

ACCEPTANCE OF RISK AND CONFIDENCE ASSESSING AVALANCHE TERRAIN AND  
CONDITIONS – A LARGE CROSS-SECTIONAL STUDY

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ABSTRACT:

The COVID-19 pandemic impacted the ski industry worldwide by closing or limiting access to ski resorts. We previously reported the results of our study looking at the impact of Covid-19 on backcountry skiing and riding. This study attempts to identify and quantify the willingness to accept risk, and to gauge self-perceived ability to assess hazards in the backcountry setting. Finally, we analyzed the data for correlations between these variables.

Self-identified backcountry skiers and snowboarders (aged  $\geq 18$  y) in the United States and Canada completed an anonymous 29-question online survey distributed primarily by regional avalanche centers, education providers, and skiing organizations (n=4792).

Multivariable linear regression models were used to test the associations between predictors and outcome variables. Kendall's tau-b correlation coefficients were used to measure the strength of the associations. Percentage bar chart was used to present the association between willingness to take risks and self-reported ability to assess avalanche risk in avalanche terrain.

Confidence in assessing avalanche terrain was positively correlated with the willingness to take risks and the level of avalanche training. There was also a correlation with factors such as years and days per season backcountry skiing. Female respondents were found to have less willingness to take risks and lower self-reported ability to assess avalanche risk in avalanche terrain, compared to male respondents.

Building on the work of Hendrikx, Johnson, Mannberg, McCammon and others, we hope this information may be used to address issues of risk assessment and over-confidence in avalanche classes.

KEYWORDS: Backcountry skiing, avalanche, risk

1. INTRODUCTION

The emergence of the coronavirus (COVID-19) pandemic in 2019 instigated a series of unprecedented disruptions to various aspects of lifestyle worldwide. Within the complex tapestry of changes, one sector profoundly impacted was the outdoor ski and snowboard industry. Most ski resorts closed in March of 2020, resulting in a landscape where access was limited, and norms were reshaped.

The consequence of such closures was a marked upswing in the number of individuals backcountry skiing and snowboarding. Notably, 81% of prior backcountry enthusiasts noticed increased numbers in the field, while 17% increased their own time in the backcountry (Valle 2022). As this shift from resort-oriented activity to backcountry exploration gained momentum, it ushered forth a host of concerns within the skiing community. One of these concerns rested on the potential for inexperienced entrants to expose themselves to risky behaviors and challenges far exceeding the confines of traditional resort settings.

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Emerging evidence highlights the influence of self-perceived risk and the allure of reward and recognition as determinants propelling

individuals beyond their established capabilities within the backcountry milieu. Riders who venture into precarious terrain demonstrate a pronounced propensity for recounting daring exploits and displaying an increased willingness to tackle even riskier lines when compared to those who don't (Mannberg 2021). Many decision-making processes associated with skiing are influenced by cognitive heuristics, which, at times, can lead to inadequate avalanche safety measures. These heuristics encompass factors such as familiarity with the environment, acceptance in a social scenario, consistency with prior decisions, trusting informal leadership, overestimation of resource value (such as fresh snow), and social facilitation. These cognitive shortcuts operate largely on an automatic level, contributing to suboptimal outcomes (Johnson 2020).

The principal objective of this presentation is to explore the interaction of experience, training, and demographics with risk tolerance, and how these factors affect decision-making in the backcountry. Through unraveling these intricate connections, our study seeks to provide valuable insights into the evolving realm of backcountry skiing and snowboarding. This underscores the critical importance of equipping backcountry enthusiasts not only with the requisite knowledge and skills, but also the proper attitudes.

## 2. METHODS

In this report, we present a subset of data collected by Valle, et al (2020) in March 2021 from the study titled "Perceptions Among Backcountry Skiers During the COVID-19 Pandemic: Avalanche Safety and Backcountry Habits of New and Established Skiers." (Refer to original study for explanation of study methods.)

The questionnaire covered several areas, including self-reported skiing/riding ability, avalanche education, risk comfort, confidence in assessing avalanche terrain, and the impact of the COVID-19 pandemic. The design of the questions drew inspiration from prior studies with established content validity.

Participants were categorized into three cohorts based on their reported seasons of backcountry experience. Those for whom 2020 to 2021 marked their first or second backcountry season constituted the "beginner cohort," while participants with more than two but less than seven years of experience were classified as the "experienced cohort," and participants with more than seven years of experience were the "expert cohort."

