

THE HUMAN BEHIND THE FACTOR: A BRIEF LOOK AT HOW CONTEXT INFORMS PRACTICE IN RECREATIONAL BACKCOUNTRY USERS

Maguire Laura<sup>1\*</sup>

<sup>1</sup>Lund University, Centre for Risk Assessment & Management, Lund, Sweden

**ABSTRACT:** Avalanche professionals have long debated human factors and nature of human error in avalanche incidents. But despite extensive research into the personal and psychological characteristics and group structures of individuals involved in avalanche incidents, our ability to understand the decisions and actions of backcountry user groups is limited. Could the avalanche profession be limiting itself?

Years of experience working in avalanche terrain and a well-developed, extensive knowledge base can generate a bias against understanding how a 'green' (or at least a little less 'grey') recreationalist approaches a trip in the mountains and how context guides their actions. In this paper I will focus on improving understanding of the recreational user experience. To contrast the limitations of existing literature which focuses on failure analysis – 'what went wrong' - I have taken an appreciative approach to provide insight into the characteristics and conditions inherent when things 'go right'. This is a narrative-based social sciences approach to research describing the backcountry users in situ. By examining the human experience behind the human factor I will consider how context can lead to performance or loss in the field. I argue that human factors research that does not appreciate the human behind the construct is detrimental to developing intervention strategies that resonate with the intended audience.

**KEYWORDS:** human factors, human error, resilience, intervention strategies, narrative inquiry, accident

## 1. INTRODUCTION

"Even though people are capable of making decisions in a thorough and methodical way, it appears that most of the time they don't."  
(McCammon, 2002).

Why don't backcountry users do the right thing?

How much do we really understand about their reasoning? Is it just a matter of not of making decisions in a thorough and methodical way, or are there other factors at play as well? The opening statement could substitute 'making decisions' for 'carrying avalanche gear', 'managing group dynamics', or 'trip planning' for the ways in which recreational users could behave but don't.

Contrary to the professional approach of a thorough and methodical approach, much of the recreational experience happens in an emergent fashion: the snow reports start to look good, a few

emails circulate to see who is available, the amount of gas money available narrows the location and an intrinsic desire for a good 'selfie' to post Monday morning sets the objective.

These are the things that context is made of.

Understanding the context and uncovering the sensemaking efforts of recreationalists – the process by which meaning is given to an experience – is central to the design and deployment of meaningful prevention strategies. Progressive safety science offers the avalanche community the tools to do so.

## 2. DISCUSSION

Classic safety management paradigms and accident models have reached the point of diminishing returns for many organizations operating in high-consequence, complex, adaptive environments. With the confluence and interactive nature of terrain, weather, vegetation, snowpack formation, slope, aspect, exposure, loading and all the variables at play in avalanche phenomenon, the backcountry can certainly be considered as such.

---

\* Corresponding author address:

Laura Maguire  
c/o LUCRAM  
P.O Box 118, SE-221 00 Lund, Sweden  
email: lmaguire@hotmail.com

The new models in safety science used in applications such as aviation, healthcare and the military challenge our understanding of how failures occur (Perrow, 1984; Leveson, 2011), reframe the perspective of human factors and human error (Woods et al 2010; Dekker 2006) and offer a new approach to preventing failure (Woods & Cook, 2002; Dekker 2011; Weick & Sutcliffe 2001; Levenson 2004; Hollnagel et al 2006) that provides opportunity to advance safety amongst backcountry users.

While there remains important distinctions between operating in occupational and recreational settings the parallels between what constitutes resilience in the teams that operate in the high risk, professional practices of flying fighter jets, performing open heart surgery or operating naval aircraft carriers are strikingly similar to the resilience shown within informal, loosely organized backcountry user communities.

If there is a common thread to such different contexts, it is in the way the human element interacts with high risk/high-consequence environments. The new paradigms draw connections between the human capacity to adapt and achieving organizational goals safely and productively. The backcountry equivalent of safely, productively achieving goals could be reasonably considered our skiing, sledding or climbing trips.

