditions varied and included journeys in 38 different countries,
267 the most common being in Asia particularly in the Himalayas. There were a variety of other
268 locations visited by multiple expedition groups including the Andes, Patagonia, Namibia, the
269 European Alps, Alaska and Antarctica. Out of the 83 participants, 72 reported to have
270 achieved their expedition aims while 11 said they did not complete what they set out to do.
271 ⁱⁱⁱIn terms of characteristics, there was a similar dispersion of participants between the more
272 than 1 week – less than 2 ($n = 26$), more than 2 weeks – less than 4 ($n = 23$), and more than 4
273 weeks – less than 8 ($n = 27$). There were fewer participants in the more than 8 weeks – less
274 than 12 ($n = 4$), and more than 12 weeks ($n = 3$) time frames. The size of the expedition
275 groups varied; 3 reported being individuals, 18 as part of a pair, 16 in a group of 3 – 4, 29 in a

276 group of 5 – 8 people and 17 who completed their trip as part of group of 9 people or more.
277 In relation to the expedition aims, participants reported wanting to complete first ascents,
278 explore remote environments and gain new experiences.

279 Reports of post-expedition growth are provided in Table 1. Scores indicate that
280 personal strength and appreciation of life displayed the most prominent perception of change,
281 while spiritual matters changed the least. With the exception of 1 item (i.e., “I have a stronger
282 religious faith”), 44 – 84% of individuals indicated some degree of change and reported
283 feelings of growth following the expedition. Independent samples t tests were used to
284 examine growth according to expedition characteristics (see Table 2). A Bonferroni
285 adjustment was applied due to the repeated t tests and a more conservative estimate of
286 significance was set at $p < .017$. There were no significant differences in reported growth
287 according to group size or duration of expedition. A difference was observed between
288 reported growth according to the level of expedition experience (i.e., more or less
289 experienced). Although this was non-significant according to the adjusted p value ($p = .033$),
290 the effect size ($d = 0.48$) could be interpreted as moderate.

291 Mean scores, standard deviations and reliability values for the remaining study
292 variables can be seen in Table 3. Reported expedition stress was scored at a moderate level.
293 On average, participants reported higher scores on extraversion, conscientiousness,
294 agreeableness, and openness, and lower scores on neuroticism than when considered in
295 relation to a more general population (see Table 3).

296 Reports of growth, including future possibilities, appreciation of life, relating to
297 others, and spiritual matters were correlated with subjective vitality but not with resilience.
298 Reports of expedition stress were positively associated with dimensions of growth, including
299 appreciation of life, possibilities for future, personal strength, and relating to others. With
300 respect to personality, there was a significant association between extraversion and spiritual

301 matters. A series of positive correlations were also found between agreeableness and future
302 possibilities, appreciation of life, relating to others, and spiritual matters. Finally there was a
303 significant positive correlation between openness, and appreciation of life and spirituality. A
304 full correlation matrix with all study variables can be seen in Table 4.

305 Results from the hierarchical multiple linear regressions are presented in Table 5.
306 Predictors included in Step 1 accounted for only 3% of the variance in participants' reports of
307 growth. Neither the number of expeditions completed or elapsed time was significantly
308 related to growth. Including reports of expedition stress in Step 2 accounted for an additional
309 11% of the variance in participants' reports of growth and the regression was significant $F(3,$
310 $79) = 4.35, p = .007$. At this stage, stress emerged as a significant predictor of overall growth
311 ($B = .35, p = .002$). In Step 3, personality factors were added and this accounted for an
312 additional 22% of the variance in growth and resulted in a significant regression coefficient F
313 $(8, 74) = 4.45, p < .01$. Stress remained a significant positive predictor of growth ($B = .39, p <$
314 $.01$) and agreeableness also emerged as a significant positive predictor ($B = .34, p = .001$).
315 The relationship between openness and growth was positive and approached significance (B
316 $= .20, p = .07$).

317 Discussion

318 The aim of the present work was to examine the expedition characteristics and key
319 psychological factors associated with post-expedition growth. To date, post-expedition
320 responses have received relatively limited empirical attention. This is surprising given that
321 the return stage has been identified as an important phase for individuals following exposure
322 to extreme environmental conditions. While a small number of studies have provided
323 descriptive information on post-expedition growth, there has been no attempt to examine the
324 correlates of growth following expeditions in extreme environment settings. In a unique
325 contribution to the literature, the findings of the present research highlight the role of

326 perceived stress and personality for ensuing reports of post-expedition growth. Dimensions of
327 growth were also associated with indicators of psychological wellbeing highlighting the
328 potential benefits of facilitating growth experiences.

