How do recreationists manage avalanche risk when travelling in the winter backcountry? Centering the stories of recreationists to identify, characterize, and contextualize avalanche risk management decision-making

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Abstract

The popularity of winter backcountry recreation has grown substantially in the last decade, drawing an increasingly diverse community of individuals to the winter mountains. To manage avalanche hazard, recreationists must make risk-informed decisions. Decision aids and frameworks have been developed to support recreational in-field avalanche risk management. Gaining a comprehensive understanding of recreationists' risk management practices is crucial to tailoring risk management supports to the needs of the diverse and expanding winter backcountry community. This study contributes to this effort using qualitative social science methods to explore how recreationists manage avalanche risk in the field. Through nine in-depth interviews, I identified and characterized patterns in recreationists' risk management decision-making processes and the contextual factors that define them. The findings provide a descriptive and empirical illustration of the broad spectrum of recreational in-field avalanche risk management practices, which has implications for different stakeholders in the recreational, professional, and academic communities.

Keywords: avalanche safety; decision making; qualitative methods; risk communication

Acknowledgements

> *"Listen, stories go in circles, they don't go in straight lines. It helps if you listen in circles, because there are stories inside and between stories, and finding your way through them is as easy and as hard as finding your way home. Part of finding is getting lost, and when you're lost you start to open up and listen."*
>
> *(Tafoya, 1995, p.12 from Wilson, 2010)*

This thesis is comprised of a multitude of stories, within each of which exists my sincere gratitude. First, the stories from study participants.

A heartfelt thank you to the participants of this study for your enthusiasm, courage, time, energy, and trust in me to represent your experiences in this study. You are truly inspiring. It was a pleasure to cross paths with you and learn from you in doing so.

Then, there are the stories of those who shaped my experience in this master's program.

I am profoundly grateful to Pascal Haegeli who, for seven years now, has fuelled my interests, nurtured my learning, guided my growth, inspired my efforts, and demonstrated what is possible when education is infused with care. I am also exceedingly grateful to have spent this time amongst the members of the SFU Avalanche Research Program. It has been an extraordinary privilege to learn from and alongside such brilliant, kind, and passionate people. I am also grateful to Becky Cox, a source of compassionate encouragement, who lit up my mind with ideas, sparked my curiosity, and provided me with guidance in my adventures in qualitative research. I also thankfully acknowledge the Canadian Mountain Network and Avalanche Canada who generously supported this research.

My gratitude also exists in the stories that connected me to the backcountry.

I am filled with gratitude for those who fuelled a love for the mountains in winter and made my experiences in these places so special. This includes students I taught (and learned from) in AST courses, participants of Mountain Mentors, my own backcountry partners, and members of the winter backcountry community I had the good fortune of meeting – all of whom showed me that there are so many ways of being in the outdoors and that the places we visit are also landscapes of change, places of learning, platforms for advocacy, and environments for connection.

Lastly, a vast universe of gratitude to those who saw me through this process.

Finding my way through all these stories has been as easy and as hard as finding my way home. Often, it felt closer to being lost than being home. I am humbled by and grateful for my friends and family, who have been helping me along the way and who have been making sure that, when I return home, the lights are on, the space is peaceful, and the table is set for a nourishing meal.

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Chapter 1. Introduction

1.1. Navigating difficult terrain: a consideration for readers

To start, I offer a cautionary note on the topic of avalanche risk management. This thesis explores the topic of avalanche risk management, which may evoke sensitive and/or personal connections for some readers. By nature, qualitative research delves into personal experiences and narratives, potentially intensifying the reading experience.

People venture to snow-covered mountains for many reasons and experience these places in a multitude of ways. However, those who travel in the winter backcountry are connected through our stories of these experiences. Because of this connectedness, we open ourselves up to the privilege of sharing positive experiences. In turn, we are also vulnerable to the hardship of the negative ones, the effects of which may ripple widely across our communities. Please seek support from your community as you engage with this material and reach out if you would like to discuss ways of accessing this research that accommodates your needs.

Our collective experiences, challenges, and lessons shape us. It is essential to approach these data, discussions, and findings with compassion and respect. In doing so, we all contribute to fostering a backcountry that is safe for all.

1.2. Researcher positionality

In their 2021 paper, *Almost Confessional: Managing Emotions When Research Breaks Your Heart*, Reed and Towers discuss the development of social science research processes that juxtapose positivist approaches that seek "objectivity and neutrality" over "reflection and emotion." This development is affirmed by a body of research that has sought to rethink the relationship between knowledge and emotion, to establish emotion as an integral component of knowledge, and to outline methods that account for the role of subjectivity in research (see, e.g., Bondi (2005); Gilbert (2002); Holland (2007); Jackson et al. (2013); Jaggar (1997); Valentine (2007). Ravitch and Carl (2016) further elaborate by describing qualitative research as an approach to inquiry that "centralizes the complexity and subjectivity of lived experience and values these aspects of human *being*" (original emphasis, p. 52). In exploring the process of accounting for subjectivity in qualitative research, Finlay (2002) defines the practice of reflexivity

as a thoughtful and conscious self-awareness that shifts research from being a process of objectively collecting data, to one that accounts for how we, as researchers, actively construct our knowledge. These perspectives speak to the importance of acknowledging and accounting for researchers' role and identity in relation to the research, its context, study participants, and the methodologies employed, thus bringing the notion of positionality to the forefront. Ravitch and Carl (2016) describe positionality as "a researcher's role and identity in relationship to the context and setting of the research."

My relationship to this study is inextricable from my relationship with the backcountry. Before discussing this relationship in more detail, I want to clarify what is meant by "the backcountry," a term I will use throughout this thesis. Colloquially, the backcountry refers to the winter mountains accessed by recreationists. However, the backcountry is a term inclusive of places that have supported and been supported by Indigenous peoples since time immemorial. They are places that are imbued with stories that have existed since long before recreationists accessed them – stories that have been told in the Indigenous languages of the 204 First Nations communities in British Columbia (First Peoples' Cultural Council, 2020) whose land I, as a settler, have become connected to. Beyond this acknowledgement, I am committed to continued learning about the ways that recreational pursuits on Indigenous lands have and continue to uphold colonial systems and to contributing to dismantling these systems. I encourage others reading this thesis to do the same.

I am inspired to think of my relationship to these places through the words of Barry Lopez, who wrote in A Literature of Place (1996) about reciprocity with places.

> *The key, I think, is to become vulnerable to a place. If you open yourself up, you can build intimacy. Out of such intimacy may come a sense of belonging, a sense of not being isolated in the universe.*
>
> *(Barry Lopez)*

I have been in the process of becoming vulnerable to the winter backcountry for as long as I can remember – something I reflected on in my first researcher identity memo, illustrated below in Excerpt 1.

Excerpt 1. Researcher identity memo excerpt: Relationship to the research

Researcher Identity Memo

Date: January 24, 2022

Among my early childhood memories, the most salient theme is being outdoors. Whether it is the memory of my knees covered in band-aids after bailing on my bike too many times, or my dad fueling a hike with candy handed to me every three minutes, I had the privilege early in life to find joy, freedom, curiosity, challenge, and growth in the outdoors… and it stuck with me (much like the band-aids).

This connection to the outdoors led to my immersion in the winter backcountry community. There, I found a sense of belonging, developed some of my most valued relationships, witnessed the growth and joy of others, learned about plants and glaciers and weather patterns, and nurtured ideas about how the outdoors could offer spaces for addressing some of the world's most pressing social and climate issues. My experiences travelling in wild places have called me to acknowledge my intersecting privileges, which enable my learning and development in academic and outdoor settings. This powered my commitment to ensuring others could access and enjoy safe experiences in the outdoors.

Several years ago, somebody shared a quote from the American poet and civil rights activist Maya Angelou: "I did then what I knew how to do. Now that I know better, I do better". To me, this occurs repeatedly as a cycle of growth where learning and acting accordingly happens continually and critically. As I continue to learn about the interactions, intersections, and implications of identities and the outdoors, I have devoted myself to work aimed at facilitating safe, kind, empowering, supportive, and educational experiences in these spaces. I have worked as an avalanche educator, as a program director and president of a local non-profit called Mountain Mentors and have taken on many roles to support others' access to and sense of belonging in the outdoors. One of the greatest gifts these experiences have given me is an understanding that there are so many ways of being outdoors that do not look like the mountain archetype, all of which are valid and belong. Furthermore, we are better off if people can bring themselves and all their unique experiences, perspectives, and insights with them into the outdoors.

This brings me back to my role now: a master's candidate looking to understand how individuals manage risk in pursuing fulfillment in the outdoors. I spent an entire undergraduate degree believing that to be an impactful academic and to contribute meaningful research I would have to set aside the personal parts of my research. I was relieved to find in my master's

research that I would not have to choose between being myself and being a good researcher. While this has made the research process more challenging, I have been encouraged by my committee, my colleagues, and social science literature to let my own stories be a part of the research process. After all, “we live in stories, not statistics” (Gilbert, 2002). This freedom allows me to understand better what is at the foundation of my research interests: supporting the safety, well-being, and enjoyment of those recreating in the winter backcountry. My stories and those shared with me through this study, have revealed this to be no small task. I am both honoured and humbled by the opportunity to ask research questions that have the potential to inform, directly and empirically, what this support looks like.

In this study, I had the opportunity to learn more about my connection to the places we call “the winter backcountry” and the people within it. I also learned about the relationships that others have with these places. I see these insights as contributing to what David A. Greenwood calls, “a colour cosmology of our relationships with other people and places, [and] a cosmology of our relationships with ourselves” (2016).

> *We all carry our places within us, and it’s not a single image, but more like a mandala, a colourful cosmology of our relationships with other people and places, a cosmology of our relationship with ourselves. How we pay attention, and what we pay attention to, depends a lot on what’s in our mandala. […] Place is where our mandalas come imperfectly together. […] People live by stories and storytelling.*
>
> *(David A. Greenwood)*

In this way, for me, this thesis is a coming together of many stories of relationships to the places we call the backcountry and to those we come to know there.

1.3. The study

In North America and Europe, the number of people accessing snow-covered mountainous areas for backcountry or out-of-bounds skiing, mountain snowmobile riding, snowshoeing and winter hiking, and ice climbing has grown substantially over the last decade (Avalanche Canada, 2022; Birkeland et al., 2017; Bürgi et al., 2021). While being active in nature has tremendous benefits for physical, psychological, emotional, and social health (see, e.g., Jenkins & Pigram, 2004 p. 363; Lackey et al., 2021; Thomsen, Powell & Monz, 2018), spending time in the backcountry also has risks that can lead to critical, harmful, and potentially irreversible outcomes. One of the most prominent hazards in the winter backcountry is snow

avalanches. Recreationists who choose to access the winter mountains voluntarily and often repeatedly expose themselves to avalanche hazard. Therefore, managing the risk from avalanches is a key task all backcountry recreationists take on when travelling in snow-covered mountainous terrain in wintertime.

While the scope and specifics differ amongst individuals, recreational avalanche risk management practices can generally be depicted as occurring throughout three stages (Avalanche Canada, 2020; SLF, n.d.-a): (1) pre-trip, where individuals use information they deem to be relevant to choose whether and where to go into the backcountry; (2) in-field, where, once travelling in the field on their chosen trip, individuals continue to make decisions about risk treatment options that eliminate their exposure to avalanche hazard or reduce it to an acceptable level; and (3) post-trip, where individuals may reflect, formally or informally, on their trip including highlights, challenges, and any notable or significant observations, decisions, or actions.

Extensive effort has been devoted to supporting recreationists in developing and applying their risk management practices through education and public avalanche safety communication products and services. In the pre-trip stage, recreationists' information gathering and processing is assisted by national and regional avalanche warning services (e.g., Avalanche Canada), which publish daily avalanche forecasts describing the nature of the expected avalanche conditions. There are also trip planning tools that help recreationists identify avalanche hazard and terrain information relevant to their planned trip through avalanche terrain. Examples of these types of tools include the Avaluator Trip Planner (Avalanche Canada, n.d.-a), the Skitourenguru website (Skitourenguru GmbH, n.d.), or the White Risk avalanche education and trip planning platform (SLF, n.d. -b). Other rules-based decision aids and conceptual frameworks exist in support of avalanche risk management decisions recreationists make in the field, for example, the Avaluator (Haegeli, 2010), the Dangerator (Avalanche Canada, n.d.-b), the 3x3 Formula (Munter, 1992, 1997, 2003), the Stop or Go framework (Larcher, 1999, 2000), the Obvious Clues method and associated ALPTRUTh checklist (McCammon, 2000, 2004, 2006), the NivoTest (Bolognesi, 2000), and the SnowCard (Engler & Mersch, 2000). These aids and frameworks are designed to reduce the complexity of decision situations by helping recreationists identify and evaluate relevant slope-scale avalanche condition observations and terrain information and select avalanche risk mitigation options in an informed way (Haegeli et al., 2006; McCammon & Haegeli, 2007). In addition to specific supports for pre-trip and in-field stages, multi-day avalanche safety courses and other

educational offerings introduce recreationists to important avalanche risk management techniques and practices for identifying and assessing avalanche hazard conditions, avalanche terrain, human factors, and responding to avalanche involvements.

Given the recent growth in winter backcountry recreation in North America and Europe and the fact that activities like backcountry skiing and snowshoeing are becoming more mainstream (Bürgi et al., 2021), it is reasonable to assume that the characteristics of the backcountry community are changing and likely becoming more diverse. To ensure that the full range of recreationists' needs are meaningfully supported, it is critical to evaluate existing risk communications and consider the potential development of new avalanche safety initiatives, aids, and products. Best practices from the field of risk communication tell us that knowing the audience is critical for risk communications to be effective (e.g., Balog-Way et al., 2020; Bostrom et al., 2016; Bruine de Bruin and Bostrom, 2013; Eastern Research Group and NOAA Social Science Committee, 2019; Lundgren and McMakin, 2009; Morss et al., 2016; National Research Council, 2006a, 2006b; NOAA Office for Coastal Management, 2016; Rickard, 2021; Spiegelhalter, 2017; Wood et al., 2012). Based on this knowledge, risk communication research has developed models and frameworks for describing how individuals use information to make risk-informed decisions about the hazards related to the environment (e.g., hurricanes, earthquakes, wildfires, climate change), health and well-being (e.g., economic, COVID-19 pandemic), and infrastructure (e.g., nuclear power).

Faced with the same need to understand the audience, avalanche safety researchers and experts have, over the last decade, committed a growing focus and research effort on developing models and frameworks of how recreationists manage avalanche risk. A considerable amount of research has examined the pre-trip stage of recreationists' avalanche risk management practices, using both qualitative and quantitative methods to examine recreationists' understanding and application of existing pre-trip planning supports (e.g., Engeset et al., 2018; Finn, 2020; Fisher et al., 2022a, 2022b; Morgan et al., 2023; and, St Clair et al., 2021). This research has yielded actionable findings that can guide improvements in public avalanche risk communications, such as the avalanche bulletin, to support recreationists' pre-trip risk management practices.

Researchers have also recognized the need to better understand recreationists' in-field avalanche risk management practices. Most studies have used quantitative methods to accomplish this. One approach has been to study recreationists' avalanche risk management

practices based on their choices, both stated and revealed. Stated choice studies have used surveys that present respondents with realistic but hypothetical decision situations designed to expose patterns in risk management decision-making influences, significant factors, and potential gaps (e.g., Haegeli et al., 2010; Haegeli et al., 2012; Marengo et al., 2017; Mannberg et al., 2018). Revealed choice studies, on the other hand, examine recreationists' in-field practices based on actual terrain and risk management choices in the field. Several of these studies, for example, the research of Hendrikx et al. (2013), Saly et al. (2016), Saly et al. (2020), Sykes et al. (2020), Johnson and Hendrikx (2021), and Hendrikx et al. (2022), have examined in-field risk management decision-making using recreationists' tracks. The tracks, recorded using GPS tracking and time-lapse photography, are seen as a record of backcountry users' behaviour and thus their "decision footprint" (Sykes et al., 2020). Both Johnson and Hendrikx (2021) and Sykes et al. (2020) combined the recorded tracks with intercept survey responses to evaluate the decision footprints as a function of known avalanche hazard and decision bias parameters. The decision bias parameters used in their study come from the body of research that has explored recreationists' decision-making practices by examining avalanche accidents with respect to decision-making challenges identified by cognitive scientists (e.g., Atkins, 2000; McCammon, 2004). Perhaps the most significant influence of this approach has been six heuristics or mental shortcuts, McCammon (2004) identified as potentially contributing to fatal avalanche accidents. In addition to studying recreationists' stated and revealed choices and patterns in avalanche accidents, a third approach to studying recreational avalanche risk management has been to evaluate recreationists' practices against normative models of risk management decision-making and criteria established by experts. Studies aligned with this approach have elicited avalanche experts' perspectives on the knowledge and skills required for making good decisions (Adams, 2004) and the gaps in recreationists' risk management capacities (Atkins & McCammon, 2004). Along similar lines, Landrø, Hetland, Engeset, and Pfuhl (2020) drew on expert risk management processes to evaluate the effectiveness of decision-making frameworks designed for "amateur backcountry recreationists". Drawing from their insights that experts pay attention to sets of observations that are different than what is promoted by the recreational decision-making frameworks, Landrø (2021) suggests that future initiatives to revise or develop decision-making frameworks should a) "be based on the factors that experts use, and not on simplifications of factors and rules," and b) "use the same workflow at all user levels" to encourage the transition between novice and expert.

This entire body of research has helped facilitate an appreciation of the human dimensions of avalanche safety and improve our understanding of how to support recreational avalanche risk management. However, there has been a selective adoption of these studies' findings into the practitioner community, which has led to some key features dominating the current understanding of recreationists and their risk management practices. These features are outlined in Table 1.

Table 1. Key features dominating the current understanding of recreationists and their risk management practices

- Systematic decision-making approaches are superior to heuristic-based decisions, which are biased and may lead to decision-making errors (Atkins, 2000; McCammon, 2004).
- Challenges in recreationists' in-field avalanche risk management practices are perceived as being rooted in flaws in their risk assessment and decision-making practices and solutions lie in adopting a more systematic and/or less biased decision-making approach, improving their knowledge, increasing their literacy, and advancing their observation skills.
- Perspectives on recreational avalanche risk management decision-making are informed by analysis of failures, which, as outlined by Maguire (2014), asks questions like "Why don't backcountry users do the right things" or, as in Atkins (2000), "Why do avalanche-aware people let themselves have avalanche accidents."
- Expert practices serve as the standard against which non-experts' practices are evaluated (Adams, 2004; Atkins & McCammon, 2004) and toward which their development is directed (Landrø, 2021; Landrø et al., 2020). In turn, professional avalanche risk management practices are often used to evaluate and/or guide the development of recreational avalanche risk management supports (Landrø, 2021; Landrø et al., 2020).
- Recreational avalanche in-field risk management decision-making is generalized. For example, novice recreationists make simple decisions, while more advanced recreationists make decisions in a more sophisticated way.
- Recreational in-field avalanche risk management is oversimplified and de-contextualized by assuming that characteristics such as avalanche education, years of experience, age, activity type, and gender are predictors of decision-making practices.

Examining how both the avalanche research and practitioner communities have developed an understanding of recreational avalanche risk management reveals some gaps that affect our ability to best support the growing and increasingly diverse winter backcountry community. First, significant gaps exist because of an analytical focus on the outcomes of recreationists' risk management decisions (i.e., tracks or accidents), which show the results of decisions that recreationists have made, but do not offer insight into *why* or *how* these decisions

were made. As March (1994) describes, the link between outcomes and processes is not a given, nor is it definitive. This challenges the notion that it is possible to discern from a "good" outcome (e.g., no accident, selection of appropriate terrain on a high hazard day) whether a recreationist followed a preferred decision-making process. Additionally, understandings of avalanche risk management decision-making that are informed by an analysis of avalanche accidents alone may be successful in highlighting decision patterns that can lead to "bad" risk management outcomes but are limited in their ability to support "good" risk management decision-making. For example, the six heuristic traps identified by McCammon (2004) encompass much of how the winter backcountry community currently understands, communicates, and teaches about decision-making in avalanche terrain (Furman et al., 2010; Zajchowski et al., 2016). Existing studies using accident-based analyses that have attributed the outcomes (accidents) to heuristics have therefore resulted in a generally negative perception of heuristic decision-making, which views it as flawed, incorrect, or failed decision-making (Fesler, 1980; McCammon, 2004; McClung, 2002). Aligned with the "heuristics-and-biases program" established by Tversky and Kahneman (1974), heuristic decision-making approaches are thus often positioned as inferior to more analytical, systematic, or probabilistic approaches that are shown to be used by avalanche experts (Adams, 2005; Landrø, 2021).

While there is a strong case for studying individuals' cognitive shortcuts and how they threaten positive risk management outcomes, the extent to which these heuristic traps have been used to encompass the human components of avalanche risk management has largely prevented the avalanche safety community from acknowledging, let alone embracing, the utility of heuristics (Zajchowski et al., 2016). The utility of heuristics is a concept well established in the research of Gigerenzer and colleagues on "bounded rationality," which is the idea that human decision-making is limited by cognitive constraints and that the complexity of the environment makes it impossible to make fully informed decisions that optimize outcomes as stipulated by the rational decision-making theory (Gigerenzer, 2004; Gigerenzer & Selten, 2001). Within their work on bounded rationality is the idea of "ecological rationality," which describes that people have access to a range of different heuristics, each of them suited for a decision environment with particular characteristics. Hence, matching heuristics to the specific decision environment at hand is critical for their effective use (Gigerenzer & Selten, 2001 p. 9). A strong match between a heuristic and environment indicates the possibility that heuristics can be an efficient way to make decisions in complex and uncertain environments where a more analytical approach (e.g., calculation of probabilities and maximization of expected utility) is

impractical and cognitively unrealistic (Todd & Gigerenzer, 2007). Importantly, research has shown that in situations with low predictability and incomplete knowledge of all alternatives, consequences, and probabilities—not untypical for avalanche risk management situations—this "fast-and-frugal" approach to decision-making that deliberately ignores information can lead to more accurate judgments than weighing and adding all available information (Gigerenzer & Gaissmaier, 2011). So far, only little avalanche safety research has adopted the concepts outlined in the work of Gigerenzer and colleagues. Examples include McCammon (2001), who acknowledged the potential for success and failure of both heuristic and systematic decision approaches has been minimally adopted in the avalanche industry, and Zajchowski et al. (2016), who highlighted the duality of heuristics in framing them both as a symptom of decision-making errors and a prescription for decision-making success.

To contribute to filling the gaps mentioned above, the objective of this study is to elicit an in-depth understanding of the landscape of practices that recreationists employ to manage avalanche risk when travelling in the winter backcountry. I used social science qualitative methods to investigate what observations inform recreationists' assessment of risk, how they piece observations together to make risk-informed decisions, and how they identify and select actions to mitigate avalanche risk. In doing so, I was able to elicit rich and in-depth descriptions of recreational in-field avalanche risk management practices; capture the complexity of recreationists' risk management experiences; uncover insights, identify patterns, and discover relationships in and between their decision-making processes; and, illuminate the contextual factors shaping them. Together, this provides a rich, descriptive, and empirical illustration of the landscape of recreational in-field avalanche risk management practices and the critical factors related to decision-making processes, the decision-makers, and their decision-making environments. I aim to present our study's findings in a way that can guide the evaluation of existing risk management tools and inform the development of new approaches to meeting the needs of a growing and increasingly diverse user audience.

The remainder of the thesis is structured into four main sections. The first presents the theoretical framework underlying this study, where I introduce the core constructs guiding this research, their background, and how I conceptualize each of them with respect to my research questions. Next, I outline my methodology, describing the choices I made in the study design, data collection, and data analysis. I will then present the findings of the study in three main sections that, together, comprehensively illustrate the data and my interpretations of it. Finally, I summarize the main findings and highlight their implications and recommendations for

avalanche warning services, avalanche education and educators, recreationists themselves, and researchers.

Chapter 2. Theoretical framework

Existing understandings from avalanche safety communities helped me identify why and how I wanted to contribute to understanding how recreationists manage avalanche risk in the field. In the study design, I also used models from the field of risk communication for valuable outlines of how individuals seek and process information to inform their risk management approaches and decisions. In addition, I explored the field of judgement and decision-making to gain a deeper understanding of the current theories describing individuals' cognitive processes. This chapter will synthesize the concepts I drew on to elicit a comprehensive understanding of recreationists' in-field avalanche risk management decision-making.

2.1. Risk communication

Risk communication researchers have sought to better understand how people gather and process information and make risk-related decisions. Prominent examples of models of individuals' information-seeking, processing, and response behaviours include the Risk Information Seeking and Processing Model (Griffin et al., 1999), the Protective Action Decision Model (Lindell & Perry, 2012), the Planned Risk Information Seeking Model (Kahlor, 2010), the Theory of Planned Behaviour (Ajzen, 1985), and the Reduced Risk Information Seeking Model (Liu et al., 2022). Of particular use to this study is the Protective Action Decision Model (PADM), a multistage model that outlines a typical approach to making decisions about the adoption of protective action, beginning with environmental cues or risk communication messages and constrained by social context (Lindell & Perry, 2003, 2012). The PADM aims to illustrate the way people typically make decisions about adopting actions to protect against hazards such as floods, hurricanes, and earthquakes as occurring through five distinct stages: risk identification, risk assessment, protective action search, protective action assessment, and protective action implementation (Lindell & Perry, 2003). The PADM also acknowledges the potential for three additional decision stages that may occur, when, at any point throughout the five stages, an individual recognizes that more information is required to advance in the decision-making process. These information search decision stages include (1) an information needs assessment, (2) a communication action assessment, and (3) communication action implementation. These stages and the associated questions and outcomes were influential in the design of the interview script. To explore each of the PADM's decision-making stages, I looked to the field of judgement and decision-making.

2.2. Judgement and decision-making

To understand how decisions are made, research in the field of judgement and decision-making has proposed two approaches to reasoning: rational, which includes decisions made through logic and statistics; and, heuristic, which reduces decision-making effort by simplifying the decision (Gigerenzer & Gaissmaier, 2011). These approaches and their characteristics have informed the formulation of the field's myriad theories outlining how people make decisions. A consistency across many, however, is the presence of two cognitive systems working to identify and process information and, subsequently, guide action. The two systems appear in the literature under different names but retain similar characteristics, for example, "heuristic" and "systematic" (Gawronski & Creighton, 2013), "System 1" and "System 2" (Kahneman & Frederick, 2002), or "intuitive" and "analytical" (Klein, 2003). In this thesis, I use the terms heuristic and systematic. Heuristics enable a decision maker to make decisions with less effort by ignoring certain pieces of information, in turn improving the cognitive efficiency of the decision (Gigerenzer & Gaissmaier, 2011; Shah & Oppenheimer, 2008). The cognitive efficiency of heuristic decision-making is enabled by the use of associations (involving recognition and perception) and intuition and is influenced by prior experiences, emotions, and memories (Gigerenzer & Gaissmaier, 2011; Kahneman & Frederick, 2002). In contrast, systematic decision-making requires more effortful and complex processing as individuals undertake controlled and conscious reasoning that involves a comprehensive consideration of available information (Gawronski & Creighton, 2013; Kahneman, 2013; Kahneman & Frederick, 2002).

Two main bodies of research have examined the interactions between quick and associative heuristic decision-making and slower and rule-based systematic decision-making. The first is the heuristics-and-biases program school of thought, which stems from the work of Tversky and Kahneman (1974) and positions heuristics as deviations from a preferred logical or statistical decision-making approach and thus focuses on heuristics with respect to cognitive limitations and irrationality (Gigerenzer & Gaissmaier, 2011; Gigerenzer & Selten, 2001). This approach investigates the disadvantages of heuristics in that, while they can serve as useful "cognitive shortcuts", they can also lead to biases, errors in judgement, and negative outcomes (Kahneman & Frederick, 2002; Kahneman & Tversky, 1996; Tversky & Kahneman, 1974). Core to this framing of heuristics is the assumption that individuals make decisions in a predictable environment wherein they have complete knowledge of alternatives, consequences, and probabilities (Savage, 1972). However, this assumption has been challenged by researchers of

“bounded rationality” who highlight that in the real world, decision-makers operate with limited time, information, and resources and, thus, the notion of rationality as optimization is unrealistic (Gigerenzer & Selten, 2001; Simon, 1956; Todd & Gigerenzer, 2007).

