Supporting Information

Anicich et al. 10.1073/pnas.1408800112

SI Text

Study 1

Recruitment Procedure. Over a 1-wk period, the first author emailed several hundred alpine associations (local chapters and national organizations), Himalayan expedition companies, mountaineering guide training facilities, and well-known climbers from around the world seeking participation in a short online survey. Potential respondents were identified through online searches that targeted only highly experienced climbers and organizations that used English as a primary or secondary language. If a non-English website provided the option to translate the page contents to English, then the website was considered to have English as a secondary language. Potential respondents were told that the research team was "studying mountaineering processes and outcomes" and that the researchers were interested in "your knowledge of and experience with mountain climbing in teams." An anonymous survey link was included in the email. Potential respondents were also encouraged to share the survey link with other experienced climbers. The survey remained open for exactly 4 wk from the time the first email was sent. Respondents were given the option to receive a summary of the research findings at the conclusion of the project (79.2% of respondents requested a summary of the findings).

Free Response Coding. Two independent coders identified the frequency with which participants specifically mentioned one of the three group processes of interest in their response—coordination, psychological safety, and information sharing—or described one of these processes in a general sense. The ratings of the two coders demonstrated high reliability for the team-level factors that contributed to success (intraclass correlation coefficient = 0.92) and failure (intraclass correlation coefficient = 0.90). Seven respondents did not answer the "success" question, and nine respondents did not answer the "failure" question. Table S1 provides sample responses that were coded as relating to each of the three group process variables.

Likert Scales.

Coordination. We assessed how effectively respondents thought the group would be able to coordinate their actions using the following three items ($\alpha = 0.78$): "How effectively would group members be able to coordinate their actions in this group?"; "How effectively would the group be able to manage interdependencies among group members?"; and "How effectively would group members be able to leverage different skill sets in this group?" (from 1 = very ineffectively to 7 = very effectively).

Psychological safety. We assessed the extent to which respondents thought the group would experience a psychologically safe communication climate using the following three items ($\alpha = 0.84$): "How safe would it be for all group members to give their opinions?"; "How safe would it be for all group members to express their concerns?"; and "How safe would it be for all group members to challenge each others' ideas?" (from 1 = very unsafe to 7 = very safe).

Information sharing. We assessed the extent to which respondents thought the group would effectively share information among team members (1) using the following three items ($\alpha = 0.88$): "Information will be freely shared among the members of this team"; "When a member of this team gets information that affects the team, they will be quick to share it"; and "The members of this team will keep each other 'in the loop' about key issues affecting the team" (from 1 = strongly disagree to 7 = strongly agree).

To provide additional support for our proposed mechanisms, we interviewed one of the world's leading experts on high-altitude mountaineering and compiled relevant quotations from two published, first-hand accounts of the 1996 Mt. Everest disaster. These anecdotes are included at the end of *SI Text* as *Appendix*.

Study 2

Analytic Strategy. Given the overdispersion present in our dependent variables, we first compared the appropriateness of using poisson versus negative binomial models. In each of our summit and death count models, the likelihood ratio test that alpha equals zero was rejected at the $P < 0.001$ level, demonstrating that the negative binomial model was more appropriate than the poisson model. Additionally, our dependent variables (i.e., summits and deaths) both had excess zeros, indicating that most climbers neither reached the summit nor died. Therefore, we tested whether correcting for zero inflation by using zero-inflated negative binomial (ZINB) estimation was appropriate. The Vuong test comparing the appropriateness of zero-inflated versus basic negative binomial estimation favored zero-inflated estimation for both summit and death models. Thus, we report results from zero-inflated negative binomial regression with the number of expedition members as the inflation variable. Finally, we used econometric procedures to analyze our data by including clustered robust SEs (2), which take into account the nestedness of expeditions within countries. This approach is appropriate given our data structure (3) and has been used similarly across a wide range of disciplines (4–7).