The overarching theme for much of the work being conducted within the mountain safety community aims at reducing negative outcomes relating to avalanche terrain and those who operate within it – be they professionals, recreational users or the public. In this paper I will focus on improving understanding of the recreational user experience. There has been strong support (Zweifel et al, 2012; Adams, 2004; McCammon, 2009) for a social sciences approach to understanding the interface of humans and avalanche terrain that this paper begins to address.

To contrast the limitations of existing literature which focuses on failure analysis – ‘what went wrong’ as discussed by (Uttl et al, 2010; DiGiacomo, 2006) I have taken an appreciative approach to provide insight into the characteristics and conditions inherent when things ‘go right’. Retrospective accident analysis generates the ‘first story’ surrounding human error. But we go into the mountains seeking refuge, elevated heart rates, expansive vistas and to soak in the magnificence of nature, not to lose lives. So the question remains: what was it about the situation –the context

- that made the violations, poor decisions or errors make sense at the time?

A change in paradigm moves us from a position of *knowing why* into a mode of inquiry that *seeks to understand why*. Qualitative research allows for a ‘second story’ to re-shape the narrative of error (Woods et al, 2010). The second story adds depth and dimension to understanding the complexity experienced in context - that is, how the confluence of cognitive, personal, social, and technological factors and epistemological perspectives play out in the field.

When we begin to speak of context – of situated practice – we must have a framework for defining what conditions the individual actors are operating in. Edmondson (1996) offers insight into contextual factors that influence detection of human error. This work challenges the pervasive reductionist lens which predominantly views the human experience as being separate and distinct from the broader circumstances in which it is being enacted. But is it really possible to fully understand decisions made in the field when we remove them from the ski boots on a skintrack?

In looking at the interface between the individual and the broader system surrounding them it is apparent that “the nature of the system [emphasis added] both influences the actions of individual operators and determines the consequences of errors” (Edmondson, 1996, pg. 8).

Therefore, borrowing from Perrow (1984), we might look to define a ‘system’ in the backcountry user groups as being comprised of 4 levels: parts, units, subsystems and the system itself.

- Parts would be defined as such: the individual pieces of equipment and tools/technology used in the tour (skis, skins, beacons). An individual failure on this level is unlikely to be a direct cause of loss. While it may disrupt or slow down your trip, it is a relatively minor incident.
- Units can be taken to be a collection of parts which perform a particular function. For instance, skins, skis and poles are used to generate travel (or in the instance of sleds – gas, oil and the rest of the myriad parts needed to keep a combustion engine –ie: the snowmobile - functioning). An individual failure at this level is unlikely to be a direct cause of loss. Again, we would consider failure at this level to be an incident.

- A subsystem might be defined as the individual and their equipment, knowledge, experience, aptitude, fitness, preparation etc. A failure between the boundary of unit and subsystem plays a more significant role in whether an incident becomes an accident.
- This of course lends itself to a collection of subsystems in other users plus the subsystem of the ecosystem itself – snow, terrain, aspect, immediate and cumulative weather) that define the actual system. It is the unanticipated ways in which individual failures interact that produces systems level accidents.

An accident can be either *component failure accidents* that “involve one or more component failures (part, unit, subsystem) that are linked in an anticipated sequence” or a *system accident* which “involve the unanticipated interaction of multiple failures.”(Perrow, 1984, pg. 70)

Breaking it down in this manner gives us an opportunity to examine how the concept of complex interactivity in the systems model redefines how we believe accidents happen. This, in turn, changes the nature of human factors in understanding accidents. Complex interactivity speaks to how multiple failures- in and of themselves insignificant- might interact to involve a significant release with multiple fatalities.

Here we depart the traditional view of causation and give rise to an appreciation of the *context for error*. Where we might once conclude our investigation when we find human error – ‘there were too many skiers on the slope stressing the snowpack’ – we might instead use human error as a starting point to seek out more nuanced findings that can better inform our work in prevention. Taking a systems view, we may find that a radio had not been charged the previous night (part), that there was a strong wind on the ridge (subsystem), it was a mixed experience group (subsystem) and there had been a tweaky binding (part) which caused a more experienced skier who would have regulated those on the slope to be slightly behind. It might reveal that a knoll in the terrain (subsystem) and hoods drawn tight against the cold meant communication was difficult. For those waiting it was hard to know if one skier had cleared the slope before the next could go. This precipitated an apprehension with the novices about getting left behind that made them more prone to having too many skiers on the slope. This group may have been aware of

the hazard and practicing solid mitigation strategies that became necessarily adaptive by the conditions they found themselves in.