Kendall's tau-b correlation coefficients were used to measure the strength of the associations. Univariable and multivariable linear regression models were used to test the associations between predictors and outcome variables.

In this analysis, confidence in assessing avalanche terrain was treated as a quantitative variable and coded as follows: 0=Not confident at all, 1=Confident in simple conditions and terrain, 2=Confident in moderately complex conditions and terrain, 3=Confident in all conditions and terrain. The significance level was set to 0.05. Statistical analysis was performed using SPSS 25.0, with figures generated using R version 4.0.4 and the ggplot2 package.

## 3. RESULTS

As previously documented, the survey garnered a comprehensive dataset comprising 5674 responses spanning the survey duration from March 1, 2021, to March 31, 2021. Following the exclusion of 882 participants who provided responses solely to the initial one or two queries, a total of 4792 valid responses were retained for analysis. The largest respondent group, constituting 49% (n=2338), came from backcountry and avalanche education sites. This was followed by referrals from US avalanche centers, which accounted for 31% (n=1494) of the participants, and media or social media platforms, encompassing 16% (n=746) of the sample. Almost all

respondents originated from the United States (99.6%), and within this group, 70% identified themselves as male. The median age stood at 34 years, accompanied by a standard deviation of 12.4.

This current investigation is focused on three pivotal facets, namely risk acceptance, the extent of avalanche training, and the self-identified confidence in assessing avalanche terrain. As delineated in Figure 1, an affirmative association emerged between self-acknowledged risk propensity and the confidence assessing avalanche terrain, as denoted by a Kendall's tau-b correlation