329 Consistent with the findings of previous research, the expedition-goers in the present
330 study reported small-to-moderate growth following exposure to an extreme and unusual
331 environment (Ihle et al., 2006; Kjaergaard et al., 2013). Most notably, perceptions of personal
332 strength and appreciation of life were reported as having changed. The perceptions of growth
333 reported suggest that as a result of the expedition, participants felt more capable of
334 overcoming future challenges and had a different perspective of their life. The present
335 findings are in line with the literature on PTG (Tedeschi & Calhoun, 1996), which suggests
336 stressful encounters may lead to a positive readjustment and hold benefits for the individual.
337 In addition, and consistent with previous findings (e.g., Ihle et al., 2006; Suedfeld &
338 Weiszbeck, 2004), changes in spiritual matters were negligible. For such a shift to occur in
339 relation to spirituality, it is possible that a major event or more profound experience would be
340 needed, rather than the environmental stress caused by expedition endeavors.

341 To better understand the growth response, we examined key expedition characteristics
342 that might account for the positive adjustment (i.e., experience, duration, group size).
343 Although no significant differences emerged, the moderate effect size noted between the
344 more versus less experienced expedition-goers, suggests that the number of expeditions
345 completed could have an impact on growth. The finding related to expedition experience is
346 not surprising given that those who spend more time in stressful environments are likely to
347 become accustomed to such settings and perhaps develop resources to cope with these
348 situations. Consequently, the personal resources of experienced individuals are less likely to
349 be challenged and growth would be unexpected. In Step 3 of the regression model, the link
350 between expeditions completed and growth approached significance. In part, expedition

351 experience may explain the modest changes in growth reported in the current work, as well as
352 in previous studies that focused on those operating in space (Ihle et al., 2006). This
353 interpretation is consistent with a plateauing effect, which suggests that substantial growth
354 will occur following initial expedition experiences and then become more stable over time.
355 Aligned with theoretical predictions, further growth would only then occur following more
356 demanding (or traumatic) expedition endeavors. Ultimately, events that challenge the
357 resources of an individual will result in a schema change, reformulation of one's self-
358 perception, and reports of growth. In future work, examining how growth is experienced by
359 both novice and more established expedition-goers could provide valuable information on
360 how extreme environments could be used to facilitate positive development. This information
361 could be used to aid the training and preparation of personnel for engagement in more
362 stressful extreme environment endeavors (Kanas et al., 2007).

363 Within the present sample, participants reported higher scores on conscientiousness,
364 agreeableness, extraversion, and openness, and lower scores on neuroticism than when
365 compared to a general population sample of adults (Nofhle & Robins, 2007). This personality
366 profile is coherent with previous research that has examined individuals operating in extreme
367 and unusual environments (Kjaergaard et al., 2013; Steel et al., 1997). Such a profile is linked
368 to the ideal characteristics needed for short-term polar expeditions as proposed by Palinkas
369 and Suedfeld (2008). Having a high sense of adventure, a desire to achieve, and low
370 susceptibility to anxiety are considered important for performance and adjustment in polar
371 environments and may hold true for other expedition contexts, such as mountaineering
372 (Palinkas & Suedfeld, 2008). In addition, the reports of conscientiousness and agreeableness
373 are suggestive of a profile that is consistent with having the "right stuff", or being high in
374 instrumentality and expressivity, which has been shown to be important for teams operating
375 in challenging contexts such as aircrews (Chidester et al., 1991), astronauts (McFadden et al.,

376 1994), and military personnel (Sandal et al., 1998). In the present study, the sample of
377 alpinists and mountaineers were self-selecting and responsible for the selection of themselves
378 and other team members. Therefore, ensuring individual members possess the attributes (e.g.,
379 conscientiousness, agreeableness) that would allow them to function optimally in extreme
380 environments is critical for the safe and successful completion of different expedition
381 activities.

