



Who's at risk in the backcountry? Effects of individual characteristics on hypothetical terrain choices



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ARTICLE INFO

Handling Editor: Florian Kaiser.

ABSTRACT

We use data from an online survey in Norway ($N = 467$, 73% male; age: $M = 34$, $SD = 10.07$) to analyze hypothetical choices in hazardous avalanche terrain. We further analyze differences in stated preference for and willingness to accept to ski relatively risky terrain. Our results suggest that risk attitudes and perception constitute important determinants for hypothetical terrain choices. We further find that many participants accept to ski runs that they perceive to be significantly riskier than their most preferred choice. Our results also suggest that while backcountry skill and experience correlate with preferences for steep terrain, these factors hold no explanatory power for accepting to ski a risky run. Finally, we find indications that social admiration plays a role in decisions related to avalanche risk. Our findings highlight the role of risk attitudes and perception, and social factors in backcountry skiing, and gives implications for future research and avalanche education.

1. Introduction

Avalanches are low probability events with potentially catastrophic consequences. Recreationalists, who voluntarily travel through avalanche terrain, represent the majority of avalanche fatalities (Birkeland, Greene, & Logan, 2017; Tschirky, Brabec, & Kern, 2000), and over 80 percent of avalanche accidents are triggered by the group that the victim was part of, or the victims themselves (Atkins, 2000; McCammon, 2000). Decision-making in avalanche terrain is especially challenging, given the asymmetric feedback that users receive in response to their decisions. Corrective feedback for poor decision-making is seldom provided, and when provided, can be fatal. This type of setting has been termed a “wicked learning environment” (Hogarth, Lejarraga, & Soyer, 2015), and is one aspect that makes decision-making and risk perception so challenging in this setting.

An analysis of mechanisms associated with high avalanche risk exposure may facilitate identification of groups that are susceptible for accidents, and holds potential to make educational interventions and communication of information more efficient to the highest risk groups. Previous research suggest that risk attitudes and perception are important determinants for risk exposure in other environments (e.g., Nicholson, Soane, Fenton-O’Creevy, & Willman, 2005; Weber &

Milliman, 1997; Zuckerman, 1994). The perception of risk partly depends on cognitive and emotional biases, e.g., availability bias (Kahneman, 2003; Slovic, Fischhoff, & Lichtenstein, 1981; Tversky & Kahneman, 1973), optimism-bias (Slovic et al., 1981; Weinstein, 1989), the affect heuristic (e.g., Slovic, Peters, Finucane, & MacGregor, 2005), and on social factors (e.g., Benthin, Slovic, & Severson, 1993).

Research on the mechanisms behind heightened levels of risk-exposure in avalanche terrain is still scant. Historically, avalanche accidents were treated as natural disasters caused solely by geophysical processes. It was not until the early 2000’s that the view changed, and avalanche accidents started being seen as catastrophic events caused by the “human factor” (Atkins, 2000; Boyd, Haegeli, Shuster & Butt 2009; Harvey & Zweifel, 2008; Hendrikx & Johnson, 2014; McCammon, 2002; McClung, 2002a, 2002b). The accident data analyses by McCammon (2000; 2002; 2004) and Atkins (2000) suggest that avalanche accidents are often caused by judgement errors that can be linked to previous findings in psychology and economics. Unfortunately, the dataset used, and nature of the environment makes it difficult to draw strong conclusions from their work.

Ideally, decision-making in avalanche terrain should be analyzed in a real-life setting. Ethical issues, data availability, and the complexity of avalanche danger makes such an approach challenging. A number of

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researchers have therefore employed hypothetical choice experiments to measure stated preferences (Furman, Shooter, & Schumann, 2010; Haegeli, Haider, Longland, & Beardmore, 2010; Marengo, Monaci, & Miceli, 2017). One advantage of this approach is that it makes it possible to evaluate how both different snow and terrain context, personality, and group characteristics affect the choices related to avalanche risk. The work by Furman et al. (2010), Haegeli et al. (2010), and Marengo et al. (2017) suggest that the most important factor for hypothetical terrain choices is the forecasted avalanche hazard. However, these studies also find a significant effect of risk attitudes, and confirm some of the findings by McCammon (2002; 2004), e.g., that familiarity with an area and the possibility to ride untracked snow increases willingness to ride a steep slope.

The present study has three aims: 1) to analyze how individual characteristics, such as risk attitudes and perception, experience and socio-demographics, correlate with hypothetical risk exposure in avalanche terrain, 2) to evaluate if different factors explain stated preference for and acceptance to ski relatively risky terrain, and 3) if individual characteristics affect the perceived relative riskiness of different hypothetical ski runs.