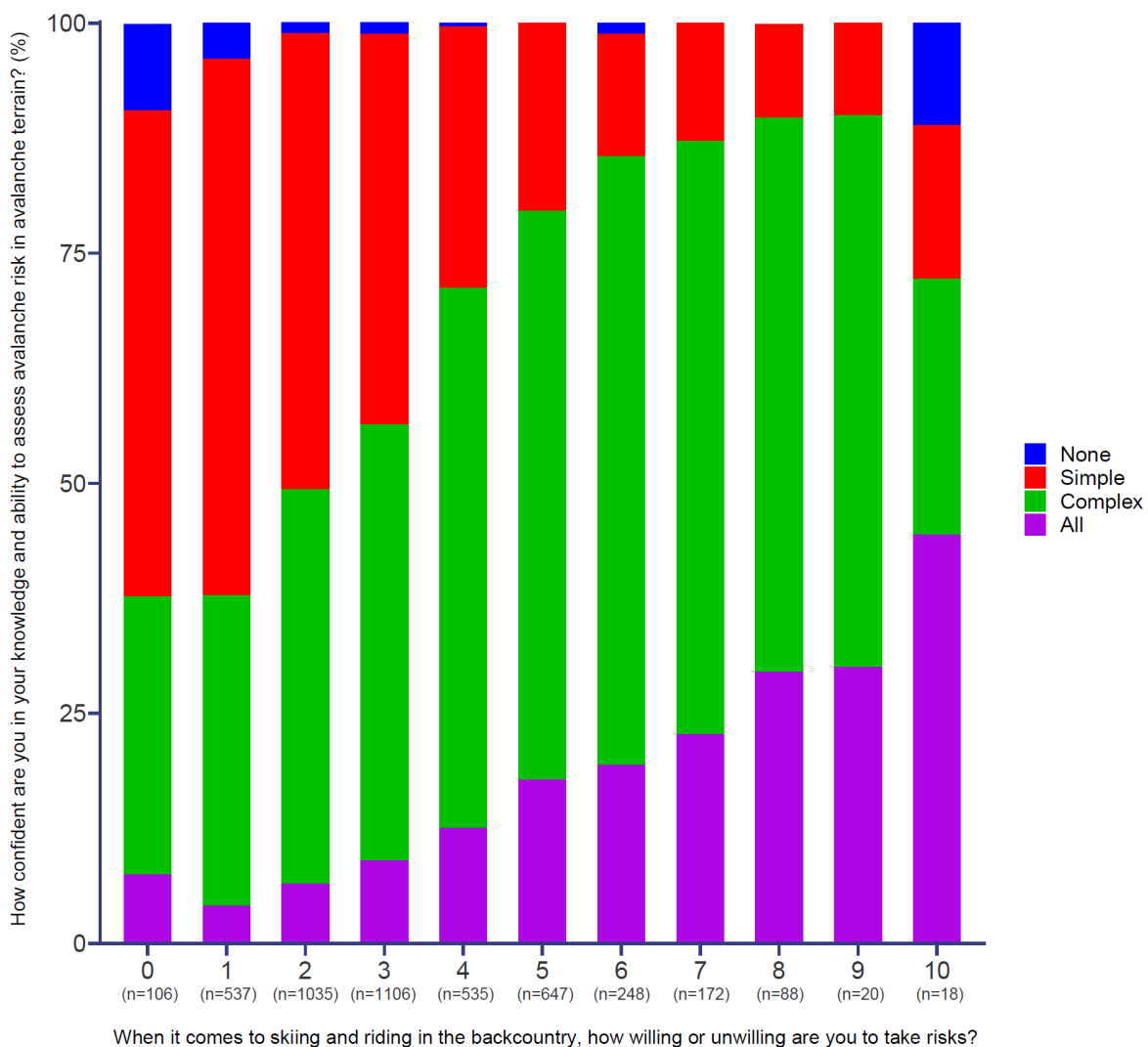


Figure 1: Willingness to take risk vs. confidence in assessing avalanche terrain.

coefficient of 0.287.

