

LEARNING FROM AVALANCHE ACCIDENTS: THE IMPACT OF THE WILSON GLADE PUBLIC ACCIDENT DEBRIEF

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ABSTRACT: On February 6, 2021, two backcountry skiing groups totaling eight people converged in Wilson Glade in the central Wasatch Mountains of northern Utah. A large hard-slab avalanche captured seven skiers; despite extensive rescue efforts, four people were killed. After the accident report and public forum were released, we surveyed Utah Avalanche Center users to understand what readers remembered and whether the event influenced later behavior. The 2021 survey produced 334 responses; 200 agreed to follow-up, and 74 responded in 2026. This paper compares immediate and five-year follow-up responses to identify durable learning, recall gaps, and reported behavior changes connected to accident reporting. The findings suggest ways accident reports and related outreach can better support long-term learning and safer backcountry decision-making.

KEYWORDS: Avalanche Accident, Education, Human Factors, Behavioral Change

1. INTRODUCTION

Public avalanche centers (PAC) in the United States have a mandate to support public safety through education, awareness, and forecasting avalanche hazard. Producing avalanche accident reports is a common practice for PACs but little attention has been given to how much participants learn or what role the format plays on retention, knowledge gained, or behavior change. On February 6th, 2021, two groups of backcountry skiers totaling eight people converged on the slopes of the Wilson Glade area in the central Wasatch Mountains of Northern Utah. Unaware of the presence of the other groups in the area, both parties were backcountry skiing in moderate avalanche terrain. While ascending, a large avalanche classified HS-Asu-R4-D2.5-O occurred, capturing and completely burying six of the skiers, while partially burying another. Despite a heroic rescue effort, four people died.

Avalanche accidents such as this are tragic and they have a profound impact on the local community. Recognizing the need to support backcountry users in making sense of the event, the Utah Avalanche Center held an innovative online forum to debrief the incident and answer questions from the public. Public avalanche centers often lead the accident investigations and report the findings to the public as an accident report.

Accident reports vary widely in depth. Some provide minimal information, while others include extensive weather, snowpack, terrain, and human factors details.

The Wilson Glade report and related public forum offered a detailed case for studying what the community learns from an avalanche accident (Utah Avalanche Center, 2021a, 2021b). This longitudinal research study surveyed participants in the months following the Wilson Glade accident and again five years later to answer the three research questions:

1. What event details did participants retain from the accident report and debrief?
2. What lessons did participants learn vicariously through this accident?
3. What behavioral changes did participants report five years later?

Through examining these three questions, the authors seek to provide insight into improved accident reporting methods with the goal of improving learning outcomes and preventing future accidents.

1.1 Background Literature

Cognitive science studies on effective learning from incidents (LFI) typically focus on memory, retention, recall, and knowledge acquisition. These studies are typically conducted in a clinical lab setting and are interested in the neurological and cognition of specific aspects of learning. While this can be helpful to inform the cognitive

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processes of learning, practically applying those findings is difficult.

More relevant is the literature from the broader safety community that focuses on naturalistic learning (in other words, how this is done in the real world). Much of this work focuses on disseminating information relating to safety events (Cooke and Rohleder, 2006) in the hopes that acquiring information equates to “learning”. However, research has shown this is not the case and efforts to improve safety outcomes in this way fall short (Turner, 1978; Smith and Defrates-Densch, 2008; LeCoze, 2013).

Public avalanche safety programs have begun studying the efficacy of learning practices in presenting avalanche safety information in bulletins (Fischer et al., 2022; St. Clair and Haegeli, 2023), in training courses (Dassler et al., 2023; Dassler et al., 2024), and via direct experiences (Homanen, 2021; Hetland et al., 2024). This study adds to the literature by examining the use of avalanche accident case studies for vicarious learning (Voit and Drury, 2006; Meyers, 2018) and how this relates to changing participant's behavior to inform their future backcountry activities (Custers, 2010; Meyers, 2022).

2. METHODS

The research used an online survey distributed shortly after the 2021 accident and a follow-up survey five years later in Spring 2026.