See Table S2 for an overview of all of the variables used and Tables S3 and S4 for bivariate correlations among all independent, control, and dependent variables. Importantly, the correlations among our three hierarchy variables and two dependent variables (i.e., summits and deaths) are larger than the vast majority of correlations reviewed in Roberts et al. (8) related to similarly important life and death outcomes (see table 1 of Roberts et al. for a summary of correlations), demonstrating that the magnitude of our effects are meaningful. Tables S5 and S6 provide coefficients and clustered robust SEs for all summit models (i.e., steps 1–6) and death models (i.e., steps 1–6).

Establishing Group Level Process. To further test our prediction that group processes drive the effects of hierarchical values on summiting and dying, we created a set of pseudo expeditions whose aggregated members never interacted. To create matched pseudo groups, we first identified all of the countries in our dataset that had at least one solo expedition and at least one group expedition. Then, we used the total number of expedition members from each real group expedition as the basis for forming a randomly drawn matched pseudo group of the same size from the same country. For example, if a real group from Argentina had 10 total members, then we randomly drew (with replacement) 10 solo climbers from the Argentinian "solo expedition sample" and summed the number of summiting members and dying members in this pseudo group. The hierarchy values were the same for the real and pseudo groups because pseudo groups were formed on the basis of real groups from the same country.

We predicted that, if group processes drive the effects of hierarchy, then stronger hierarchies would not be associated with more climbers summiting and dying among pseudo expeditions ($n = 4{,}230$). This prediction was supported because the direct effect of the combined hierarchy measure was not significantly

associated with either summiting (b = 0.137, SE = 0.106, P = 0.194) or dying (b = −0.118, SE = 0.325, P = 0.717) for pseudo groups when analyzed using zero-inflated negative binomial regression with clustered robust SEs. [For solo expeditions that had one or more hired individuals, we averaged the number of summits and deaths when creating pseudo groups so that the number of summits and deaths in the pseudo group was not based on a larger total number of climbers. Importantly, when using only the true solo expeditions (i.e., expeditions with only one climber and no hired help; N = 560) and binary logistic regression with clustered robust standard errors, the effect of hierarchy on the likelihood of summiting (b = −0.246, SE = 0.189, P = 0.193) and the likelihood of dying (b = 0.110, SE = 0.430, P = 0.799) was null as predicted.]

Additional Robustness Analyses.

Outlier analysis. The mean summit rate was 0.322 and the SD was 0.367. We did not treat any summit rates as being outliers because a 100% summit rate was less than 2 SD above the mean summit rate in our sample. For deaths, however, there was more variance. The mean death rate was 0.016 and the SD was 0.073. We determined the outlier cutoff value to be 0.234, which was equal to the mean death rate plus 3 SDs (9). We identified and excluded 93 expeditions that had death rates that exceeded this cutoff value. We then reran our analyses (including all control variables in model 6 in Table S6), and the results remained significant in the predicted direction: Deaths (excluding expeditions with a death rate greater than 0.234): Hierarchy Composite (ref. 10, hereafter cited as "Schwartz"): b = 0.411 (0.141), P = 0.004; Power Distance (refs. 11 and 12; hereafter cited as "Hofstede"): b = 0.013 (0.006), P = 0.022; Combined: b = 0.593 (0.167), P < 0.001. Even after excluding expeditions with extreme outcomes, the effect of hierarchy on summiting and deaths remained.

Consistency of effects over time. To test whether the observed effect of hierarchy on summiting and deaths was consistent over time, we reran the analyses reported in Tables S5 and S6 using the following: the past 50 y of data only (i.e., 1963–2012), the past 40 y of data only (i.e., 1973–2012), the past 30 y of data only (i.e., 1983–2012), the past 20 y of data only (i.e., 1993–2012), and the past 10 y of data only (i.e., 2003–2012). Table S7 includes all regression coefficients from zero-inflated negative binomial regression examining the relationship between hierarchical cultural values and summiting and deaths while controlling for all of the relevant control variables. The effect of hierarchy on summiting was positive and significant in all models (all P < 0.01). Similarly, the effect of hierarchy on deaths was positive and significant in all models (all P < 0.01). The direct effect of hierarchy on summiting and deaths for all time periods was also always positive and significant (all P < 0.05). These additional tests revealed that the cultural value of hierarchy had a consistently positive and significant effect on summiting and deaths regardless of the time period that was evaluated.