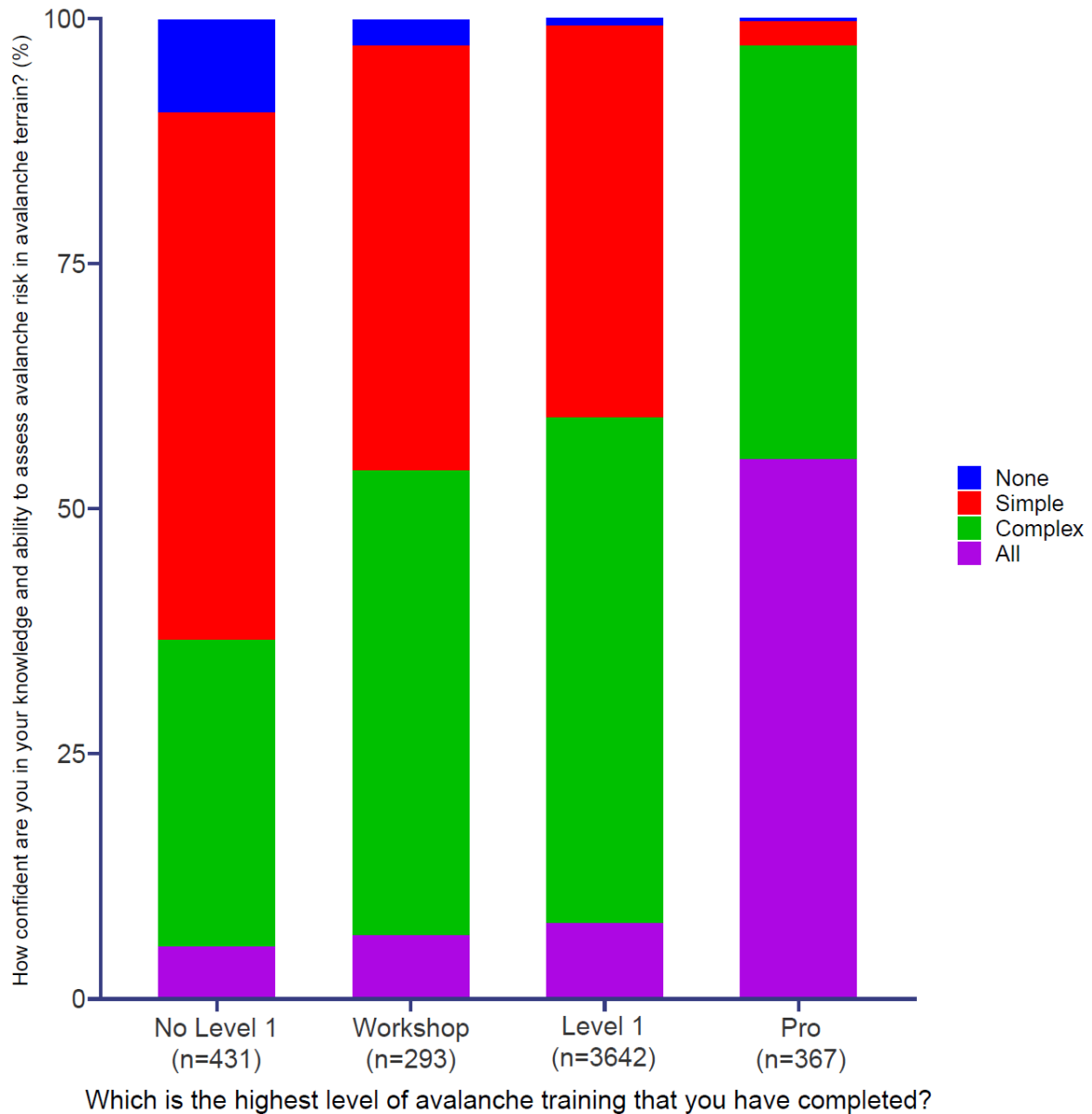


Figure 2: Level of training vs. confidence in assessing avalanche terrain.

Subsequently, an examination was conducted to examine the relationship between the level of avalanche training and the degree of self-confidence exhibited in assessing avalanche terrain. The average level of confidence demonstrated a positive correlation with the extent of training, exhibiting a correlation coefficient of 0.282. As illustrated in Figure 2, an increase in confidence became apparent as individuals acquired greater levels of training, with a pronounced upsurge observed upon reaching the professional tier of training.

Analyzing confidence levels when it comes to evaluating avalanche terrain within each group, it's evident that while self-assessed competence

does improve with training, as depicted in Figure 3, more than 30% of individuals lacking level 1 avalanche training still expressed confidence in appraising complex terrain.

When analyzing the relationship between avalanche training levels and risk taking, as depicted in Figure 4, our observations indicate that two specific groups exhibited risk-taking tendencies similar to the overall mean. These groups include individuals with no formal avalanche training and those with advanced, professional-level training (risk scores: no training group - 4.20, pro level training group - 4.26). Notably, the group without any training comprised only 25.

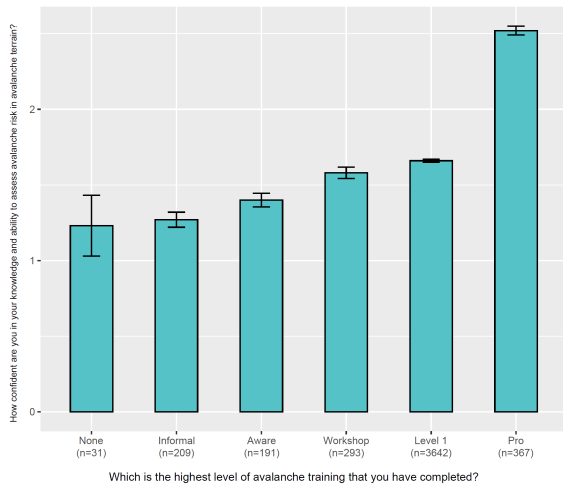


Figure 3: Confidence in assessing avalanche terrain vs. highest level of avalanche training.

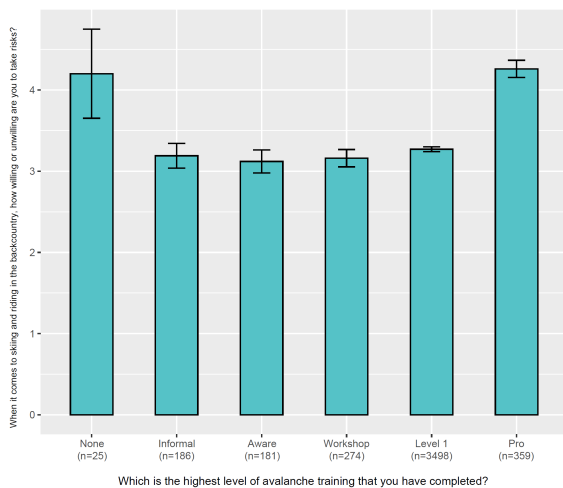


Figure 4: Highest level of avalanche training vs. willingness to take risks.

