

HOW RISKY IS IT?
PERCEPTION OF RISK AMONG NORWEGIAN BACKCOUNTRY RIDERS

Andrea Mannberg^{1*}, Jordy Hendrikx², Markus Landrø³, and Martin Stefan⁴

¹ School of Business and Economics, and Center for Avalanche Research and Education, UiT – The Arctic University of Norway, Tromsø, Norway

² Snow and Avalanche Laboratory, Department of Earth Sciences, Montana State University, Bozeman, MT, USA

³ The Norwegian Water Resources and Energy Directorate, and Center for Avalanche Research and Education, UiT – The Arctic University of Norway

⁴ Öhlin Racing

ABSTRACT: We use a hypothetical choice scenario to analyze factors that affect the perceived risk of potentially risky backcountry terrain. Our results show that factors, which are expected to affect the objective level of risk (e.g., backcountry travel skills and experience), are correlated with the perceived level of risk. However, we also find suggestive evidence that social factors, which should not affect objective risk, do affect the perceived riskiness of a line. More specifically, our research points to the possibility that irrelevant, but ski related, information on social media affects perceived risk. Implications and limitations of our research are discussed.

KEYWORDS: Perceived risk, Terrain, Backcountry, Hypothetical Choice

1. INTRODUCTION

The trend in yearly recreational avalanche fatalities in Europe has flattened out since the 1980s, in spite of a dramatic increase in recreational backcountry use (Techel et al., 2016). This is very encouraging. However, avalanches continue to kill a relatively large number of people each year. In a majority of these fatal accidents, the victim or someone in the victim's party triggered the avalanche (Atkins 2000; McCammon 2000). The seminal work by McCammon (2002; 2004) show that a large share of avalanche victims had avalanche training, but still missed cues that should be obvious to a novice.

Previous research in psychology suggest that the perceived level of hazard or risk is an important determinant for risk-exposure (e.g., Weber and Milliman, 1997). A recent study by Mannberg et al. (2018a) analyze hypothetical terrain choices among backcountry skiers in Norway. Their results confirm that the perceived personal risk of skiing a line has a substantial impact on the willingness to ski it.

The fact that perception of risk is important for choices under uncertainty is not surprising. It is neither necessarily alarming as long as factors, which objectively affect risk exposure, determines the level of perceived risk. However, a relatively

large literature suggest that risk perception is only partly a function of the objective level of risk. Instead, it appears as if our estimates of risk to a relatively large extent depends on cognitive and emotional biases, such as availability bias (Tversky and Kahneman 1973; Slovic, et al., 1981; Kahneman 2003), optimism-bias (Slovic et al 1981; Weinstein 1989), the affect heuristic (e.g., Slovic, et al., 2005), and on social factors (e.g., Benthin et al., 1993). The findings by McCammon (2002; 2004), Furman et al (2010) and Marengo et al (2017) support the notion that these biases also affect individuals who recreate in avalanche terrain.

In this paper, we present results, which build on the research and data collected by Mannberg et al (2018a). The aim of our research is to identify factors that affect the subjective risk of potentially risky backcountry terrain. We are especially interested in analyzing the role of social factors. To do this, we use data from a hypothetical backcountry scenario in which participants rated the perceived riskiness of a set of more or less objectively risky runs.

Based on theories in psychology and economics, along with previous findings on risk-taking behavior in, and outside of, avalanche terrain we test the impact of the following set of potential explanatory factors: backcountry travel skills, backcountry experience, avalanche training and

* Corresponding author address:

Andrea Mannberg, School of Business and Economics,
Centre for Avalanche Research and Education,
UiT – The Arctic University of Norway
email: andrea.mannberg@uit.no

experience of avalanches, avalanche gear, group composition, social media use, social norms, personal norms, age, gender, and education. To the best of our knowledge, this is the first study of its kind.

2. METHOD

2.1 Participants

We collected the data in Norway during March - May, 2017, using an online survey. The survey was distributed on popular social media sites for backcountry skiers, and via an online backcountry magazine. Three hundred and thirty-three individuals over 18 years of age agreed to participate and provided complete and logically consistent answers to questions relevant for analysis. Of these participants, 24 percent were female. Median age was 35 (Mean = 34, SD=10.07). Nearly 50 percent of the participants had skied in the backcountry for more than five years, and about 26 percent had on average 30 or more ski days per season during the past five years. Eighty-one percent of the participants rated themselves as either strong or expert backcountry travelers but over 45 percent lacked formal

avalanche training. Thirty-eight percent had experience of avalanche accidents and/or close calls.

2.2 Measurement instruments

In the survey, respondents read about a hypothetical backcountry ski tour, with four alternative routes down a mountain. We provided respondents with weather and avalanche forecasts, and informed them about the potential terrain hazards associated with each run.