It is still possible to simply discount this example as human error but to do so misses an important opportunity for understanding the complexity of what we do when we travel in avalanche terrain. The reluctance to simplify (Weick & Sutcliffe, 2007), either as an individual investigator or as a community of practice is critical for improving outcomes surrounding backcountry winter travel.

Because it figured so prominently in the research conducted in this study- it is worth briefly examining what is ‘safety’ for a backcountry user while traveling in avalanche terrain. It is certain that technical knowledge, well-developed decision making skills and experience all lend themselves to generating safe actions and behaviours. However, in the social studies of risk Slovic (1992) determines that “safety does not exist ‘out there’ independent of our minds and culture, ready to be measured, but is a constructed human concept, more easily judged than defined.” (Rochlin, 1999, pg. 1550). Interpreting safety as a social construction broadens its definition as more than the management of risk and includes salient properties around learning, duality, communication and the locus of responsibility (Rochlin, 1999).

### 3. METHODS

“We may not always be aware of it, but how we understand problems generally shapes our attempts to solve them.” (McCammon, Human factors in avalanche accidents: Evolution and interventions, 2009)

This is a social sciences study conducted from an interpretive perspective – meaning it “assumes the social world is constantly being constructed through group interactions, and thus, social reality can be understood via the perspectives of social actors enmeshed in meaning-making activities” (Nagy Hesse-Biber & Leavy, 2011, pg.5).

Four in-depth interviews were conducted with participants engaging in ‘recreational backcountry winter travel’ – defined as ski touring, snowmobiling and mountaineering. This study is based on action research methodology (Glanz, 1998) and narrative inquiry (Bruner, 1990) with an appreciative inquiry design. These methods were chosen to integrate the experiences of participants in practice and to engage the targets of intervention in mapping the landscape of the individual, social and macro-environmental interactions.

The purpose of this research is exploratory in that it seeks to investigate an under researched aspect of social life to provide insights and understanding. As such, findings are not intended to provide conclusive evidence and can only be considered tentative. This study demonstrates the value of qualitative research design in broadening the understanding of human factors in avalanche accidents to aid in designing intervention strategies.

Participants were purposively selected to represent a cross-section of successful backcountry user groups. Success is defined as achieving the team or groups objectives with rare or no experience of loss. Objectives were multifactor – satisfaction, good exercise, skiing great lines and spending time with friends and family. Loss is defined as serious injury or fatality.

Participants were between the ages of 28 and 39, 3 were male, 1 female. Experience ranged from 4 to 15 years with participation levels varying across the years - from no days to 30 days over the course of a season.

#### 4. FINDINGS

##### 4.1 *Early learning and socialization*

3 out of 4 participants entered the backcountry through friends or family, 1 participant began as a part of a guided outing. All had some degree of 'slackcountry' experience with little to no avalanche training prior to participating in organized trips. While these are not particularly enlightening findings what is striking was the consensus that the initial group strongly socialized and environmentally sensitized participants to safe backcountry travel. With 1 exception, participants continued to travel with the same group over a period of years, further embedding the social values and practices of the primary group.

Though the extent of early involvement in trip planning and decision making in the field was limited, several commented on the practice of vocalization as instrumental to their learning – both the leader or decision-makers voicing their thought processes and the individual voicing their own opinions as a way of seeking validation or correction of their own analysis.

Argyris (1976) provides further support to this finding. "At least two important sets of variables can be altered to increase the effectiveness of learning, no matter at what point the learning is to occur. One is the degree to which interpersonal, group, intergroup, and bureaucratic factors pro-

duce valid information for the decision makers to use to monitor the effectiveness of their decisions. The other is the receptivity to corrective feedback of the decision-making" (Argyris, 1976, pg. 365)

Also particularly relevant to this application is Dreyfus & Dreyfus (1980) which supports vocalization within the group structure as actively cultivating this informal knowledge-transfer to enhance and support skill acquisition, improve proficiency in decision making and lay the groundwork for later stage, higher level synthesis in the novice participants whereby they draw on the "everyday, concrete, experiences" of more experienced group members.