382 Not surprisingly, reports of expedition stress were positively correlated with
383 indicators of growth, including future possibilities, appreciation for life, and personal
384 strength. These findings are consonant with the literature on PTG that suggest when a
385 person's resources are challenged they may experience a positive reaction, especially if they
386 are able to overcome the difficulties faced (Calhoun & Tedeschi, 1996; 2006). Interestingly
387 and consistent with the view that growth and resilience should be considered as distinct
388 constructs (Levine et al., 2009; Palinkas & Suedfeld, 2008), there were no significant
389 correlations between the dimensions of growth as measured by the PTGI and resilience. The
390 present results are in line with findings by Levine et al. (2009) and highlight the
391 independence of resilience and growth in this extreme environment context. One possible
392 explanation is that growth is more likely a positive reformulation, rather than simply a
393 tendency to withstand or bounce back from a stressful encounter. Consequently, this finding
394 is in line with the recommendations made by Suedfeld (2001) and highlights the need to
395 consider the complementary variables of growth and resilience in future extreme environment
396 research.

397 Further positive correlations were found between dimensions of growth and
398 subjective vitality, an indicator of well-being linked to optimal functioning within the
399 eudaimonic perspective (Waterman, 1993). Interestingly, there was no correlation between
400 stress and subjective vitality. This finding is encouraging and suggests that growth

401 experienced as a result of stress may have subsequent implications for promoting
402 psychological health (i.e., subjective vitality), but that stress in and of itself is not well-being
403 promoting. It is important to highlight that these data are correlational and causal pathways
404 cannot be assumed. Nevertheless, such findings provide impetus for future research in this
405 area and data from prospective studies would allow for a stress-growth-well-being model to
406 be tested further.

407 After controlling for number of expeditions completed and time since completion
408 (elapsed time), stress remained a positive predictor of growth. This might suggest that
409 regardless of expedition experience or the elapsed time since completion, if the expedition
410 experience was stressful enough to challenge an individual's resources they would be more
411 likely to report growth (also consistent with our earlier interpretation). In addition to stress, a
412 positive association between the personality dimension of agreeableness and growth
413 emerged, suggesting that those who are more affable and able to work with others are likely
414 to report more positive adaption following exposure to extreme and stressful environments.
415 The link between openness and growth was approaching significance and might suggest that
416 those individuals who are interested in new experiences and opportunities are likely to report
417 more growth. Such findings are line with previous research on PTG in disaster and
418 emergency settings (Paton, 2006). In relation to previous extreme environment work, high
419 agreeableness and to some extent openness (similar to a sense of adventure) have been
420 identified as important for individual and team performance in challenging conditions
421 (Biersner & Hogan, 1984; Mocellin, Suedfeld, Bernaldez & Barbarito, 1991; Palinkas et al.,
422 2000; Palinkas & Suedfeld, 2008; Sandal et al., 1999). The present findings suggest that the
423 characteristics of agreeableness, and to some degree openness, may be important for
424 adjustment, and more specifically reports of growth during the post-expedition phase. When
425 included within the same model, the remaining dimensions of personality were not associated

426 with growth. This suggests that factors other than personality may account for the
427 unexplained variance in the growth response. In upcoming work researchers may consider
428 variables such as personal values, which relates to a person's motivation and may also impact
429 upon adjustment after exposure to stress (Sandal & Bye, 2015; Sandal, Bye, & van de Vijver,
430 2011). Understanding the motives of expedition-goers is important, especially given that such
431 a group choose to participate in these activities. Examining the quality of motivation (i.e.,
432 Intrinsic or Extrinsic; Deci & Ryan, 2000) and/or individuals' goal orientation, or conception
433 of success (Dweck & Leggett, 1988; Nicholls, 1989), may explain how individuals respond to
434 self-imposed stress and account for variability in growth. Motivation has been well-studied in
435 other self-initiated contexts, such as sport, and may help explain how individuals respond and
436 adjust following exposure to extreme environmental conditions.

437 **Limitations**

438 It is important to acknowledge the limitations of the present study. First and foremost,
439 the study utilized cross-sectional data that relied on a retrospective account of the most recent
440 expedition. As such, we were lacking pre-measurement reports of personality, resilience and
441 vitality, which would have allowed us to control for changes in these variables following
442 individuals' most recent expedition experience. However, despite the retrospective nature of
443 the research, the present findings are consistent with previous work on personality predictors
444 for adaptation in extreme environment and provide validity to our results. This approach also
445 overcomes some of the constraints of previous extreme environments research that relies on
446 small sample sizes. Secondly, there are a number of factors that were not considered within
447 the study. In previous work in extreme environments, the coping strategies used by
448 expedition-goers have been shown to be important for adaptation and performance in the face
449 of stress (Nicolas, Sandal, Weiss, & Yusupova, 2013). It is also likely that coping strategies,
450 such as problem- and emotion-focused approaches, would hold relevance for reports of