Multilevel modeling as an alternative analytical approach. The primary analyses reported in this paper used clustered robust SEs at the country level to account for the nestedness of expeditions within countries. Clustered robust SEs account for the correlation that exists among expeditions from the same country and result in more conservative SEs. An alternative approach is to model the data using a multilevel procedure with country as the level two variable and expedition as the level one variable. Given the similarity of these statistical procedures, we expected to observe the same pattern of results using both techniques. Tables S8 and S9 include regression results from zero-inflated negative binomial mixed models (random intercept only) for summits and deaths, respectively. Variables were entered in the same six steps as reported in Tables S5 and S6. As predicted, the combined hierarchy measure was significantly and positively associated with summits (P < 0.001 in steps 1, 2, 3, 4, and 6 and P < 0.01 in step 5) and deaths (P < 0.001 in steps 1–3 and P < 0.01 in steps 4–6) when using this alternative statistical procedure.

Appendix: Interview and Book Excerpts

Interview Excerpt. The following is an excerpt of our interview with Gordon Janow, Director of Programs and a founding member at Alpine Ascents International, a leader in the climbing industry:

> The overall structure of climbing expeditions in the Himalayas is relatively well-established. You don't see much variance in terms of assigned roles. Where you see the most variance is in the decision making processes and in how group members interact with each other on the mountain. But these differences are hard to detect before climbing. On paper, you may have two climbing teams that look nearly identical, but once they begin to climb they end up having different expeditions based on their interactions and decisions.
>
> Sometimes you'll see or hear about a team that made a certain decision on the mountain and you'll just wonder how they arrived at that decision, while other groups will work their way up the mountain and back down like a well-oiled machine. So one challenge facing any expedition leader is setting clear expectations early on and making sure the group sticks to these predetermined decision making protocols during the climb, while also maintaining the capacity to respond to unexpected situations that arise. This also means that the team needs to have the capacity to get the most critical information on the table in a timely fashion, regardless of who holds that information.
>
> One thing that definitely contributes to different team processes is what country the climbers are from. Climbers from some countries tend to take more of a go-with-the-flow approach while climbers from other countries tend to speak up quickly and share their thoughts even if it means challenging or questioning a leader's decision. Of course, not everyone will demonstrate these cultural tendencies and how experienced a climber is from any culture matters, but in general, certain cultural patterns of behavior are noticeable.
>
> So I think that expeditions don't differ much in how they are structured. What varies is how people interact within those structures. And culture is one factor that influences those interactions and communication patterns.
>
> Gordon Janow, Director of Programs, Alpine Ascents International.

Book Excerpts. The following are excerpts from Jon Kraukauer's *Into Thin Air* (13) and Anatoli Boukreev's *The Climb* (14) (written with Weston DeWalt) with the most relevant text in bold.

Quotations about team coordination. A "dogpile," as Beidleman would later call it, was forming up… **"It wasn't really clear that there was a leader versus a non-leader or followers at that point**," Beidleman said, "because people were being buffeted around by the wind and walking based on whoever had a headlight in front of them. **I tried to yell several times that we needed one leader and one headlight to follow, otherwise we would be wandering aimlessly** (ref. 14, p. 174).

In climbing, having confidence in your partners is no small concern. **One climber's actions can affect the welfare of the entire team. The consequences of a poorly tied knot, a stumble, a dislodged rock, or some other careless deed are as likely to be felt by the perpetrator's colleagues as the perpetrator**. Hence it's not surprising that climbers are typically wary of joining forces with those whose bona fides are unknown to them (ref. 13, p. 40).