We measured individual characteristics, including socio-demographics and risk attitudes through an online survey. To measure willingness to ski a risky slope, we use a stated preference approach, in which participants choose between different ski runs down a mountain. Our research is closely related to the work by Furman et al. (2010), Haegeli et al. (2010), and Marengo et al. (2017). However, our empirical strategy differs from previous research on several important aspects. First, and perhaps most important, we explore both stated preference for a hypothetical run, and the stated willingness to accept to ski down a run if someone else in the group say that they want to ski it. The distinction between the two is important, because it provides information on what individuals want to do, and what they might be willing to do.

A second difference is that we evaluate how a set of personality characteristics affect risk-exposure. This means that we, in contrast to previous researchers, are not primarily interested in measuring how a set of objective risk factors affect the choice to ski/choose a slope. Instead, we use a set of choice alternatives, which vary systematically in terms of risk-exposure, and evaluate how personal characteristics affect the chosen risk level. Third, previous research has relied on relatively stylized examples of planned tours. This facilitates both the analysis and the choice for the participant. However, it also makes it more difficult to relate to real life choices, as participants may plan to re-evaluate the decision when on tour. Our approach means that respondents make a “go or no go” decision.

2. Material and methods

2.1. Participants

We collected all data using an online survey. To target the main population of interest for this study, backcountry riders (skiers, snowboarders etc.), we published a link to the survey on the research project web pages (<https://whiteheatproject.com>, and <http://site.uit.no/care/>), and on popular online platforms for skiers in Norway during March to May 2017. The aim of the survey was both to evaluate the relationship between individual characteristics and risk-taking behavior, and to test a set of instruments for future research. The estimated completion time was 35 min. To incentivize participants to complete the survey, they were given the opportunity to participate in a lottery to win an avalanche backpack (value about €500/US\$600) upon completion.

Eight-hundred and thirty-six individuals agreed to participate in the survey, and were over 18 years of age. Among these, 467 provided complete answers on the relevant sections of the survey. An overview of the sample is provided in Table 1, below.

Twenty-seven percent of sample participants are female. Median

Table 1

Descriptive statistics of the sample characteristics.

Gender		Years of BC skiing	
Female	27%	Less than 1 year	13%
Male	73%	1–2 years	19%
		3–4 years	21%
Age (mean)	34	5 or more years	48%
		Self-assessed ski skill	
Education		Beginner	3%
Prim or sec education	20%	Intermediate	16%
University: Bachelor	41%	Strong	50%
University: MSc/PhD	39%	Advanced/expert	28%
Ski days past 5 years		Extreme	3%
0–10 skidays	25%	Avalanche education	
11–20 skidays	31%	No formal training	45%
21–30 skidays	19%	Avi Level 1	32%
31–40 skidays	8%	Avi level 2 or 3	20%
41–50 skidays	8%	Professional	3%
More than 50 days	10%	Avalanche experience	39%
N	467	N	467

age was 33 (mean = 34, SD = 10.07), and 80 percent were currently enrolled at university or had a university degree. Nearly 50 percent of the participants have 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 rate themselves as either strong or expert backcountry travelers¹ but over 45 percent lack formal avalanche training. Thirty-eight percent has experience of avalanche accidents and/or near-miss incidents.

2.2. Measurement instruments

2.2.1. Risk-taking behavior in avalanche terrain (dependent variable)

We measured risk-taking behavior in avalanche terrain via hypothetical ski terrain choices. We elicited stated preferences for ski terrain by describing a hypothetical backcountry ski tour² to the respondent, and by asking the respondent which of four alternative routes down the mountain that s/he would prefer, and accept, to ski. The alternatives were constructed in collaboration with the head of avalanche forecasters in Norway (and co-author on this paper), such that the alternatives would represent different levels of risk exposure. Brief descriptions of the hypothetical runs are presented in Fig. 1, below (see the online Appendix A) for a full description).

Weather, snow conditions, and the overall avalanche danger level and problem were identical for all runs, while the risk and consequences of a fall or an avalanche varied systematically. We introduced this variation in risk via differences in slope of the run and presence of terrain features that amplifies the consequence of a fall or an avalanche. The Ridge and the Field represent low angle terrain with low probability of an avalanche occurring and no dangerous terrain features, while the Bowl and the Chute represent steep terrain traps where avalanches are possible (see Fig. 1). To ensure that the order did not affect the answers, we randomized the order of presentation of the run choices between respondents.

2.2.2. Risk attitudes and perception

We measure attitudes to risk via the Brief Sensation Seeking Scale (BSSS-8; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002), a short version of sensation-seeking scale (SSS) developed by Zuckerman (1979; 1994; 2007). Both SSS (Robinson, 1992; Rowland, Franken, & Harrison, 1986) and BSSS-8 (Eachus, 2004; Lepp & Gibson, 2008;

¹ See the online Appendix B, or Hendrikx and Johnson (2014) for a definition of backcountry travel skills.

² Touring on skis/splitboard/snow shoes in mountainous terrain that is not possible to reach from a ski lift.

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