In contrast to the heuristics-and-biases program, the idea of ecological rationality linked to the work of Gigerenzer and colleagues embraces the duality of heuristics and emphasizes their utility in environments where the conditions for rational decision-making are not met (Gigerenzer, 2004, 2008; Gigerenzer & Gaissmaier, 2011; Todd & Gigerenzer, 2007). This work argues that, given the uncertainty inherent to the real world, more information and computation are not necessarily better. To support this notion, researchers investigate why and when more cognitively efficient and less information-intensive heuristics may work better (Todd & Gigerenzer, 2012, p. 3-4). Thus named the fast-and-frugal program, this school of thought draws from the early work of Herbert Simon (1956) who described bounded rationality with the metaphor of a pair of scissors, where one blade represents the decision-maker's cognitive limitations and the other represents the structure of the decision environment. In an example of applying the scissor metaphor, Lockton (2012) broadened it slightly by stating that one blade represents cognition and the other context. puts it more simply with one blade representing cognition and the other context. The fast-and-frugal program advocates for the need to study both blades and aims to describe the process of heuristic decision-making and to identify the environmental conditions where heuristics will succeed or fail (Gigerenzer & Selten, 2001 p. 4; Todd & Gigerenzer, 2007). In this study, I aligned the design, analysis, and representation of findings in alignment with the fast-and-frugal program perspective on different decision-making approaches. More specifically, the focus in these stages was to explore what decision-making approaches recreationists use in different environments and under different conditions.

Chapter 3. Methodology

This is an applied qualitative social science study. I used the guidance of Ravitch and Carl (2016) to design a study that would yield descriptive data, center the lived experiences of the research participants, and retain the complexity of and context within which those experiences are embedded. I completed the study design, data collection, data analysis, and writing stages simultaneously and iteratively. As such, each of these processes is integral and connected to the others. While fluid and flexible in that sense, I upheld a commitment to conducting relational, reflective, and reciprocal research, which recognized how I affect and am affected by the research experience. In addition to being core values in this study, these characteristics are methodological.

3.1. Trustworthiness

Ravitch and Carl (2016) describe trustworthiness as a concept, a methodological process, a central value, and a research goal through which the researcher affirms that their findings are faithful to interview participants' experiences (p. 278). They illustrate four concepts that help develop and assess trustworthiness: (1) credibility, which is practiced by accounting for complexities; (2) transferability, which is practiced by ensuring applicability to broader contexts without compromising context-specific richness; (3) dependability, which is practiced by developing sound reasoning for study design choices and by ensure the data are aligned with those reasons; and, (4) confirmability, which is practiced through ongoing and structured reflexivity to acknowledge and account for the influence of subjectivity. My efforts to achieve trustworthiness as described in these concepts are presented throughout the remainder of this thesis. Table 2 summarizes these efforts as they pertain to the four standards outlined by Ravitch and Carl (2016).

Table 2. Methods for ensuring trustworthiness: fulfillment of trustworthiness standards

Trustworthiness standard*	In practice	Methods
Credibility	Accounting for complexities.	1. Flexible, recursive study design 2. Thick descriptions 3. Dialogic engagement (peer debrief, critical group inquiry) 4. Memos 5. Purposeful, staggered sampling
Transferability	Ensuring applicability to broader contexts without compromising context-specific richness.	1. Thick descriptions 2. Participant memos 3. Context-situated coding
Dependability	Developing sound reasoning for study design choices and ensuring the data are aligned with those reasons.	1. Strategic sequencing of methods 2. Research design with articulated rationale 3. Iterative processes
Confirmability	Ongoing and structured reflexivity to acknowledge and account for the influence of subjectivity.	1. Memos, research journal 2. Transparency 3. Audit trail

* Trustworthiness standards and description of their application in practice are drawn from Ravitch and Carl (2016)

In addition to the efforts outlined in Table 2, I maintained a systematic and documented audit trail, wherein I recorded my decision-making, thought processes, interpretations, and research activities. This record is contained in the remainder of this section. It was also recorded in the memos outlined in Table 3, some of which will be mentioned in the following methodology sections.

Table 3. Memo types and their research purpose

Memo	Purpose
Interview memo	Prepare for the interviews and record during-interview thoughts and observations related to the participant; myself, my role, and my social identity; and about the interview itself
Pre-coding memo*	Record what I learned in the process of pre-coding the interviews (from transcription through initial coding).
Research journal	Record, daily, my thoughts, questions, challenges, ideas, self-reflections as well as meeting notes and additional literature.
Researcher identity memo	Document and explore how my positionality, personal experiences, biases, and values influence the research process, shape my interactions with research participants and inform my interpretations of the data
Research question memo	Document the evolution of my research questions and the thoughts, experiences, and learning that informed them.
Coding choices memos	Document choices I made in the processes of categorizing and connecting the data.
Theoretical framework memo	Engage with relevant literature, develop meaningful connections to data, and consider how my conceptual and theoretical frameworks may need to evolve.

* After the interviews were finished, I combined the Interview and Pre-coding memos to make it easier to access a more complete representation

** This memo format was informed by guiding questions from Ravitch and Carl (2016). The pre-coding memo template is included in Appendix A.

3.2. Data collection

Due to the connectedness of research stages and the relational nature of the chosen method, the data collection process described in this section is best understood as processes of data generation and co-construction (Ravitch & Carl, 2016). These processes are described semi-chronologically below, starting with a description of the interview design.

While this study investigates the in-field stage of recreational avalanche risk management, I included interview questions related to the pre-and post-trip stages to capture contextual insights that would support a more complete understanding of risk management practices used during the in-field stage. The design of the interview questions was informed by the Protective Action Decision Model. Specifically, the warning stages, actions, and associated questions helped me identify meaningful topics to direct questions toward, as shown in Table 4 (Lindell & Perry, 2003).

Table 4. Integration of the Protective Action Decision Model (PADM): Mapping warning stages and actions to interview questions

Warning stage activity (PADM)*	Warning stage question (PADM)	Interview guide example
Risk identification	Is there a real threat that I need to pay attention to?	What information do use to make your risk management decisions?
Risk assessment	Do I need to take protective action?	What does this information tell you to do?
Protective action search	What can be done to achieve protection?	Are there other actions/practices that you would consider? Why? Why not?
Protective action assessment and selection	What is the best method of protection?	How do you choose the best option?
Protective action implementation	Does protective action need to be taken now?	How do you know when you need to take this action?
Information needs assessment	What (additional) information do I need to answer my question?	How do you know to look for information?
Communication action assessment and selection	Where and how can I obtain this information?	Do you use any supports/tools/products to help you in your risk assessment in the backcountry?
Communication action implementation	Do I need this information now?	Why and when are these helpful?

* PADM warning stage activity and question are from Lindell and Perry (2003)

Once the interview design was completed, I conducted six pilot interviews. In the piloting process, I sought feedback from the pilot interview participants and discussed the process and its successes and challenges with my supervisor. I recorded my reflections from these processes in memos and used them to refine the interview questions and to provide myself with the confidence necessary to conduct an interview that assured participant comfort and authenticity.

I used purposeful sampling strategies to recruit a diverse group of study participants who could provide context-rich insights into the type of experiences required to fulfill my research objectives. To do this, I created a signup survey with questions related to respondents' winter backcountry experiences and practices and personal background. The signup survey questions are summarized in Table 5 and screenshots of the complete signup survey are included in Appendix B.

Table 5. Signup survey question summary

Signup survey topic	Signup survey questions
Winter backcountry experience and practices	Which winter backcountry activity do you associate with the most?
	Overall, how much experience* do you have in all your recreational winter backcountry activities combined?
	What is the highest level of avalanche awareness training you have completed?**
	Which of the following statements best describes your use of avalanche bulletins when planning a backcountry trip?**
	Briefly describe two or three of your typical backcountry trip destinations.
	What tends to be your decision-making role in the groups you typically go on these backcountry trips with?
Personal background	Which of the following age categories describes you?
	Which gender do you identify with?
	Optional – Is there any other personal information or personal identifiers that you would like to share with us?

* Participants could describe their experience using number of winters and average number of days per winter
** Avalanche awareness training included both formal and informal recreational courses as well as professional courses
*** This question and the possible options were informed by the Bulletin User Typology developed by St. Clair (2019)

I recruited study participants recreating in the Lower Mainland (Metro Vancouver and Fraser Valley) and the Sea-to-Sky regions (Horseshoe Bay to Pemberton). I targeted potential study participants by promoting through different communication channels including partner organizations, local backcountry recreation clubs and organizations, local avalanche education course providers, and online backcountry recreation community platforms. I also created activity-specific promotions (Appendix C) and published them on the SFU Avalanche Research Program social media accounts and shared them with partner organizations that serve specific user groups (e.g., snowshoers, and snowmobilers). I staggered the selection of participants and interviews in an effort to ensure a comprehensive and nuanced understanding of the research topic. At first, I invited 23 of the 130 signup survey respondents to schedule an interview, from which I scheduled an initial five interviews.

Because this study was completed during the COVID-19 global pandemic, the research setting was not selected based on what best related to my study's goal, but instead to ensure the safety of myself and the study participants and to follow the direction of the Provincial Health Officer and Simon Fraser University. As a result, I completed the interviews over Zoom (Zoom Video Communications, 2021). To accommodate any discomfort with virtual interviews, I took

care to create an environment that was relaxed, personable, transparent, consensual, and without distractions. This included processes such as providing research team profiles of myself and my supervisor as an introduction to our backgrounds and our roles in the study; offering opportunities for participants to ask me questions at the start of the interview; allowing for flexibility in the amount of time spent simply conversing at the start of the interview; maintaining professionalism without enforcing formality; and working in a quiet space where I would not be interrupted and where participants could be assured that their confidentiality was maintained.

In practice, the interview script became more of a guide (Appendix D) for a personalized questioning approach. In this way, it served as a check to ensure I had covered the topics essential to investigating my research question. I customized the order, wording, and probing of questions to each participant to follow the conversation naturally (Ravitch & Carl, 2016). I conducted the interviews in a non-evaluative way and prioritized participant comfort and response authenticity. I recognized the participants as experts of their own experiences – as having complex combinations of knowledges, perspectives, experiences, and expertise (Jacoby & Gonzales, 1991; Ravitch & Carl, 2016). In this setting, my role was to learn from them. I shared these priorities and position with each participant before beginning the interview. Formatting the interviews in this way created an interview environment that enabled the research participants to share rich descriptions of their avalanche risk management experiences, thereby allowing me to preserve the meaning they attributed to their experiences. As we worked together, the participants provided detailed accounts of managing avalanche risk in the backcountry. While this was the focus of the discussions, participants elaborated their stories of managing avalanche risk with insights into the contexts that have shaped them.

Once the initial interviews were underway, I recorded some preliminary emergent themes and potential areas for further exploration in the pre-coding memo. I scheduled an additional four interviews intending to strategically address gaps and delve deeper into specific topics, capture a wider range of perspectives and experiences, and identify potential new lines of inquiry.

Throughout the study, I practiced reflexivity and maintained awareness of my positionality through memo-writing, journaling, and discussions. These practices helped me ensure that the methods and how I undertook them were representative of my commitment to the participants and their experiences and the co-production of this research. An example of this practice is illustrated in Excerpt 2.

Excerpt 2. Research identity memo excerpt: Reflexivity and positionality in participant-centered research

Researcher Identity Memo

Date: January 24, 2022

For the most part, I think the experiences, insights, and knowledges I have related to my research questions are beneficial. They allow me to empathize with research participants, to see complexity, to appreciate both individual- and system-level considerations, and to understand the significance of the insights and experiences shared with me. At the same time, I am being challenged to maintain a critical awareness of what assumptions and biases I have about people who recreate in the winter backcountry and how that plays out in the research context. In particular, I am working hard to maintain awareness of the impact of my role as an avalanche educator and President of Mountain Mentors, where I work to identify needs and respond accordingly. In these positions, I care so deeply that individuals have the opportunity to learn in a way that supports safe and enjoyable experiences.

In my interactions thus far with research participants, I catch myself wanting to facilitate those experiences for them. I am working to remember that my purpose as a researcher is not to impact their experience but rather to create and hold spaces for them to share it. I am also aware that my embeddedness in the avalanche safety community has the potential to contribute to a power imbalance with interview participants, where I am perceived as being an expert or as having a certain degree of expertise on the topic. I am very carefully working to ensure that interview participants feel empowered in the interview process and understand that my role is not to evaluate or pass judgement, but rather to elicit their own expertise.

As I progressed in the study and reflected more on these ideas, I came to understand that I was part of the interview participants' "social world" (Reed & Towers, 2021). As Reed and Towers (2021) put it, I both affected and was affected by the "shared experience of research". The interactive and relational nature of conducting qualitative research, as documented by social scientists such as Gilbert (2002), Jackson et al. (2013), Reed and Towers (2021), and Valentine (2007) makes the researcher vulnerable to emotional challenges. In my experience, I found this to be heightened by my personal connection to the backcountry. I felt that this personal connection supported many characteristics of skilled interviews outlined by qualitative researchers. For example, it made me an attentive and empathetic listener, allowed me entry into the experiences of the participants themselves, and helped me delve into their stories as deeply as required to understand the details of their perspectives. However, in my case, this personal connection also presented the potential to be connected to the harmful realities of recreating in the winter backcountry. By the time I completed nine interviews, friends of mine were tragically involved in a fatal avalanche accident. The experience of that loss was also a loss of the relationship I had with the places and people central to my research topic and, thus, of my ability to engage with the study in the same way. In this case, the emotionality of the research meant my ability to uphold my commitments to the interview participants, how I

conducted the interviews, and how I interpreted the data was no longer possible. Some of these impacts are illustrated in the research journal excerpt from the week immediately following the accident (Excerpt 3) from week immediately following the accident:

Excerpt 3. Research journal excerpts: Impacts of emotionality in research

Research Journal Entry **Date: February 7-13, 2022**
Realizing how connected my life is to these topics. How focused it is on work that gets people into the backcountry
What does this mean for my study? How will it affect my interviews and analysis?
The more connected I become, the more people I'll lose. It makes me want to stop everything.
I read in Ravitch and Carl (2016): "know how to enter into another's experience," "interviews as social interactions where you're sharing in constructing a story and its meanings," "centrally important to delve into each person's experience." This is what makes it so difficult right now. Because I do these things. I have to "genuinely care about the experience of the research participant" and I do. This is why I thought of all my interview participants when I found out there had been a fatality.

I continued recording these impacts in subsequent research journal entries as I tried to reconcile my personal and research experiences (Excerpt 4).

Excerpt 4. Research journal entry: Impacts of emotionality in research

Research Journal Entry **Date: February 21-27, 2022**
Research Journal Excerpt 1: I am noticing myself in a less 'generous' or curious mindset as I transcribe/pre-code.
Excerpt 2: How hard it is (while transcribing and interviewing) to be present [with the] interviewee, be listening, be mindful of relevance to research/research [questions], and be aware of my own biases (reflexivity, criticality). No wonder it's hard to do when I'm already impacted by the loss.

The impact of this experience resulted in my ending the data collection process. As a result, the chosen sample size of nine was selected not for its alignment with any of many existing sampling strategies but rather to maintain the standards of trustworthiness to the best of my ability and to account for the emotionality of social science research and its impact on the remaining research stages.

In the remainder of this thesis, the nine participants will be referred to by their pseudonyms - Clem, Kit, Chris, Robin, Rowan, Alex, Blair, Bret, and Riley – and, in my writing, I

refer to them using the pronouns they and them. They are introduced with the primary signup survey response data used to inform their selection are included in Appendix E. In addition to the interview data (participant communications and interview recordings interview transcripts), the data analyzed in this study also includes researcher-generated data (e.g., memos, and research journal entries).

3.3. Data analysis

My analysis was exploratory and descriptive or, as Guest et al. (2012) describe, “content-driven”, such that specific codes and categories were not predetermined but rather derived from the data itself. In their guidance on qualitative analysis, Maxwell and Miller (2008) advocate for strategies involving analytical “moves” that both categorize and connect the data. Throughout the analysis, I openly explored interview participants’ experiences – moving between a focus on similarities and differences to making connections to identify patterns, discover relationships, and generate insights. I recorded these findings in memos and research process records, taking care to include thorough descriptions of their contexts (related to the interview participant, their stories, and my own experiences) that would help maintain fidelity to individuals and their experiences.

The first stages of my analysis consisted of interacting with the data (transcribing, listening to, reading, and discussing the interviews), coding, and developing preliminary themes. I used a precoding memo to record notes throughout these processes, the template for which is included in Appendix A. Once the interviews were completed, I used Adobe Premiere Pro's speech-to-text software (Adobe, 2023) to generate verbatim transcripts automatically. I reviewed and edited the auto-generated transcripts in detail for clarity and to ensure representativeness. Using the precoding memo as a guide, my supervisor and I had intentional and open discussions about each interview. In these discussions, we discussed the characteristics of the interview participants and explored emergent patterns within each interview participant’s experiences and emerging similarities and differences. This engagement was also an opportunity to reflect and receive feedback on any improvements or changes necessary in the subsequent interviews. Next, I proceeded with two distinct, but concurrent, methods of analyzing the interview transcripts.

In the first method of analysis, I started with a focused reading of the transcript wherein I identified segments of text that contained examples of the participant making a risk

management decision. I developed categories of decision components through multiple iterations over an initial few transcripts. These categories provided a structure that allowed me to code the text segments in a way that captured the nuances and complexities of participants' decisions. I completed this coding stage in Microsoft Excel (Microsoft Corporation, 2022). Table 7 lists the categories and provides a code example to illustrate.

Table 6. Cognitive coding structure

Category	Category description	Example code
Purpose	The objective of the risk management decision-making process	Choose whether to proceed
Cue	Information that initiates a risk management decision-making process.	Avalanche activity
Assessment stage	A step in the risk management decision-making process where information is identified, analyzed, or evaluated	Evaluate terrain
Consideration	Information used in an assessment stage	Slope angle
Value	Specific criteria associated with a consideration	> 30 degrees
Outcome	The result of the risk management decision-making process	Turn around

Then, to better understand the relationships between the decision components, I created visualizations of the coded decisions (hereafter referred to as "decision-making networks") using the concept mapping software CmapTools (Institute for Human & Machine Cognition, 2019). A simplified example of this visualization using the example codes in Table 7 is shown in Figure 1, where the colour of the code represents its category.

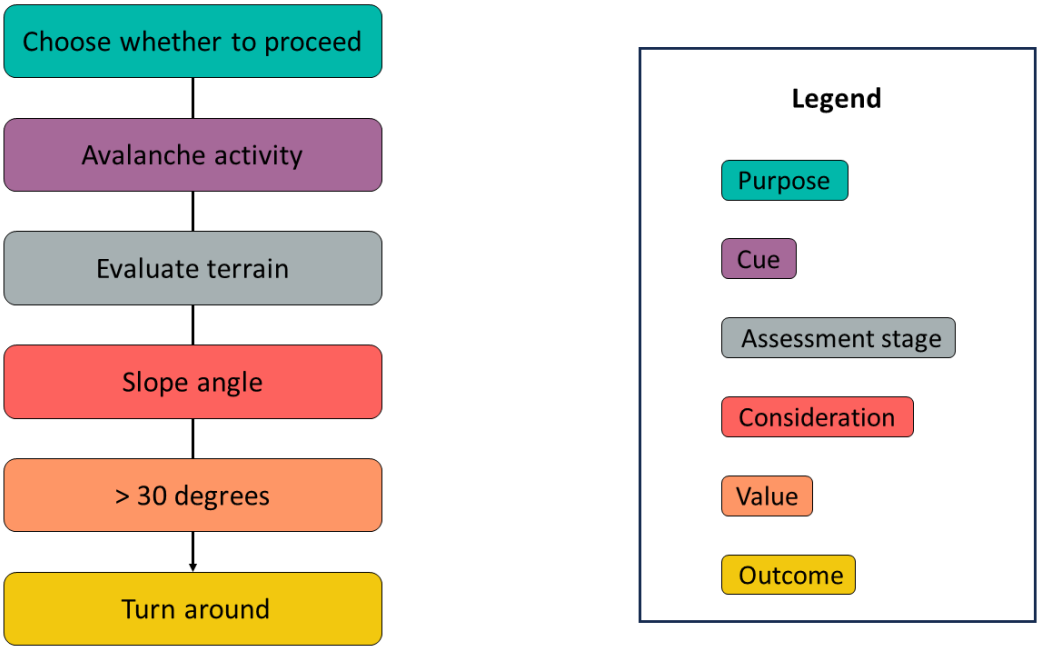

Figure 1. Cognitive coding visualization: Mapping the decision-making process

Similarly to the networks described by Miles and Huberman (1994), the decision-making networks allowed me to better see connections between components of a decision i.e., to see the decision-making process and not just its components (Maxwell & Miller, 2008). I repeated this coding and visualization for one segment of text at a time. In doing so, I began to see patterns within the decisions described in a single participant's interview. As I completed this process with other transcripts, I iterated back through decision-making networks in previously coded interviews to ensure any new insights or emergent patterns were accounted for. Doing so also revealed cross-interview patterns and variations. Once all segments of risk management decision-making were coded and mapped, I grouped each participant's decision-making networks by stage (pre-trip, in-field, or post-trip) and purpose (e.g., "Choose whether to proceed", "Route finding"). This grouping provided a clearer understanding of individuals' decision-making processes. At this point, I was also able to discern patterns both within and across interview participants' decision-making processes and better examine their contextual variations, which I recorded in memos.

As I coded the decision-making processes, it became clear that participants' in-field avalanche risk management decisions did not occur as isolated instances, but rather were extensions of rich and descriptive context. To better understand the context of participants' avalanche risk management, I examined the interview scripts with the second method of

analysis. Here, I used NVivo 12 (QSR International Pty Ltd., 2021) for iterative and recursive cycles of “breaking down” and “reassembling” the data (Maxwell & Miller, 2008). I started with an open, descriptive, and inductive coding approach to generate substantive categories. This involved coding the transcripts in a way that stayed as “close to the data as possible” (Ravitch & Carl, 2016), sometimes using the same wording as the participant. I also reviewed and coded the themes I had previously noted in the precoding memos. I then grouped these codes into descriptive patterns in multiple cycles, winnowing those unclear or relevant to the research objectives.

Chapter 4. Findings

> *Nothing makes itself, nothing tells its own story. Stories nest like Russian dolls inside ever more stories and ramify like fungal webs throwing out ever more sticky threads.*
>
> *(Donna Haraway)*

The above quote highlights the interconnectedness of accounts of individuals' experiences. In this study, each finding did not exist in isolation but rather is embedded in participants' experiences and connected to the experiences of others. As such, the analytical process continued throughout the writing stage, as I made deliberate analytical choices about how to interpret and represent the data in a way that was authentic to and representative of the participants' experiences and illuminated core insights in the data without sacrificing their complexity and nuance. To facilitate a coherent, clear, and comprehensive representation of central themes and interconnected insights, I chose to group findings into substantive categories, meaning they outlined central themes derived from emergent understandings (Maxwell & Chmiel, 2013). Table 8 outlines and defines key terms for each of these sections.

Table 7. Key terms used in representation of findings

Term	Definition	Findings sections
Environmental factors/cues	Factors/cues external to the individual or contextual to the physical environment that influence individuals' avalanche risk management decision-making.	All
Subjective factors/cues	Factors/cues that are personal or internal to the individual and their experiences. Subjective factors may also be interpersonal, manifesting through social interactions in the backcountry.	All
Formative experiences	Experiences specific to participants' personal journeys and pivotal stages in backcountry recreation, including entry point, early experiences, first impressions, avalanche awareness development, and development of avalanche risk management practices.	4.1.
Direct response decision-making	Risk management decision-making processes that involve one or more cues and an outcome.	4.2.1.
Layered decision-making	Risk management decision-making processes that require one or more assessment stages and associated considerations and values.	4.2.2.
Proactive initiation	Layered decision-making processes that started with a deliberate step in a participant's in-field risk management process. This type of initiation starts with an assessment stage.	4.2.2.
Reactive initiation	Layered decision-making processes that started in response to one or more observations. This type of initiation started with a cue.	4.2.2.
Assessment strategies	The strategy that guided the layered decision-making process.	4.2.2.
Avalanche risk management supports	Supports and resources that participants draw on and incorporate into their avalanche risk management practices and in-field decision-making.	4.3.

Throughout the findings, I include illustrative examples from participants' interviews including quotes. To improve clarity, I edited the verbatim transcripts following the approach described by Roulston (2013). This involved removing filler words (e.g., "umm," "like," and "you know") and repetitions from both the participant's quotes and my own when they detracted from readability. However, I chose to keep these elements when they supplemented the findings by communicating the nature of our conversation or helping to maintain the uniqueness of a participant's voice or the nature of our conversation. Also, to maintain the participants' voices, I added or described conversational features like pauses and laughter in parentheses (). I added words for clarification and noted them using square brackets []. Lastly, to protect the anonymity of the interview participants, I replaced specific names (e.g., places, outdoor groups) with more general or neutral descriptors in square brackets.

I also included contextual details relevant to the setting and the participant to guide the reader through the meaning of the data in a way that captures its depth and complexity. As a result, the distinct sections of findings presented here are more like the stories described by Haraway (2019) in that they are layered, intertwined, and interdependent. To make the findings easier to navigate, I used *italics* as a visual distinguisher between interview participants when introducing a different participant's perspectives or experiences. Additionally, I **bolded** terms in the findings that were used to code the key concepts.

4.1. Formative experiences

Within participants' descriptions of their personal journeys and pivotal stages in their backcountry recreation, I identified factors that shaped their avalanche risk management practices and thus influenced their avalanche risk management decisions. This includes descriptions of their early experiences, including how they got into the activity, their first impressions, as well as the changes in their avalanche risk awareness and the development of their risk management practices. Together, these descriptions provide rich insight into the foundations upon which recreationists build their in-field avalanche risk management practices and the factors that subsequently influence their avalanche risk management decisions.

Riley entered winter backcountry recreation enthusiastically around 15 years ago, at first hiking into the mountains on snowshoes with downhill skis and boots on their back. Two years into that, Riley took an outdoor education program in school. Through this program, they had the opportunity to take their first Avalanche Skills Training (AST) course, for which they rented backcountry skis and avalanche rescue equipment. The course experience was so good that Riley recalled the following:

> I remember taking that course and just like realizing that you could basically hike and ski and thinking like, "Wow, this is the best. Like this is the best activity ever."

Two years after taking the AST1 course, Riley used their savings to purchase their own winter backcountry equipment. Within the following couple of years, Riley was doing trips into the backcountry ranging from local day outings to more lengthy resort-accessed backcountry routes. They described going out at that time with a group of friends that was "a little bit more extreme." In our discussion about these trips into the backcountry, Riley provided some insight into two moments that were pivotal in the early development of their avalanche risk awareness.

Riley recalled noticing a “big trajectory of learning” within that group when they started to understand that some of the trips they did were “actually kind of sketchy.” The other pivotal moment came later when they had the opportunity to learn from a highly experienced colleague. Riley recalls their colleague telling them, “It’s really easy to make a bad decision. It’s really easy to [mess] up. The best people in this industry lose their lives doing this.” Riley reflected on this moment as being “pretty humbling” and that it “really changed how [they] went about going into the backcountry.”

Rowan also had an enthusiastic start to their journey as a winter backcountry recreationist. Despite hailing from a “land that doesn’t have snow”, Rowan gained experience skiing at resorts. They were later introduced to backcountry skiing by two friends, who already had a lot of experience. Rowan moved to the Vancouver region and, now with access to snow and mountains, “hit the ground running.” They took an AST1 course shortly after moving, by which time they had already been out backcountry skiing with their more experienced friends. Rowan told me that their first experiences travelling in the winter backcountry were not in avalanche terrain and the objective was to practice with their equipment.

> […] We're talking like less than, you know, 25-degree slopes. Like, essentially it was practicing putting skins on and skinning. Umm. I don't even think that where we travelled was technically avalanche terrain […] it was with the mindset of "we don't know what we're doing", like "we just want to practice our gear."

Despite doing “fairly mellow tours,” Rowan described their initial experiences as both exciting and “nerve-wracking.” The causes of these feelings, they said, were the uncertainty they felt and being a novice in the group and, thus, not knowing how to contribute to the group’s risk management.

> […] You don't necessarily feel like you have a ton to add. And so, then you're kind of in a position where, like, "I'm unsure of the terrain […] I don’t know what I don’t know yet.” So, I was so nervous. Like, "Should I ski this slope?” Like, "How many pits do I need to dig?" Those kinds of things.

Rowan said that, since then, their perspective on risk and their approach to managing it has changed. Now, they “know what’s going on” and know what information they need to make risk management decisions.

> I think my view has probably changed. And not even really that I'm taking on that much more risk. I think just my view of the risk, in general, is maybe more data-driven, right? It's less, like, "I don't know what's going on" and it's more,

like, "I feel like I know what's going on. I'm going to use observations to confirm or not."

