INITIAL EXPLORATIONS ON HOW SKITOURENGURU AFFECTS USERS' TRIP PLANNING AND AVALANCHE SAFETY PRACTICES

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ABSTRACT: Skitourenguru (STG) supports backcountry skiers by automatically combining public avalanche forecast information with terrain characteristics to provide route-level risk ratings. While online tools like this can help users plan backcountry trips, their effects on users' decision-making, confidence, and avalanche safety practices have not been examined in detail. Using responses to an online survey conducted during the 2025/26 winter season, this study explores how STG users incorporate the platform into their trip planning process, how strongly they rely on its risk assessments, what benefits they perceive, and how its use influences interest in further avalanche safety education. Responses from 851 survey participants indicate that STG is primarily used to obtain first impressions of route suitability and identify lower-risk trip options. Median reported reliance on STG risk assessments was 67 with distinct peaks and varying with route familiarity and avalanche danger level. Consulting STG increased median trip-planning confidence from 67 to 82, but we observe distinct subpopulations. Participants valued faster trip planning and improved understanding of how avalanche forecasts apply to terrain. STG did not reduce interest in further avalanche safety education. This study contributes to a growing body of research to better understand the effectiveness of avalanche risk communication tools and provide scientific evidence to guide future developments. Having a comprehensive perspective of the benefits and potential unintended negative impacts of a product is critical for understanding its overall effectiveness.

KEYWORDS: Decision support tools, trip planning, automation.

1. INTRODUCTION

When planning a winter trip, the task of backcountry users is to inform themselves about the existing avalanche conditions, evaluate trip options, and select a trip that achieves their personal objectives without unnecessary exposure to avalanche hazard. For most users, public avalanche forecasts are the primary source for avalanche hazard information, but there is a growing body of research that shows that applying the provided hazard information to terrain is a challenging task for many users (e.g., Finn, 2020, Haegeli et al., 2023a, Brugger et al., 2023).

To address this challenge, several analog decision support tools have been developed over the last 30 years to help backcountry recreationists make trip planning and slope scale decisions. Examples include Werner Munter's Reduction Method (Munter, 2003), Stop-or-Go (Larcher, 2000), the Snowcard (Engler & Mersch, 2000), the Obvious Clues method (McCammon, 2004), and the Avaluator (Avalanche Canada, 2026). More recently, however, Günter Schmudlach and colleagues developed the Skitourenguru website (STG; https://www.skitourenguru.com/) to automate the process and help backcountry skiers in their trip planning process by providing daily avalanche risk scores for thousands of backcountry ski routes in the European Alps. The underlying SLABS algorithm (Degraeuwe et al., 2024) calculates the risk scores by combining the hazard information from the public avalanche forecast with terrain characteristics of routes. The resulting risk values range from 0 to 3 and are displayed with green (0-1), orange (1-2), and red (2-3) symbols.

STG was initially introduced in Switzerland in 2015 and gradually expanded to other European countries. The strong following that the website has developed—it has an average of 75'000 daily route clicks during wintertime—indicates that there is a considerable demand for such decision support tools, at least among certain segments of the winter backcountry skiing community.

While automating the application of avalanche hazard information from the public avalanche forecast to terrain during trip planning has certainly potential to make the process more objective, more consistent, and avoid certain human factors, there is also the possibility that the introduction of a tool like this might also have unintended negative consequences on users' trip planning and general avalanche safety practices. For example, there is research evidence that cognitive offloading can result in reduced learning and skill erosion (e.g., Bastani et al., 2025), Users

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might also not be aware of the limitations of the decision support tool and might therefore trust its assessments more than is warranted. Or the tool might negatively impact users' interest in formal avalanche safety education because they think the automated risk assessments is all they need for their trip planning process.

To better understand the overall benefit of a decision support tool like STG, it is critical to comprehensively understanding its impact. To address this question, we are currently conducting a multi-stage survey study to explore how people use STG, how they understand how it functions, and what factors affect their trust in the risk scores presented on the website. In this paper, we present preliminary results from our initial survey that examined participants' use patterns, how much they rely on STG in their trip planning process, what benefits they get from the use of the website, and how the website has affected their interest in further avalanche safety education.

2. BRIEF INTRODUCTION TO STG

A detailed description of STG is unfortunately beyond the scope of this paper, but to provide context, we briefly describe key functionalities.