In our case… **we didn't have to cooperate and work out who was going to haul this load or who was going to cook or do the dishes or chop the ice for water. Which contributed to the fact that we never coalesced as a team, which in turn contributed to the tragedy**: We were all in it for ourselves when we should have been in it for each other. When I should have been there for others, I wasn't (15).

…**since leaving Camp IV we had had no discussions and I was unsure about many details. About the general plan, yes, I understood, but things were changing. Should I now be going up or**

falling back? Should I be moving aggressively toward the summit or rendering help (ref. 14, p. 138)?

If they went up healthy and properly acclimatized and they made good decisions **and their efforts were added and multiplied correctly** and the weather gave them grace, he knew everyone could come back alive (ref. 14, p. 68).

At Base Camp before our summit bid, **Hall had contemplated two possible turn-around times – either 1:00 PM or 2:00 PM He never declared which of these times we were to abide by, however – which was curious, considering how much he'd talked about the importance of designating a hard deadline and sticking to it no matter what**. We were simply left with a vaguely articulated understanding that Hall would withhold making a final decision until summit day, after assessing the weather and other factors, and would then personally take responsibility for turning everyone around at the proper hour (ref. 13, p. 185).

Bashkirov and I alternated changing the oxygen mask on the three exhausted Indonesian summiters. We moved the mask between them, stretching the oxygen throughout the night. Left too long without the precious bottle, one would cry or pray. Bashkirov, Vinogradski, and I quietly worked in turns during the night. **We made it by working together** (ref. 14, p. 248).

Quotations about team psychological safety. Beidleman, sensitive by nature, **was quite conscious of his place in the expedition pecking order**. **"I was definitely considered the third guide,"** he acknowledged after the expedition, **"so I tried not to be too pushy. As a consequence, I didn't always speak up when maybe I should have, and now I kick myself for it**." (ref. 13, p. 208).

The day before departing Base Camp, Rob had sat the team down in the mess tent and given us a lecture about the importance of obeying his orders on summit day. "**I will tolerate no dissention up there**," he admonished, staring pointedly at me. "**My word will be absolute law, beyond appeal. If you don't like a particular decision I make, I'd be happy to discuss it with you afterward, but not while we're on the hill**." (ref. 13, p. 174).

. . .**we had been specifically indoctrinated not to question our guides' judgment**. The thought never entered my crippled mind that Andy might in fact be in terrible straits – that a guide might urgently need help from me. . .Given what unfolded in the hours that followed, the ease with which I abdicated responsibility – my utter failure to consider that Andy might have been in serious trouble – was a lapse that's likely to haunt me for the rest of my life (ref. 13, p. 196).

Like Ed Viesturs, I was not happy with conditions on the mountain. . .**I wanted very much for my feelings to be heard, but it had become increasingly clear to me that Scott did not look upon my advice in the same way as he did Rob Hall's…My voice was not as authoritative as I would have liked, so I tried not to be argumentative, choosing instead to downplay my intuitions** (ref. 14, p. 121).

And now Lopsang had just towed Pittman on a short-rope for five or six hours above the South Col, substantially compounding his fatigue and preventing him from assuming his customary role in the lead, establishing the route. . .**Pittman explains that she didn't unclip herself from the Sherpa out of respect for his authority – as she put it, "I didn't want to hurt Lopsang's feelings**." (ref. 13, p. 177).

Ahead, I figured, was the summit assault, and I didn't have any wish to do it. **For some reason my internal voice was quiet**, and I didn't have the usual preassault high when every muscle is ready and poised for the first command (ref. 14, p. 128).

Quotations about team communication and information sharing. **Communication was a huge problem last year**, a problem I failed to completely appreciate until it was too late. . .**the system of radio communication was not well thought out** (ref. 14, p. 233).