451 growth following stressful experiences (Paton, 2006) and should be considered in future
452 work. Linked to the coping response, it is possible there is a stress threshold after which no
453 further growth would be reported and maladaptive responses may emerge. Although beyond
454 the scope of the present study, more work needs to be done to examine the threshold of stress
455 likely to result in growth whilst minimizing potentially adverse effects. Collecting temporal
456 assessments of growth (as well as challenges faced) during the post-expedition phase may
457 elucidate the link between stress and adjustment after exposure to extreme environments.
458 Thirdly, in the current work we employed a single item indicator of perceived stress. This
459 approach has been used in previous studies (Elo et al., 2003) and aimed to provide a global
460 indicator of perceived stress to aid the recall of participants. However, we acknowledge there
461 are a variety of stressors likely to emerge before, during and after exposure to extreme
462 settings. In future work, a more detailed description of stress could be taken to examine
463 whether certain types of stressor (e.g., danger, monotony, psychosocial, weather etc.) account
464 for reports of growth. Fourthly, the present research adopted a largely positive psychological
465 viewpoint consistent with the recommendation of Suedfeld (2001). The expedition-goers may
466 have experienced challenges on return from their experience that were not captured in the
467 present study. In future, considering both the benefits and challenges faced by individuals
468 during the post-expedition phase would be beneficial.

469 **Conclusions**

470 To our knowledge, this is the first study to examine the relationship between
471 personality, stress and growth after completing an extreme environment expedition. The
472 findings of the work are encouraging and highlight the potential ensuing benefits associated
473 with engagement in pursuits in stressful environmental conditions. It is important to caution
474 that although stress and growth are related, more work needs to be done to examine this
475 relationship, particularly as excessive levels of stress are likely to be marked by both adaptive

476 and maladaptive responses. We also re-emphasize the importance of the personality factors of
477 agreeableness and openness, not only for optimal performance in stressful environments, but
478 also for adjustment in the post-expedition phase. A particular strength of the present work
479 was the considerable sample size, which is often acknowledged as a constraint to studying
480 groups in extreme conditions (Palinkas et al., 2004). In the future, studying mountaineering
481 groups may allow extreme environment researchers to recruit larger samples and aid
482 understanding of optimal performance and psychological adjustment both during and
483 following exposure to extreme environments. Knowledge from such studies could then be
484 applied to the selection, preparation and training of individuals that are due to operate in
485 stressful environments (Kanas et al., 2007).

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Table 1

Reports of Post-expedition Growth by Item

Subscale (and items)	Alpha	Subscale (Mean +/- SD)	Item (Mean +/- SD)	% reporting any change
New Possibilities	.86	1.65 +/- 1.35		
New opportunities are available which wouldn't have been otherwise			1.81 +/- 1.70	64
I am able to do better things with my life			1.71 +/- 1.74	59
I developed new interests			1.80 +/- 1.59	71
I'm more likely to try to change things which need changing			1.60 +/- 1.70	58
I established a new path for my life			1.18 +/- 1.63	44
Appreciation of Life	.85	2.26 +/- 1.47		
I can better appreciate each day			2.04 +/- 1.77	68
I have a greater appreciation for the value of my own life			2.19 +/- 1.73	71
I changed my priorities about what is important in life			2.45 +/- 1.56	84
Personal Strength	.83	2.27 +/- 1.45		
A feeling of self-reliance			2.49 +/- 1.68	79
Knowing I can handle difficulties			2.47 +/- 1.82	78
Being able to accept the way things work out			2.16 +/- 1.66	74
I discovered that I am stronger than I thought I was			1.86 +/- 1.84	61
Relating to Others	.90	1.69 +/- 1.26		
Knowing that I can count on people in times of trouble			1.87 +/- 1.63	71

Having compassion for others			1.62 +/- 1.57	62
A sense of closeness with others			1.96 +/- 1.67	72
A willingness to express my emotions			1.21 +/- 1.47	51
Putting effort into my relationships			1.82 +/- 1.64	68
I learned a great deal about how wonderful people are			1.66 +/- 1.76	58
I accept needing others			1.39 +/- 1.51	55
Spiritual Matters	.61	.75 +/- 1.07		
A better understanding of spiritual matters			1.20 +/- 1.53	49
I have a stronger religious faith			0.28 +/- 0.87	13
TOTAL	0.95	1.73 +/- 1.12		