Analyzing the demographic characteristics of the respondents, we found that males exhibited a notably higher degree of self-confidence when evaluating avalanche terrain (males=1.78±0.673, females=1.50±0.655, p<0.001). Upon introducing age as a covariate, a subsequent analysis demonstrated that the level of confidence among males exceeded that of females by 0.268 units (p<0.001). Moreover, a substantial correlation was observed between confidence and both years of experience (correlation coefficient = 0.454) and the number of days per skiing season spent engaging in backcountry skiing (correlation coefficient = 0.425). Intriguingly, a more nuanced relationship surfaced regarding age, with confidence exhibiting only a modest correlation

(correlation coefficient = 0.079). These revelations underscore the multifaceted nature of confidence determinants in the assessment of avalanche terrain, with gender, experience, and frequency of backcountry skiing proving to be pivotal elements in shaping individuals' self-assuredness in this context.

#### 4. DISCUSSION

Our large sample allowed us to explore not only how the Covid-19 pandemic affected backcountry skiing (reported previously), but also to examine how self-identified risk taking may influence decision making in the backcountry. Notably we found that increasing self-identified risk taking is correlated with increased confidence in assessing avalanche terrain, a perception-action linkage that is unsurprising and correlates with Mannberg et al (2021), who found that risky behavior among backcountry riders is, in part, a function of their self-conception as consumers of risk. A particularly interesting finding of our study is that risk taking level was similar for all levels of avalanche training except for those with no training and those with Pro training. While the small numbers (25) in the “no training” cohort may have allowed for skewing from 2 who reported a confidence of 10 out of 10, this may be consistent with the Dunning-Kruger Effect, that beginners often don't know what they don't know, and therefore may be (dangerously) overconfident (Kruger 1999).

We also found that confidence in assessing avalanche terrain gradually increases with the level of training, but with a large jump as respondents went from Level 1 to Pro. This may be due to the combination of increased education and increased time spent backcountry skiing, as they both correlated with increased confidence. These trends in confidence enhancement through enhanced education and experience mirror the trends observed in gender and years of experience. In line with the patterns elucidated earlier, we observed analogous associations in these domains. This is particularly concerning, given that recent trends, as documented by Peitzsch, et al 2020, reveal that the older and more experienced backcountry skiers are over-represented in avalanche fatalities. By

recognizing these correlations, we deepen our understanding of the intricate interplay between demographic, experiential, and educational variables that contribute to shaping confidence levels within the realm of backcountry activities.

What we don't know is whether this confidence is well placed, and whether it matches their true ability. Of concern is that so many novices felt comfortable assessing complex avalanche terrain. This may suggest that avalanche classes should focus more heavily on differentiating simple from complex terrain and helping students understand more of the challenges in evaluating complex avalanche terrain.

It is important to acknowledge several limitations in our study. Although achieving a high response rate is usually a positive for any survey, the substantial sample size may have allowed for the identification of correlations that, while statistically present, may not hold substantial clinical significance. To mitigate this concern, our reporting focused primarily on correlations characterized by higher coefficients, thereby prioritizing those with more robust associations. Another limitation is that a substantial majority of respondents were drawn from individuals who had encountered our survey through avenues such as avalanche education course providers or avalanche forecast centers. This demographic composition potentially introduces a bias, skewing our findings away from individuals who lack interest in participating in avalanche education programs or who do not consult avalanche forecasts as part of their backcountry activities. Lastly the absence of precise definitions for terms denoting avalanche terrain complexities, such as "simple," "complex," and "all." may have led to divergent understandings among respondents, possibly resulting in an underestimation of the true import and implications of these terminologies. The implications of these limitations warrant careful consideration when interpreting the findings of our study and underscore the necessity for future investigations to address these constraints in a more comprehensive manner.

## 5. CONCLUSIONS

In the context of this large internet-based survey conducted among backcountry skiers during the winter and spring of 2021, notable insights emerged. We observed a positive correlation between self-identified risk propensity and the increasing levels of formal avalanche education, both of which were similarly associated with heightened confidence in assessing avalanche terrain. However, a notable area of concern manifested in the considerably high levels of confidence exhibited by respondents, even in instances where their training was minimal or absent.

Our findings that backcountry skiers express surprisingly high levels of confidence assessing avalanche terrain suggests that this might be an appropriate focus for avalanche education. By incorporating these insights, educational programs and forecasts can be strategically designed to effectively communicate risk factors, while remaining cognizant of the propensity for individuals to overestimate their own capabilities. This study's contributions extend beyond the present moment, potentially steering the trajectory of avalanche education to better address the perception-action gap and foster a community of backcountry enthusiasts who are both safer and more informed.

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