2.1 Survey Design

The 2021 survey comprised 30 questions, divided into four categories: demographics, describing the context for the event, recalling who was involved, and describing the rescue. The 2026 survey comprised 24 questions, divided into four categories: demographics, recalling event context and rescue, describing how this event influenced their behavior (if at all), and takeaways or lessons learned from the event.

2.2 Recruitment

The 2021 survey participants were recruited through a link posted on the Utah Avalanche Center website. The survey produced 334 responses. Of those, 200 agreed to be contacted later for a follow up survey. The follow up survey was sent via email in May 2026, receiving 78 responses. After exclusions, the analytic data sets included 256 responses from 2021 and 74 responses from 2026.

2.3 Analysis

For each individual survey, quantitative results (demographics, multiple-choice recall) were calculated as a percent of the total participants. Qualitative results (event description, behavioral changes, and lessons learned) were coded using a sequential recoding technique, starting with line-by-line open coding and abstracting to larger themes with each round of coding.

Sixty-seven participants were matched across surveys for direct demographic comparison. Aside from demographics, the questions in each survey differed enough to prevent direct comparison of other question types.

3. RESULTS

3.1 Participant Demographics

Table 1 summarizes the demographic information for 2021 and 2026 surveys.

Table 1: Summary of demographics

	2021	2026
Participants	256	74
Gender	66% Male 34% Female	65% Male 31% Female 4% Unknown
Age	14% Under 25 64% 25 – 40 22% Over 40	8% Under 30 65% 30 – 45 24% Over 45
Years of experience	58% 1 – 5 42% Over 5	53% 6 – 10 47% Over 10
Days per year in the backcountry	8% 1 – 2 21% 3 – 10 25% 11 – 20 31% 21 – 50 15% Over 50	18% 1 – 2 26% 3 – 10 27% 11 – 20 20% 21 – 50 9% Over 50
Avalanche education	27% Informal 58% Rec. 1-2 12% Pro 3% Unknown	16% Informal 62% Rec. 1-2 20% Pro 2% Unknown
Primary terrain	52% Simple 40% Complex 8% Extreme	45% Simple 47% Complex 8% Extreme
Primary equipment	80% use skis	88% use skis
Primary region	92% ski in the Wasatch	85% ski in the Wasatch

In 2021, the typical participant was male, age 25 to 40 who had less than six years of experience in the backcountry, took a Recreational Level 1 course, spent more than 10 days a year in the backcountry, primarily used skis, and spent time in simple to complex terrain in the Wasatch region.

The 2026 survey reflected a similar demographic, with age and experience increasing consistent with the five years between surveys. The most notable difference was a decrease in days spent in the backcountry. Of the 67 participants we successfully matched between surveys, 63% reported a decrease in days in the backcountry.

3.2 Event Recall and Description

In 2021, participants answered eight multiple choice questions about the involved parties, victims, and context of the day. Table 2 summarizes the responses to these questions.

Table 2: 2021 Multiple Choice Event Recall

	Correct Responses	Other Responses
# of parties involved	96% 2 Parties	3% 3 Parties 1% Don't know
# of people involved	56% 8 people	16% 4 – 6 people 25% 7 people 1% 9–10 people 2% Don't know
Victim Gender	96% Both male & female	2% Male only 1% Female only 1% Don't know
# of fatalities	77% 4 fatalities	14% 2-3 fatalities 8% 5-6 fatalities 2% Don't know
Equipment victims used	74% Skis	25% Mixed ski and snowboard 1% Snowboard
Avalanche equipment victims carried	78% Probe, Beacon, & Shovel	14% Also said air-bag
Forecasted avalanche hazard	41% Considerable 44% High	7% Moderate 6% Extreme 2% Don't know
Weather that day	77% Clear & calm 10% Moderate wind	11% Overcast 2% Moderate snow 1% Strong wind

The 2021 participants were also asked to describe the snowpack that day, the avalanche observations of each party as they approached Wilson Glade, and the rescue efforts after the avalanche. This section will describe each in turn.

For each of these open-ended questions, participants were brief but accurate in their descriptions. Most participants mentioned only a few factors in the snowpack, rescue, or observations, but they were typically correct.