Interestingly, despite primarily being mentored into the activity by other more experienced parties both the individuals themselves and the groups collectively spoke of "keeping out the riff raff" and avoiding those they deemed "flighty or lofty". While this is understandable in partnered touring or small groups, there appeared to be a selective willingness to include others who may need mentoring in their groups. The notable exception, a 28 year old female firefighter/EMS and former ski patroller spoke expansively about purposeful mentorship of a group of novice women in relatively safe, controlled exposures. The role of mentorship in knowledge and skill acquisition in this context warrants further investigation.

##### 4.2 *Group selection & dynamics*

Group composition changed over time. Participant's experiences ranged from 2 person touring or climbing teams to larger group outings. The most variability in group composition was found in the snowmobiler who would frequently maintain a partnership with one from the original group but join other groups (often with less familiar or unknown members).

Issues of difficulty establishing strong, functional group dynamics when the skill level and decision making ability of new partners was less known was identified. The issues were in appraising skill and establishing a common perspective for making decisions. Interviewees all indicated they appraised potential trip partners skills and knowledge prior to engaging in the activity but the methods and timing of this assessment often limited the potential value. Appraisal was highly subjective: the other person "seemed confident", was "physically capable", demonstrated "humility" and the "ability to make smart decisions" and willingness to 'adjust their thinking'. Whether the subjective nature of this appraisal is problematic remains

to be seen, but employing 'gut feelings' is certainly practical given the dynamic nature in which backcountry parties often come together.

Noticeably, participants spoke of an implicit shared set of values and beliefs between members of the established group - particularly those who had been together for a number of years or had strong social or family ties. Whether this had evolved as the group collected more experiences together or had already been in place before they began touring together is unknown. While this aspect was unilaterally identified as important that it was a source of uncertainty and anticipation in establishing new partnerships or groups indicates this important aspect of cohesive groups was manifest in subtle ways and not well understood in new scenarios.

#### 4.3 *Defining success*

In the methods backcountry user groups were considered 'successful' examples if they met the group's objectives with no loss. While safety is never solely defined by the absence of accidents there appears to be parallels between how the group defines success in relation to avoiding loss.

Of the participants interviewed, all had very fluid constructs of 'success' as it relates to a day in the field, but it was less clear on how the groups operationalized this in ways that could (or perhaps should) be replicated.

Some comments, such as, "everyone comes back fulfilled and happy with how the day went, our expectations were met" indicated the group *had* expectations around what would be skied or climbed but when explored further this revealed a dynamic, collective representation of how those expectations were defined.

The forming of expectations began with most participants at the initial trip discussion but was evolving throughout the preceding days, while gearing up in the parking lot and as they moved into terrain. While this is fairly obvious to experienced backcountry users, there was evidence to support that with the least experienced interview participant that the objectives held more of a static goal. As one participant put it when the summit or slope is "the be all end all and we haven't left the car... That's the bad path"

This becomes a relevant finding that adds to the accepted wisdom and teachings of adaptability when it comes to developing expectation management skills -both your own and others.

#### 5. IN ULLR WE TRUST

Implicit or explicit, heading into avalanche terrain involves a tremendous amount of trust between touring partners.

All participants spoke of trust as being foundational to backcountry travel. Implicitly, participants were counting on their trip partners to be of sound mind, body and spirit as well as to keep the bigger picture of survival as the priority. Explicitly - though we often test- we trust our own and each other's contributions to decision making and route selection to ensure safe travel.

Yet, all participants had stories of events where they should not have trusted themselves or their partners. And it is here where the current thinking on human factors in navigating avalanche terrain becomes most relevant.

Because trust represents both sides of the coin - it can endanger and end lives but it can also enable us to experience the mountains in ways that feed our souls and fills our lives with meaning.