Note: Growth items range on scale from 0 – 5

Table 2

Differences in Reported Growth Based on Expedition Characteristics

Variables	N	Mean (SD)	<i>t</i>	Sig.
Less Experienced	38	2.01 (1.13)	2.17	.033
More Experienced	45	1.48 (1.07)		
Small group	37	1.80 (0.95)	0.69	.491
Large group	46	1.62 (1.34)		
Shorter duration	49	1.72 (1.08)	0.01	.998
Longer duration	34	1.72 (1.17)		

Note: Less experienced = 1 – 4 expeditions, More experienced = 5+ expeditions; Small group = 1 – 4 people, Large group = 5+ people; Shorter duration = 1 – 4 weeks, Longer duration = 5+ weeks

Table 3

Means, Standard Deviations and Reliability of Growth Correlates

	Mean	Std. Deviation	α	General Population Mean (SD)
Stress	46.83	23.14	N/A	-
Time elapsed (months)	28.30	48.21	N/A	-
Expeditions completed	7.55	7.68	N/A	-
Extraversion	3.50	.85	.88	3.26 (.75)
Agreeableness	3.89	.58	.75	3.71 (.60)
Conscientiousness	4.01	.54	.74	3.49 (.62)
Neuroticism	2.20	.77	.85	2.95 (.72)
Openness	3.89	.43	.57	3.55 (.59)
Subjective Vitality	4.84	1.11	.87	-
Resilience	3.91	.78	.90	-

Note: Range for Stress = 0 – 100; Personality = 1 – 5; Subjective vitality = 1 – 7; Resilience = 1 – 5; Comparative general population sample of 10,497, 18 – 30 year old students from Nofle & Robins (2007)

Table 4

Correlations Between Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Extraversion	1												
2. Agreeableness	.37**	1											
3. Conscientiousness	.11	.31**	1										
4. Neuroticism	-.40**	-.42**	-.22*	1									
5. Openness	.32**	.20	.27*	-.09	1								
6. Stress	-.08	-.14	-.15	.12	-.11	1							
7. Time elapsed	-.14	-.17	-.01	.11	-.03	.26*	1						
8. Possibility	.09	.25*	.04	-.02	.16	.25*	-.05	1					
9. Appreciate Life	.13	.24*	.02	.07	.23*	.33**	-.03	.78**	1				
10. Strength	.14	.20	-.04	.07	.03	.30**	-.01	.76**	.76**	1			
11. Relating	.12	.32**	-.11	.08	.02	.24**	-.04	.72**	.69**	.69**	1		
12. Spiritual	.27*	.23*	.01	-.05	.31**	.19	-.23*	.56**	.57**	.45**	.46**	1	
13. Subjective Vitality	.33**	.40**	.16	-.45**	.32**	.01	-.19	.42**	.29*	.19	.24*	.32**	1
14. Resilience	.38**	.26*	.08	-.61**	.35**	.07	-.05	.20	.20	.11	.10	.16	.59**

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

1 Table 5

2 *Hierarchical Multiple Linear Regression Predicting Post-expedition Growth*

		Beta	Sig.
Step 1	Elapsed time	-.08	.459
	Expeditions completed	-.16	.159
Step 2	Stress	.35**	.002
	Elapsed time	-.17	.115
	Expeditions completed	-.13	.222
Step 3	Stress	.39**	.000
	Elapsed time	-.11	.273
	Expeditions completed	-.19+	.080
	Extraversion	.08	.458
	Agreeableness	.39**	.000
	Conscientiousness	-.12	.299
	Neuroticism	.12	.296
Openness	.20+	.070	

3 *Note:* Growth is computed as an aggregation of its 5 subscales; ** $p < .01$, + $p < .10$

4

ⁱ Separate hierarchical multiple linear regressions were conducted with each of the submissions of growth. The findings were consistent across dimensions with stress and agreeableness predictive the growth response. For parsimony, the results for overall growth are presented. Further information can be provided by the first author upon request.

ⁱⁱ On request from one of the reviewers, we examined the difference in stress and growth scores for completers (72) versus non completers (11). Those who completed the expedition reported perceived stress to be 43.72, whereas non-completers indicated perceived stress to be 59.09. Differences in growth scores between completers and non-completers were relatively small.