To introduce variation in risk-exposure, we systematically varied slope, and terrain features affecting the consequences of a fall or an avalanche between the alternatives (see *Figure 1*). The Ridge and the Field represent low angle terrain with low probability of avalanching and no dangerous terrain features, while the Bowl and the Chute represent steep terrain traps where avalanches are possible. To ensure that the order did not affect the answers, we randomized the order of presentation between respondents.

NAME OF RUN:	THE RIDGE	THE FIELD	THE BOWL	THE CHUTE
DESCRIPTION:	A wide ridge with mellow and safe skiing	A field with easy going skiing from top to bottom	A bowl with consistent steep skiing	A winding chute that is a no fall zone from top to bottom
SLOPE (MAX/MEAN):	23°/20°	35°/25°	40°/30°	45°/37°
ASPECT:	NW	NW	NW	NW
VERTICAL DROP:	1000 m	1000 m	1000 m	1000 m
DANGERS:	No dangers	20 m > 30°	400 m > 30°	1000 m > 30°
EXPOSURE:	Very low	Low	High – terrain trap	High – terrain trap
AVALANCHE HAZARD:	Moderate (level 2). Wind slabs constitute the main avalanche problem. A poor bonding between the old and new snow, and a persistent weak layer further down in the snow pack. Human triggered avalanches are possible at a large additional load, especially on steep slopes.			
SNOW:	Mostly loose powder. At places, the wind has created soft wind slabs.			
WEATHER:	Sky: clear. Temperature: -10°C. Wind: 10 m/s from the south			

Figure 1: Hypothetical terrain scenarios.

We measured perception of risk by asking respondents to answer the following question: “Keep the information about terrain and snow conditions in mind, and think about how big the risk of an accident (e.g., due to an avalanche or a fall) would be for you if you skied it. How safe or risky do you think that it would be for you to ski down each line?” The respondents answered the question on a scale from 1 (completely safe) to 6 (very risky). In this paper, we focus on the perceived risk of the steep lines, i.e., the Bowl and the Chute. The motivation for this focus is that these runs represent terrain in which avalanches can, and may even be relatively likely to occur.

We would like to highlight that we, in the below analysis, only include individuals who ranked the risk of the runs consistent with our intended design (i.e., risk of Ridge < Field < Bowl and Chute). We provide an elaborate description and discussion of data quality issues in Mannberg et al (2018a).

We elicited attitudes to risk via the Brief Sensation Seeking Scale (BSSS-8; Hoyle, et al., 2002). Our factor analysis of the BSSS-8 indicator variables shows that the measure displays a satisfactory fit to the data (Kaiser-Meyer-Olkin test = 0.82, Chronbach’s alpha = 0.79).

We measured backcountry travel skills by the use of a method developed by Hendrikx and Johnson (2014). More specifically, we asked respondents to self-assess their skills in backcountry travel on a scale from 1 (beginner) to 5 (extreme), where each scale point was accompanied with a detailed description. Backcountry experience was measured by two questions: number of years with at least ten days of backcountry skiing, and average number of ski days during the past five ski seasons.

Concerning social- and personal norms, we asked respondents both how important it was for them, and how important they thought it was for others in their social circuit, to ski steep or exposed lines on a scale from 1 (completely unimportant) to 6 (extremely important). We also asked about how many of the respondent’s friends that s/he thought skied steep or exposed lines during an average season. The scale used for this question was from 1 (no one) to 6 (everyone). Finally, we asked two questions related to social media. The first asked about how often the participant used social media, and the second how often s/he saw posts made by friends containing ski activities. These questions were on a scale from 1 (never) to 6 (several times per day).

2.3 Statistical analysis

We used STATA 15 to analyze our data. Our outcome variable is on ordinal scale, thereby suggesting an ordered Probit or Logit approach. However, these models are suited mainly for large datasets with a high number of observations in each data cell. Our sample is relatively small. In addition, the upper limits of the scale of the dependent variable (“completely safe” and “very risky”) are censored in the sense that an individual can perceive the risk to be higher than the end point of the scale. We therefore use interval regressions to fit our models.

3. RESULTS

Table 1 presents the distribution of perceived risk of the two steep lines: the Bowl and the Chute. As can be seen in the table, a relatively large share of our sample perceived both the Bowl and the Chute to be relatively risky, but there is a substantial variation in the *level* of perceived risk.