I followed up and asked Rowan about what has made a difference for them in that development. They told me that they have taken courses, been out with guides, and read books, but the only thing that has "alleviated those nerves" was time spent in the backcountry. They specified that different types of trips (e.g., long distances with low vertical gain) and different conditions (e.g., bad skiing conditions, high avalanche hazard) have led to their development of a "mental logbook." The importance of time spent in the backcountry in different conditions was emphasized again later in Rowan's interview when I asked them if there was anything they would share with people who are just getting into winter backcountry recreation.

> To me, the biggest piece of my development was just a big N. So, like the number of days out. Like, go out. Like even if it's [bad conditions], even if the snow is not good, even if the avalanche risk is high, like, there are always places you can go […] like you could go to a meadow. […] I'm not saying go out and take big risks, but like go experience different conditions. You don't know what a shooting crack looks like until you've been out [when there are] shooting tracks. You don't know what a whumpf sounds like until you've heard a whumpf. You don't know what a massive avalanche going off a couple mountains over sounds like until you're out and you hear a giant bomb go off. You know? Like, they're scary experiences, but like they're massively valuable in terms of lowering your risk overall.

I interpreted Rowan's willingness to gain experience in a variety of conditions in part as attributable to their general enthusiasm and their motivations in the backcountry. Rowan expressed excitement for "longer, suffer-fest adventures days" and motivation for "just being outside, adventuring, trying something new, and testing [oneself]." In continuation of these pursuits, Rowan described the skills, knowledge, and experience that they hope to develop in the future, including glacier travel, understanding of snowpack, and risk identification.

> Rosemary (RL): So, when you think about your development in the future and what skills and proficiencies you want to have, what are there things that you can identify that you need to work on or that you want to do to accomplish future objectives?
>
> Rowan: I took a glacier travel course […] a lot of the objectives I wanted to do this year had some crossing of some glaciated terrain. […] I'm a big climber. Probably more so even than a skier […] it all plays into my love of like ropes and shiny metal things. So, that was a skill that I was looking to build so that we could [do] a lot of the long ski tours and traverses that we wanted to do. Umm, […] obviously there's still - there's an infinite amount of room to grow in terms of understanding snowpack and being able to identify risk.

Rowan elaborated specifically on options they considered for learning more about the snowpack, including hiring a guide, taking a professional-level training course, and taking the more advanced AST course (AST2).

> Ultimately, I would love to spend a couple days with a guide or maybe - umm, I don't think that an OPS1[1] course would be super helpful, frankly, but probably, like, an AST2 course could be. You know? Something that really delves more into the snowpack […] generally, learning from someone much more experienced than me, then I think I could, you know - would be super valuable.

Kit also described the role of their peers in their first experiences in the backcountry. Like Rowan, Kit also had experience skiing in bounds before being exposed to the possibility of skiing in the backcountry. Kit picked up backcountry skiing after renting equipment and going out several times with their friends. Kit described their initial experiences backcountry skiing simply as "a lot of fun," and "a lot of untouched powder." Kit described additional benefits of backcountry skiing, including "not being in crowds," "a good way to do cardio and get a sweat on," a good time to have "good life conversations" with friends, and, in contrast to their experiences at the resort, they said,

> The backcountry is just perfect to enjoy nature in a very quiet setting […] you're hearing birds and you're hearing the sounds of like humming ecosystems, and you never get that in resort settings.

Kit's draw to the backcountry was further illustrated early in the interview when we spoke about their risk management practices. Using a specific trip that they frequently go on as an example, I started by asking what their objectives on that trip typically are. Kit's response summarized many of the motivations they had already mentioned. They said,

> Honestly, as long as I'm out there and, like, breaking a sweat and enjoying the elements with a good friend, then it's just a win for me.

Following up with additional questions about their typical trip and objectives, I asked Kit about the decisions they make when working to fulfill their objectives. Kit replied at first saying that they often consider "how [their] body is feeling" and what their gut is telling them. The rest of their explanation sheds light on why those considerations are important to them. Kit mentioned

[1] Refers to the Canadian Avalanche Association course, Avalanche Operations Level 1, which is the first professional-level training course for those seeking employment in avalanche risk management operations (Canadian Avalanche Association, n.d.)

having had an incident in the backcountry the year prior when they were on a backcountry trip with their sister and another partner.

> The halo effect was really prominent when I had the incident last spring because we all kind of kept quiet, […] but we all felt in our gut that, like, "this is really kind of sketchy, maybe we should turn back." But because of the halo effect, none of us really voiced that and kept going. And that's when we got ourselves in a lot of trouble.

When I asked Kit if I could ask them more questions about this incident, they expressed a desire to talk more about it. In addition to the "halo effect," and gut feeling they already mentioned, Kit told me about their observations on that day. It seemed like the observations most strongly featured in Kit's recollection were signs of warming.

> Going in was fine, and then say, like, half an hour later, because it had warmed up so much, the snowpack was changing so rapidly, and our footholds were caving.

Kit told me that, due to the unstable footing, their sister slipped and fell into a tree well. As Kit described, the shock of this made them turn around.

> I was just like, "Oh my God, I think I'm an only child now. She's gone forever." And that's when we decided to turn around. I just wanted to get out of there as soon as possible.

Then, as they were returning, Kit also lost their footing, causing them to fall down the slope. They described getting caught in the "last tree well of the area [beyond which] it was just sheer cliff." The fall resulted in an emergency evacuation and lasting injury. As the interview went on, it seemed like this incident informed much of Kit's present-day in-field avalanche risk management practices. Warming-related information appeared in Kit's descriptions of their in-field risk management decisions (Table 9).

Table 8. Impacts of a notable incident on Kit's in-field avalanche risk management practices

Example 1:	If there's pinwheeling, what the high [and] low is temperature-wise, umm, how the snow's reacting to any type of movement that I'm creating […]
Example 2:	RL: Are there any other, umm, like, changes in the environment that you typically look for?
	Kit: Aspects. […] Like, umm, sun angles aspects. Umm. Yeah. Warming.
Example 3:	RL: Let's say that you are on an aspect where there's some warming, What types of actions do you or have you considered using to manage that? Like, what are the options present for you at that point?
	Kit: I guess it really depends on, like, time of day. How much warming? Like, the range of low to high temperature-wise that day. With respect to how much warming really happens.
	RL: And so how much warming would need to happen for you to say it's time to go home?
	Kit: Oh, that's a good question. Umm. Say, approximately five to eight degrees [of change].

Kit shared a lesson they learned from that day, saying that the impact of the "halo effect" taught them about the importance of voicing their concerns and hesitations. At the end of the interview, I followed up asking if anything else had changed over the time they had recreated in the backcountry. Kit replied saying that they are now more knowledgeable and, in turn, more conservative.

> RL: So, you mentioned that since this incident, you have become more conservative. Umm. Has - has anything else changed in terms of your practices since you started doing this in - way back in 2017? Like, when you think back to [name of participant] out then, umm, and then [name of participant] now what - what else has changed or in what ways have you, yeah, developed?
>
> Kit: I'm more knowledgeable about the risks involved, and so I make more conservative choices in that sense. [Back then, I] was kind of like, "ignorance is bliss," and then just kind of went out there and didn't really know what could go wrong and what to do if things did go wrong. But now I'm more knowledgeable and educated, so that's good.

Lastly, I asked Kit if there was anything they would encourage others to do in their initial experiences in the backcountry. In their response, I could see how their draw to the backcountry, the incident they had in the early days, and what they have learned since have all influenced how Kit manages avalanche risk now. After some thought, Kit said that they would remind them that "it is a lot of fun to be out there," and that "it's also very dangerous and things can go south in an instant." The advice they gave was: "Just be prepared for anything and really just get all the resources and the education you can because that could save your life."

Chris's coworkers encouraged them to get into snowshoeing. It was March when Chris rented snowshoes for their first hike since moving to Vancouver. This was also Chris's first time snowshoeing, and they had not yet received any avalanche safety training. In the interview, they reflected on the trip, recalling the steep terrain, lack of crowds, and how the "snow [made] everything look beautiful." After seeing how much enthusiasm Chris had for hiking, their colleagues equipped them to get the gear they needed. Before that winter ended, they used their new gear on a couple of trips in the mountains near Vancouver and in "easy stuff" in more remote areas. Chris continued hiking with a group throughout the summer and fall and transitioned to snowshoeing once the snow started falling. Chris recalled finding out about Avalanche Canada and the avalanche forecast through a Facebook group. They said that they did read the forecast at that time, but only parts of it because they had not yet completed their training.

> I remember I knew something about [the avalanche forecast]. I knew how to play with the website. I don't remember how I found out about it. Maybe it was through the Facebook groups […] I would read the forecasts, but I didn't know the [avalanche] problem side. I only learned about that in the [AST course]. […] There's a mapping feature where you see like the Simple, Challenging, Complex terrain. I might have known about that before the [AST course].

Chris described more about their first experiences in the backcountry before having completed an AST course. In a story about their "first snowshoe in avalanche terrain," Chris mentioned avalanche risk information used in their risk management practices on that day, including the Avalanche Terrain Exposure Scale (ATES) rating, the avalanche danger ratings, and signs of instability.

> I remember looking at that map and I knew it was going through avalanche terrain. Like, the Simple terrain. But the day we went, it was like maybe Low, Low, Low or Moderate, Low, Low. Something like that. But then, yeah, even today, I think, like, Moderate is not non-existent. And then I remember when I was going up there, I was like, "Oh, I see some like some cracks on the snow" […] we didn't really have to trail break because we followed the skiers. But I could see signs of something on the slope. And then I remember thinking, "Oh, I don't know if this is safe," but there was someone experienced in the group.

Chris recalled that they realized that it was avalanche terrain only once they had taken their AST course, saying, "It hit me after I did avalanche training, like, yeah, it was avalanche terrain." Through my interview with Chris, I got the sense that their learning process since then has not been straightforward. Chris had told me that they have a low risk tolerance and said that, because they know more than they used to and have gained more experience, they now get

more scared. In turn, they said, this leads them to do more extensive research to prepare for their trips.

Chris described an impactful moment in the development of their avalanche risk awareness that they had recently when they watched a video of a snowshoer who triggered an avalanche while sliding down a slope, something they said they didn't realize was possible.

> They were butt sliding down the hill […] you can't quite tell what the slope looks like, […] so it's probably one of the convex slopes. And then, before you know it, the guy has just triggered an avalanche and he's going down with the snow. So, until I saw that, I actually didn't think about it. That snowshoers can also trigger avalanches just by playing and butt-sliding.

Chris concluded this example by saying, "So, yeah, the more I know, the more scared I get."

Chris's transition between hiking and snowshoeing was also apparent in my interview with *Robin*. Robin found a particular love for hiking during the COVID-19 pandemic as a way to support their physical and mental health. A combination of realizing they had the strength and fitness to explore the mountains near Vancouver, a seasonal shift to winter, and subsequent awe and appreciation for the places they could access in the winter made snowshoeing a natural extension of an activity that they already loved.

> Then [we] realized that we could hike because we were actually fit enough to do it. And then we were going to places that were unbelievable. And then there was snow. And we were like, "Oh my god, this is even cooler." Or it [was] cool in a different way.

Robin then described more about their introduction to snowshoeing by telling me about taking their AST course.

> [I took the course] as a beginner snowshoer, but also just [as] a hiker. I'm a hiker. That's just what I do. I was venturing and trying to do all the hikes, but there was snow. (Laughter). And so, we wanted to make sure we were safe. It was [an] excellent course. Loved it.

Robin expressed being grateful that someone they knew had encouraged them to take an AST course because it was not something that, as a novice, they had not known they needed to do.

> We didn't know that we needed to take it. So, it was very cool to have someone say, "Actually, you should take it." […] We see a lot in the communications. If I look at, like, Facebook and some of the groups I'm in, it's nice to see that everybody's saying, "You need an AST1", "You need the training". And so, I think that's a good messaging […] and making it sound that it's open for people,

> especially like [my partner] and I. Like, we were in a sense, a bit new to it, right?

Robin shared more reflections on how the course influenced their awareness of the risks of hiking in the winter and the difference it made to the start of their time as a snowshoer:

> Robin: My whole thought of snow before the training and after the training totally changed. Because I had no idea. So, I really came in with, like, no knowledge of snow and how it works and what I should be watching out for and what I shouldn't be concerned about that maybe I thought I should be concerned about.
>
> RL: Oh, interesting. What kinds of things did you realize that you did or didn't need to be concerned about that you maybe didn't know before?
>
> Robin: I think more the stability of knowing that when we look at terrain and when the avalanche risk is Low, that we're… like, to actually feel comfortable and safe, right? So, it's the difference [between] going into an unknown and thinking "oh" [expressing uncertainty] and actually just feeling confident in what we're doing and our decision-making.

With the confidence to make decisions that allow them to feel comfortable and safe, Robin described enthusiasm for snowshoeing in the backcountry near Vancouver because of its accessibility and mentioned that, while still in their first season of snowshoeing, they go out every weekend.

> […] and the fact that we're [so close to the mountains], which is so incredible. Like, we can go - it's just right there all the time, you know? So, we're out every weekend.

The physical health benefits of hiking are part of what led *Alex* to pick up snowshoeing as a winter equivalent to hiking, along with not knowing how to ski. When I asked what their first experiences snowing in the backcountry were like, Alex spoke specifically about their decision-making process. Describing their use of the avalanche bulletin, they said,

> I didn't really understand at first […] when I see, like, a green, yellow, orange there, that's all I based my decision on.

Now, Alex sees that they have made improvements since then. When I asked more about the changes that have occurred since their initial experiences, Alex said that learning about the mountains is becoming "a passion." A desire to continue learning and gaining experience came up again at the end of the interview when I asked Alex specifically about what has made a difference in their development as a backcountry recreationist.

> Learning. I like to keep on learning and learning things correctly. It's not just, "Oh, I made a mistake now I learned from it." No. I'm the kind of person who wants to learn before I make the mistake. I probably did a lot of mistakes, I just didn't know what it is, looking back. But with the mindset that I have right now, I like to keep on learning. As I said, the more I learn, the more I realize that I have more things to learn. It just never stops. […] the more I learn, it gives me more comfort to improve myself, to go for bigger mountains. And I get the experience that I need that helps with growth. But it all comes down to learning. Learning how to forecast, learning how to do rescues, learning how to read the mountains, how to navigate through it.

Alex's passion for learning about the mountains extends beyond snowshoeing. Alex mentioned that, since having started snowshoeing, they have taken a mountaineering course, started to rock climb, and want to continue developing their experience in winter recreation.

> But I want to gain more experience, especially during the winter [with] winter travel. I just want to have more experience, I think. And do it safely.

Alex's motivation to learn in the outdoors was further illustrated when, at the end of their interview, they told me that they were looking into becoming a certified hiking guide and may even pick up skiing.

Despite being introduced to snowshoeing in the backcountry many years ago, *Clem* vividly recalled their initial experiences. Clem's story as a recreationist began with snowshoeing with their dad, an outdoor educator. Having received their first pair of snowshoes as a gift in university, Clem described their continued participation in snowshoeing not as a love for the activity itself but, like other snowshoers I interviewed, as a way to continue hiking during the winter.

> I don't like winter, and so that's why I don't ski. Because I don't want to put a lot of money and effort into an activity that costs money (laughter). Snowshoeing is a way for me to stay active in the winter and to be able to get up into the mountains where it's sunnier than hiking down in the forest. And, you know, it's a way to spend time with friends and get some exercise. But primarily it's a way to continue doing my favourite activity, which is hiking at high elevation, but in the winter season.

As a result, Clem's choice of backcountry objectives generally includes "moderate objectives that are a fun way to pass time while waiting for summer." Over the years, Clem has collected a group of trips that meet this criterion from which they will choose for a day in the backcountry: "Really, with any of the objectives in [this area]. I've been there before […]."

When recalling their early experiences travelling in the backcountry, Clem said that they had little awareness of risk when making decisions. In several instances, Clem outlined their decision-making in those days and how that has changed since having taken their first AST course. Illustrative examples are included in Table 9.

Table 9. Clem's early experiences of risk management and changes since

Example 1:	I really didn't think that I could ever put myself in serious danger until I was in that course and saw that slide. And I was like, "Oh, I really need to rethink the decisions that I am making." Because I was like, "Yeah, I'm going with friends to backcountry ski, they know what they're doing, people go here all the time, there's a hut there, I'm sure it's fine."
Example 2:	I mean, I definitely made decisions before I got avalanche training (laughter) that were not informed. But since I've had avalanche training, I've been much more conservative with my decision-making and have very rarely been in a decision-making situation where we've had to decide, "Are we going to turn around or not?"
Example 3:	I feel like before you do any training, you don't know what you don't know.

While they described learning a lot in their AST course, Clem told me that there is not much that they are hoping to do in the future to continue learning and developing their experience because snowshoeing is not a passion for them.

> RL: […] When you think ahead and like what future experiences look like, are there specific skills you hope to develop or parts of your practice that you feel could be improved?
>
> Clem: Unless I change the type of things I'm doing in the winter outdoors, there's not a lot that's going to change [in terms of] development. I could probably stand to take AST1 on snowshoes as a refresher. I think everybody could stand to refresh any of their outdoor skills every decade or so. But yeah, like I said, winter travel is not a passion of mine, it's more of a necessity.

Bret, a very experienced backcountry skier, also spoke about their initial experiences making risk management decisions in the field, recalling how they "relied much more on other people" and how they were "kind of guessing" because nobody in their group had much experience.

> We learned through our guesses, but [with luck]. I remember in '74, people got caught in small sloughs and stuff.

Bret started backcountry skiing in 1973, shortly after a mountaineering course where they saw others doing it. Bret recalled the nature of the gear that they equipped themselves with that year and how uncomfortable it was as they ventured out on a two-day trip into the backcountry. Many of Bret's trips into the backcountry were with local outdoor clubs. They have continued their

involvement with these clubs since then, now as a group leader. Bret told me that their motivation for going out in those days was to avoid crowds (in addition to being in the wilderness and skiing good quality snow) and laughed when they said that that had not changed. Though they had not taken an AST course, Bret accessed some avalanche safety education through the recreational groups and gained some experience with avalanche safety practices as a ski patroller. They also said that reading books on the topic and going out with guides made a big difference in their learning.

Blair picked up snowshoeing originally for its physical health benefits – a sport which, unlike the downhill skiing they used to do, was less physically taxing and through which they could still maintain their physical fitness over the winter months. Blair also highlighted that snowshoeing was a means to support their mental well-being. Having experienced a traumatic accident, depression and stress, Blair described snowshoeing as "a good release because it was not only physical, but it was in nature." They also acknowledged the mental health benefits of the social aspect of snowshoeing, which they had discovered by going out with friends and with organized groups. This eventually led Blair to take on a position as a hiking trip leader, a role that they were mentored in. Eventually, they also led snowshoeing trips, something that they found to be "a lot different." Blair said that after their first season in that role, they "started making mistakes" and found they needed additional knowledge. When I asked where they found that knowledge, they initially laughed and said, "Some of it was learned through the school of hard knocks." Then, in earnest, Blair elaborated with some thoughts on the lesson they had learned about developing experience in the backcountry.

> Looking back at situations, […] I got to think back to what are some of the lessons I learned. And I guess one of the things I learned is that, even though somebody or someone or something says "this is a good idea" or "this is totally fine," until you kind of experience it yourself, it's best not to lead to group through that situation.

After providing a specific example, Blair disclosed that,

> Part of the big problem was I didn't want to look like mud or admit to the group that I hadn't been here before and it looked sketchy, and we were going to turn around early and call it a day. You know? I wanted to look good, and I didn't want to appear incompetent or the group know that I made a mistake. […] One of the things I was quite aware of - probably too well aware of - is that I wanted to be perceived as an expert or as confident and knowledgeable. And so, I didn't want to let people know that I was human at the same time.

Since then, Blair has continued leading groups and clearly distinguishes between their risk management practices in the times they lead groups and the trips they do with friends. For example, when they are not leading groups, they seek objectives that they know will challenge them.

> I will sometimes go snowshoeing with friends in between leading trips. Whenever I do that, I try to either explore and almost get myself in a position where I get lost on the hill finding new trails, or I tackle something that's well above or beyond the group's abilities.

4.2. Risk management decision-making

In this section, I present the findings on how participants make decisions about managing avalanche risk in the backcountry, including the various ways they approach avalanche risk management decision-making and the factors that shape their in-field avalanche risk management decision-making processes.

4.2.1. Direct response decision-making

Some decisions I identified in participants' descriptions of their avalanche risk management experiences were made in direct response to an observation. For example, in *Alex's* interview, we were talking about how they respond to dangers that they identify in the field. Alex mentioned two cues whose significance allows them to bypass additional hazard-relevant information-seeking and processing to make a decision.

> […] If I'm hearing whumpfing or if I see signs of crack, I think that's going to be – that's it. I can't decide for the entire group, but it's something that I insist on. That it's not safe to be out there.

I coded these decision-making processes in terms of the observation ('cue') and the decision ('outcome') as shown in Figure 2. For representation in this thesis, I refer to these as examples of "direct decision-making processes."

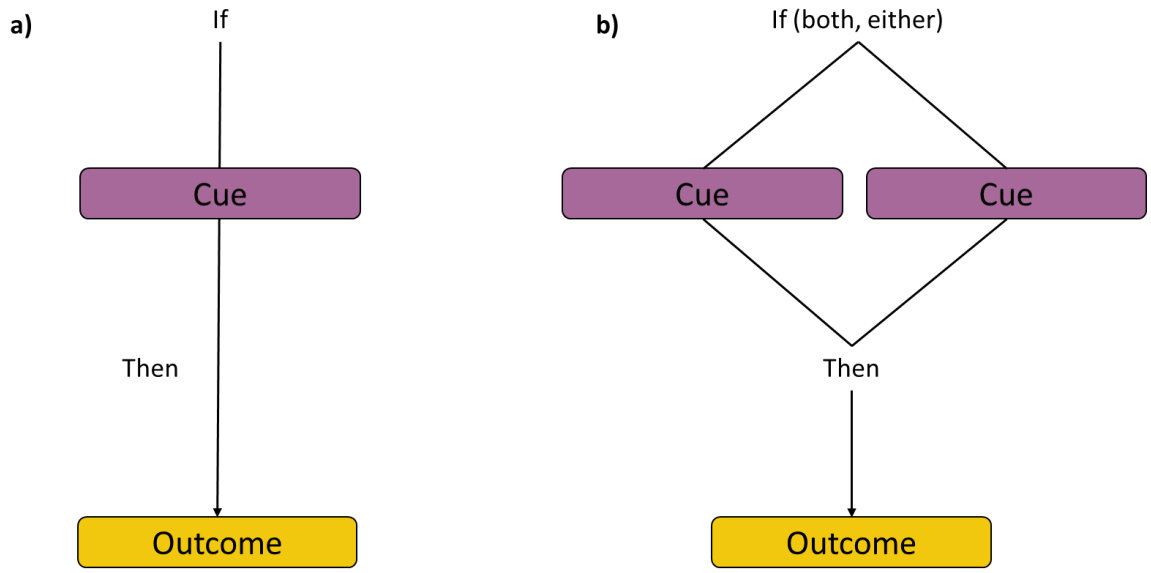

Figure 2. Examples of coding structure for direct response decision-making processes with a) one cue, and b) two cues

The direct decision-making processes identified in participants' interviews are diverse and differ in the cue and the outcome, some variations of which are described here in detail.

In many instances, direct decision-making processes were used when a participant was choosing whether to proceed with their trip. In most circumstances, the outcome was to **not proceed with the trip** due to environmental cues such as **avalanche conditions** (e.g., significant test pit result, recent avalanche activity, whumpfing and cracking, near miss, reactive conditions), **weather conditions** (e.g., poor visibility, heavy and warm snowfall, or freezing rain), or **terrain characteristics** (e.g., open slopes). Oftentimes, participants described actions they took in response to multiple environmental cues. For example, in a choice of whether to proceed, *Riley* chose to **turn around** when they observed an **open slope** and **natural avalanche activity**. However, in other instances**,** a single environmental cue was enough information to merit action. For example, *Kit* had spoken about how noticing "cracks" and "movement" would cause them to systematically evaluate terrain. I followed up asking if there was any information which, upon observing it, would result in them simply turning around. After pausing for a moment to think, Kit responded with an example of observing **avalanche activity.**

> Maybe like a, umm, mini avalanche somewhere, like, further into the landscape. That would be pretty uneasy to witness.

When I asked what avalanche activity signifies to them, Kit said it tells them the "conditions are changing," and that "it's probably pretty unstable at the moment." Elaborating on what they do

as a result, Kit said it means "[they] **should probably get out**." Like Kit, avalanche activity served as a single environmental cue in experiences shared by *Rowan* and *Riley*, who, in both cases, ended their trips.

In another example of a single environmental cue resulting in a decision to turn around, *Rowan* shared an instance of **snowpack instability test results** leading them to **modify their route**. I followed up with Rowan about their mention of "telltale signs of instability" in an earlier discussion about what information they look for when doing snowpack instability tests. Rowan mentioned that a "**scary, easy result**" on an Extended Column Test (ECT) was likely to cause them to **turn around**.

> […] What always scares me is if I were to get a really easy, sudden planar on an ECT. Like, you know, an ECT2, sudden planar down 30 centimeters or a meter or whatever. Like, maybe I'd dig another pit [20 meters away] and try to confirm it. But, like, just one of those results would probably scare me enough, that I'd turn away.

In addition to subjective or environmental cues, the quality of the environmental cue also plays an important role in how the information is perceived and processed. For example, the **unexpectedness of a field observation** was described in instances coded as direct decision-making. In one case, *Rowan* noticed **conditions that they had not expected** (in this case, related to warming) and subsequently chose to **turn around**. In their interview, this type of observation was referred to as a "red flag."

> […] especially here on the coast, like massive warming faster than I expected or we're out late in the day and you've got [more] solar exposure than I want to ski that line. […] If it's like plus five outside and then there's of sun and I'm skiing, umm, south aspects that day, it's - that would be a red flag that would cause me to turn around too.

In another example, the **lack of unexpectedness** led them to **proceed with their trip**. Here, they described their practices of gathering information whilst on a trip to confirm whether their assessment of their trip objective in the pre-trip stage (i.e., choice of trip) was "correct." I asked what indicators would confirm that it was correct, in response to which Rowan said that the lack of unexpectedness would confirm their choice.

> I mean, I like to think if we have done the trip planning and we thought it was safe and we're not seeing anything that deviates from that in a significant or dangerous way, like I would say, like it makes me feel safe […] if nothing in those conditions were different than what we planned for, that makes me feel good. That our trip planning was adequate.

This response was interpreted as direct decision-making, where it was safe enough to continue if **no observation deviated from their trip plan**. Contextual factors that I identified in Rowan's interview provide further insight into Rowan's use of this approach. Rowan told me in detail about how they select and prepare for their trip into the backcountry, which they described as part of their "data-driven" approach to risk management. This exemplifies Rowan's analytical and systematic pre-trip planning process that seemed to be developed by applying processes used in their career as a data scientist to the backcountry context. This involves season-long monitoring of snowpack development; continued weather and snow condition assessments in the week leading up to their trip; terrain, and route planning activities (e.g., reading trip reports, downloading GPS tracks); and establishing trip and/or route alternatives ahead of time with the key observations that might indicate a need to change objectives or routes. My interpretation is that this extensive pre-trip planning allows Rowan to focus their in-field risk management decision-making on identifying key observations or indicators that signify that things are as expected or not. This is further illustrated in the quote below.

> I guess that would be an example of using data that we gather along the way to confirm or not whether our ideas about the objective initially were correct.

Notably, Rowan did acknowledge that this approach to determining whether it was safe was susceptible to confirmation bias, adding cautiously and with a bit of laughter,

> And that's - you know, it's all - again, it's all confirmation bias, right? Like, you're right until you're not, and you're dead.

Clem described something similar in their description of looking for **signs of instability that they didn't expect** to see based on their pre-trip planning.

> Sort of looking for evidence that the snow conditions are different than I expected because, generally, if I've done my research and looked at the avalanche forecast, I don't expect to find sort of more avalanche-prone conditions, but I want to make sure I'm still looking for them.

I identified another example of a direct decision-making process that led to a choice to proceed in *Blair's* interview. Blair and I talked about their motivations to snowshoe in the backcountry and what types of trips they take to fulfill their motivations. In response, Blair described a recent memorable trip they took to a "rugged and beautiful and challenging" objective.

> […] It was almost everything I had to finish the hike. I wanted to quit a number of times, and the weather was really not that cooperative. It was snowing really heavily and there wasn't a lot of people around and it was late in the day. […] So, I was kind of like, "There's no way I would dream of taking [my groups] up

> there in this situation." But I was really glad that I pushed myself and we were all safe. But we were all, again, you know, maxed out when we got to the top.