3.2.1 Snowpack Descriptions

Participants primarily described that there had been a persistent weak layer (50%) with new snowfall on top (35%) and buried facets at the

base (19%). The danger rating that day was considerable to high (30%), depending on the elevation at that aspect (22%). Demographics did not noticeably impact how many factors participants described, but it did impact the language they used and details they prioritized. Participants with formal avalanche training (Rec Level 1 – 2, Professionals) used more detailed technical language (e.g. persistent weak layer, column test, facets, depth hoar, etc.) and were more likely to mention how aspect and elevation played a role, how deep the weak or faceted snow was, how there were many recent avalanches, and how the snowpack problems had been ongoing throughout the season.

3.2.2 Avalanche Observations Descriptions

On their approach, both groups saw signs of large natural avalanches on similar aspects and elevations as Wilson Glade. Only 6% of participants recalled that both groups saw avalanches. 29% couldn't recall anything about the observations. The remaining participants remembered that one group had seen avalanches, described other warning signs not mentioned in the report (e.g. sluffing, whumping) or commented on mindset (e.g. they thought they were playing it safe enough, knew about the forecast) and/or activities (e.g. they didn't dig a pit, they had already skied multiple runs) instead of observations.

3.2.3 Rescue Descriptions

Participants frequently used general descriptors for the event such as heroic, skilled, tragic, confusing, and/or complex. When describing details, they focused primarily on:

- **Set up:** where people were when the avalanche occurred, how many parties were present, what they were doing when the avalanche occurred, who was buried and who wasn't, and how Chris & Steve evaded being buried
- **Outcome:** Number of rescuers, number of people saved and from which party
- **Rescuer roles:** Chris lead, Steve assist, Nate joins to assist and provide medical care
- **Sequencing** of unburied victims

Participants were less likely to mention details on:

- **Equipment:** switching to beacon search, deploying avalanche probe
- **Search strategy:** partially unburying people to assess before moving on, surprised to find another group
- **Coordination:** Chris yelling for help from Steve, calling 911, Heli teams have difficulty landing, Asking Nate to assist

- **Medical care:** CPR, clearing airways and checking pulses
- **Afterwards:** Search and rescue evacuations for survivors, return for victims next day

Participants also noted constraints that made it difficult for the rescuers to save everyone. First, the number of victims outnumbered the rescuers, and rescuers didn't have enough time to dig everyone out before they ran out of oxygen. The rescue was also complicated by the surprise of multiple parties involved and how deeply buried the victims were.

3.3 Behavioral Changes

In 2026, participants were asked if they had changed their plan or behavior based on this event. 43% responded yes. 45% responded that they were not sure if it was related specifically to the Wilson Glade Accident. 12% responded that there was no impact on their behavior, often noting that they have always been very conservative in the backcountry.

As a follow-up question, participants were asked to describe their behavior change. The responses were organized into the following five topic groups.

3.3.1 Interaction with Others

Most commonly, participants said this accident made them more cautious around other parties in the backcountry. Many participants described this as keeping an eye out for other groups above and below them (28%). Some said they avoid or use extra caution in popular / crowded areas (8%). A few mentioned talking more within their group (3%) and talking more with other groups they cross paths with (3%) to make sure no one is skiing on top of others.

3.3.2 Persistent Weak Layer

Participants also reported that this accident compelled them to stay up to date on the possibility of a persistent weak layer (PWL) and to use extra caution in terrain choice when a PWL is possible (18%). A few people mentioned that PWLs are too unpredictable to think they can be controlled (3%). Many of the participants who mentioned PWL said they avoid avalanche terrain altogether when a PWL is present (9%).

3.3.3 Route selection

Many participants mentioned that this accident influenced them to think more about the safety of their uptrack (15%) and route choices (8%) to avoid exposing themselves and their group to overhead hazards. Some participants also developed touring strategies and/or heuristics for doing this. For example, one person mentioned that

they always try to ski in a manner to avoid having people above them without their knowledge.