Table 1: Perceived risk of the steeper runs

	Very safe					Very risky
	1	2	3	4	5	6
The Bowl	0.0%	6.3%	30.3%	29.7%	27.3%	6.3%
The Chute	0.0%	1.5%	8.7%	22.2%	34.5%	33.0%

Table 2 contains the results of models with best fit to the data according to the Akaike Information Criterion (AIC). As can be seen in the table, our results suggest that some factors, which may reduce the objective level of risk, do have a significant impact on the level of perceived risk. For example, our results suggest that individuals who rate themselves to be experts in backcountry travel perceives the risk of skiing the Bowl and the Chute to be substantially lower than do individuals who rate their skills as lower. For the Bowl, we further find that the number of years as an active backcountry skier has a significant effect. However, note that we find no such effect on the perceived risk of the Chute. Instead, our analysis suggests that individuals with experience of avalanche incidents perceive the risk of the Chute to be significantly lower than do individuals without such experience.

Concerning socio-demographic factors, we find that individuals with university education (bachelor degree) perceive the risk of both the Bowl and the Chute to be higher than individuals, who only have secondary education, do. Older individuals perceives the risk of the Bowl as slightly higher than younger individuals do. We find no significant effect of gender, but the variable adds to the fit of the model according to the Akaike information criterion. We neither find any significant contribution of risk attitudes.

Table 2. Interval regression – perceived risk

	The Bowl	The Chute
Male	-0.214	-0.121
Age	0.012+	
Self-assessed skills (ref is beginner to intermediate)		
Strong	-0.208	-0.364+
Expert	-0.689***	-0.826***
BC ski years (ref is < 1 year)		
1-2 years	-0.466*	
3-4 years	-0.596**	
5 or more years	-0.507**	
Avalanche experience		
		-0.328*
Education (ref is secondary educ or lower)		
Bachelor	0.321*	0.396*
MSc or PhD	0.174	0.387+
More skilled partner present in group	-0.212+	
Social media exposure	-0.979**	-0.930*
Constant	5.844***	6.731***
Insignia constant	-0.071+	0.065
N	333	333
Chi square	74.391	50.685

+ p<0.10, * p<0.05 ** p<0.001

Let us finally turn to the social factors. Our analysis suggest a significant and relatively strong correlation between risk perception and reading posts about others' skiing activities. More specifically, individuals who updates about skiing activities on social media at least a few times per month, perceive the risk of the Bowl and the Chute to be substantially lower than do individuals who see such posts less often. For the Bowl, we further find that individuals, who assumed that they were travelling with a more skilled partner, perceive the risk to be lower than individuals who assumed that they toured with partners with equal or less backcountry travel skills. We find no significant impact of social or personal norms.

We would like to end the presentation of our results by highlighting that the explanatory power of our models is relatively low. Interval regression models do not produce measures of explained variance, but we have also estimated Ordinary Least Square (OLS) models. The results are qualitatively the same as the once presented in Table 2. The OLS models explain 12 to 14 percent of the variance, thus suggesting that important explanatory factors are missing from the analysis.

4. DISCUSSION

Our results show that factors, which we expect have an effect on the objective level of risk, correlate with the perceived level of risk. This is

expected and reassuring. It is also encouraging that we do not find any effects of risk preferences, social or personal norms on the level of perceived risk.

However, our analysis also provides less reassuring results. Some factors that should affect objective risk do not seem to have a significant effect, and some seemingly irrelevant factors correlate significantly with perceived risk.

Let us start by discussing the role of backcountry skills and experience. As we have seen, we find a significant impact of both. However, we only find an effect of backcountry experience on the perceived risk of the Bowl, and we find no effect of the level of activity (number of ski days per season) or avalanche training on either of the runs. We have evaluated models where we interact the number of active years with the number of ski days, but we find no significant effects. Instead, we find that individuals with experience of avalanche incidents perceive the risk of the Chute to be lower, than do individuals without such experiences. This finding is consistent with previous research by Marengo et al., (2017). Note also that the most important factor is *self-assessed* backcountry travel skills. The analysis made by Mannberg et al (2018b) suggest that some individuals may over-rate their ability to manage backcountry terrain.

Turning to the effects of social factors, our results suggest that touring with skilled partners reduce the perceived level of risk. The presence of skilled partners may well reduce the risk in a real backcountry setting, due to e.g., a high ability to evaluate avalanche risk or navigate micro-terrain features. However, in our hypothetical scenario, we specifically described that the individuals should presume that the only information attainable was the one provided by us. The presence of a skilled partner should therefore not affect objective risk. Similarly, although skiers can share information about snow conditions and avalanche risk on social media, this was not the case for our hypothetical terrain scenarios.

There are several potential explanations to the effect of social factors. Individuals, who often tour with partners who are more skilled than they are, may pay less attention to risk factors and therefore perceive the risk to be lower. This may be especially the case in situations where the risk is less strikingly apparent than in the Chute, thereby explaining the lack of effect on the perceived risk of this run. A potential explanation for the role of social media is that people more often posts updates of successful rides, and less often of situations where things went wrong or

nearly went wrong. This may contribute to a feeling of, potentially false, safety.