I interpreted this instance of decision-making as Blair noting **environmental cues** (heavy snowfall, poor weather conditions, late in the day) and **subjective cues** (physically challenging) and choosing to **proceed**. Blair's professional role as a leader of hiking groups in both summer and winter and how that influences their motivation in their recreational pursuits provides contextual detail that helps inform Blair's response to the above-mentioned cues. The quote above, in addition to Blair's explanation below, suggests to me that their recreational pursuits are motivated by a desire for experiences that they do not have professionally, in turn influencing their in-field decision-making.

> [...] I will sometimes go snowshoeing with friends in between leading trips. Whenever I do that, I try to either explore and almost get myself in a position where I get lost on the hill finding new trails or tackle something that's well above or beyond the group's abilities that I've always looked up to and wondered what it would be like to climb up the side of this mountain.

I identified another example of direct decision-making involving both environmental cues and subjective cues combined in *Riley's* description of a situation where they observed **reactive avalanche conditions** that, combined with cues related to **group dynamics**, caused them to **turn around**.

Some subjective cues were related to a person's physical experience, such as insufficient energy or difficult travel. These, too, resulted in the participant turning around. For example, *Kit* described one example of direct decision-making where **physical discomfort** caused by a "bad blister" caused them to **turn around**. Kit shared insights that indicated that the decision to turn around was made possible due to the nature of the relationship that Kit values and fosters with their backcountry partners.

> I guess I'm very picky with backcountry partners. I have to feel, like, really open and comfortable with them and - and so then I feel comfortable expressing my concerns.

Another subjective cue was mentioned in *Riley's* interview. In one instance, Riley said that regardless of whether it is the "safest day," they will **turn around** if there are **challenges with a group member** such as somebody acting selfishly in pursuit of their own objectives, not listening to others in the group, or is being inconsiderate of others' abilities and capacities.

> Like, maybe it's Low, Low, Low and I'm going out with someone [who is] just not actively listening to other people in the group, [who has] clear objectives

> that they want to do for themselves and they're not considering like the group abilities and capacities, and [are] just, like, not sensitive. That might be a "Hey, I'm going home" or a "Hey, I'm not going to ski your objective. You might never want to ski with me again and I definitely never want to ski with you again. But I don't care how safe the conditions are. Like, this is a hard boundary. You're not listening to people in the group I don't want to do what you want to do."

While the purpose of most direct decision-making processes I identified in the data was to choose whether to proceed, others occurred when choosing how to proceed. In these cases, the cues led participants to take mitigative action by changing their route either to avoid features of concern or to select features that reduce risk. For example, *Chris* described an experience where they observed an **overhead hazard** (which they identified by observing debris from a cornice fall) while travelling through a **terrain trap** (as they described, underneath “two big bowls”). However, rather than turning around, Chris described taking action to **reduce their exposure** to the hazard by travelling outside of the area of concern. In another example, *Robin* shared an example of a time they identified that the trip was taking **longer than expected** and that **travel was more difficult than expected**, so their original trip plan and objective to summit a local peak was no longer feasible. Robin and their partner **modified their planned trip**. In their description of this experience, Robin alluded to some factors that have contributed to making a decision in this way, including a shared value with their partner of not being rushed and awareness of characteristics of snowshoeing such as the physical difficulty of travelling on snowshoes without a set trail, and that it is on slightly faster to descend on snowshoes (something that other snowshoers affirmed in their interviews).

> Nobody had been there yet […] and it was hard going. […] I think the one thing that both of us have learned is that we, number one, don't want to be rushed, right? [...] And so, I think it - especially for that whole idea that you still have to get back. [...] Like, it's not like you get there and it's like, "OK, let's turn around and go," […] it is a bit faster because you're going downhill, but yeah.

Both Riley and Kit described experiences where a notable incident caused them to turn around. *Riley* described a decision to **turn around** immediately after recovering from a **near miss** (wherein they triggered an avalanche). In *Kit’s* case, while the incident was not specifically related to an avalanche, they **ended their trip** after **an incident** where their sister fell into a tree well. Kit described this decision to turn around as immediate, though did mention that they did so carefully as the hazard (in this case, the potential to slip and fall) remained.

> I was in shock, and I was just like, "Oh my God, I think I'm an only child now. She's gone forever". And that's when we decided to turn around and I just wanted to get out of there as soon as possible. I was careful, I was being cautious […]

4.2.2. Layered decision-making

In addition to direct decision-making approaches, I also identified instances of risk management decision-making where a participant's risk management decision involved one or more assessment stages with potential associated considerations and values. To represent these processes in this thesis, I refer to them as "layered decision-making processes." There are many ways that the variations of layered decision-making processes could be examined and represented. Two themes that helped me to understand how these layered decision-making processes varied were based on (1) what initiated the decision-making process, and (2) the assessment strategy that guided the decision-making process itself.

Initiation

Proactive initiation

Participants described taking a deliberate and intentional step to initiate a risk management decision. I coded these instances as beginning with an assessment stage, as outlined in Figure 3, and refer to them here as "proactive initiation".

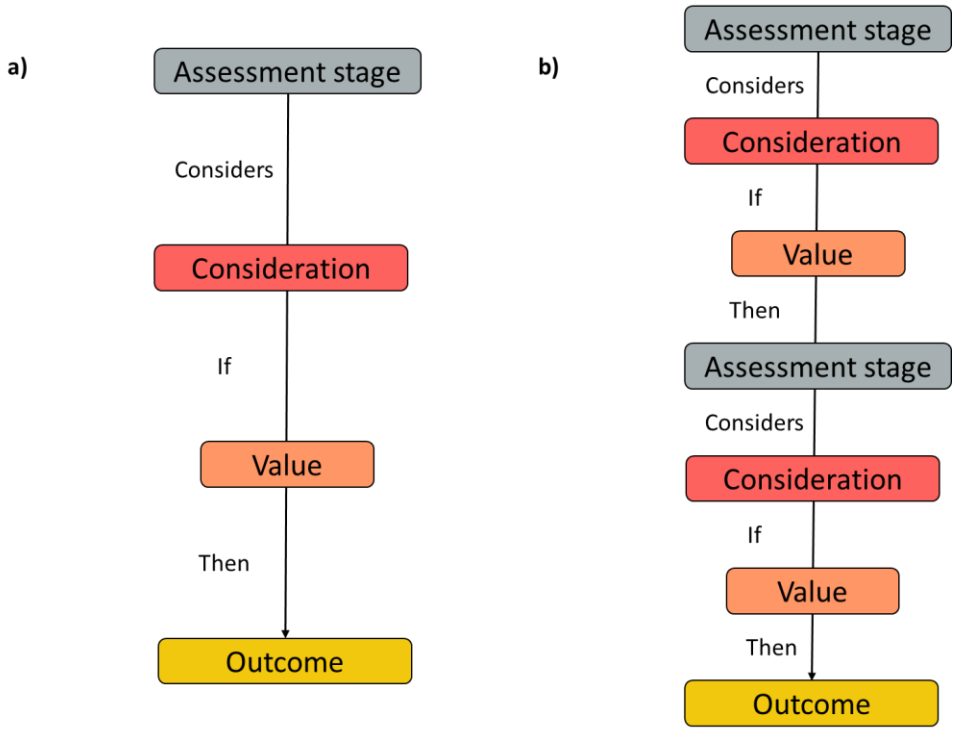

Figure 3. Examples of coding structure for proactive initiation of layered decision-making processes with a) one assessment stage, and b) multiple assessment stages

Assessment stages that I identified in the data as commonly initiated layered decision-making processes included:

1. **Evaluate terrain** (e.g., considering slope size, slope angle, duration of travel)
2. **Evaluate avalanche conditions** (e.g., considering natural avalanche activity)
3. **Evaluate weather conditions** (e.g., considering visibility and temperature)
4. **Evaluate snowpack characteristics** (e.g., considering instability test results, snow depth, signs of wind effect)
5. **Analyze in-field observations relative to the pre-trip plan** (e.g., considering similarities and/or differences)
6. **Evaluate personal experience** (e.g., considering energy level, comfort)
7. **Evaluate risk level** (e.g., considering the consequence of an avalanche or duration of exposure)
8. **Evaluate others' route selection** (e.g., considering whether others' choices are aligned with own or where others are travelling in the terrain)
9. **Evaluate group dynamics** (e.g., considering the behaviour and attitude of a partner)
10. **Evaluate options** (e.g., considering the characteristics of alternative routes or preference for alternative objectives)

I identified layered decision-making processes as often used when participants were route finding, completing field assessments, or choosing whether to proceed with their trip.

One exemplary case of proactive initiation of systematic decision-making is from *Rowan's* interview when we talked about what actions, in addition to turning around or proceeding, are feasible. Rowan said that one risk mitigation option that they use "all the time" is to adjust their route by changing "where [they are] going or how [they] going to get there." They were describing their route finding when travelling in terrain that was new to them. In this example, Rowan said, despite being able to identify some specifics of their route ahead of time (e.g., what ridgelines they will travel on), "You don't know until you get there." As we spoke more, Rowan described the systematic approach to seeking and processing information where they first evaluate the terrain by comparing their in-field observations to how hazardous they had expected it to be in their pre-trip planning stage and by determining whether the risk associated with the terrain was acceptable. In this case, they determined that it was above their

acceptable risk level, thus necessitating a **change in their route**. I probed Rowan for additional information on what typically happens they have determined that the route needs to change.

> RL: And so, when you are switching a route, what kinds of things would you be looking for in an alternative?
>
> Rowan: [...] if it's just "we have this objective, we don't necessarily know the best way to get there. We thought we did," the variables that would impact my decision largely would be around avalanche safety. Like, "[does] the slope that we're crossing have avalanche risk?", "What's the slope angle?" And then that all kind of plays into what we think the snowpack is like on that aspect. So maybe it's the same aspect, but there's a massive cornice on that side, and I don't really want to be hanging on underneath it for any amount of time. Like, all these things. To me, it's all based around risk. Like, "How likely am I to, like, get messed up in an avalanche or injured or whatever?" But it kind of manifests itself, I guess, in looking at those geographical features and the terrain features.

I interpreted the process that follows Rowan terrain evaluation as a **systematic evaluation of route alternatives** that considered avalanche risk factors (likelihood and consequence of an avalanche) and terrain information (slope angle, aspect-related snowpack characteristics, slope-scale terrain features, overhead hazard).

Bret also described the proactive initiation of layered decision-making in an example of when they go out with groups of people from different local outdoor clubs. They described their practice of gathering the group at the trailhead to discuss what they are going to do, how long it will take, and where the "avalanche issues are going to start." I asked Bret several follow-up questions to better understand what they meant when they mentioned identifying where the avalanche issues would start. Through that probing, I was able to assemble the pieces of a decision-making process that systematically evaluates information that is relevant to mitigating those avalanche issues. In my understanding, this process is initiated by **evaluating the terrain**, which involves considering whether the slope angle is greater than 30 degrees and whether there is overhead hazard.

> RL: Can you tell me a bit more about what you mean when you say, like, where the avalanche issues will start?
>
> Bret: Well, mostly by slope angle is how I do it.
>
> RL: […] When you're thinking about slope angle, is that kind of the key for you?

Bret: […] It's just one of the tools in the toolkit - knowing the slope angle and what's above where you are. Because the slope angle where you are at any one time is one [thing], but it's also the slope angle higher. Because there could be an avalanche that starts at a higher elevation that can come down and get you too.

RL: And so, is there like a critical slope angle that you're looking for […] when it becomes too risky for you?

Bret: Like, above 30 degrees.

In their interview, *Kit* described an instance of systematic decision-making initiated by evaluating subjective factors. For example, Kit described an experience where a "gut feeling" had influenced their risk management decision. When expanding on that feeling, Kit described "slowing down and really listening to your gut and what your body's telling you." They included an example where, **in evaluating their physical experience in that way**, they determined that they had insufficient energy to continue their trip.

Reactive initiation

While I identified some layered decision-making processes as being proactive initiated by the interview participant, others seemed to occur in response to an observation. These I refer to as "reactive" and I coded them as outlined in Figure 4.

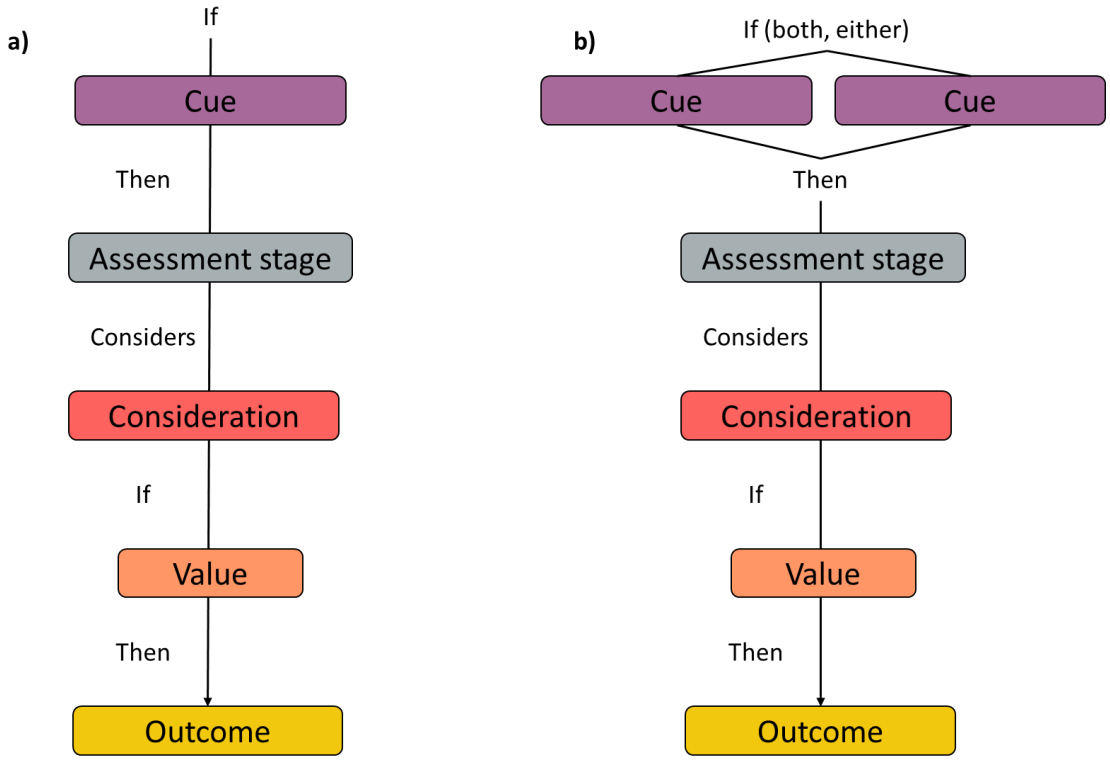

Figure 4. **Example of coding structure for reactive initiation of layered decision-making processes involving one assessment stage and a) one cue, and b) two cues**

The cues that I identified as initiating layered decision-making processes were both environmental and subjective. Many of the environmental cues were related to **avalanche conditions** (e.g., avalanche activity, snowpack reactivity) and **terrain** (e.g., overhead hazard, steep slope, elevation band, Avalanche Terrain Exposure Scale rating). For example, when reflecting on their development as a recreationist, *Alex* shared an experience where they made a systematic decision in response to an environmental cue. Alex started by saying,

> […] The more I learn about my surroundings, the more I make an informed decision that it's really dangerous. If you're seeing signs [that] it is dangerous, it is dangerous.

When I prompted Alex about the signs that indicate danger, they mentioned **whumpfing** and **shooting cracks**. In Alex's description that followed, I uncovered the layers of their decision-making process that had been initiated by those cues. It involved **evaluating terrain** using criteria related to the Avalanche Terrain Exposure Scale, slope angle, and slope size.

> If it's just a short section of avalanche terrain and it's going to be Simple or Challenging and then the slope is not that steep after that part, then we can

> keep going. But […] then we're going to minimize the risk, maybe go one at a time and, you know, watch out for that [next] person. So, it depends on how big the avalanche terrain is, how complex again [it can] get.

In their interview, *Clem* was detailing one of the trips they commonly go on.

> The first little bit, you gain the ridge, so there's no overhead hazard there and so it's pretty benign. And then you can get up to sort of the first viewpoint. And then from there, you descend into a little gully and to a very steep ascent below rock slabs in the trees and that's the part where, like, you kind of decide like, you know, like are you going to do that part […]

Based on their descriptions throughout the interview, I interpreted Clem's detailed description of the route (including where the viewpoints are, where travel can be difficult in different snow conditions, and what signs of wind effect exist along the route) as related to their choice of going on trips that they have been on before and know very well. With it being a known trip, Clem has already established points along the route that signify to them that a decision is required. When I probed further on the topic, Clem provided other examples from known trips of terrain-based decision points that cue systematic decision-making, including (1) **reaching treeline elevation**, which causes them to **evaluate weather and avalanche conditions as well as their energy levels** to choose whether to **proceed** or **turn around**, and (2) a location on a route where there is an **overhead hazard**, causing them to choose whether to **proceed**, **turn around**, or **reduce exposure** by spreading out, depending on the avalanche conditions.

In addition to environmental cues (i.e., external to the individual), interview participants also described examples of systematic decision-making processes being initiated by subjective cues**.** *Robin* shared experiences where a "**bad gut feeling**" initiated a systematic decision-making process. In this case, they had been discussing their descent with their partner and told them, "[I] can't do it," something they identified as a gut feeling. This, in combination with it being difficult snow conditions to travel in, resulted in them systematically **evaluating their route options.**

In some cases, layered decision-making processes were initiated by **uncertainty.** For example, *Bret* described how, when backcountry skiing, the route they ascend on may differ from their descent route and that, as a result, they may not have any observations that are representative of the slope they will be skiing. This uncertainty about slope-specific conditions initiates layers of decision-making that, in this example, involved **evaluating snowpack conditions** by conducting and interpreting an instability test. In another example, *Rowan* said that layered decision-making could be initiated by their uncertainty regarding their interpretation

of an observation. In this example, Rowan described **observing something that they had not yet encountered** (in this example, “styrofoamy” snow). In their description, this led them to **evaluate the information** to categorize it as good or bad. When combined with their existing observations, they can determine whether this “new information” has a categorically good or bad effect on avalanche hazard, which, in turn, enables them to make a risk mitigation decision.

> So, like, maybe it’s new information. But I've learned enough tricks along the way that don't necessarily need to know what it means. It's like, I know that it's categorically good or bad, and that kind of adds to the rest of the data that I've gathered. So […] there's still like, "I've never stood on this slope, I don't know how slides, I don't feel confident" or "I don't feel confident in this particular snow. It's, like, feeling a little styrofoamy. I don't really know what that means. I've never skied here." So, I can't necessarily take that and give myself the experience to be able to, like, "Okay, now I know what that means." But it's like, now I can add that in like, "Okay, that generally is a negative thing" and that adds to the information I've already gathered. And while I don't actually know what that means, I feel comfortable that I am or am not okay with it, right?

Layered decision-making processes were also identified in response to subjective cues related to the individual’s physical experience**.** For example, *Clem* mentioned an instance in which they noted having **low energy**, which then initiated a process of **determining whether it was worthwhile** to continue their trip.

Assessment strategies

Pre-trip plan

Some participants described processing information in layered decision-making by comparing in-field observations against expectations that they had established during their pre-trip planning. For example, late in my interview with *Rowan*, I followed up on something they had mentioned about their use of field observations in making risk management decisions. In response, Rowan shared an experience starting with a description of their trip planning through which they developed expectations of what they will see in the field based on weather conditions (historical and forecasted) and trip reports.

> RL: Can you tell me a bit more about that idea of gathering information that would confirm or not confirm an idea of where to go?
>
> Rowan: […] In our trip planning, we don't know whether XYZ mountain will ski well. […] We’ve formulated this idea of what we think conditions are going to be like based on all the things we talked about - the historical weather, forecasted weather, what we think the snowpack has been like and what it is like based on trip reports nearby.

As Rowan described, once in the field, they use this “database” to **compare their field observations to expectations** and, thus, inform their risk management decision.

> And so, our observations along the way all add into that database […] if we're travelling along and we thought it was going to be minus five and it's like zero, we got kind of a late start, we're seeing tree bombs, we're seeing like some little sloughing along the way. Maybe that's enough observation to say, like, "OK, conditions aren't what we thought. We've got to pass an avalanche path and I don't really want to do it when it's two degrees outside and there are cornices above." So, like, I guess that would be an example of using data that we gather along the way, to confirm or not whether our ideas about the objective initially were correct.

Further to this point, Rowan talked about establishing route and trip alternatives during the pre-trip stage distinguished by specific observations. Once in the field, they can look for those observations to choose between the pre-established trip alternatives. In this case, Rowan had identified options for different slope aspects. Once in the field, they could then pivot to an alternative if they experienced poor snow quality on their current aspect, or if they were exposed to avalanche hazard.

> RL: And what tends to distinguish plans A, B, and C from each other?
>
> Rowan: I wouldn't say it's differing risk profiles. […] It’s not a good way to group it, but we tend to do things based on like aspects. So, if the south aspect is skiing bad, we have a north aspect backup or east, west, whatever it may be, depending on the objective. But I'd say, at a higher level, it's probably different ways to manage risk. Like, if the south aspect is risky or this approach is risky, we'll go do this one. And "risky" obviously being defined as like a chance to put ourselves in harm's way via exposure.

In another example of using information gathered during the pre-trip plan to choose whether and how to modify a trip, *Clem* spoke about how they may decide to change their objective in the field. In this case, they described first establishing that the snow conditions are “going to be okay.” Once they have done that, they evaluate the applicability of their pre-trip conditions assessment to the new objective and have determined it to be applicable.

> […] We’ve probably looked at the avalanche forecast and thought that the danger of getting up to [the farther peak] is not really any worse than going up to [closer one].

In their interview, *Kit* also touched on another way that in-field observations are compared to information from the pre-trip plan, in this case, to help situate themselves in the terrain. Kit’s pre-

trip planning practice involves using maps to research and plan their trip. They mentioned that, once in the field, they will reference the pre-trip terrain-based information.

> Kit: I usually look at maps and do my research before a trip. And then have a copy with me on my phone or whatnot and then go from there when I'm in the field. I find it hard to 100% stick to that when you're in the field, but it's good to have a copy.
>
> RL: So, you can kind of, like, reference where you are compared to, like, where you planned to be?
>
> Kit: Totally, yeah. And, like, what you're seeing on the landscape the day of.
>
> RL: OK. And then you're kind of bringing that out with you and then based on what you see in the landscape, you might stop and make changes to that?
>
> Kit: Totally.

Previous experiences

I identified another guide for layered decision-making processes as participants' prior experiences or knowledge. For example, *Clem* shared an example of how they choose an option that mitigates the risk of what they identified as a "common runout slope." Clem mentioned that this particular slope had historically "avalanched once or twice a season in Considerable avalanche conditions," but that it doesn't "commonly go when it's Low or Moderate." Clem described choosing to travel across this slope by comparing the avalanche danger rating on the day of their trip to the danger rating on the days the slope avalanched.

> It doesn't commonly go when it's Low or Moderate. I don't know that there's any history of it going when it's Low or Moderate, which gives me the confidence to travel through there when the conditions are rated Low or Moderate.

Options

In several experiences, participants described processing information in layered decision-making by weighing options. For example, *Clem* described being at a decision point where they chose whether to proceed with their trip by **weighing many different factors**, including:

- Route-finding requirements: "[…] It requires a lot more route-finding."
- Route-finding difficulty: "[…] The route is difficult to find in the winter because it's much less commonly travelled, and the gondola doesn't put up wands up that far."

- Overhead hazard: "[…] You think that you're in the trees, but if you know the terrain, you know that you're actually below a granite slab that is quite angled and is not going to hold snow the way that a forested slope would."
- Weather conditions: "[…] Deciding - mostly due to energy and weather […]"
- Forecasted avalanche hazard and in-field hazard observations: "[…] Knowing beforehand what the forecast is - for avalanches and weather - and what you've seen lower down."
- Required physical effort and available energy: "[…] And I've definitely turned around in there quite a few times and not gone up, but it's usually more to do with energy level and breaking trail than making a decision based on snow conditions that would be like an avalanche hazard."
- Trip objective and motivations: "[…] It's a lot more effort physically for a slightly better view than you just had."

At another point in their interview, I interpreted Clem's decision of whether something is worthwhile as including considerations of their energy, the weather, and the snow conditions and is made easier by the accessibility of the trips they choose and the fact that the trips they go on are ones they have been on before:

> I'm a season pass holder, so, like, there's not a lot of pressure to complete the trip for me. I've been there before. Really, with any of the objectives in [that area] - I've been there before. I know what it looks like on a good day, so I'm usually pretty willing to turn around if I'm tired, or the weather sucks or the snow conditions aren't great.

In addition to determining whether the experience was worthwhile, I identified examples of participants more explicitly weighing risks and rewards. In several instances, these examples were related to participants' descriptions of their risk tolerance or perceptions of risk. For example, *Rowan* outlined how their perceptions of risk influence group decision-making. Describing themselves as "pessimistic by nature" and "on the risk-averse side of things," Rowan provided an example of when the difference between their risk tolerance and that of others in their group may lead them to split up the group so that some can fulfill their objectives. As part of the process of weighing risk and reward, *Blair* described an instance when they chose an alternative that mitigated risk by asking themselves, "How is going to look in the news? Am I going to look back on this and think, how did I miss all those flags?", they decided to choose an alternative that mitigated risk. Weighing risk and reward was also apparent in *Riley's* interview when they reflected on their near miss and the events leading up to it. Riley alluded to pursuing certain objectives not being worth the risk: "I'm really not interested in losing my life skiing […] now I feel very cautious about who I go with." *Robin* also described an appraisal strategy for

processing information. They outlined how they choose what backcountry trips they will or will not do and provided an example illustrating how the risk of travelling in certain areas makes those areas not worth exploring. In this situation, Robin's understanding of the risk inherent to these places was informed by their history of notable incidents.

> And we don't do [that trip]. I think losing that girl really touched me. I avoid that partly because of what happened to her and that I don't think it's worth the risk. […] I don't want to have to get rescued up there. There's just too many rescues up there.

4.2.3. Themes of factors influencing decision-making

In addition to identifying variations in participants' risk management decision-making processes, I also identified themes of factors that seemed to really influence their risk management decisions. The definitions of each and descriptions of how they are characterized with the interview data are presented below.

Snowpack information

Participants described many avalanche hazard factors considered in risk management decision-making, but **snowpack information** emerged as a key factor informing participants' approaches to making in-field avalanche risk management decisions. Throughout the interviews, there were numerous references to the significance (or lack thereof) of this information in participants' decision-making. While the extent to which snowpack information influences their decision-making varied, Bret, Rowan, Blair, Kit, and Riley all mentioned "digging pits" (Bret) to identify layers in the snowpack and conduct snowpack instability tests. *Bret* described this practice as "one tool in the toolbox of evaluating [the] safety of [a] slope" and highlighted that it is central to their in-field risk management. Bret provided two examples of specific rules related to when they do snowpack instability tests. First,

> So, if I'm gonna ski a slope that's above 30 degrees, usually that's when we'll start digging pits. […] If we think there's danger […] then we'll usually dig a pit and figure out, you know, what the snow's actually like.

And,

> I like doing just a small shovel test […] It's a case of sticking your fingers in the snow and looking for those layers and, you know, see if it really matches what Avalanche Canada is saying in their report or not. Because, you know, they don't have reports from everywhere […]

In another example, Bret mentioned a specific rule related to the information they obtain from a particular instability test (in this case, a “simple pole test”).

> That just tells you (pause) you know, what the potential danger is to some extent. If there's no fresh snow and it's pretty consolidated, then usually there's no avalanche danger. It's when you get to the unconsolidated snow that there's more.

However, Bret also acknowledged that this snowpack information rule has not always held when they described a near miss, having triggered an avalanche in what they had identified as consolidated snow.

> But, you know, I've set off avalanches on very hard-packed snow […] I didn't think there was avalanche danger because it was so well-bonded. […] It was getting late in the day, so we didn't really want to ski down the north face. And so, we just decided to ski down through the northwest ridge, where I thought there would be less avalanche danger. But it turned out – I set off a good avalanche, but, luckily, there was no one below me.

Bret said that the purpose of digging pits is to find out whether “a layer [is] in the snow.” When I asked Bret more specifically what they might find in a snow pit that would influence their decisions, they provided an example where finding a “big persistent weak layer” in the snowpack caused them to deviate from their objective and select an alternative (“safer”) descent route.

> Sometimes when you dig a pit and you just put a bit of pressure on the back of the block of snow, it just slides on a layer really easily and you find those persistent weak layers. […] Then it's the case, "Oh, well, I guess we can't do this slope because there's this big persistent weak layer. We just have to find a safer way down."