The landing page of STG consists of an overview map of the Alpine area. The website displays the route risk ratings in several different ways. While the landing page shows them as pie charts to reduce clutter, once users have zoomed into the map sufficiently, individual routes appear with their risk ratings shown as larger green triangles, and smaller orange upside-down triangles and red dots. When users click on an individual route, the map zooms to the specific route, and a side panel opens with detailed information about the route, which includes the numeric risk value for the entire route. At this zoom level, the course of a route is also color-coded in 10 m segments based on local risk assessments to highlight areas that are more/less exposed to the current avalanche hazard conditions.

Readers interested in learning more about STG are referred to the background information provided in wiki section of the STG website at https://wiki.skitourenguru.com (German only).

3. METHODS

3.1 Survey design

To address our research objective, we developed a comprehensive online survey system that includes questions on a) participants' backcountry activities, experience, and avalanche safety following Haegeli et al. (2023b), b) how they learned about STG, c) how they typically use STG and how much they rely on the provided risks assessments in their trip planning, d) what benefits they gain from the use of STG, e) how the use of STG affects their interest in formal avalanche safety education, f) knowledge questions on how STG works, g) questions that examine what makes users trust STG, and h) basic sociodemographics.

To make it easier for STG users to participate in our study, we split our questions up into three separate but connected surveys. Survey 1 focuses on STG use patterns, benefits, and impact on desire to pursue further avalanche education, Survey 2 includes knowledge questions, and Survey 3 focuses on trust. While each survey includes the background questions (Sections a, b, and h), they are skipped when participants have already completed them in another survey. Responses from the same participants across the three surveys are linked with anonymous unique identifiers. Survey 1 (the focus of this paper) was conducted during the 2025/26 winter, whereas Survey 2 and 3 are scheduled for future winters.

Each survey includes considerable if-then logic to facilitate a natural dialog with participants and adjust the questioning to their needs. To use participants' time wisely and ensure all questions are relevant, the questions on STG use in Survey 1 were presented in four different pathways reflecting the main use patterns. Each of these pathways included detailed questions about this particular use of STG. Contact Pascal Haegeli for a full copy of Survey 1 with all its questions.

3.2 Survey deployment and analysis dataset

Survey 1 was launched at https://stg2026. sfu-arp.ca/survey1use on February 27, 2026. Participation in our survey was promoted with a banner and news post on the STG website as well as social media posts and/or member emails by various partner organizations (Gipfelbuch.ch, Swiss Alpine Club, Austrian Alpine Club, German Alpine Club, South Tyrol Alpine Club). Survey responses were collected continuously throughout the winter, and the sample for the present analysis was drawn on May 1, 2026.

From February 27 to May 1, 2026, a total of 1507 people visited the survey website (i.e., clicked on 'Umfrage starten' on the landing page). 1135 actually started the survey (i.e., continued beyond the overview and the consent form), of which 937 completed the survey (completion rate of 82.6%). After eliminating participants who did not answer critical questions (e.g., backcountry skiing experience) or completed the survey unreasonably quickly, our final dataset for the present analysis consisted of 851 valid participant responses.

3.3 Statistical analysis

All our data preparation and statistical analyses were performed in R statistical environment (R Code Team, 2026). In this paper, we primarily present an overview of the survey responses across the entire survey sample using simple descriptive statistics including correlations. Simple comparisons between groups were conducted using Pearson chi-squared tests, Wilcoxon rank-sum tests, or Kruskal–Wallis tests depending on the nature of the variable of interest. We used a p-value threshold of 0.05 to determine whether differences are statistically significant, but we paid equal attention to the size of effects to determine their relevance.

To find common patterns in sets of responses, we used latent class analysis (LCA; McCutcheon, 1987), a probabilistic clustering technique for categorical variables. In an LCA the observed variables are considered indicators of a higher level, latent grouping variable with a limited number of mutually exclusive classes (Collins & Lanza, 2010). The goal of an LCA is to identify the number of classes that best describe the variations in the observed response patterns, and respondents are subsequently assigned to the class with the highest probability. We used the R package poLCA (Linzer & Lewis, 2011) to perform all LCAs. We estimated a range of models with different numbers of classes and identified the best fitting model using the Akaike Information Criterion (AIC; Akaike, 1974) and Bayesian Information Criterion (BIC; Schwarz, 1978) with lower values indicating better model fit. However, we also considered classification diagnostics (e.g., average assignment probabilities), as well as the interpretability and utility of the estimated models.