In conclusion, our results point to the role of both self-perceived skills, and social factors for risk perception. The social factors that we have identified are not directly related to peer-pressure. Rather, they point to that our risk perception depend on, potentially irrelevant and skewed, information available in our social circuit. In other words, our results support the notion that availability bias plays a role.

We would like to end this section with a discussion about the limitations of our research. First, we would like to emphasize that our data only allows us to speculate on the potential explanations to our observed correlations. For example, our data does not allow us to establish the direction of the correlation between perceived risk and experience of avalanches. It is possible that individuals, who have survived avalanches, develop a sense of invulnerability and therefore perceive the risk to be lower. However, it is equally possible that individuals, who perceive a low level or risk, are more likely to have avalanche experiences.

Finally, our study is based on hypothetical choices. As such, it can only tell us so much about what people do in a real-life setting. Due to these caveats, our research mainly serves to point out areas for future research. We especially welcome studies of real-life decision-making in avalanche terrain, combined with survey material. Within these studies, a special focus on social factors hold potential to yield important knowledge that can be used in avalanche education and communication.

ACKNOWLEDGMENT

We thank all of our participants. Financial funding for the White Heat Project from the Norwegian Research Council is also gratefully acknowledged.

REFERENCES

- Benthin, A. C., Slovic, P., and Severson, H. H., 1993. A Psychometric Study of Adolescent Risk Perception, *Journal of Adolescence* 16(2): 153-168
- Furman, N., Shooter, W., and Schumann, S., 2010. The Roles of Heuristics, Avalanche Forecast, and Risk Propensity in the Decision Making of Backcountry Skiers, *Leisure Sciences* 32: 453-469
- Hendriks, J., and Johnson, J., 2014. Using Global Crowd-Sourced Data to Understand Travel Behavior in Avalanche Terrain, *Proceedings of the International Snow Science Workshop*, Banff, Alberta, Canada
- Hoyle, R. H., Stephenson, M. T., Palmgreen, P., Lorch, E. P., and Donohew, L., 2002. Reliability and Validity of Scores on a Brief Measure of Sensation Seeking, *Personality and Individual Differences* 32: 401-14
- Kahneman, D., 2003. A Perspective on Judgment and Choice: Mapping Bounded Rationality, *American Psychologist*, 58(9): 697-720
- Mannberg, A., Hendriks, J., Landrø, M., and Stefan, M., 2018a. Who's at risk in the backcountry? Effects of individual characteristics on hypothetical terrain choices, *Journal of Environmental Psychology* (In press). <https://doi.org/10.1016/j.jenvp.2018.08.004>
- Mannberg, A., Hendriks, J., and Johnson, J., 2018b. Are they experts? Self-assessed backcountry skills among backcountry skiers in Norway and North America, International Snow Science Workshop, Innsbruck, Austria
- Marengo, D., Monaci, M. G., and Miceli, R., 2017. Winter Recreationists' Self-reported Likelihood of Skiing Backcountry Slopes: Investigating the Role of Situational Factors, Personal Experiences with Avalanches and Sensation-Seeking, *Journal of Environmental Psychology* 49: 78-85
- McCammon, I., 2000. The Role of Training in Recreational Avalanche Accidents in the United States, *Proceedings of the International Snow Science Workshop*, Big Sky, Montana
- McCammon, I., 2002. Evidence of Heuristic Traps in Recreational Avalanche Accidents, *Proceedings of the International Snow Science Workshop*, Penticton, British Columbia, Canada
- McCammon, I. 2004. Heuristic Traps in Recreational Avalanche Accidents: Evidence and Implications, *Avalanche News* 68
- Slovic, P., Fischhoff, B., and Lichtenstein, S., 1981. Perceived risk: psychological factors and social implications, *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences* 376 (1764): 17-34
- Slovic, P., Peters, E., Finucane, M. L., and MacGregor, D. G., 2005. Affect, Risk, and Decision-Making, *Health Psychology* 24(4): S35-S40
- Techel, F., Jarry, F., Kronthaler, G., Mitterer, S., Nairz, P., Pavšek, M., Valt, M. and Darms, G., 2016. Avalanche fatalities in the European Alps: Long-term trends and statistics, *Geographica Helvetica* 71: 147-159
- Tversky, A., and Kahneman, D. 1973. Availability: A heuristic for judging frequency and probability", *Cognitive Psychology* 5: 207-232.
- Weber, E. U., and Milliman, R. A., 1997. Relating Risk Perception to Risky Choice, *Management Science* 43(2): 123-144
- Weinstein, N. D., 1989. Optimistic biases about personal risks, *Science* 246 (4935): 1232-1233