Rowan told me that they try to approach decisions to ski something with the idea that “no single piece of information should ever be the answer” and described snowpack instability test results as part of the “universe of information [they] have available.” In that sense, Rowan describes their search for snowpack information as a process of looking for specific information that they have identified during their planning in advance of their trip. In particular, they described looking for “standard telltale signs of instability,” such as a persistent weak layer, “buried hoar,” a “nasty ice crust” as well as how well bonded new snow is. They described this practice more generally as:

> Usually what we're looking for is, like, the big, low probability, high consequence buried slab. "Is it going to propagate?" […] when I'm digging a pit, like, that's what I'm looking for.

While snowpack information contributes to Rowan's in-field risk management decision-making, they also acknowledged that some observations override their need to dig a pit e.g., "a ton of wind loading on the aspect that I'm trying to go to," or "a massive cornice."

My interview with *Riley* was unique in that they touched on the topics of my interview guide in a way that was centered around an incident they had had in the backcountry, where they triggered an avalanche that they were not caught in. While describing the moments that led to the incident, Riley mentioned that they had suggested to their partner to dig a pit. Their partner, however, suggested doing "just a quick hand pit" or "just a ski cut" because they thought instability tests would take too long. In reflecting on this experience, Riley mentioned that digging a pit is a valuable practice not only for collecting information about the snowpack but also for giving time to consider other factors (both environmental and subjective).

> By forcing yourself to dig a pit, you just force yourself to slow down. It's like that pause. And then maybe if you pause, you can be like, "I'm actually feeling really uncomfortable with this." Because I was. And you actually get the time and space to think about articulating that, versus if you're just like, "No, we need to get down," you don't get that opportunity to pause and be like, "What do I want? What am I feeling? Do I have concerns? Okay. Yes, I do. Okay. Well, now that I'm thinking about it and I have the time and space to think about it, maybe I can like, dig into that more."

While Blair, Rowan and Riley all mentioned the use of specific snow instability tests, *Blair* also described other methods of gathering snowpack information that will influence their decisions. Blair travels in the backcountry without an avalanche transceiver or probe. However, they do bring a shovel (in addition to a long list of other winter safety equipment), which they often use for setting up lunch spots for their group. Blair mentioned that they also frequently use their shovel to "explore and look at the snow." When I asked them more about what that meant, they described digging into the snow to see "the depth of the snow and the consistency of the snow as you go through." Elaborating on this practice with a specific example, Blair mentioned identifying and analyzing layers in the snow and evaluating them with respect to terrain features.

> I was kind of using my ski poles or trekking poles and kind of brushing the surface and trying to figure out where that next layer was and, depending on whether it was on the sunny side of the trail or the shady side of the trail, where it had frozen and where it had melted and frozen again, you know? Just being more in touch with the snow and the conditions that were at large […] those areas where it's not so uniform. […] Things that, uh, create two layers of snowpack as opposed to one consistent layer of snowpack.

Paying attention to these types of distinct layers in the snowpack was also mentioned by Kit, who described these layers as a record of the "bigger-ish events that are highlights in the season."

Like my probing in Bret's interview, I asked Blair how identifying those changes in snowpack might influence their decisions, to which they responded that it would make them "more nervous and more cautious" and that, in combination with an analysis of the group dynamics, it would inform whether and how they proceed with their trip. Ultimately, they said,

> I'd much rather have an extra half hour at [the coffee shop on the way back] than, at the end of the day, going on an extra adventure that led us into a problem area.

Clem told me that they do not seek or use "a lot of really in-depth snow analysis," because they "travel with less experienced groups, and people are mostly on snowshoes and mostly fairly recreational."

Other backcountry hazards

In addition to avalanche hazard, hazards such as the potential for **slip-and-fall** incidents and **rockfall** are environmental factors that shape participants' avalanche risk management practices. *Rowan* mentioned both hazards in our conversation about times when they have decided to turn around or change their objective. Rowan had used the word "sketchy" to describe situations that would cause them to change or abandon their objective. When I asked what they meant by "sketchy," Rowan broadly defined it as:

> It's largely like, "Are we putting ourselves in avalanche risk?" Or, even if there's not a ton of avalanche risk, "Are there other hazards?" I've done a couple where maybe it's like not a crazy avalanche day […] maybe it's going to warm up and there's some rockfall hazard and there's like a death fall, right?

Three of the five snowshoers I interviewed mentioned the effect of fall potential on their risk management decision-making. *Clem* described how they manage a very steep and often icy portion of a route they know well.

> And the problem is actually not usually avalanches, but ice […] to the point where, to traverse them in snowshoes, you should probably take the snowshoes off and put crampons on.

Clem also mentioned another route on which travelling a specific section on snowshoes "can be kind of dangerous for a slip and fall hazard." They also said that this hazard is "something that a

lot of snowshoers don't recognize." For *Robin*, the fear of falling has been prominent since their first experiences in the backcountry.

> Well, one thing is that I have a bit of a height thing that I never really realized until we started doing backcountry. And when you have a bit of that fear of heights, you have a fear of sliding, which comes along with being on snow and snowshoes.

Chris shared with me that they, too, are concerned by the potential of falling on snowshoes. While Chris had acknowledged slope angle early in the interview in relation to their evaluation of avalanche terrain, their description shows that travelling on steep slopes involves the incorporation of additional hazard considerations related to equipment (e.g., whether they have an ice axe), training (e.g., knowing how to self-arrest), and snow quality (e.g., whether it will be difficult to stop a fall).

Route obstacles were also mentioned as additional environmental hazards to be mitigated in addition to managing avalanche risk. Twice in their interview, *Clem* mentioned managing creek crossings, which they describe as "the most hazardous part of the trip." *Blair* also spoke about the risk of creek crossings in the winter backcountry. As the group leader in both professional and recreational contexts, Blair is the first to come across route obstacles in the field and often tries to find out about them ahead of time by "[researching] online and [talking] to others who have been there." Once, on a personal trip in the backcountry, Blair came across a washed-out bridge. To Blair, this signified that they should turn around. In addition to the risk of crossing a cold river in winter, Blair described an awareness of it being late in the day and not wanting to "[return] in the dark." This example points toward another environmental factor not related to avalanches but influential in avalanche risk management practices: **timing**.

Trip considerations

In addition to timing a turnaround point, Bret described route-finding choices made in consideration of timing their route with the group's energy levels. For example, Bret described their choice to travel through hazardous areas in the earlier portion of a trip.

> So, when we did the loop, we almost always, for whatever reason, do them counterclockwise. […] But that puts you in a little bit of a sketchy area and in a steeper area which has the river below at the end of the day, when you're more likely to fall and it's going to be a bigger deal because night's coming. So, I did that section at the beginning of the day. Got it out of the way while everybody was fresh, and it was early in the day.

Timing also came through in my interviews with *Alex*, *Clem*, *Riley*, and *Robin*, each of whom integrates this consideration differently. For *Alex*, considering turn around points and trip duration comes up in continuous check-ins with their group which include questions such as "Are we running behind with our schedule?" and, "What is our turnaround point?" as well as "How are you feeling?" and "Still comfortable with what we're doing?" *Clem* alluded to timing considerations specific to snowshoeing in response to me asking them if there was any advice that they would give to recreationists with less experience in the backcountry than they have.

> A lot of people, umm, don't recognize how much more tiring winter travel can be, especially if the snow conditions are, you know - like, you're - even in snowshoes, you're up to your knees in snow, your travel time goes down, your exertion goes up and now the possibility of making your objective is harder. I think the whole, like, "if you can walk, you can snowshoe" is true, but it also leads people into a lot of situations that they're not prepared for.

However, the duration of a trip on snowshoes arose several times in *Robin's* interview as something that influences their risk management choices. In one example, their trip was taking longer than expected. As a result, they decided to change their trip objective.

> An example would be where we [wanted to go to a farther objective]. Nobody had been there yet, and it was hard going. It took us longer than we expected. And so, we were like, "Let's just go down and explore." […] And I think the one thing that both of us have learned is that we, number one, don't want to be rushed.

At the time of our interview, being able to "go farther" in the backcountry was something that Robin aspired toward. Robin's acknowledgement of the **difficulty of travelling** on snowshoes was echoed by other snowshoer participants. *Alex* admitted making a concerted effort to remind themselves that, while they know that they should not always follow the tracks of other recreationists, it is "easier to follow that track. It's right there," and *Chris* acknowledged the benefits of not having to break trail even though they do not "necessarily like the idea of just following someone's foot trails just because it's easier" because they do not know "what kind of decisions [have been] made at certain points."

The influence of **timing** and **trip duration** on risk management decision-making also came up in *Robin*'s interview when I asked whether they had observed unsafe practices of others in the backcountry. Robin replied saying, "I think passing a certain point where you know it's going to get dark soon." However, Robin did acknowledge that being in the backcountry after dark is something that many people can be prepared for. In fact, Robin expressed that while winter was the "most beautiful time for the snow," it was also when "you're limited by daylight

hours." As a result, they, too, go into the backcountry after dark on routes that they know are "not in an avalanche zone at all," and where they are "in a group and [are] safe" and with safety gear (including headlamps and the "10 essentials[2]").

Riley's description of their near miss also featured the influence of trip duration. For example, they said that their decision to ski the slope that had released was because the alternative would have taken longer. At another point in the incident description, they mentioned that they had been "running out of daylight and just made some, like, not ideal decisions" (including, as discussed earlier, not digging a pit because there was insufficient time). Since then, Riley has had other experiences where trip time has been the deciding factor leading their group to choose a "very good backup option" over their "primary option."

Qualities of the decision-making environment

Participants described the **spatial variability** of their decision-making environment as a factor affecting their risk management practices. For example, when describing their use of snow instability test information, *Bret* said that part of the purpose of their tests is to see if their results "[match] what Avalanche Canada is saying in their report or not because they don't have reports from everywhere." *Riley* echoed something similar in their interview when reflecting on lessons they learned from a near miss.

> And so, I think another lesson in that was that forecasts are for, like, these huge areas and there are specific conditions that happen in certain areas that really change what's happening.

Rowan also acknowledged the inherent spatial variability of avalanche hazard, where different "micro-climates" result in variations in the snowpack in a given area. They spoke about how they address this variability when they explained how they plan their backcountry trips to me.

> […] Looking at "How has the weather changed since we've been there last?" We're talking everything from like [precipitation] to wind direction to if there are already existing weak layers. Really, we're looking for information on the snowpack we find either via historical weather or projected weather. […] We try to find as many trip reports on similar aspects as we can. Even if they're not similar aspects, having that info is helpful. […] We're just trying to gather as much data as we can to figure out in advance what the snowpack's like or what we think it will be like, right? It's always different depending on where

[2] The 10 essentials are often referred to as the "basic survival items" outdoor recreationists should have and include: a light; fire-making kit; signaling device; extra food and water; extra clothing; navigation and communication tools; first aid kit; emergency shelter; pocketknife; and sun protection (AdventureSmart, n.d.).

> you are and the microclimate that you're in but that's typically kind of what we're looking at. Like, weather - historical, future-based - and then any observations we can get to make a determination on the snowpack.

Bret also acknowledged the local variability of the snowpack when talking about their use of information from snowpack instability tests, something they believe is "the best information source as far as slope safety." Bret said,

> But, you know, there's still a potential that when you ski down 50 meters or 100 meters, you're going to find something slightly different. And you can't dig - you don't want to stop every 15 meters and dig a pit.

When I asked Bret how they account for this when they are using instability test information, they admitted that they did not have a good answer and that they "don't dig more than one pit for a slope."

Rowan's mention of "micro-climates" touches on another aspect of participants' decision-making environments: the **scale of assessment**. This also came up early in *Alex's* interview when they were telling me about how they prepare for a trip into the backcountry and, specifically, about how they choose where to go based on "whatever is closer and appropriate for the conditions." I prompted Alex about the meaning of "appropriate." In their example, they described using weather considerations and avalanche problem information to choose a destination where "the terrain is okay." To determine what terrain meets this criterion, Alex described looking for "micro-terrain." Later in their interview, they alluded to considering the scope of terrain again in a conversation about decision-making processes that occur in response to different observations. Alex shared an example of their decision-making when they notice signs of instability ("whumpfing" or "signs of cracking"). They told me that the size of the slope and the Avalanche Terrain Exposure Scale (ATES) rating determine their risk response.

> So, if we're going to be travelling in like, uh, big avalanche terrain, then that's definitely a turning point. But if it's just, let's say a short section of avalanche terrain and it's going to be Simple, umm, or Challenging and you know the slope is not that steep after that part, then we can keep going. But […] then we're going to minimize the risk. Maybe go one at a time and watch out for [each] person. So, it depends how big the avalanche terrain is, how complex it can get.

Another example where Alex described how terrain size affects their risk management practices helps me to better understand their approach.

> […] There's avalanche terrain there. It's a micro-terrain, it's, uh, quite short. So instead of going one time, we just went all through it because we didn't see

> any signs at all, and we thought it's safer to get through it instead of waiting for one another and spending more time just crossing through that avalanche terrain.

In this case, they chose to reduce risk by decreasing the duration of their exposure to the terrain of concern because of its size.

I interpreted the reason for Alex's consideration of the scale of assessment to be related to the complexity of making decisions across different scales. This interpretation is supported in one of Alex's descriptions of managing risk in an area with varying slope angles on different parts of the terrain.

> […] I don't think it's all the same angles all throughout from left to right. […] The farthest right it's pretty steep and then on the other side it's a little mellower. So, at face value, you're going to go up the left side, not on the right side. But when once you're on the left side and then you get closer to it, you're going to realize that the left side has its own features. One is steeper, the other one is mellower.

More can be understood about recreationists' decision-making environment through their descriptions of the **uncertainty** they experience. In their interview, *Kit* discussed accepting the uncertainty inherent to risk management in the backcountry.

> I think it's important to note that there never will be a perfect snowpack and it's kind of accepting, like, whatever type of risk you want to accept for that trip.

Bret had touched on uncertainty in our discussion about confidence in their risk management practices, which emphasize the use of snowpack instability tests. They said that, while confident in their practices, they know the results of their instability test do not rule out risk.

> I mean, because I've been doing it for so long […] when I get to the steeper angle slopes, then it's always concerning making those decisions […]. I look at the pit and it seems to be solid. But, you know, there's still a potential that when you ski down 50 metres or 100 metres, you're going to find something slightly different.

I asked Bret how they take this uncertainty into account when using instability test information in their risk management decisions, to which they replied, "I don't have a good answer to that." This discussion prompted me to ask Bret if there were other situations where they experienced a similar uncertainty. Here, *Bret* mentioned the experience of travelling in the backcountry with poor visibility. To reduce the uncertainty that results from not "[seeing] the hazards that well", Bret described selecting gentler slopes and avoiding overhead hazard.

RL: Are there other challenges or parts of being in the backcountry that make you feel a little less certain or make you feel similar to managing steep terrain?

Bret: The weather is always a factor because if it's a whiteout, then you can't really see the hazards so well. That makes it challenging.

RL: Mmm. How would that change your practice - if you were travelling in a whiteout?

Bret: Well, I tend to go to usually easier slopes or gentler slopes where you're not so worried about problems from above being an issue.

RL: Mm-Hmm. Yeah, where you're managing more, like, what's immediately in front of you or –

Bret: - Yeah. Mm-Hmm. –

RL: Where there's more predictability?

Bret: Yes.

In another example, *Rowan* mentioned that they use uncertainty as a piece of information. They mentioned a situation where they might observe something they had not before, but knowing whether it is "categorically good or bad" means that it can still contribute to their risk assessment. Rowan said,

> I don't necessarily need to know what it means. […] I know that it's categorically good or bad, and, you know, that kind of adds to the rest of the data that I've gathered. […] there's still like, "Oh, I've never seen - I've never stood on this slope, I don't know how slides, I don't feel confident." Or "I don't feel confident in this particular snow. It's feeling a little styrofoamy, I don't really know what that means." So, I can't necessarily take that and give myself the experience to be able to say, "Okay, now I know what that means." But I can add that in. Like, "That generally is a negative thing." And that adds to the information I've already gathered thus far. And while I don't actually know what that means, I feel comfortable that I am or am not okay with it, right?

Participants also described the nature of the **feedback** they get when making decisions in the backcountry. *Riley* described this in an example of a trip they had been on where they had observed natural avalanche activity. To them, natural avalanche activity is the type of feedback that makes their risk management decision easy. The following quote illustrates how Riley defines that type of feedback and what they do as a result.

> And I was like, "This is so cool. Like, look at all these tiny naturals. We're going to go home." […] That was such obvious feedback. I mean, like, when it's that obvious, it's really easy to make a decision. Like, let's get out of here.

Rowan spoke about the *lack of* feedback when reflecting on how they have made avalanche risk management decisions in their early experiences in the backcountry. Rowan said that they like to think that they would make better decisions now because they are a "better decision-maker", but that "there is no way to validate or test it." Elaborating on that point, Rowan said,

> I guess I have, like, anecdotal evidence. Because we have turned around more often, I would say that we have improved upon [our decision-making]. But, like, again, there's no real way to know.

Rowan acknowledged, however, that this represents confirmation bias: "It's just 100% confirmation bias, right? Because you're right until you're not." *Clem* also shared an awareness of confirmation bias.

> Well, I mean, it's kind of self-fulfilling, right? Because so far, I haven't had any problems, so probably I'm doing something right, which is going to give me confidence in my decision-making and my research abilities. But I'm certainly aware that you don't - you don't know what you don't know.

Not knowing what you don't know is something that *Rowan* recalled experiencing as a more novice recreationist. At that time, it made Rowan nervous. However, later in the interview, Rowan said that their ability to recognize that they don't know what they don't know is informative.

> I think that we're better decision-makers in that we can recognize that we don't know what we don't know, umm, and that in and of itself is a data point.

Relationships

The significance of relationships in in-field avalanche risk management practices is illustrated in an example from my interview with *Riley*, when they said something that showed how the quality of their relationships with their backcountry partner supersedes other, avalanche-related, considerations.

> At this point in my life, group dynamics would be one. Like, it can be the safest day - maybe it's Low, Low, Low. [If] I'm going out with someone and they're just not actively listening to other people in the group, they have clear objectives that they want to do for themselves and they're not considering the group's abilities and capacities, and they're just not sensitive, that might be like a "Hey, I'm going home" or a "Hey, I don't [care about your objective]. You might never want to ski with me again and I definitely never want to ski with you again." I don't care how safe the conditions are, this is a hard boundary.

Riley elaborated on their perception of the importance of backcountry relationships later in the interview when they told me that they had realized how important relationships are for them and

how they choose to spend time in the backcountry with people they feel "honoured to be in relationship with."

> So, I think it's just finding people who you, like, genuinely love and care about. And I think when you're out with people who you love and care about, you're going to want to make the best decisions for you and them because you love them. Maybe "love" is a strong word, but "have love" for them might be the way to put it. And you have love for all aspects of their life. And you acknowledge that the loss of this life would harm so many other relationships that they have, it would be heartbreak for so many people. And I think we just don't always (pause) there's just so much glory and pride and I just don't have time for that.

Clem also described the importance of going out with people they have good relationships with. They have been going out with friends for almost two decades and mentioned that they avoid the "interpersonal stuff" that comes with going out with people they don't know well, as it "leads to [their] trip going a different way," and potentially negatively so. Intentionally selecting trip partners for the benefit of relationships came up in several other interviews. *Chris* described planning who they are going with as an important part of their pre-trip planning process. They also mentioned specifically avoiding going with people who do not have avalanche rescue equipment. *Robin* explained that they travel in the backcountry with the same partner whom they feel aligned with. *Kit* described themselves as being "very picky with backcountry partners" because they have to feel "really open and comfortable with them so [they] feel comfortable expressing [their] concerns." And *Rowan* has a "core group of six people" who are all involved in the "trip design and planning" and have fun gathering "all the data."

In contrast to the consistent partnerships described above, *Bret* and *Blair* typically travel in the backcountry with partners they have met in organized community groups. For both participants, organized groups have been their entry points into the backcountry. Now in leadership roles, the characteristics of relationships with their partners drive their decision-making in different ways. In *Blair's* experiences, the diverse composition of the different groups influences many of their choices about where to go and when to turn around. In contrast, *Bret*, in their group leader role, generally chooses an objective, invites others, and then supports less experienced group members' risk assessments.

> I will usually send an email saying what the objectives are for the next day, and we don't usually have a group discussion until we get to the actual trailhead. […] We'll have a group discussion of what we're going to do, how long it's going to take, and where the avalanche issues are going to start. [I] try to get people to […] tell me where they think there is avalanche danger as we go up the trail.

It is worth noting that, when I asked Bret about their backcountry objectives, they summarized their response by saying, with laughter, “It’s just, you know, be happy, be safe, and have fun.”

Table 10 contains additional participant quotes that illustrate the impact of relationships on in-field avalanche risk management.

Table 10. Participant quotes: how relationships influence decision-making

Participant	Quote
Riley	“I guess like I think at the end of the day, maybe [good decision-making] is prioritizing the relationship and the communication around the relationship over trying to like ski some sweet stuff.”
Robin	“I've got a great hiking partner […] like, we think the same, we trust each other, we trust our guts, we're always willing to change, you know? And I think that's why we go on so many amazing hikes.”
Chris	“The group that you go with makes a huge difference.”
Alex	“I always advocate for safety before I go […] the safety of everybody. Because we care about each other, right? We go with our [loved ones] and I ask how much do you care about yourself? How much do you care about them? I think that's the question you ask.

Communication

The topic of interpersonal backcountry factors in decision-making is further revealed in participants’ descriptions of shared decision-making and communication. Most participants alluded to shared decision-making by acknowledging the importance of everyone’s perspectives in making decisions. For *Alex*, who is the primary decision-maker in their group, shared decision-making is part of achieving the goal of being safe.

> I don't really like feeling as though I'm dominating the conversation because I make mistakes. And I like to have valuable input from it. The goal is for all of us to be safe. The goal is not for me to leave them somewhere. We come there as a group. We're going to decide there as a group.

This was also expressed by *Bret*, who said,

> I think everyone should be responsible for their own safety. I don't want to be the leader who makes the decisions without considering other people's input.

Being in a leadership position during much of their time in the backcountry, *Blair* is the primary decision-maker. However, they said that when they go out with friends, they “try not to over-plan or over-coordinate.”

> I try to give them a chance to be the leader and I try to not worry or be so concerned.

This is similar to what *Clem* described as being "not a top-down leadership situation," but one that is more "consensus-based." Some participants outlined practices that they use to accomplish this and experiences where they have had to manage group decision-making scenarios. For example, *Robin* identified the flexibility that exists in their partnership that allows them to shift objectives and to "always turn around" if needed. In another example, *Rowan* described a group risk management decision scenario where they might choose to split up the group because there are "different dynamics and different risk tolerances."

> We've split up. Like, if we have six and three of us feel good, three of us don't […] if there's a safe way down and, like, I'm sure that they're going to die, it's like, "Okay. As long as we all carry avy gear. We meet at the bottom of the slope where it's safe."

Alex also described managing within-group differences through communication, something that they outlined as being an important part of how they choose where they go in the backcountry. This includes facilitating a group discussion with questions aimed at getting everyone "on the same page" (e.g., what they want to do, what objective will satisfy everyone's needs, and whether they are motivated to push themselves or to "just [have] a fun day out there"). Alex ensures that communication is possible while they are travelling with their group. When it is not, Alex described taking steps to address the situation.

> Another danger is if someone just wants to go up there and the other one is lagging behind. I think that could be dangerous in a group setting. Because now we're not in reach anymore. When that happens, it's time to regroup and just reassess and talk about what's going on.

Physical wellbeing

Other subjective factors influencing recreationists' experience of managing risk in the field were related to participants' physical well-being and comfort. At one point in my interview with *Kit*, I asked them whether they had any experiences to share when, in contrast to an incident they had previously described, the group dynamics had resulted in a favourable risk management outcome. In response, Kit shared an experience of having "terrible blisters," which caused them to turn around. For Kit, this experience was made possible because of the relationships they foster with their backcountry partners. In another example, *Clem* and I were talking about how they align their objectives with their risk tolerance when they said, "In general,

I'm pretty risk intolerant in the winter." They added that this is not only with respect to avalanche risk but also in terms of their physical safety related to hypothermia.

> I know that I need to be really careful about managing my temperature and the weather and my layers. I can head into hypothermia very quickly if I stop. So, like, that informs my decision-making as well. I don't want to go too far or exert myself too much if I can't cope with the conditions.

Being prepared to manage physical well-being was also mentioned in *Blair's* interview. Blair had told me about an experience in the backcountry in which they noticed that another member of their snowshoeing group was unprepared for the trip. I followed up by asking them what it would look like for a snowshoer to be prepared for a day in the backcountry, to which they replied, laughing, "Well, number one, you need to look like you're staying the night," before carrying on with a description of what snowshoers should be considering with respect to their physical wellbeing in the backcountry including extra clothing, food, appropriate footwear, hand warmers, sun protection, hydration, an "adventure medical kit," and a signalling device.

4.3. Avalanche risk management supports

Throughout the interviews, participants offered insight into their use and perception of different avalanche risk management supports they draw on and incorporate into their avalanche risk management practices. I categorized these supports as avalanche safety education, decision aids, and other avalanche risk management supports, each of which is described in the remainder of this section.

4.3.1. Avalanche safety education

Avalanche education offerings described in the data were described as those that help recreationists develop their risk management practices and enhance their knowledge and/or preparedness. They are outlined in Table 11.

Table 11. Summary of educational offerings described in the data

Aid	Description
Avalanche education	Experience in and perception of Avalanche Skills Training (AST) courses and other Avalanche Canada education
Mentorship	Descriptions of mentorship relationships and their value.

The topic of **avalanche education**, both formal and informal, came up in all interviews. However, participants' experiences and perceptions of the course varied as well as the impact the course has had on their avalanche risk management practices. At the time of their interview, *Robin* had recently done their AST1 course after finding out about it from a friend. Robin told me that their AST1 course, which they had recently taken, was pivotal in their avalanche risk awareness development, having "[gone] in with no knowledge of snow and how it works and what [they] should be watching out for." Describing it as an "excellent course," Robin said,

> My whole thought of snow before the training and after the training totally changed. Because I had no idea. […]

Elaborating further, Robin described, with enthusiasm, how the knowledge they gained from the course has helped them understand and be more interested in their in-field observations.

> So, it's like we both check in with each other. And before we were like, "What do you think?" But we were doing it without any knowledge. […] We're always looking around now, and it's kind of fun. And that's why it's so interesting. There's a whole science behind it, you know? And my hiking partner is a bit of a science geek, too, so she's like "This is so cool".

This was further illustrated when Robin described being able to identify surface hoar on a trip shortly after their course.

Alex's first avalanche awareness education was in a mountaineering course, when their guide "explained a few words," and "explained how avalanches work." Alex said that this had been helpful. Then, because it was a trip requirement, they took their AST course through a university club. Alex said that the course was easy for them because they "[knew] about it already" but that they still learned things that they had not previously known. When I asked whether there was anything in particular that they recall learning for the first time in their course, Alex responded by saying that the companion rescue portion of the course was one. Then they told me about the impact of the companion rescue portion of the course and how emotional it was for them to picture rescuing somebody they cared about.

> I really visualized myself that that's someone I care about, like when it was my turn to do the rescue. That was my first time really feeling the panic, you know? Like, how I can get to someone. Because I've previously been exposed to how the companion rescue rolls out. It just… I never physically tried to find the transceiver by itself and really visualize or think that that's someone I care about. […] I want to be ready for it in case something happens. You want to know it, but you don't want to experience it.

Rowan said that, given that the AST course is only two days, one of the main benefits to them was that it showed them what skills they need to improve.

> I mean, it's a two-day class, right? Like, there's only so much they can teach you. […] But I think my big takeaway was like, "OK, what are the things that I should know that I need to improve my skills on?" And it kind of gave me a really good starting point to get going from. I thought that was awesome.

When we spoke, Rowan mentioned that they were considering taking the level two AST course in hopes that they would learn more about the snowpack than avalanche rescue techniques. This seemed to be aligned with Rowan's use of snowpack information in their risk management decisions.

While *Riley* said that they enjoyed their AST2 course, they also recalled there being "so much unintended sexism." Riley remembered seeing how the course environment alienated the women in the group and how it "instilled toxic masculinity [rather than] deconstructing it." Later in our discussion, Riley told me about first realizing that topics related to identity that had come up in their course were relevant to avalanche hazard when they read about the impact of gender on decision-making.

> […] People have researched how gender impacts decision-making. And when you add one or two men to a group, the risk actually increases. And there's all these different factors. […] seeing those things highlighted on paper […] was really nice.