3.3.4 Environmental Scrutiny

Participants listed a variety of factors they pay more attention to, in the planning stage and out in the backcountry. These include overhead hazards, the forecast, slope angles, aspect changes, small rollovers, and rescue gear available. Most notably, participants mentioned being more cautious in terrain that's borderline avalanche terrain. To them, this means being more careful in areas that are approaching 30 degrees or have small sections that tick just above 30 degrees, especially when a persistent weak layer is present.

3.3.5 General Risk Reduction

Another common sentiment was that this accident influenced participants to generally reduce their risk-taking (11%) and maximize their safety margins (3%). Some participants said they reduce risk-taking if a PWL is present, on considerable to extreme danger days, or generally. A few participants described that they are less confident overall, hesitant to ski Wilson Glade, or hesitant in the Wasatch generally after this accident.

3.4 Lessons Learned

In 2026, participants were asked if they shared the lessons they learned from this event with others. 64% said they had shared with others. 24% could not recall. 11% said they did not share. The remaining 1% left the question blank.

Table 3 compiles participants' takeaways and lessons learned from across the 2026 questions, organized into five topic groups: snowpack and forecast, route selection, coordination, rescues, and other lessons.

Table 3: Lessons Learned and Takeaways from 2026 Survey Participants

Snowpack & Forecast
1. It's better to stay home than to try and "solve" the persistent weak layer problem. They are "insidious," "unpredictable," uncontrollable, and "often unsurvivable when they release due to their depth." There can be so many overlapping factors that it's difficult to assess the current risk in the field, and you "may not observe any typical indicators of instability (cracking, collapsing, recent loading) leading up to the avalanche." As a result, "the only way to guarantee safety is to avoid avalanche terrain where these persistent weak layers are present." 2. Don't underestimate terrain. "Slopes that look friendly and fun [just] over 30 degrees can still kill you on the wrong day." 3. "Avalanche terrain is avalanche terrain, regardless of whether or not I have ever seen or heard of it sliding." 4. Consider the forecast over time, including weather in the area for the season, weather the week leading up to a trip, and the forecast for the day. 5. Make conservative choices after big weather events. It's tempting to go big on the first big sunny pow day, but days like this are a risk if the snowpack hasn't fully healed. It's better to continue with mellow terrain for the first several sunny pow days.
Route Selection
1. "Mellow terrain connected to bigger, steeper slopes isn't necessarily safe." Terrain that is near 30 degrees has possible avalanche risk even if it feels low angle. This is especially if there are pockets that tick up above 30 degrees. "You can be in low angle terrain and still be very exposed" due to overhead hazards, connected terrain, and proximity to other groups. It's difficult to judge the connectivity between low angle terrain and avalanche terrain nearby. 2. Choose your uptrack wisely because locked toe pieces increase risk. Don't approach through avalanche terrain if another group is on top. Don't assume an established skin track is safe or stable. Try to increase your margins and limit exposure. Consider who might be below you when you start to cross avalanche terrain. 3. Limit exposure to one person at a time. "We need to be better about limiting our exposure and increasing our margins in the backcountry." Even heroic efforts are unlikely to save everyone when more people are buried than available to perform the rescue. 4. Slopes that gain a reputation for being safe/easy and slopes you are already familiar with can still be dangerous. It's dangerous to assume that a slope is safe because it has that reputation or because you're familiar with the area. Re-evaluate these assumptions often. 5. "Trees do not equal safety." Trees on steep slopes can slide. Trees on low angle slopes below avalanche terrain can be a terrain trap. 6. Choose more cautious routes in crowded avalanche terrain. 7. Being in or below avalanche terrain is a risk. You have to be aware that you are risking your life any time you travel in or beneath avalanche terrain. 8. Watch for overhead hazards. 9. Consider relative versus actual safety. Ask yourself if the area is actually safe, or if it's just relatively safe compared to other options you've considered. For example, one participant said, "I always ask myself now 'Am I assessing this terrain in terms of its RELATIVE danger, or am I looking at it with a clear view of the dangers it presents? Does it look mellow relative to the steeper slopes but still is >36*?'"
Coordination
1. Look out for other groups both above and below you. 2. Exchange plans with other groups you pass to be aware of where others are around you. 3. Talk more with your group about plans, to avoid exposing multiple people at the same time. 4. Your actions can change the lives of others. This is also true in the reverse: you can prepare as best you can, "but the actions of others can change your life as well." 5. Avoid or use extra caution in popular and crowded areas. 6. Consider what is a manageable group size. For example, one participant suggested that you shouldn't travel in groups bigger than 3 people.
Rescues
1. Use your resources efficiently in the rescue. Examples were to ask unburied victims to help search for others, to dig people out only enough to clear their airway before moving to the next signal, to turn off beacons as you unbury people, and to generally triage victims. 2. Prepare for rescue events to be ready to respond quickly. Suggestions were to practice rescue techniques for individual and multiple burial situations, to practice with and understand your gear, to learn to triage victims, to take first aid and rescue courses, and to stay physically fit to be able to dig others out.
Other
1. Consider high consequence events when planning a trip and making ad hoc decisions in the backcountry. 2. Accidents can happen to experienced, knowledgeable, and well-trained groups. Many others could have made the same decisions and ended up in the same situation as these parties. 3. Always be willing to change your objective. "It will snow again and there will be a day where the terrain choice is 'safer'." "Don't get caught in FOMO." 4. Avalanche fatalities have long-lasting impacts on families and friends.