Our fallibility as humans becomes readily apparent through the lens of Fredston & Fesler (1994) or Uttl et al (2010). Cognitive bias and social dynamics are very much a part of the explanation of why things go wrong in the backcountry and as such, sometimes we cannot trust in ourselves. But trust is also the interplay where our current interpretation of human factors and the proposed broader systems view of human factors exist to complement one another if can extend our investigation into *what* happened to look deeper into the *context of why* it happened.

Atkins (2000) reflects that "there is often not a single "correct" or "best" solution to move or not move during a storm".

So if there are multiple courses of action, none of which may be immediately apparent to the participant in practice and multiple sources of crucial dependence then the creation of 'safety' in the backcountry becomes rather difficult to prescribe.

It stands to reason then, that simply avoiding human factors 'traps' or relying on information processing strategies does not equate safe backcountry travel.

If we accept that "the nature of the system both influences of actions of individual operators and determines the consequences of errors" (Edmondson, 1996, pg. 8) then we must begin on a deep inquiry into the system dynamics at play in the elusive hunt for fresh tracks.

## 6. CONCLUSIONS

The skiers want to ski, the sledders want to ride, the climbers want to summit – so what to do?

First and foremost, we need to move forward from categorization of human error. Woods & Cook (2002) have presented nine steps to shifting safety paradigms. Their approach can be applied to a wide variety of high risk settings including mountain safety.

- 1) Pursue second stories
- 2) Escape from hindsight bias
- 3) Understand the work performed at the sharp end of the system
- 4) Search for systemic vulnerabilities
- 5) Study how practice creates safety
- 6) Search for underlying patterns
- 7) Examine how economic, organisational and technological change will produce new vulnerabilities and paths to failure
- 8) Use new technology to support and enhance human expertise
- 9) Tame complexity through new forms of feedback.

Second, using social science we can unearth subtle but impactful evidence to support our intervention efforts.

- Recognize the importance of the primary group in socializing and sensitizing the individual participant through collaborative engagement and the presence of a formal or informal leader who actively encourages skill acquisition.
- Broaden our definition of learning beyond training and into community of practice. There is strong evidence to support mentorship as being an valuable method of developing safe, constructive knowledge and skills in novices that allow for activity objectives to be reached while operating within safe boundaries.
- Build mentorship into the system by supporting and promoting existing channels like the ACC or outdoor clubs, offer 'mentored' as opposed to 'guided' off-piste skiing. Mentorship training could be offered to more experienced backcountry users to

actively promote knowledge transfer across the community.

- In addition to structured programs, cultivating a community approach to mentorship may encourage existing cohesive groups to include new members and/or to increase the number and quality of their in-the-field interactions. The informal exchanges that happen in the mountains provide an excellent opportunity to share information and improve both parties awareness of conditions. Further research is suggested into the current quality and frequency and how these interactions can be used to benefit backcountry safety.
- Engage backcountry users to better understand their experiences and perceptions as they happen in the field and focus intervention efforts on systemic improvements that address local rationality.

There will be no ultimate and simple solution to the complex problem we face as humans recreating in unpredictable environments. But it is my hope that we build on the body of science that has shaped our ability to understand and manage risk by embracing new modes of inquiry and new paradigms of safety.

## 7. ADDITIONAL INFORMATION

### Acknowledgements

I would like to acknowledge Drs. Richard Cook, Johan Bergstrom, Anthony Smoker, Sofia Wikman and Thomas Bigda-Peyton for their guidance, support and dedication to the pursuit of conducting good science and cultivating great people; My friends and family also deserve deep gratitude for their patience and enthusiasm with all of my ideas.

## REFERENCES

- Adams, L. (2004). Supporting sound decisions: A professional perspective on recreational avalanche accident prevention in Canada. Proceedings of the *International Snow Science Workshop*, Jackson, WY, 441-451.
- Argyris, C. (1976). Single-loop and double loop models in research on decision making. *Administrative Science Quarterly*, 363-375.
- Atkins, D. (2000). Human factors in avalanche accidents. Proceedings of the *International Snow Science Workshop*, Big Sky, MT, 46-51.