Blair had also not yet taken any formal avalanche education despite having travelled in the backcountry for years and offered some reflections on their reasoning. Early in the interview, I asked Blair where they had acquired their knowledge and experience. Laughing, they initially responded by saying, "Some of it was learned through the school of hard knocks." Later, Blair offered more insight into their educational experiences. I offered some time for Blair to share any remaining thoughts at the end of their interview, in which they told me that our conversation had made them aware of their limited level of understanding about the snowpack. They mentioned that they had thought about enrolling in a course but had not yet done it due to considerations of time requirements, cost, and how much educational value they would get from it. They also said,

> I've always just sort of kind of avoided the avalanche-y territory and focused more on, you know, staying out of trouble.

This led to a conversation about educational resources, and, after discussing Blair's course registration considerations in more detail, I asked what would make it easier for them to take the course. Blair expressed a preference for a shorter-duration, lower-cost AST option.

> […] Like an AST point five, where you could just go to Seymour for two to four hours and kind of look at snowpack or measure some angles. I'd be good with that. And $99 as opposed to $299 or something. And then I could go snowshoeing afterward on my own. You know what I mean? Do something fun, but not spend eight hours out or something.

I followed up to find out what other information besides snowpack information and slope angles would be valuable. Blair added that knowing more about terrain traps, overhead hazards, and how far an avalanche might travel.

> RL: Is there any other information that you would really like to have or skills that you would like to develop to feel more, like, confident and/or fulfilled with your knowledge?
>
> Blair: Yeah, I guess just like the whole terrain trap - and how you can be in an area that, like, is perfectly fine, but the surrounding area could shift and move and travel into the area you're in. That was one of the things I wasn't 100% sure of when I was on [my trip]. I was looking at [my mapping app] and trying to figure out, like, how much snow is up there and how far it would slide, […] how far is it going to travel?

Like Blair, *Bret* has not taken an AST course, and, while they did not say explicitly state why, Bret shared a few perspectives on the AST curriculum that may indicate their reasoning. One example, in particular, is illustrative of Bret's perspective on the shortcomings of the current AST curriculum and how it could be improved. In it, they mention that the courses lack lessons on snow instability tests, that those teaching the courses are motivated not by education but by developing their clientele, and that there is not enough time to meaningfully teach people how to make decisions.

> Bret: I really think Avalanche Canada should do more teaching on pits, and they don't seem to want to do that […] the guides are too focused on getting people to use guides and not on training people how to make decisions properly.
>
> RL: Hmm. What do you mean by making decisions properly? Like, what would that look like?
>
> Bret: Well, it's really understanding the snow science and I think giving people the tools to understand when you dig a pit, what's going on […] and making a decision based on the information you're seeing in the field.

RL: Do any examples come to mind where you think that people are making decisions that are not safe or not "right"?

Bret: I just don't think that people - they don't teach enough on the AST1 course for people to make decisions. In my opinion.

RL: Like, on how to use the information and make a decision?

Bret: Yeah.

RL: What could that look like do you think?

Bret: Well, you can't teach that in two days because teaching companion rescue takes three hours or something, getting to where you want to go takes a number of hours. And, yeah, you don't learn that over two days. And they don't have that much time. So, an AST1 course is much more an avalanche appreciation course. So, you've got to help people understand that "oh well, maybe I don't have the understanding to make a decision." […] What I've heard is that they don't emphasize decision-making with digging pits too much. And it actually says in the AST manual that they don't encourage that for recreational users, which I can't figure out why.

RL: What difference do you think it would make for folks to know how to dig pits and interpret them?

Bret: I just think that's the best information source as far as slope safety. It tells you whether there are actually persistent layers on the slope you're skiing and if there's likely to be an avalanche or not because of that persistent weak layer.

RL: Mm-hmm. So, when you're talking about people learning about decision-making, is that specific to the idea of digging pits and using that information?

Bret: Yeah.

In addition to the perception of the value of the AST course, Bret mentioned that the cost of the course seemed unreasonable given how much experience they already had and the learning opportunities they already have from travelling with guides and others with extensive experience. Later in the interview, Bret added insights into the value they perceive of learning from others with more experience. I asked Bret if they had any words of wisdom that they might share with more novice recreationists, to which they replied,

> Well, I say go with experienced people because the best way to learn is just to go on lots of trips with experienced people. Ask questions. It takes years to learn the snow science because it's really complex.

It became clear to me that Bret had already taken on their own mentorship role when I asked them whether there was anything they hoped to accomplish in their future in backcountry skiing. Bret's response was illustrative of their care for supporting others in learning how to recreate safely.

> Well, mostly teaching the younger generation how to do it safely, and I want to pass on that course so that other people in the club can help teach people these safe practices.

Other participants also spoke to the value of **mentorship** as a form of education other than formal education services offered by Avalanche Canada. In their interview, *Chris* told me that they had started going on trips with new people some of whom are more experienced. Chris described this as "a good opportunity to learn from them." Toward the end of the interview, I asked Chris to reflect on their development from the time they took their AST1 to the present day. In their response, Chris further illustrated the type of mentorship relationships that have been valuable to their development in the backcountry.

> RL: […] there anything that you can identify between like those early days and now that has made a really big difference for you?
>
> Chris: Well, I would say it makes a huge difference going with people that are good teachers, that have the patience […] to walk you through. Because most of the time that I freaked out, it wasn't because I was in avalanche terrain, it was really just because I wasn't comfortable. […] Having an experienced person calm me down made, like, such a huge difference.

While most participants' descriptions of the value of learning from those with more experiences were related to ongoing relationships with backcountry partners, *Robin* shared experiences of being a source of knowledge regarding avalanche conditions and terrain for others they encountered in the backcountry.

> […] These girls came up to us and were like "Should we go this way?" And we're like, "No". But we had known that because it had been on the [avalanche forecast].

In another example, Robin shared their knowledge of a route that they have experience travelling.

> [two people] came by saying "Which route should we take?" And we're like, "Not this one. Follow the poles." So, we pointed them in the other direction.

4.3.2. Decision aids

In the data, I identified risk management decision-making aids as products designed to help recreationists make risk-informed decisions in the field. Table 12 provides an overview of the decision-making supports discussed in the interviews.

Table 12. Summary of decision aids described in the data

Aid	Description
Avaluator decision aid	Perception and use of the Avaluator decision aid.
Avaluator Trip Planner	Perception and use of the Avaluator Trip Planner tool.

Participants provided insight into their use of the **Avaluator decision aid**. *Alex* mentioned that they use the Avaluator, something they learned about in their AST1 course, in their practice of constant assessment in the field. *Chris's* mention of the use of the Avaluator was described in conjunction with their mention of the Avalanche Terrain Exposure Scale (ATES) ratings. Chris described "getting to a point when [they] are in the terrain that has the risk" being a point where they need to discuss as a group how to manage the risk. To learn more, I asked them more about how they identify where those points are. Chris said that they include points where they leave terrain rated on the ATES as simple to terrain rated as challenging or complex. Their mention of that seemed to remind Chris about the Avaluator and while they couldn't initially recall what it was called (describing it as "the little table with different colours"), they remarked that they would find it valuable to bring it with them because it, as they said, "kind of tells you at what point you need to stop and assess where you're going […] it's a guide point to help." The significance of ATES ratings in Chris's in-field avalanche risk management practices was further illustrated when I followed up asking whether they could tell me how they recognize what type of terrain they are in. They responded saying, that they weren't sure whether they had ever been in Complex terrain, but that it "sounds really scary." Similarly, *Robin* said that they avoid going to areas where the terrain is rated as Complex, which Robin identifies using the ATES maps on Avalanche Canada's **Avaluator Trip Planner**. Robin added that, while valuable, they find the maps difficult to locate. *Clem* spoke to their own difficulties with using the ATES maps and Avaluator Trip Planner, saying that the mapped routes seem to be more targeted to ski-touring and snowmobiling and that "routes for snowshoers – especially [trips that are] pretty benign - just don't seem to exist." Elaborating on one such trip, Clem offered additional insight into a snowshoer's perspective on decision-

making supports using a popular snowshoeing trip as an example of the lack of snowshoe-specific resources and how that might affect their decision-making.

> I think the first time that you encounter a sign about avalanche danger is [not until later in the trip]. So, […] if you've never been there before, to not have knowledge of the terrain and knowledge of the specific dangers on that route online and then to not have it at the trailhead […] if people have already driven up to the trailhead and then skied or snowshoed uphill for five kilometers, not going to want to make an assessment at that point that is conservative.

Bret echoed Clem's perspective on the ATES maps, sharing with me their perspective that the maps only existed "where people have paid for it to be done and it's mostly snowmobile areas." Bret described being "not so keen" on the ATES ratings and, instead, identifying areas where "avalanche issues are going to start" using slope angles.

4.3.3. Other avalanche risk management supports

In the data, other risk management supports included equipment and information that participants described using to mitigate risk in either/any of the pre-trip, in-field, or post-trip stages. Table 13 outlines the risk mitigation resources I identified in the interviews, some of which I will describe in further detail in this section.

Table 13. Summary of risk mitigation resources in the data

Resource Type	Resource	Description
Safety equipment	Avalanche rescue equipment	Perception and use (or lack thereof) of avalanche transceiver, shovel, and probe.
	Backcountry safety equipment	Gear in addition to avalanche rescue equipment, for example, avalanche airbags, first aid equipment, general winter safety gear, the "10 essentials".
	Terrain information gathering equipment	Use of tools such as an inclinometer and mapping resources (e.g., GPS tracks and maps) that help gather terrain information.
Information sources	Avalanche Canada and the public avalanche forecast	Perception and use of Avalanche Canada's information sources, including the public avalanche forecast.
	Guidebooks	Perception and use of published guidebooks.
	Highway cameras	Perception and use of highway cameras as sources of backcountry condition information.
	In-field signs	Noticing and using in-field public communications, for example, trail markers and hazard level descriptions.
	Media	Use of information published by both professionals (excluding Avalanche Canada) and recreationists.
	Ski resort information	Discussing conditions or trip information with others pre-trip or in-field.
	User network	Perception and use of resort information, for example, weather reports and resort webcams.
	Weather forecasts	Perception and use of weather forecasts.

Safety equipment

Avalanche rescue equipment (which includes a transceiver, shovel, and probe) came up in my interviews with Clem, Chris, Robin, and Blair all of whom are snowshoers. In these conversations, the topic of avalanche rescue equipment was around how having or not having it influences their decisions. In their interview, *Chris* provided their perspective on this conversation among snowshoers. Chris had been talking about their choice to travel in areas where they know there will be other recreationists because of "the feeling to know you're not alone." Upon further reflection, they said, "But, if you think about it, if something happens, they can't really do anything because, first of all, they're in snowshoes." The second reason that Chris mentioned was related to their belief that likely only 20-30% of snowshoers carry avalanche rescue equipment (adding that they think almost all backcountry skiers carry it). Later in the interview, Chris told me that they will "not [go] out with people that don't have the gear." Elaborating further on that decision, Chris said,

> Cause I bought the gear, I paid for it, it doesn't make sense for me to go out with someone [if] they can't rescue me if I need help. And I hope to God I never need to use it. I hope in ten years it's never been used. I don't want to use it ever, that's not the intention of mine.

Later, Chris expressed outrage at the decision someone they know made to not purchase avalanche rescue equipment because they did not feel it was necessary.

In their interviews, Clem, Robin, and Blair all shared their own reasons for not bringing avalanche rescue equipment with them into the backcountry. For example, *Blair* put it quite simply when I followed up with them about their mention of bringing a shovel into the backcountry. I asked Blair whether they carry a transceiver and probe in addition to their shovel. They told me that they do not and that, instead, they avoid areas that they have determined it is needed.

> RL: Earlier you mentioned that you have a shovel to dig out places to sit at lunch. Are you and the folks you are going out with also carrying transceivers and probes?
>
> Blair: No. No. No. We just avoid that area. I know one of the fellows used to carry a probe with him. You know. And he would just sort of put it out once in a while and check the snow depth and see if there's like a log underneath or whatever. But, no, we just stay out of that backcountry steep terrain.

Blair's choice to stay out of terrain where they would need avalanche rescue equipment is reflective of *Robin's* reasoning. Robin described bringing with them an extensive amount of gear and said that they had been meaning to get a shovel and an ice axe but that they "don't have the probe because [they] actually just don't go there." Robin then described having thought it through:

> Our whole thing is that at some point we might, and we'll get the equipment we need. And it's not even like we're worried about the cost or whatever. It's just, like, there wouldn't be a reason for us to get it now, because we just wouldn't go where that's needed.

Later in the interview, I circled back to the topic to learn more about how Robin identifies places where avalanche equipment is needed. In response. Robin told me that the information they find on social media is helpful for this.

> RL: What - what distinguishes those areas from the places you do choose to go to that you feel are appropriate for not having that equipment?

Robin: I would say, like, umm (pause) all the social media. […] the communications on [a popular destination] say, like, you don't go up that way unless you have AST1. And same with [some other areas].

Robin then told me about several other trips that they avoid going on because they have heard, through social media, about there being "too many rescues up there." The impact of notable incidents on Robin's choice to travel to certain locations was further illustrated when they said,

> I think losing that girl really touched me like […] I avoid that partly because of what happened to her and that I don't think it's worth the risk. Umm. That whole area […] I avoid that. I don't want to have to get rescued up there. There's just too many rescues up there. So, a lot of it is […] where we know that there are continued rescues or issues, right? [We?] avoid that because, like, we know that people are having difficulty up there. So why would we go and try it? Like, it just doesn't make sense, right?

Clem told me that they also choose to travel without avalanche rescue equipment.

> And we don't travel with beacons. Umm. Like, if - if there's a situation where - like, basically like, we are very conservative.

In addition to informing their general approach to winter backcountry recreation, Clem's choice to travel without avalanche rescue equipment also informs specific travel behaviours they select. This was illustrated in Clem's example of a route they often travel through a runout zone. Clem was telling me about choosing to space out when passing across a runout slope. I probed them to share more about their selection of spacing out as a risk mitigation option, which they responded to by saying that spacing out "means that the whole party wouldn't be buried in an avalanche at the same time." Detailing this answer, Clem said, that "given that [they are] not carrying transceivers, it doesn't really make recovery any easier, it just means there are less people to recover."

Clem: Because I also travel routes that are familiar most of the time, I know the dangerous spots on those routes. I guess it could lead to complacency that I think that I know everything there is to know about that area. But I also know that like, for example, of the routes that I travel regularly, none of them is travelling through a big common runout slope, except [one]. And I know where that runout slope is, and I know that I'm either going to turn around before I get there or space out through it.

RL: Mm-hmm. And spacing out – what's the purpose of doing that? Like, when you think about that as an action that manages that risk, why does it fill the criteria?

Clem: Well, I mean, it means that the whole party wouldn't be buried in an avalanche at the same time, but given that we're not carrying

> transceivers, it doesn't really make recovery any easier. It just means there are less people to recover.

In addition to avalanche rescue equipment, participants described their use of other **backcountry safety equipment** in the field. Table 14 contains a list of this equipment, its summarized purpose, and an illustrative example.

Table 14. List of backcountry safety equipment and its purpose(s)

Equipment	Purpose	Example
10 essentials*	General backcountry preparedness	So, like, we're always prepared. We have our ten essentials […]. (Robin)
		So, your gloves and your hat, your toque, those instant chemical hot-shot hand warmers. I always carry extras of those. […] And then having some kind of sun protection for the eyes, the lips, and the skin when the sun comes out. And then going down into the 10 essentials and some sort of a thermal cushion to sit on for lunch is always really helpful. Having good snacks, and good water. Making sure, if you're using a hydration pack, that your, straw doesn't freeze in the sub-zero temperatures. (Blair)
		And then layers of clothing from, you know, the AdventureSmart profile. (Blair)
Avalanche airbag	Mitigate avalanche risk	I guess in terms of like mitigating avalanche risk - I - I always - or at least this season, I've been skiing with an avy bag. Umm. So that's - that's something, I guess a tool that I use. It's not helpful, really, to the rest of the group, umm, aside from the fact that they may not have to dig as far. (Rowan)
Alternative travel mode**	Ease of travel	She put her micro spikes on that time where I kept my snowshoes on, and to me, you know, it was safer to be in snowshoes for me. (Robin)
First aid	Injury management	I always bring a very well-stocked First aid adventure medical Kit. But I also always tell Them to bring their own. […] I was just amazed at how many people had No first aid kit at all - with them or with the group they were with. (Blair)
		[…] That's my personality to be, like, way overprepared. I bring all the things. Like, I think I always have with me like a Sam Splint. (Rowan)
Emergency equipment, signalling, and communication	Response and evacuation	You know, like things, that like most people - you just press your [personal locator beacon] and get [search and rescue] to come pick you up. It's like "No, I'm building a rescue sled and I'm pulling them out." (Rowan)
		[…] At least three of us will have a Garmin InReach or some sort of locator device (Rowan)

		And I have an InReach, so I send a message out that says "I'm back at the trailhead, everything's good." That goes to my wife and my colleague, [name of colleague], who then can sit back and not worry. (Blair)
		One thing I wanted to say, though, before I wrap up is [that I bring] a signalling device. Very important. So, I have like my whistle that's on my carabiner and when I put my pack on I put the whistle around my wrist. (Blair)
		I remember getting the whistle and going "I never thought that I would need a whistle," […] and now we always [bring one]. (Robin)
Snow shovel	General preparedness	I bring a snow shovel with me always. I was carving out some seats […] (Blair)
		And I actually needed the shovel to gently dig him out so that I could get his - his snowshoe off and then foot out and put his snowshoe back on. So, it's for things like that that I'm bringing it. […] I also use it when I'm clearing off a snow-covered log so people can sit down, without sitting down and six inches of snow. Things like that. (Blair)

* The "10 essentials" refers to a list of survival items that are recommended for those participating in wilderness activities. In this study's setting, the 10 essentials commonly refers to the list of essential items promoted by AdventureSmart, a search and rescue prevention program.

** Changing the model of travel was only mentioned in my interviews with snowshoers. For example, when choosing between snowshoes and micro-spikes.

Lastly, participants described their use of equipment for **terrain information gathering**. The most mentioned tool used to gather terrain information was maps. *Alex, Blair, Bret, Chris, Clem, Kit,* and *Rowan* all mentioned using maps (both app-based and physical) and downloading GPS tracks in the field. Some examples of how participants described using these tools in the field are included in Table 15.

Table 15. Participants' use of maps for in-field risk management decision-making

Participant	Use description	Example
Alex	Avoid terrain that they have identified as a concern in the pre-trip stage.	"I like making routes. [They] really help us navigate. So, I know I'm going to avoid going into that terrain […]."
	Avoid specific terrain features.	"I like [the app] because it shows me kind of like the easiest way to go there. Like, which [slope] is not as steep […] I don't want to go to steeper sections if I don't have to."
Blair	Identify terrain of concern in the field.	"Because when you looked at the map, it showed a very large red area right next to the trail and even onto the trail […] you know, in the avalanche zone."

	Identifying route characteristics and decision points.	"I'll take my computer and I'll [make] a little sheet which will have things like the elevation […]. And then I'll do like a little, umm, series of lines or drawings of the route that I'm expected and planning to take and then measure things out and put little mile markers or little checkpoints. Like, this is where I'm planning to have lunch and this is where, you know, I'm going to decide if I want to go further or I want to turn around."
Bret	Identify slope angles.	"[…] if you're planning to go somewhere, it's pretty easy to print out a map that shows the slope angle before you go."
Chris	Identify terrain in the pre-trip stage that is relevant to in-field risk management.	"I download the GPX, I look at the […] gradient, the aspects, and all that."
	Inform in-field route-finding.	"[…] this coming weekend we'll probably go somewhere that it's a little bit more scary. And then at that point, I have to be a little bit less strict about following the GPX, because then it really depends […] it could be because, for example, I downloaded the GPX track of someone that went, let's say, in May where the conditions of the snow is a lot different than it is right now. So, the GPX at this point should just serve as a reference to know where the person went. But I need to decide when I'm there looking at the terrain."
Clem	Navigation in unfamiliar terrain	"Sometimes I'll be running [the app] to have a look at the terrain coming up when we're making a decision if it's an unfamiliar location."
Kit	Compare in-field location to pre-trip route planning.	"I usually look at maps and do my research before a trip. And then have a copy with me on my phone or whatnot and then go from there when I'm in the field."
	Identify terrain in the pre-trip stage that is relevant to in-field risk management.	"There's also maps that show the aspect and just how much sun they typically get. So, you have a couple of tabs open to show kind of where you're going when you're choosing routes."
Riley	Establish route alternatives	"And then I'll usually like, maybe like look at [the app] or pull out one of my maps and just think about where we're going and what alternative options we would have. Like, I kind of always have an [idea of] if it isn't good, then what's our backup plan?"
Rowan	Inform route finding.	"You know, we're not necessarily a "we have this GPX file and follow it to a tee" kind of team. Umm. […] But you know, it's all in-the-moment kind of decision-making and evaluation of our risk at that point in time."
	Identify terrain in the pre-trip stage that is relevant to in-field risk management and establish route alternatives	"[…] it's researching what the approach is like. We always have GPS tracks [and] hard maps, umm, that we'll always bring with us. But it's, you know, route-finding - "where are we going", "how are we going to get there"- [and] backups."

In addition to equipment used for mapping, both *Bret* and *Rowan* told me that they carry inclinometers to help them determine slope angle. *Rowan* mentioned they do not use their

inclinometer often, but described a type of situation where they would: when there is uncertainty about whether a slope is appropriate given the risk.

> I don't use it that much. But there have been a few times where we're like, "Oh," (expressing uncertainty), "it's a higher risk day and that slope looks sick, but we don't really know". So, we've got it out a couple of times.

Information sources

Information that participants use in their risk management practices was described in the data with respect to the source of information, its use, and how it is perceived by participants. Many participants described their perception and use of the **public avalanche forecast** published by Avalanche Canada. For several participants, the forecast serves as a tool in the pre-trip stage to choose when and where to go. For example, when describing their pre-trip planning process, *Bret* described monitoring conditions throughout the week and, closer to the weekend, "[looking] at Avalanche Canada reports." When I followed up by asking them how they use those reports, Bret said that they are "mostly looking for information about persistent weak layers," something they believe is an indicator of the likelihood of an avalanche.

> I think that's the thing that'll tell you if there is really a chance for avalanches or not, so that's a real gotcha when it comes to avalanches in this area. […] I've got a rule of thumb: if it snows wet snow and a couple of days later, it's usually pretty safe here on the Coast. As you go farther away from the coast, it's not quite the same.

I probed Bret again to learn about how the presence of a persistent weak layer might inform how they make decisions. In response, they alluded to a decision to travel in lower-angle terrain. They said that this is something they do anyway given that it is more suitable to the type of skiing they do but that has the added benefit of having "a lot less danger."

> When I telemark ski, I really don't want to ski on slopes greater than 30 degrees, usually. It's just not as much fun. So, I find if I go out and ski places that are less than 30 degrees angle, where there's a lot less danger anyway, that I have a good day. So, I just won't go to places that are steeper.

Similarly, *Clem*, *Rowan*, and *Chris* all mentioned using the avalanche forecast as part of their choice of where to go on their backcountry trips.

Some participants also shared their perceptions of Avalanche Canada's information sources. For example, *Robin* told me explicitly that they don't like the danger rating terms. In particular, they alluded to the "Moderate" and "Considerable" ratings that they see on hazard

information signs in the backcountry not adequately communicating the severity of the conditions.

> I think, like, Moderate and the Considerable […] I don't know if those words are good. Because when you pass the sign, people are like, "Oh, it's only Moderate," right? Moderate if you're in the wrong place is still kind of not good. It's just the word Moderate. Like, what's your risk of doing something if Moderate?

Robin did mention later in the interview that they the other resources on Avalanche Canada's website to be valuable, saying "I do think that the educational videos, the stories, are really helpful." At one point, Robin even mentioned that they watched a video that touched on an avalanche accident that happened in a local area and that, as a result, they choose to not go on that route. Similarly, *Blair*, who had not yet taken an AST course, mentioned that they find Avalanche Canada's online tutorials to be helpful.

Other participants shared insight into the development of their use of avalanche forecast information. For example, in telling me about their early experiences snowshoeing, *Alex* said that while they had been aware of the avalanche forecasts, they "didn't really understand it at first" and used the danger ratings to make decisions.

> I [was] always aware [of] the avalanche forecasts and all that, but I didn't really understand it at first. When I [saw] a green, yellow, orange there, that's all I based my decision [on].

Alex mentioned, however, that this is something they have since "improved." *Chris* also reflected on their initial use of the public avalanche forecast. They said that, although they didn't remember how they found out about it, they "knew how to place with the website." Elaborating, they described reading the forecasts, but that they "didn't know the [avalanche] problem side." When *Blair* described their current use of the public avalanche forecast, they said that they use information such as the hazard rating (which they described using numbers "one, two, or three"), the elevation of the avalanche problem, and "the description and the reason that they're forecasting for that and the kinds and the areas and the sizes of avalanches." Blair said that this helps them to "make a much better decision of whether to go or not."

Clem touched on some of these approaches to using the avalanche bulletin when describing how they perceive others to use it. They outlined how they think others only use certain information (e.g., the hazard ratings) to make decisions, speculating that these users lack understanding about how to use it.

> One of the things that I find is that people tend to read the avalanche forecast as like, "go, caution, don't go" - just looking at the colours, rather than clicking through the tabs to read the rest of the forecast and understanding the implications of the forecast, and that it might still be safe to go some places. Or, like, they don't understand the above, below, at treeline distinction. And so, they're like, "Oh, I see that the forecast is Considerable. I'm not going to go [on a certain]."

Clem also spoke to their perception of the applicability of **in-field information sources** to snowshoeing. Clem said that the signs communicating avalanche hazard and terrain information are "applicable and meaningful to a point. In that if the snowshoer is staying on the same route as a snowmobiler or ski tourer." However, they said that is often not the case because "[snowshoers] are not looking to get turns in. They're looking to get to the viewpoint or the summit or whatever it is, and they're going to go back down the same way as long as it seems safe."

For additional information regarding avalanche conditions, participants described using **online media** (e.g., conditions update videos from professionals), **ski resort conditions** (e.g., snowfall amounts, temperatures), **highway cameras**, and various **weather forecasts**. To gather route-specific information, participants described the use of **guidebooks**, **social media** (e.g., trip reports, online group posts), and their **personal networks**. Lastly, *Clem* and *Robin* both mentioned the use of **in-field signs**. In their descriptions, this included both route and terrain markers, for example:

> The route is difficult to find in the winter because it's much less commonly travelled and the gondola doesn't put up, umm, wands up that far. They don't want you to go any further, which makes sense. (Clem)

> In all the cases mentioned, you're on places where either there's a marked winter route or the route is obvious enough that you don't have to do a ton of route-finding or it's busy enough that there usually will be tracks to follow. (Clem)

> […] We're going on mostly established routes. (Robin)

> I think some of the markers that are up there are really great where they say, "Don't pass this point" because I think people actually look at them. I also think the ropes that are up […] are really useful. (Robin)

Both *Clem* and *Robin* also mentioned avalanche hazard and terrain information signs in the backcountry. *Robin* described the value of these signs as being "little markers to think for a sec."

> I do think the signage is really important for people that don't have the knowledge or experience. It makes them think, right? You just need those little markers to, like, think for a sec.

Clem also spoke to their perceptions of these signs' value, saying that they think that the signs, "as a decision-making tool", are not as valuable for snowshoers because of how they have been positioned on routes commonly used by snowshoers.

Chapter 5. Discussion

The objective of this study was to elicit an in-depth understanding of the landscape of practices that recreationists employ to manage avalanche risk when travelling in the winter backcountry. The core insights are the focal points upon which multiple findings converge and offer interconnected answers to my research question. I present the core insights in four interconnected points. Together, they address gaps in the existing understandings of recreational in-field avalanche risk management practices by illustrating a rich diversity of decision-making processes, the broader in-field avalanche risk management practices within which those decision-making processes exist, and the unique needs that recreationists have as they work to safely fulfill their objectives in the backcountry.

1. **Recreationists use different approaches to making avalanche risk management decisions when travelling in the backcountry.**

Within the in-field avalanche risk management experiences interviews participants shared, I identified two types of in-field risk management decision-making approaches. The first I coded as direct response decision-making, where a cue initiated an immediate response by the participant, without requiring additional assessment. This process is aligned with heuristic decision-making as outlined in the field of judgement and decision-making, where individuals make use of "cognitive shortcuts" to make a given decision easier (Gawronski & Creighton, 2013; Gigerenzer & Gaissmaier, 2011; Shah & Oppenheimer, 2008; Tversky & Kahneman, 1974). The second approach I coded as layered decision-making, where participants described making decisions involving one or more distinct assessment stages, each with potential associated considerations and values. This approach is akin to systematic decision-making, which requires more effortful and complex processing of information (Gawronski & Creighton, 2013; Kahneman, 2013; Kahneman & Frederick, 2002).