4. DISCUSSION & RECOMMENDATIONS

These findings demonstrate that there is moderate recall of specifics from avalanche accident reports, that behavioral changes result from sharing accidents, and that readers remember different lessons from the same accident. Many of these behavioral changes and lessons are desirable as an outcome for a public avalanche center who is likely to be the author(s) of the report.

The following section focuses on recommendations for public avalanche centers who want to enhance the value of the efforts in communicating post-incident findings.

4.1 *Collaborating with the Public*

The survey demographics highlight that avalanche accident reports serve a wide variety of readers. Therefore, what readers know and what they are going to learn from an accident report is going to vary. Public avalanche centers should consider how their current report formats address the varied education, experiences, and goals of the readers. For example, writers must consider how the report helps (a) educate a 20-year-old in their first season without any formal avalanche training who wants to understand how to avoid similar situations, (b) recalibrate a 30-year-old who took their Recreational Level 1 training five years ago who might have made similar decisions as the participants of this event, and (c) inform a 45-year old professional forecaster in another area who wants to prevent similar accidents for their community.

However, no single author will be able to represent all the perspectives and possible lessons. Typically, avalanche accident investigators have significant training in snow science, a deep understanding of the snowpack for that season, and familiarity with the area. On top of that, they become experts in the details of the accident through the investigation. This expert perspective will limit them from being able to fully anticipate what is unclear to less experienced readers and, given the variability in knowledge and experiences, what lessons they learn from the event.

Therefore, we suggest that the completion of the accident reports should be a starting point for learning. What constitutes lessons learned is an ongoing dialogue between expert authors and their readers in the community. Meyers (2018) refers to this as coactive vicarious learning (CVL) and notes that “it is only through the discourse emerging from interaction with others that individuals come to understand the meaning of an experience, and this meaning is co-created with

their interaction partners, making these interactions fundamental to learning” (p. 613). By creating a forum for readers to ask questions, the Utah Avalanche Center shifted the focus from learning as static consumption of a final report to learning as a dynamic dialogue between the public and the forecasters, as well as between members of the public themselves. The online forum became a part of an ongoing ‘dialogue’ when the center later posted the Questions & Answers (Staples, 2021). Expanding the concept of accident reporting to include a dynamic, co-created learning process could be achieved in multiple stages in the reporting process. Consider the following methods: early readers, public Q&A, and a living list of lessons learned.

4.1.1 *Early Readers*

In a complex social and physical phenomenon like an avalanche accident, there will always be remaining questions when it is released to the public. However, some of those could be anticipated and addressed if it were sent out to a subset of community members representing a range of experiences (professionals, first year back-country users, Recreational Level 1 students, community leaders, etc.) who could provide feedback on questions they still have and what they learned from the report. This allows the report’s authors to clarify some of the open questions and augment the lessons learned before publishing it for the public. Considerations may be necessary to balance tight timelines surrounding the completion of the report with the methods of engagement, and to avoid dissemination of incorrect information.