Indeed, shortly after dark, after Beidleman's group failed to return and the storm had risen to hurricane intensity, Boukreev realized they must be in trouble and made a courageous attempt to bring oxygen to them. **But, his stratagem had a serious flaw: because neither he nor Beidleman had a radio, Anatoli had no way of knowing the true nature of the climbers' predicament, or even where on the huge expanse of the upper mountain they might be** (ref. 13, p. 219).

. . .we reminded them that they needed to carefully monitor the condition of their bodies, being constantly aware that at high altitude their sensations and reactions would not be altogether familiar. . .**only they would know the interior truth. Between us we needed to be clear and communicate** (ref. 14, p. 78).

It had been Dr. Hunt's impression throughout summit day that **she wasn't getting accurate or complete information** from Ngima Sherpa, **that messages were being "augmented" to put the best spin on them** (ref. 14, p. 164–165).

As team leader. . .I needed to be able to count on associates who could share my understanding and **who would respect my impressions and opinions in critical situations. Likewise, I wanted the benefit of their expertise and some balance for my rather difficult personality** (ref. 14, p. 233).

"Scott strong person," Boukreev acknowledged after the expedition, "but before summit attempt is tired, has many problems, spend lots of power. Worry, worry, worry, worry. **Scott nervous, but he keep inside**." (ref. 13, p. 210).

1. Bunderson JS, Sutcliffe KM (2002) Comparing alternative conceptualizations of functional diversity in management teams: Process and performance effects. *Acad Manage J* 45(5):875–893.
2. Rogers W (1994) Regression standard errors in clustered samples. *Stata Tech Bull* 3(13):1–32.
3. Hamilton LC (2012) *Statistics with STATA* (Cengage Learning, Boston, MA).
4. Nenova T (2003) The value of corporate voting rights and control: A cross-country analysis. *J Financ Econ* 68(3):325–351.
5. Henrich J, et al. (2010) Markets, religion, community size, and the evolution of fairness and punishment. *Science* 327(5972):1480–1484.
6. Chudek M, Heller S, Birch S, Henrich J (2012) Prestige-biased cultural learning: Bystander's differential attention to potential models influences children's learning. *Evol Hum Behav* 33(1):46–56.
7. Madsen PM (2009) Does corporate investment drive a "race to the bottom" in environmental protection? A reexamination of the effect of environmental regulation on investment. *Acad Manage J* 52(6):1297–1318.
8. Roberts B, Kuncel N, Shiner R, Caspi A, Goldberg L (2007) The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspect Psychol Sci* 2(4):313–345.
9. McClelland GH (2000) Nasty data: Unruly, ill-mannered observations can ruin your analysis. *Handbook of Research Methods in Social Psychology*, eds Reis H, Judd C (Cambridge Univ Press, Cambridge, UK), pp 393–411.
10. Schwartz SH (1999) A theory of cultural values and some implications for work. *Appl Psychol* 48:23–47.
11. Hofstede G (1980) *Culture's Consequences: International Differences in Work-Related Values* (Sage, Beverly Hills, CA).
12. Hofstede G (2001) *Culture's Consequences: International Differences in Work-related Values* (Sage, Thousand Oaks, CA), 2nd Ed.
13. Krakauer J (1997) *Into Thin Air: A Personal Account of the Mount Everest Disaster* (Random House, New York).
14. Boukreev A, DeWalt GW (1997) *The Climb* (St. Martin's Griffin, New York).
15. Bryant M (May 1, 1997) Everest a year later: False summit. *Outside Magazine*. Available at www.outsideonline.com/adventure-travel/asia/nepal/Everest-a-Year-Later-False-Summit.html.

Other Supporting Information Files

Table S1 (PDF)
Table S2 (PDF)
Table S3 (PDF)
Table S4 (PDF)
Table S5 (PDF)
Table S6 (PDF)
Table S7 (PDF)
Table S8 (PDF)
Table S9 (PDF)