When positioned in relationship to judgment and decision-making literature, participants' use of both heuristic-based and systematic decision-making approaches has two implications for existing understandings of recreational in-field avalanche risk management. First, it suggests an alternative to the "heuristics-and-biases" or "heuristic traps" school of thought, which focuses on the potential pitfalls of heuristic-based decisions. Instead, participants' descriptions of using direct response decision-making processes demonstrate the utility of heuristic approaches to make decisions in a more cognitively efficient or "fast and frugal" way. Second, the use of both

the direct response decision-making processes and the more systematic, layered decision-making processes across all participants suggests that an association between more systematic processes with higher levels of experience or expertise may not be warranted.

Participants' descriptions of their risk management approaches also offer interesting insights into their use of intuition ("gut feeling"). As noted in the recognition-primed decision (RPD) model, as people accumulate experiences, they form a set of patterns that can be drawn on to facilitate more cognitively efficient decision-making (Klein, 2008; Klein et al., 1986). For intuitions to work in this way, however, they need to be based on informative experiences that allow individuals to learn meaningfully from their responses. However, the development of effective intuitions in the winter backcountry is challenging due to it being a "wicked learning environment" (Hogarth, 2001; Hogarth et al., 2015), where the informative feedback on decisions is limited and potentially misleading. As a result, the use of intuition may not be well matched to the conditions of every environment in which it is applied. Throughout the interviews, the topic of "gut feeling" primarily emerged in the context of participants' experiences of uncertainty, such as "not knowing what you do not know" and the difficulty of distinguishing between good decision-making and luck. In these situations, intuition primarily led participants to end their trip. Hence, participants' descriptions suggested they use their intuitive as an effective flag to manage the difficulties of the decision-making environment. Furthermore, their use of intuition in choosing to turn around seems to indicate an awareness of the challenging learning environment that makes the development of avalanche risk management intuition difficult.

2. Recreationists different avalanche risk management decision-making approaches in different environments, under different conditions, and due to unique contextual factors.

In addition to the insight that participants use different approaches to making in-field avalanche risk management decisions, the richness of participants' descriptions revealed that these decision-making approaches vary depending on the characteristics of the environment and conditions. In an example of different decision-making approaches for given conditions, Alex described an instance of heuristic-based decision-making where two cues (whumpfing and cracking) caused them to turn around. In another instance, however, Alex described a more systematic decision-making process involving a series of assessments of terrain and avalanche conditions in order to choose a risk mitigation option. This insight is supported by the concept of ecological rationality, which describes individuals' use of different decision-making approaches

as an adaptive response to exploit the characteristics of their decision-making environments (Gigerenzer, 2004; Gigerenzer & Selten, 2001; Todd & Gigerenzer, 2007). In this way, Alex's use of a heuristic-based decision could be seen as an adaptive response to a decision-making environment where "Class 1" information, information that has a high degree of ease of interpretation and relevance for snow stability assessment (McClung, 2006), was available (in this case, whumpfing and cracking) thus making the decision more cognitively efficient. Additionally, Alex's use of a more systematic assessment of terrain and avalanche conditions can be seen as adapting their decision-making approach to a decision-making environment with potentially more uncertainty or less obvious feedback. The adaptability of individuals' decision-making processes in response to demands and limitations of decision-making environments is also outlined by Payne et al. (2012), who introduced the notion that individuals are "adaptive decision-makers." In the book, *The Adaptive Decision Maker,* Payne et al. (2012) write that individuals' use of multiple decision-making approaches is an intelligent adaptation to the demands of complex decision tasks and often reflects "a reasonable compromise between the desire to make a good decision and the desire to minimize the cognitive resources used in making the decision" (p. xi). This perspective, Payne et al. say, is aligned with prior research that has shown that decision-making is highly sensitive to a wide variety of task and context factors (2012).

The context-dependency of in-field avalanche risk management decision-making is also illustrated in the way that different participants made decisions with the same piece of information. This variation in response to the same information can be seen in how participants' use of snowpack information arose in the interviews. For example, Clem described making a deliberate choice to not incorporate snowpack information into their risk management decisions, Bret's interview illustrated their belief that snowpack information is highly important to determine whether a slope is safe, Rowan shared an example of using snowpack information in a direct response decision, and Kit mentioned that having snowpack information is part of how they stay informed about conditions throughout the season. In addition to illustrating the context-dependent nature of recreationists' in-field risk management decision-making processes, this insight adds complexity to the perception that variables such as avalanche education, years of experience, age, activity type, and gender can be used as meaningful predictors of recreationists' avalanche risk management decision-making.

In addition, to the variations in participants' in-field risk management decisions resulting from the in-situ environment and conditions, the findings revealed that their approaches to

making in-field avalanche risk management decisions are influenced by and inextricable from contextual factors that define their overall avalanche risk management practices such as their initial experiences, motivations, pursuits, distinct experiences, and formative moments. Together, these factors help to characterize participants' in-field risk management practices and, as such, help to better understand how and why decisions are made.

3. Participants' in-field avalanche risk management decisions are inclusive of and influenced by an extensive breadth of information.

In addition to information typically perceived as informing of avalanche risk (for example, avalanche conditions, weather, and terrain characteristics), some participants described decision-making processes that included or were influenced by subjective factors related to physical and psychological safety, previous experiences, and other backcountry hazards. Some examples include Riley's description of how, regardless of the avalanche hazard, they will choose to turn around if the group dynamics are concerning; the descriptions from Kit's interview that suggested a significant impact of a notable incident on their overall risk management practices; Clem's description of the importance of managing the risk of hypothermia or their level of fatigue and that those considerations may influence how their in-field decisions are made; and Robin's use of an area's accident history to inform their trip selection. The inclusion and influence of such a breadth of information into avalanche risk management decisions is supported by findings from other avalanche risk research that acknowledged that in-field decisions are not only related to avalanche safety but also to recreationists' well-being and overall experience (Zweifel & Haegeli, 2014) in addition to other contextual factors (Israelson, 2015).

4. Participants use and perceive existing risk management supports differently.

Throughout the interviews, participants described their use and perception of different existing avalanche risk management supports. In some cases, participants shared insights into the ways that existing products support their risk management needs. This was illustrated, for example, in many instances where participants described the value of Avalanche Safety Training courses in developing their awareness of avalanche risk. The value of existing supports was also demonstrated in participants' descriptions of their use of Avalanche Canada's public avalanche forecast, for example using the danger ratings to make decisions about whether and where to go or using the Avaluator pre-trip planning tool to identify notable characteristics of their trip that they will look for in the field.

However, the findings also revealed insight into the ways that existing products may not be connecting with recreationists in the way they are intended to or, in some cases, at all. Some notable examples include Clem's reflection on how some of the existing risk communications are not designed for snowshoers and, thus, are not supportive of their in-field risk management practice; Bret's perception that existing avalanche safety curriculums lack insight into the use of snowpack information for risk management decisions; participants' descriptions of the value of educational pathways that do not currently exist, such as structured opportunities for experiential learning and learning from others with more experience; and some participants' decisions to travel without avalanche rescue equipment.

These insights suggest that just as there is diversity in participants' approaches to making in-field avalanche risk management decisions and the contextual factors that shaped these approaches, so too are the approaches required to support them. Therefore, there is no one-size-fits-all approach to supporting recreational avalanche risk management. This complexity also suggests that supports designed using dominant assumptions of how recreationists manage avalanche risk and expert models of avalanche risk management may be limited in how well they serve recreationists. The findings on the diverse and contextual nature of recreationists' in-field avalanche risk management practices and decision-making approaches demonstrate that recreationists are not simply less experienced experts and may benefit from supports that are designed with this complexity in mind and informed by the perspectives of recreationists themselves.

5.1. Recommendations

The exploratory and descriptive methods I chose for this study allowed me to capture the complexity and richness of participants' in-field avalanche risk management practices. In doing so, this study contributes in-depth insight that underscores that the current understandings of recreational avalanche risk management described in the introduction of this thesis are limited in depth and insufficient in complexity. The findings also suggest pathways for addressing them. Overall, the insights from participants' stories suggest a need to more meaningfully account, incorporate, and action the contextual detail of recreationists and their avalanche risk management practices. While the practical implementation of approaches that accomplish this will and should vary, this study provides recommendations for public avalanche warning services, avalanche education and educators, recreationists, and researchers in support of their integration.

5.1.1. Recommendations for public avalanche warning services

The insights emergent from the findings make it clear that not all recreationists share the same aspirations or capacities to engage with avalanche risk in the ways conventionally perceived as essential for making safe decisions. This is aligned with existing research by St Clair (2019) on recreationists' pre-trip risk management practices, which revealed that individuals can manage avalanche risk at various levels of depth and sophistication, each of which is valid. In essence, some recreationists may not find it necessary, valuable, or possible to undertake extensive development of their knowledge of avalanches and their avalanche risk management capabilities. In-field avalanche risk management supports should exist in accommodation of that diversity and in service of those individuals. Rather than steering individuals along a trajectory of skill development, this underscores the importance of meeting recreationists where they are at, providing tailored supports that align with their unique aspirations and associated needs.

This study's findings illustrate that the ways recreationists manage avalanche risk in the field are diverse and that they use different information when making in-field avalanche risk management decisions. As a result, the findings suggest that recreationists may benefit from customized avalanche risk management products and messaging. While customizing products has been challenged by real-world time, cost, and energy constraints, the trend toward using models and automation creates new opportunities for products that are more targeted to the unique needs of diverse individuals. This requires that public avalanche warning services have insights into the characteristics of their users, including who they are (for example, their activity, training, motivations, and experience), and what they do (their risk management practices). In turn, warning services could better match their communications to the user. Avalanche warning services should collaborate with researchers to gain informed insights into the users of their products. For example, the Bulletin User Typology developed from the research of St Clair (2019; 2021), outlines a hierarchical classification of backcountry recreationists' avalanche bulletin use based on their pre-trip information-seeking and processing behaviours. This classification provides a meaningful framework for understanding who might use what information and how. While developing a typology of in-field risk management practices was beyond the scope of this study, its findings lay the groundwork for future inquiries that can contribute to a similar typology based on in-field practices.

Lastly, this study's findings underscore the value of actively seeking the perspectives and experiences of recreationists to inform the evaluation and design of risk communications and supports that can best meet their needs. While expert perspectives should be a part of developing recreational avalanche risk management supports, it is critical to evaluate their use and perception by eliciting insights from the users themselves.

5.1.2. Recommendations for avalanche education and educators

Avalanche education and those delivering it are uniquely positioned to foster and integrate a comprehensive understanding of the diversity of recreationists and their risk management practices. This study's findings suggest that this could be accomplished in several ways.

First, the findings suggest that the current curriculum on the human dimensions of avalanche safety centered on heuristic traps does not encompass the full range of decision-making approaches. Instead, avalanche education curriculums on the human dimensions of avalanche safety should be expanded to inform course participants more holistically on the diversity of approaches to making decisions, their strengths, and their potential pitfalls. For example, this includes educating recreationists not only on the potential for heuristics to be misleading or lead to harmful outcomes but also their utility for decision-making in backcountry environments where uncertainty and limited feedback exist. Rather than focusing on decision-making "failures" or decisions that lead to avalanche accidents, this approach could help course participants develop an awareness of their own decision-making approaches, improve their understanding of the backcountry decision-making environment, and deepen their understanding of how to improve the "match" between decision-making approach and environment. Additionally, this would assist course participants in developing an informed repertoire of patterns from which they can draw on when making avalanche risk management decisions in the future.

Second, it is important for educators to acknowledge that the frameworks used to teach avalanche risk management practices are models and, thus, are simplifications. While these serve as helpful tools for teaching and as reference points for recreationists' learning and development, the practices themselves will look different for each person, depending on contextual factors related to the individual and the backcountry environments within which they make decisions.

Third, this study demonstrates the value that eliciting the experiences of recreationists has for better understanding how to support them. The value of stories is illustrated by Griffiths (2007), who listed storytelling as one of three "valued techniques of humanities research."

> Story is sometimes underestimated as something that is easy and instinctive. But story is actually a piece of disciplined magic, of highly refined science. It is the most powerful educational tool we possess; it is learning distilled in a common language. It is also a privileged carrier of truth, a way of allowing for multiplicity and complexity at the same time as guaranteeing memorability.

Griffiths goes on to say that stories have the potential to change the way people act and the way they use available knowledge. Those working in avalanche safety communities have long harnessed this potential by using avalanche fatalities or near misses as case studies. However, beyond stories of avalanche incidents, avalanche educators could leverage the value of recreationists' stories in their courses. For example, avalanche educators could create structured opportunities (for example, in pre-course intake forms and course introductions) to elicit more nuanced understandings of the individuals in their courses, their experiences, what they do and do not already know, and what their needs are. Additionally, educators could integrate stories into their lesson plans to help course participants connect with the information.

Fourth, the study's findings suggest that safe backcountry recreation is not solely a matter of managing avalanche risk and instead encompasses numerous factors related to both their physical and psychological safety. By encompassing broader aspects of backcountry safety beyond traditional avalanche risk management, avalanche educators could contribute to a more well-rounded and comprehensive understanding of how to manage risk in the winter mountain and could use avalanche safety training courses as an opportunity to model this environment. For example, equipping avalanche educators with the skills necessary to acknowledge and understand course participants' identities and how they may influence their learning experience and subsequent risk management practices.

Last, the participants of this study offered valuable feedback on recreational avalanche education courses (AST1 and AST2 courses), shedding light on both their value and potential gaps in the existing avalanche education system. In addition to these courses, participants emphasized the importance of time spent in the field under different conditions as an integral part of their learning journey. Furthermore, the participants highlighted how integral learning from others with more experience was in their development. This feedback from participants suggests that while existing avalanche courses like AST1 and AST2 are valuable, additional

educational opportunities may be necessary to comprehensively support their avalanche risk awareness and risk management skills. For example, complementing existing courses with opportunities for experiential learning and field practice could enrich participants' understandings of course curriculums. Importantly, mentorship provides a pathway through which these experiences could be attained and through which recreationists' practices could be developed.

5.1.3. Recommendations for recreationists

Philosopher and writer Thom van Dooren says of stories that they can "connect us to others in new ways. Stories are always more than simply descriptive: we live by stories, and so they are inevitably powerful contributors to the shaping of our shared world" (2014, p. 10). In this way, stories are opportunities for different people to see themselves represented in others' experiences. This study highlights the potential of stories as ways to build connection and empathy, both of which are integral to physically and psychologically safe winter backcountry experiences. In this context, my first recommendation for recreationists is to continue sharing their stories. Through this, we all (professionals and recreationists alike) can work collectively to build a winter backcountry characterized by understanding, support, and empathy.

In the interviews, participants provided valuable perspectives on what has made a difference in their learning, development, and experiences in the backcountry. They also offered advice for others as they look to pursue winter backcountry recreation. For example, Rowan suggested seeking as many opportunities as possible to learn, no matter what the conditions are; Bret's words of wisdom were to go with experienced people and ask questions; Kit encouraged others to get all the resources and education possible; Riley suggested finding people who you genuinely love and care about because when you love them, you will make the best decisions you can; and, Clem said that picking your objective carefully is one of the most important things. Additionally, participants described instances of supporting their partners in the backcountry, sharing information with other backcountry users, and mentoring more novice recreationists in backcountry groups. These findings demonstrate the depth and breadth of knowledge, experience, and skill that recreationists have – something that they should continue to find opportunities to share with one another.

The experiences that study participants shared encourage a deepened awareness of recreationists' efforts and skills in navigating difficult decisions in challenging decision-making

environments. Norms in the backcountry set standards of risk management practices that are potentially not attainable, necessary, or desirable for all. The findings suggest that there are many ways of making risk-informed and nuanced decisions and that recreationists do so in response to the needs of their environments. This study substantiates that recreationists adaptively employ a diversity of practices to make difficult decisions in challenging decision-making environments. Therefore, rather than evaluating their own decision-making based on existing standards, recreationists may find it helpful to develop awareness and understanding of their own risk management practices and existing proficiencies.

5.1.4. Recommendations for researchers

The significance of this study's findings highlights the value of social science research approaches that center individuals and their experiences. Aligned with these insights are four recommendations for researchers exploring ways to deepen understandings of recreationists' in-field avalanche risk management practices and enhance communications between avalanche risk information providers (public avalanche warning services, avalanche education curriculums, and educators) and recreationists.

First, a perception of heuristic decision-making as being flawed or biased and, related, the focus on failure analysis have supported the development of normative models of avalanche risk management decision-making that are based on expert practices. This upholds understandings that are aligned with a deficit model of risk communication, which assumes that expert knowledge and practices represent the optimal ways for managing risk and should be relevant for non-expert experiences (Rickard, 2021), and that simply communicating expert knowledge and practices to non-experts should lead to their adoption of a similar process. This approach is embodied in studies that focus on examining when and why recreationists did or did not employ expert-based models in their in-field avalanche risk management decisions or in recreational risk management "failure analyses" to determine "what went wrong" (Maguire, 2014). The deficit model also underlies recommendations that decision-making supports and frameworks should model expert decision-making processes (Landrø, 2021, p.99). However, risk communication research supports the notion that improving risk communications is less about closing the gap between experts and non-experts or simplifying expert knowledge for non-expert audiences, as outlined in the discussions in both Landrø (2021) and McCammon (2001). Rather, communications that facilitate informed decision-making involve both experts and non-experts engaging in non-hierarchical ways, go beyond the perspective of non-experts

as being information or knowledge deficient, and are supported by understandings of what recreationists are doing rather than what they *should* be doing (Brown, 2009; Bruine de Bruin & Bostrom, 2013; Schultz, 2002; Simis et al., 2016). The latter centers the risk information receivers, seeking to know more about how people make decisions, how they learn, their motivations, and what support they need. Research aligned with this perspective better captures the unique contexts to which decision-making processes are sensitive (Bruch & Feinberg, 2017). Maguire (2014) has contributed along these lines by demonstrating the value of detailed accounts from recreationists about the social and environmental contexts within which their avalanche risk management decision-making occurs.

Second, rather than aiming to isolate and distill specific factors in recreationists' avalanche risk management practices, it would be valuable to surface important contextual details and seek to understand the diversity of recreationists themselves, their risk management practices, and their needs. To account for context and complexity, researchers could also continue to expand on the information traditionally used to characterize recreationists (e.g., education, amount of experience, age, gender, and chosen activity). This is something that recent studies such as St Clair et al. (2021) and Neweduk and Haegeli (2023) have taken on by offering insight into additional characteristics that could be used to better understand recreational avalanche risk management practices such as avalanche forecast information use, avalanche information literacy, and motivations. Adding to this expanded characterization of the backcountry recreation community, the findings of this study highlight the importance of recognizing recreationists as whole, complex, and unique individuals with diverse lived experiences and personal characteristics (e.g., formative experiences, personal values, and emotions) that shape their risk management practices.

Third, the significance of this study's findings suggests that qualitative methods can contribute to shifting the focus of analysis from the outcomes of recreationists' decisions to the decision-making processes themselves. Ravitch and Carl (2016) relate this explicitly to qualitative research methods, writing that such methods "do not believe or claim that there are universal, static truths", but rather that there are multiple truths that are situated in context. In addition to answering questions related to *what* avalanche risk management decisions recreationists make in the field, this approach can shed light on the *why* and *how* of recreational in-field avalanche risk management decision-making. This difference is illustrated in a quote by Bruch and Feinberg (2017), who said "Researchers can fairly easily determine what college people attended, what job they chose, or whom they married, but they rarely observe how they

got to that decision." Understanding how decision-makers arrive at their decisions, they say, includes understanding how they learn about and evaluate options and how they select options based on feasibility or acceptability.

Lastly, I prioritized a research approach that was respectful, relational, and reciprocal, the outcome of which was a trusting environment that encouraged participants to share their experiences enthusiastically and authentically. Additionally, this made the interviews not only valuable to my data collection but also a valuable experience for the participants, who expressed gratitude for that during the interviews and in post-interview correspondence. These research principles offer guidance for future research and encourage researchers to adopt approaches that cultivate trust, authenticity, and value for study participants. Some suggestions on how this might be done include:

1. Acknowledging that we, as researchers, affect and are affected by study participants and their lived experiences (Ravitch & Carl, 2016). In practice, this could involve maintaining awareness of, monitoring, and accounting for researcher positionality as the power asymmetries within both academic and winter backcountry contexts that converge in avalanche safety research.

2. Positivist research paradigms have argued that knowledge should be objective, verifiable, and free from bias. In contrast, qualitative social science methods emphasize the subjectivity and non-neutrality of the researcher and see these qualities not as a problems, but as an opportunity to augment research processes (Finlay, 2002; Ravitch & Carl, 2016). Doing so can reposition the researcher as an expert to the researcher as a "co-constitutor," involved in the joint production of understanding.

3. Maintaining fidelity and accountability to participants' experiences as part of efforts to achieve rigour throughout the research stages (Ravitch & Carl, 2016) and emphasizing person-centered approaches that amplify their voices and recognize the significance of their contributions.

4. Ensuring that research on recreationists is undertaken in service of recreationists.

5.2. Limitations

As described in the methodology section, the course of my research activities was changed due to a personal experience that intensified the emotionality inherent to my research methods. This led to two notable limitations. First, I regretfully could not include participant validation processes in this study, as originally planned. Participant validation strategies (otherwise known as "member-checking") can be a meaningful way for qualitative researchers

to achieve validity (Ravitch & Carl, 2016). This was a missed opportunity to share emergent insights and representations with study participants, gain their perspectives on the alignment of my interpretations with their lived experiences, and identify any gaps, misunderstandings, or misrepresentations. The inclusion of participant validation strategies would enrich future research. Second, while snowmobilers and ice climbers were included in my selection of interview participants, I did not end up interviewing any due to the abrupt end of my interviewing process. Perspectives from both groups would have added valuable insight and a broader representation of recreational in-field avalanche risk management practices.

On a related note, I chose a sampling method aimed at capturing a diversity of recreationists and experiences. However, the group of interview participants and their perspectives do not fully represent the entire diversity that exists in winter backcountry recreation. The study sample is not reflective of the rich racial, ethnic, socio-economic, physical, and cognitive diversity of those who participate in winter backcountry activities. Additionally, it is worth noting that those who willingly participate in such studies are often already eager and/or engaged in backcountry activities. While efforts made to connect with those beyond these groups were proven successful in terms of the range of experience levels represented in the sample, additional efforts to strengthen outreach and relationships with recreationists who are more difficult to target could benefit future studies. These limitations highlight the need for future research to continue efforts to account for a more comprehensive range of perspectives and identities within the winter backcountry community.

Chapter 6. Conclusion

The increase in popularity of winter backcountry recreation must be met with efforts to support individuals accessing snow-covered mountains to achieve their objectives safely. While decision aids and frameworks exist to support in-field avalanche risk management, tailoring these resources to meet the needs of the growing and increasingly diverse winter backcountry community requires a comprehensive understanding of the practices recreationists employ to manage avalanche risk when travelling in the winter backcountry. Existing research using quantitative methods to evaluate recreationists' avalanche risk management practices has made significant headway in relating recreationists' terrain choices to avalanche hazard conditions. However, their ability to inform the design of risk management decision-making supports is limited due to the lack of insight into how and why recreationists make in-field avalanche risk management decisions and into the contexts that shape how recreationists manage avalanche risk in the field.

Using qualitative social science methods, I sought to contribute to existing research and illustrate the diverse landscape of recreationists' in-field practices. Through nine in-depth interviews with recreationists, I elicited detailed insight into recreational risk management decision-making approaches, who uses them, and when. My central research question asked how recreationists manage avalanche risk when travelling in the winter backcountry. In response to this question, the findings reveal that the ways recreationists manage avalanche risk in the field are diverse and are shaped by a breadth of contextual factors. By eliciting insights from recreationists themselves into the diverse practices, decision-making approaches, and contextual influences, this study offers valuable insights that can inform the evaluation and development of risk communications and risk management support initiatives to support a growing and increasingly diverse community of recreationists in achieving safe and enjoyable winter backcountry experiences.

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Appendix A.

Precoding memo template

The memo prompts in tables A.3-7 were informed by Ravitch and Carl (2016).

Table A.1. Signup survey response information

Name:
Pronouns:
Age:
Location:
Activity:
Years of experience:
Days per year:
Avalanche training:
Bulletin user type (self-reported):
Typical trip:
Role in group:
Other information:

Table A.2. Interview notes

Date:
Time:
Future considerations:
Improvements:

Table A.3. Emergent insights and learnings

What stands out? Seems noteworthy?
What themes, patterns, consistencies, and inconsistencies do I notice within this interview? Across interviews?
How do the data relate to my research questions?

Table A.4. Points of inquiry

What questions do I have from this interview?
What uncertainties exist?

Table A.5. Reactivity and reflexivity

How am I influencing the data? How do I address this?
Am I answering my research question? Why or why not? Am I asking the right overall research questions?
How does my conceptual and/or theoretical framework need to evolve?
How do subsequent interviews need to change? What can I improve upon?
What are the limitations of the data? What data do I still need to collect?
What other questions do I have?

Table A.6. Transcription and coding choices

What assumptions and choices did I make when transcribing the interview?
What prompted these codes? Are they emic or etic, inductive, or deductive?
Are the codes related to theory? If so, in what ways?

Table A.7. Theoretical and conceptual grounding

How do the data speak to concepts found in prior research and/or theory?
How do emerging learnings map onto and/or challenge my theoretical and/or conceptual frameworks? Do they need to evolve?
What literature do I need to consult?

Table A.8. Personal reflections

How does it feel to listen to this interview?
What thoughts arose around this interview?

Appendix B.