4.1.2 *Public Q&A*

Following the publishing of the report, public avalanche centers could consider the role of a synchronous public debrief to provide a forum for community members to directly ask questions. Questions could be collected in advance via survey or, question box at the bottom of the report, or via a follow-up email with debrief participants. A proportionate amount of time should be allocated for an interactive dialogue during the public debrief and pre-collected questions integrated with real-time audience queries. “CVL emphasizes interpersonal interactions as the key site of vicarious learning, focusing on the joint, interactive processing of an experience between individuals (i.e., learners and models), whereas observational approaches focus on individuals’ opportunities to observe the behavior of a model, viewing observation and imitation as the key activities

by which individuals learn from others at work” (Meyers, 2018, p. 614). To capture the interactive dialogue for later readers, authors can either update or supplement the original report with answers to questions. The Utah Avalanche Center demonstrated this by posting written Questions & Answers (Staples, 2021) following the Wilson Glade public debrief. It’s key that supplements such as these get incorporated into the original report directly or linked as supplement material, so other readers can find them. To cater to readers of a variety of backgrounds, it is also key that these events answer questions ranging from “obvious” to highly nuanced or technical.

4.1.3 Living list of lessons learned

Like the Q&A, public avalanche centers can crowd-source lessons as a way of eliciting opportunities to calibrate mental models (Maguire et al., 2023) surrounding the technical aspects of a specific event. This acts as feedback for the avalanche center on what takeaways people of different experiences have. The authors can then amplify lessons they agree with and offer alternative interpretations for lessons that are not advised. For example, the Wilson Glade event reminded and/or taught many participants that “trees do not equal safety” (See Table 3). Trees on low angle slopes with overhead hazard can become a terrain trap. This lesson was not included in the original report but could be amplified by the authors after hearing it from the community. In contrast, some participants attributed the accident to an “expert halo” even though the report provided little evidence of such. After hearing this, the authors could use this as a teaching opportunity to explain why this is not a good example of that heuristic and point readers to more pertinent examples. In doing so, the community develops a more informed perspective on technical and human performance concepts.

4.2 Balancing Event Details & Long-term Learning

The data shows that participants’ recall and description of the event was relatively shallow compared to the degree of detail in the official accident report (Utah Avalanche Center, 2021a). However, their self reported behavioral changes and lessons learned have more depth than what was suggested at the end of the official accident report. This suggests that while event recall may degrade over time, concepts that are well integrated into one’s own knowledge have significant staying power.

This does *not* mean authors should scale back the details in their reports. Frequently accident reports seek simplicity, based on the common belief that the author is writing for a reader who will not complete reading the report if it is too long or too detailed. However, the details are necessary for community members to identify their specific knowledge gaps and backcountry practices that may need to be updated. The details are necessary for readers to appreciate the complexity of avalanche accidents and calibrate their mental models. Perhaps most critically, the details may help in pattern recognition to notice similar signs of danger on their own trips early enough to adjust decision-making.

Instead, public avalanche centers should sustain their commitment to the event details *and* provide conditions to promote coactive vicarious learning. Public avalanche centers could operationalize this finding by considering how supplemental materials like blogs and social media posts could narrow in specific topics drawn from themes that emerge from cross-incident analysis. Given the high public engagement with the webinar for this accident (~8700 views), public avalanche centers could benefit from cross-promotion of their supplemental materials and written reports with social media and webinar outreach (Utah Avalanche Center, 2021b).

5. CONCLUSION

Avalanche accidents offer a distinct opportunity for vicarious learning through others’, sometimes tragic, experiences. Enhanced integration and synthesis of lessons learned is possible through coactive vicarious learning whereby the intended audience becomes part of the co-creation process of enhancing knowledge and awareness. This ‘learning in public’ is possible with dialogues facilitated by public avalanche centers. A well-written and detailed accident report should be seen as the starting point for a dialogue that influences future decision-making and choices in the backcountry. Further research is needed for closer examination and efficacy of various learning activities like online public forums for backcountry audiences.

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