- Dekker, S. (2011). *Drift into Failure*. 1<sup>st</sup> ed Burlington: Ashgate, 234pp.
- Denton, G. (1994). The human experience of avalanche rescue. Proceedings of the *International Snow Science Workshop*, Snowbird, UT, 431-438
- DiGiacomo, N. (2006). Toward better decision-making: recognizing the effect of selection bias in the analysis of recreational avalanche data. Proceedings of the *International Snow Science Workshop*, Telluride, CO, 244-253.
- Edgerly, B. (2010). Under the Radar: Exploiting "New School" media to capture unreported avalanche incidents. Proceedings of the *International Snow Science Workshop*, Squaw Valley, CA, 304-309.
- Edmondson. (1996). Learning from mistakes is easier said than done: group and organizational influences on the detection and correction of human error. *Journal of Applied Behavioral Science*, 5-28.
- Fesler, D. (1980). *Decision-making as a function of avalanche accident prevention*. Ottawa, CA.
- Hollnagel, E., Woods, D., & Levenson, N. (2006). *Resilience engineering: concepts and precepts*. Burlington: Ashgate Publishing Company, 238pp.
- Klassen, K. (2010). Experience is not enough: Persistent weak layers in Western Canada 2007-2010. Proceedings of the *International Snow Science Workshop*, Squaw Valley, CA, 172-177.
- Levenson, N. (2004). A new accident model for engineering safer systems. *Safety Science*, 237-270.
- Levenson, N. (2011). Applying systems thinking to analyze and learn from events. *Safety Science*, 55-64.
- Leveson, N. (2004). A new accident model for engineering safer systems. *Safety Science*, 237-270.
- Leveson, N. (2011). Applying systems thinking to analyze and learn from events. *Safety Science*, 55-64.
- McCammon, I. (2002). Evidence of heuristic traps in recreational avalanche accidents. Proceedings of the *International Snow Science Workshop*, Penticton, BC, 244-251.
- McCammon, I. (2009). Human factors in avalanche accidents: Evolution and interventions. . Proceedings of the *International Snow Science Workshop*, Davos, CH, 644-648.
- McCammon, I., Haegeli, P., & Gunn, M. (2008). Out-of-bounds avalanche awareness: assessment, current practices, and future management. . Proceedings of the *International Snow Science Workshop*, Whistler, BC, 490-497.
- Nagy Hesse-Biber, S., & Leavy, P. (2011). *The practice of qualitative research (Second edition)*. Thousand Oaks: SAGE Publications Inc, 400 pp.
- Perrow, C. (1984). *Normal Accident Theory: Living with high risk technologies*. 1<sup>st</sup> ed Princeton : Princeton University Press, 386pp
- Rochlin, G. (2010). Safe Operation as a social construct. *Ergonomics*, 1549-1560.
- Turner, K. (2010). Youth avalanche education programs in the Pacific Northwest: analysis and recommendations. . Proceedings of the *International Snow Science Workshop*. Squaw Valley, CA.
- Uttl, B., Kinsinger, K., McDouall, Mitchell, C., & Uttl, J. (2010). Human Factors in avalanche avoidance and survival: consequences of violating the rules of safe travel. Proceedings of the *International Snow Science*, Squaw Valley, CA, 530-535.
- Weick, K., & Sutcliffe, K. (2007). *Managing the unexpected: Resilient performance in an age of uncertainty*. San Francisco: Jossey Bass.
- Woods, D., & Cook, R. (2001). *From Counting Failures to Anticipating Risks: Possible Futures for Patient Safety*. Retrieved 03 21, 2014, from Cognitive Technologies Lab: <http://www.ctlab.org/documents/FromCountingFailures.pdf>
- Woods, D., & Cook, R. (2002). Nine steps to move forward from error. *Cognition Technology & Work*, 137-144.
- Woods, D., Dekker, S., Cook, R., Johannesen, L., & Sarter, N. (2010). *Behind human error*. 2<sup>nd</sup> ed Burlington: Ashgate, 292 pp.
- Zweifel, B., Techel, F., & Bjork, C. (2012). Who is involved in avalanche accidents? Proceedings of the *International Snow Science Workshop*, (pp. 235-239). Anchorage, AK.