Signup survey

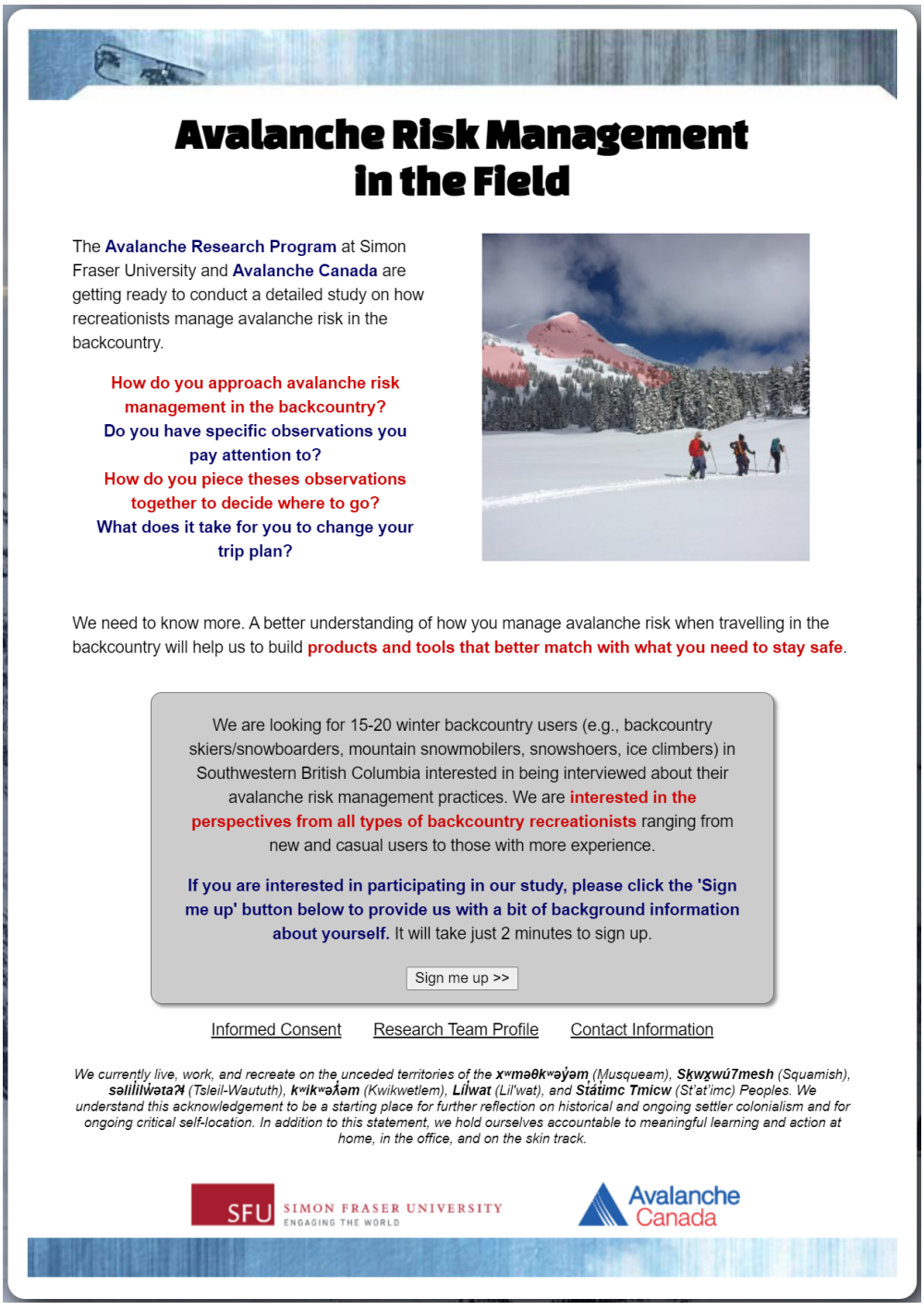


Figure B.1. Signup survey landing page

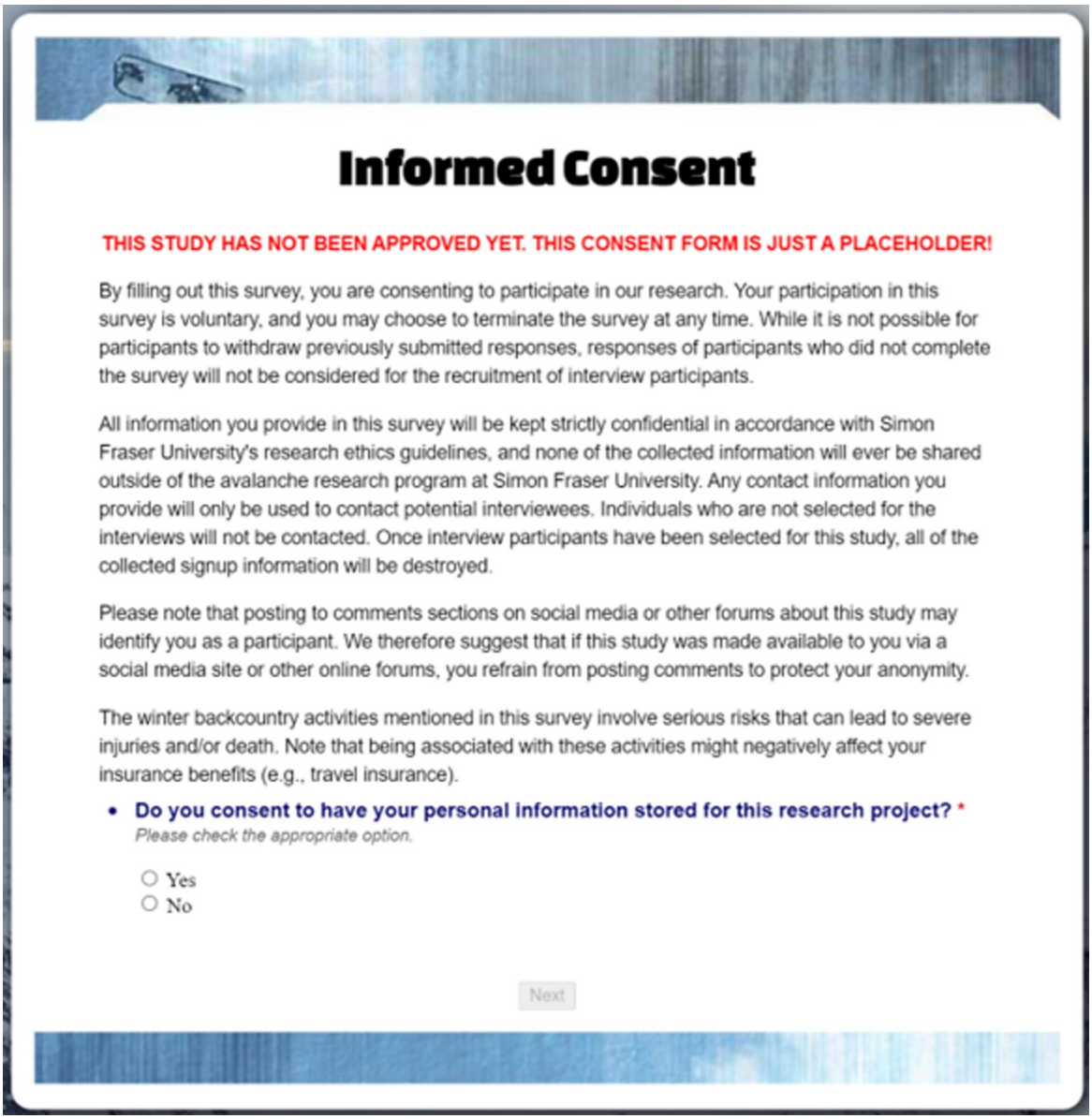
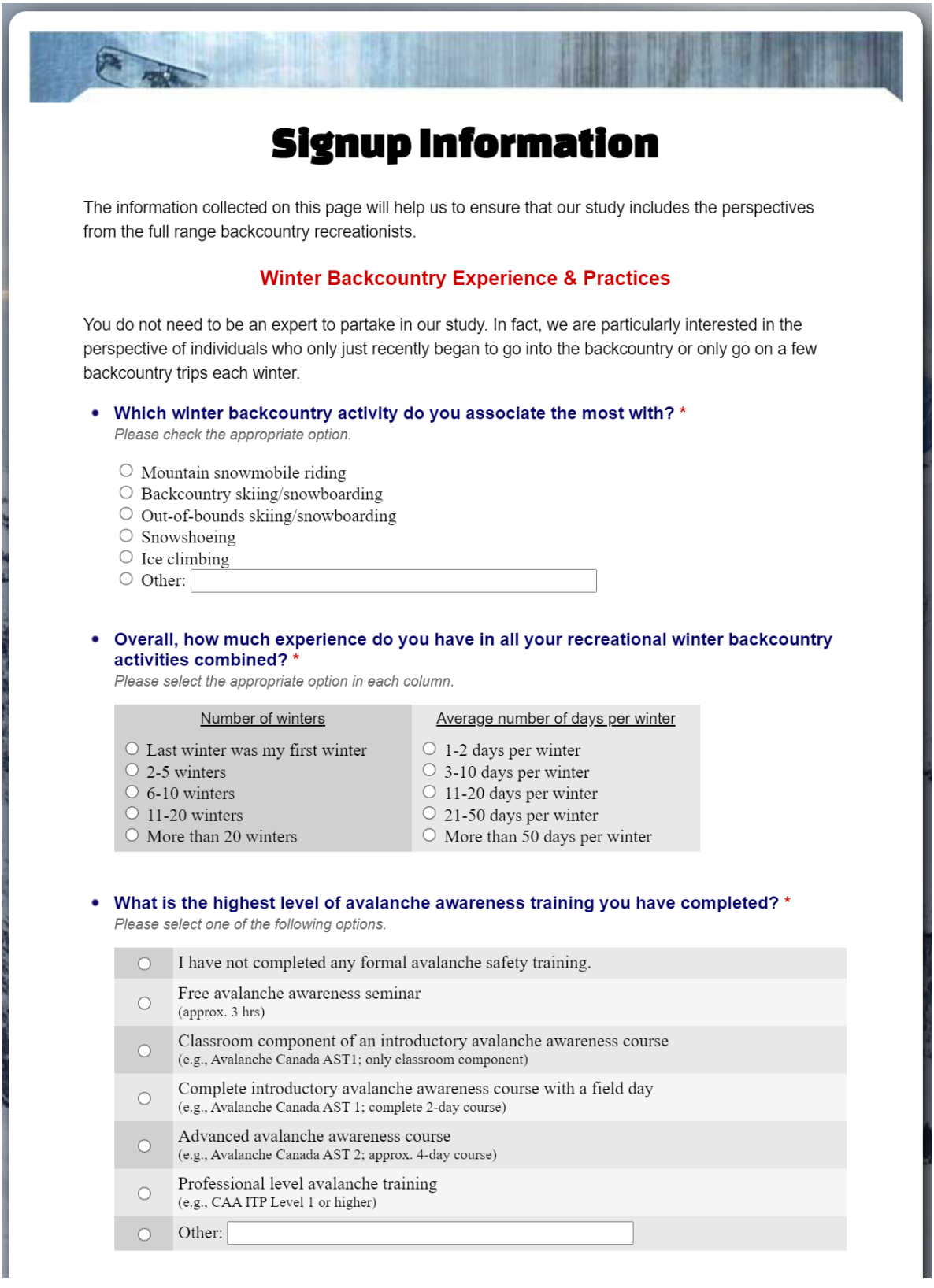


Figure B.2. Informed consent page



Signup Information

The information collected on this page will help us to ensure that our study includes the perspectives from the full range backcountry recreationists.

Winter Backcountry Experience & Practices

You do not need to be an expert to partake in our study. In fact, we are particularly interested in the perspective of individuals who only just recently began to go into the backcountry or only go on a few backcountry trips each winter.

- **Which winter backcountry activity do you associate the most with?** *
  Please check the appropriate option.

  - ○ Mountain snowmobile riding
  - ○ Backcountry skiing/snowboarding
  - ○ Out-of-bounds skiing/snowboarding
  - ○ Snowshoeing
  - ○ Ice climbing
  - ○ Other: [ ]

- **Overall, how much experience do you have in all your recreational winter backcountry activities combined?** *
  Please select the appropriate option in each column.

Number of winters	Average number of days per winter
○ Last winter was my first winter	○ 1-2 days per winter
○ 2-5 winters	○ 3-10 days per winter
○ 6-10 winters	○ 11-20 days per winter
○ 11-20 winters	○ 21-50 days per winter
○ More than 20 winters	○ More than 50 days per winter

- **What is the highest level of avalanche awareness training you have completed?** *
  Please select one of the following options.

○	I have not completed any formal avalanche safety training.
○	Free avalanche awareness seminar (approx. 3 hrs)
○	Classroom component of an introductory avalanche awareness course (e.g., Avalanche Canada AST1; only classroom component)
○	Complete introductory avalanche awareness course with a field day (e.g., Avalanche Canada AST 1; complete 2-day course)
○	Advanced avalanche awareness course (e.g., Avalanche Canada AST 2; approx. 4-day course)
○	Professional level avalanche training (e.g., CAA ITP Level 1 or higher)
○	Other: [ ]

Figure B.3. Signup survey page 1

- **Which of the following statements best describes your use of avalanche bulletins when planning a backcountry trip?** *

Please select one of the following options.

○	It is not typical for me to consult avalanche bulletin information when making my backcountry travel plans.
○	I typically use the forecast to check the danger rating which informs my decision of whether or not it's safe to travel in the backcountry.
○	I typically combine the danger rating from the forecast with knowledge of how avalanche prone an area is to determine where to travel in the backcountry.
○	I typically make a decision about where or when to go based on the nature of the avalanche problem conditions reported in the forecast and whether I feel that I can manage my travel in the terrain given these conditions.
○	I typically use the available information about the specific nature of the avalanche problem conditions from the forecast as a starting point for my continuous assessment in the field to confirm or disconfirm the information where I am travelling.
○	It is not typical for me to consult public avalanche bulletins or forecasts because I have access to professional information sources (e.g., InfoEx) that offer more detailed insight into current conditions.

- **Briefly describe two or three of your typical backcountry trip destinations.**

Examples are 'Snowshoeing on Cypress', 'Backcountry skiing on Seymour', 'Out-of-bounds skiing in Whistler' or 'Backcountry skiing on the Duffy'.

- **What tends to be your decision-making role in the groups you typically go onto these backcountry trips with?**

Please check the appropriate option.

○ I am the primary decision-maker in the group.
○ I am part of a small number of individuals who make the decision together.
○ Everybody in our group contributes to the decisions equally.
○ I speak up when I have concerns, but I mostly leave the decision-making to others.
○ I leave the decision-making up to others.

Personal Background

It is important to us that our study captures a wide range of perspectives. The following questions help us to put together a diverse sample of participants where many voices are represented. Click here to learn more about the personal backgrounds of the research team members.

- **Which of the following age categories describes you?** *

Please select one of the following options.

○ Under 20
○ 20 to 24
○ 25 to 34
○ 35 to 44
○ 45 to 54
○ 55 or over

Figure B.4. Signup survey page 2

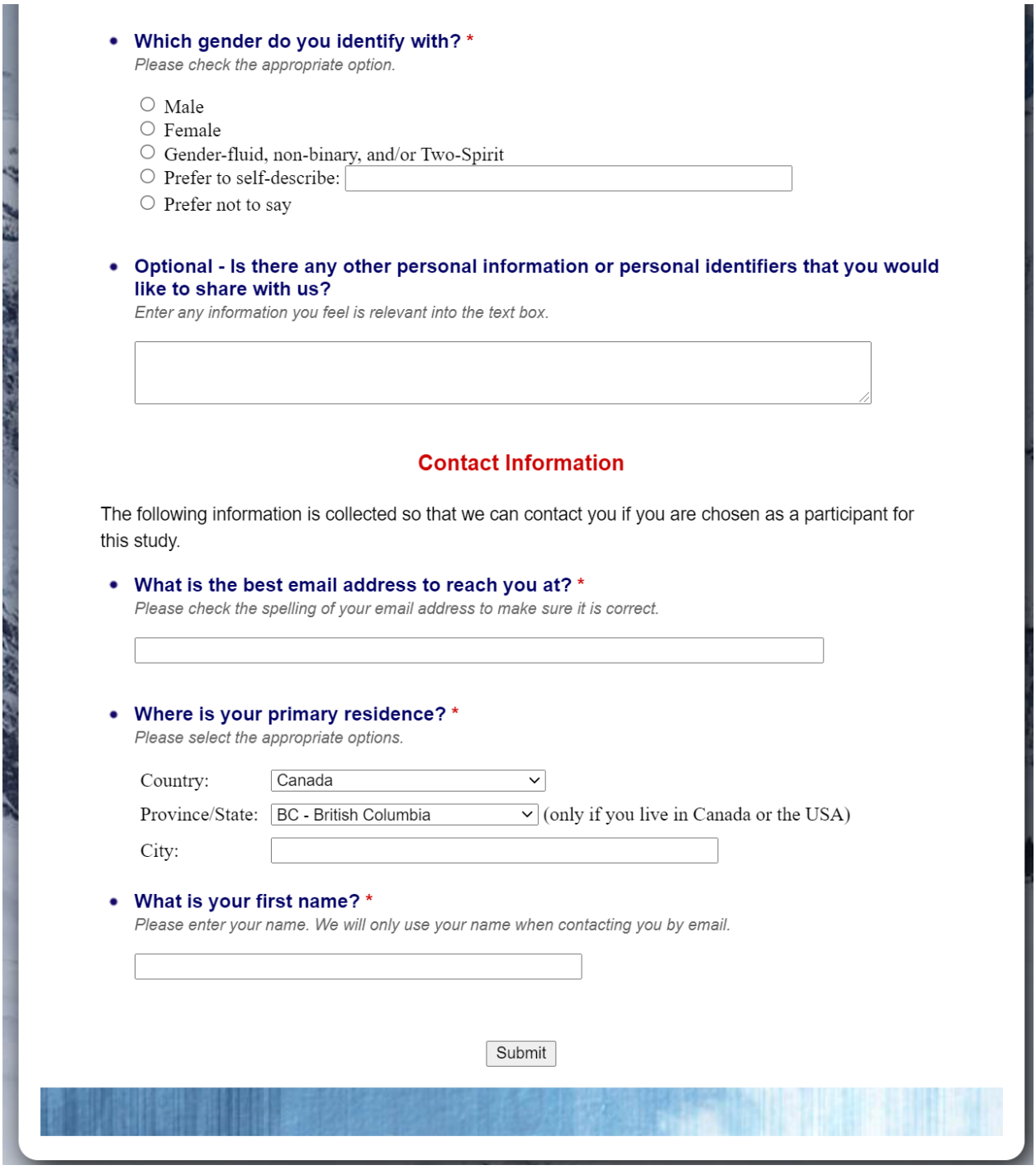


Figure B.5. Signup survey page 3

Research Team Profiles

It is important to us to create a research environment where research participants feel save and comfortable to share their opinions and perspectives with us without being judged. Part of this is to be completely transparent about who we are, where we have come from, and what our motivations are. This page provides some personal background information on the research team members involved in this study.

Rosie Langford (she/her)

Master's Student and Research Lead

Growing up in a family who values the outdoors, I am fortunate to have had the opportunity to begin my adventures in the winter backcountry at a young age where I found joy, freedom, and a strong sense of curiosity. This eventually motivated me to learn more about the winter backcountry and about how to be there safely. Now, I have the opportunity to both learn from and alongside others and also share what I have learned in my role as an avalanche educator, as a Director with Mountain Mentors, and in my master's research. I first joined the SFU Avalanche Research program as an undergraduate student in 2016 and am inspired by the opportunity to work at the crossroads of academia, backcountry recreation, and avalanche safety.

I am humbled by and grateful for experiences I have had, the places I have visited, and the people I have had the pleasure of being out with. I acknowledge the intersecting privileges I hold that have led to my learning and development in the both the academic and backcountry settings and am committed to working to ensure that others can access and enjoy safe experiences in the outdoors.

My role in this study is to conduct the one-on-one interviews and analyze the experiences and perspectives shared in the interviews to elicit meaning and gain understandings. In this sense, my role is to ask questions, maintain curiosity, to listen intently, and to learn from the study participants.

Figure B.6. Research team profile page 1

Pascal Haegeli (he/him)

Associate Professor and Supervisor

I found my love for the mountains, snow and skiing in my childhood in Switzerland where I was born and raised, but it was only during my early years at university that I started to ski in the backcountry. I had the fortune to have a few knowledgeable friends who introduced me to the craft of reading the avalanche bulletin, setting a track, and using a transceiver.

In 1998, I moved to British Columbia to pursue a PhD at the University of British Columbia focusing on avalanches, which allowed me to combine my interest in science with my passion for the winter backcountry. I simply wanted to learn more about how avalanches work and how to manage the associated risks. Over the last 23 years, I was fortunate to have worked with many amazing people who shared their avalanche experiences, knowledge, and wisdom, and I was lucky to find a way to contribute to the Canadian avalanche community with my academic skills. Since 2015, I have the pleasure to work with a wonderful team of students to explore interesting avalanche safety related research topics at Simon Fraser University. And even though I am not spending that much time in the backcountry anymore, my motivation to learn more about avalanches and help others to enjoy the backcountry safely remains the same.

My role in this project is to assist Rosemary and guide her research approach in the background to ensure we make the most out of her enthusiasm and research talent.

Land Acknowledgment

We currently live, work, and recreate on the unceded territories of the **xʷməθkʷəy̓əm** (Musqueam), **Sḵwx̱wú7mesh** (Squamish), **səlilw̓ətaʔɬ** (Tsleil-Waututh), **kʷikʷəƛ̓əm** (Kwikwetlem), **Lil̓wat** (Lil'wat), and **St̓át̓imc Tmicw** (St'at'imc) Peoples. We understand this acknowledgement to be a starting place for further reflection on historical and ongoing settler colonialism and for ongoing critical self-location. In addition to this statement, we hold ourselves accountable to meaningful learning and action at home, in the office, and on the skin track.

For more information on our perspective on justice, equity, diversity and inclusion, visit our JEDI positionality statement at https://avalancheresearch.ca/jedi/.

Close Window and go back

Figure B.7. Research team profile page 2

Appendix C.

User-targeted recruitment promotions

Figure C.1. User-targeted promotions, all

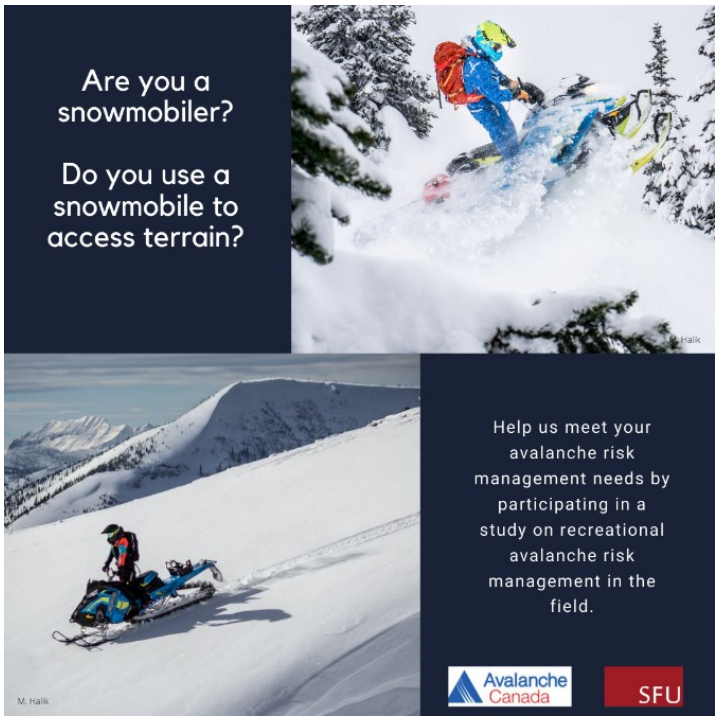


Figure C.2. User-targeted promotions, snowmobilers

Figure C.3. User-targeted promotions, snowshoers

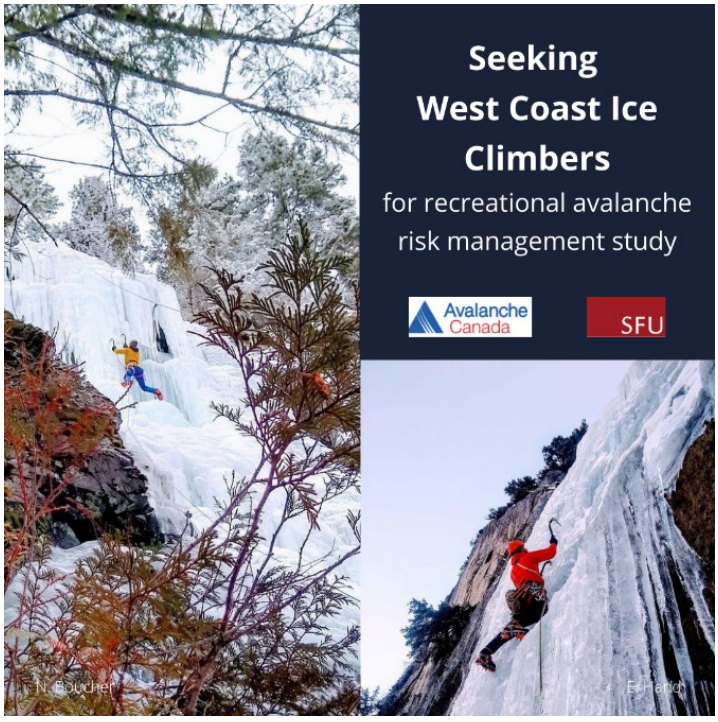


Figure C.4. User-targeted promotions, ice climbers

Appendix D.

Interview guide

INTRODUCTION

1. Welcome participant

2. Confirm participant name and pronouns

3. Introduce myself

- Name, pronoun
- My role in the study (to listen and learn)

4. Overview of the study (research questions, objectives)

- Introduce the nature of the interview **(no** right answers**, non-evaluative, conversational)**

5. Outline interview process

- Consent
- The interview will last approximately one hour with room to accommodate needs.
- Welcome to take breaks or opt out at any point.
- Time for feedback and/or questions at the end.

6. Questions?

7 Consent to start recording (Zoom)

BEGIN AUDIO RECORDING

Consent to participate in the study:

- Did you have a chance to review the study consent form ahead of time?
- Do you have any questions about the study consent form?
- Your consent indicates that you have received a copy of the consent form and that you consent to participate in this study. Considering that, do I have your consent to proceed with this interview?

PART 1: CONTEXT

1. Your primary backcountry activity is [signup survey response]. How did you first get into it? What were your first experiences like?

2. Today, what are your main motivations for engaging in winter backcountry recreation?

3. (If the signup survey indicates avalanche safety education) You also indicated in your sign-up survey that you've taken [signup survey response regarding avalanche education]. Can you tell me a bit more about that experience?

4. It sounds like you've gone [signup survey response regarding typical trips] … Are those typical backcountry destinations? Any others? What do you enjoy about these areas/why do you go there?

5. Is there anything else you'd like to share?

PART 2: TRIP PLANNING

6. How do you prepare for your day backcountry skiing?

7. What is the purpose of your trip plan?

8. Is there anything else you'd like to share?

PART 3: IN-FIELD AVALANCHE RISK MANAGEMENT

Let's take one of the destination examples you mentioned before and talk about how a backcountry trip would unfold for you.

9. How would you characterize your objectives (personal and group) on a backcountry trip? Can you describe what a successful day in the backcountry looks like for you?

10. Can you walk me through the process of achieving that objective(s)?

11. What information do you use when you're making decisions in the backcountry?

12. What do you do with this information?

13. Does this process ever change?

14. Do you use any supports in this process?

15. How confident and/or comfortable are you in your avalanche risk management skills?

16. How do you (/and your group) approach the decisions you mentioned?

17. Can you tell me a bit about where/how did you pick up these avalanche risk management skills?

18. So far, we have mainly been talking about the practices that you and your group use to manage avalanche risk when you're travelling in the backcountry. Have you seen or noticed other practices people use to achieve the same objective(s) as you?

19. Is there anything else you'd like to share?

PART 4: POST TRIP

You've done all this pre-trip planning, you've been out in the backcountry, and you've returned…

20. What happens then? How do you/does your group typically end a day in the backcountry?

21. Is there anything else you'd like to share?

PART 5: SPECIFIC EXAMPLES

22. Are there any situations that come to mind where you approached (or would approach) your avalanche risk management differently?

23. (If more detail is required about in-field practices) Do any stories come to mind that you feel are representative of the approach you've described?

REFLECTIONS

24. When you think about your experiences, are there any challenges that you encounter?

25. Thinking back to your earlier experiences in the backcountry, can you recall what your risk management approach was back then?

26. Do you have any goals for your activity? What do you think or feel you need to accomplish those goals?

27. Is there anything else you'd like to share?

EVALUATION OF INTERVIEW

I just have a few questions related to the interview experience (discuss the option to email the feedback questions if there is no time).

28. Do you have any feedback for me related to the interview process or the research project in general?

29. Is there anything else you think we should be asking?

30. Would you like to provide contact information for research updates or to be included in a larger, online survey in the future?

31. As you'll have read in the consent form, we would like to offer you compensation as a sign of our appreciation for your contributions to this study. You can choose either a $100 cheque or a $100 donation in your name to the Avalanche Canada Foundation (which will provide you with a tax receipt). Which would you like?

END AUDIO RECORDING

Appendix E.

Study participants

Table E.1. Study participants

Participant	Signup survey data
Clem	- Snowshoeing - 11-20 days out per year - Introductory avalanche safety training course (2013) - Indicated that they are actively involved in the local snowshoeing community
Kit	- Backcountry skiing - 2-5 years - 3-10 days - Age 25-34 - Introductory avalanche safety training course (2021) - Selected bulletin use description: I typically use the forecast to check the danger rating which informs my decision of whether or not it's safe to travel in the backcountry
Chris	- Snowshoeing - 2-5 years - 3-10 days - Introductory avalanche safety training course (2021) - Advanced bulletin use - Selected bulletin use description: I typically make a decision about where or when to go based on the nature of the avalanche problem conditions reported in the forecast and whether I feel that I can manage my travel in the terrain given these conditions - Described many trip destinations in a variety of terrain
Robin	- Snowshoeing - First year - 21-50 days - Age 45-54 - Introductory avalanche safety training course (2021) - Selected bulletin use description: I typically use the available information about the specific nature of the avalanche problem conditions from the forecast as a starting point for my continuous assessment in the field to confirm or disconfirm the information where I am travelling. - Described choosing to go on different trips "if it's safe to do so"

Table E.1. (cont.) Study participants

Participant	Signup survey data
Rowan	- Backcountry skiing - 2-5 years - 21-50 days - Included that they did not grow up in a place with snow and that they "learned everything recently"
Alex	- Snowshoeing - 11-20 days per year - Introductory avalanche safety training course (immediately before the interview) - Outlined a range of trip types - Identified themselves by their ethnicity
Blair	- Snowshoeing - 2-5 years - No formal avalanche safety training - Primary decision-maker - Selected bulletin use description: I typically combine the danger rating from the forecast with knowledge of how avalanche prone an area is to determine where I travel in the backcountry - Mentioned that they lead snowshoe groups
Bret	- Backcountry skiing - 20+ years of experience - 11-20 days out per year - Aged 55+ - Advanced avalanche safety training - Outlined a range of trip types
Riley	- Backcountry skiing - 11-20 years - 21-50 days per year - Age 25-34 - Advanced avalanche safety training - Range of trip types