4. RESULTS

4.1 Characteristics of analysis sample

Our survey sample was highly experienced with 37% of participants having backcountry skied for 20 or more years, and another 22% for 11-20 years. Only 8% of the sample were in their first or second winter of backcountry skiing. On average, our sample spends 11-20 days of backcountry skiing each winter.

The level of avalanche safety training was also relatively high and recent with 40% having completed an introductory course, 27% an advanced multi-day course, and 9% having completed a course targeted at avalanche safety professionals, but only 4% of our sample (34 individuals) reported to be active avalanche professionals at the time of the survey. Nine percent of the sample reported not to have any avalanche safety training, and 6% only completed a seminar (online or evening event). Most of the completed avalanche safety training was relatively recent with 70% in the 2020s and an additional 19% in the 2010s.

Most of the survey participants have some decision responsibility in their typical backcountry group with 46% contributing to group decisions, 20% being part of a small group of decision-makers, and 23% reporting that they are the formal or informal leader of their group.

The sample consisted of 73% men and 26% women, and survey participants covered a wide range of ages (18 to 88) with a median age of 50. Our sample was highly educated with 58% reporting that they have completed a university degree (bachelor or masters), and an additional 11% having completed a doctoral degree. Forty-three percent of our sample came from Germany, 35% from Switzerland, 14% from Austria, and 8% resided in other countries.

4.2 Familiarity with STG and general use

Most participants in our study learned about STG from friends (33%), through their Alpine Club (18%), or avalanche awareness events (16%). Only 4% reported to have heard about STG in an avalanche safety course for the first time.

Slightly more than half of the sample (52%) reported being familiar with the most important functions of STG, and another 32% stated that they have an in-depth understanding of the functionality of the website. STG is most used for trip planning (62% reporting that they use the website often for that), followed by exploring new areas (45%), and practicing one's avalanche risk assessment skills (26%).

Participants use STG for most of their trip planning. Fifty-five percent reported using STG for half or most of their trips, and 28% stated that they use it for all their trips. However, when asked about how they typically inform themselves about avalanche conditions, 58% reported that they regularly use both STG and the website of the local avalanche warning service, and 31% and 5% stated that they mainly or only use the forecast website respectively. Only 6% indicated that they mainly or only use STG to inform themselves. Eighteen percent reported that they typically consult the avalanche forecast website before all their trips, 49% before all trips and occasionally in between, and 12% read the forecast daily.

4.3 Objectives for using STG for trip planning

To assess participants' objective for using STG, we asked them to assess how well four statements apply to them on a 5-point scale from Does not apply at all (1) to Agree completely (5):

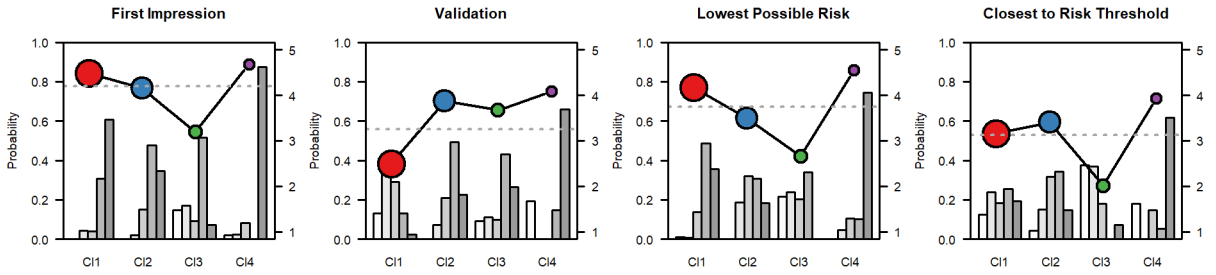

Figure 1: Results of LCA for objectives for using STG. Bars indicate probabilities for the different response options: (1) Does not apply at all, (5) Agree completely. To give a summary impression, the colored dots show the mean response for each class assuming that the response options are numerically equidistant. Sizes of dots roughly represent class size, and horizontal dashed lines show the average response across entire sample.

1) I use STG to get a **first impression** of whether a ski tour is suitable for me under the current conditions.
2) I first assess independently whether a ski tour is suitable and then use STG to **validate my assessment**.
3) I use the STG risk assessments to find the tour with the **lowest possible risk** among the tours that match my interests.
4) I know the upper limit of my personal risk tolerance and look for tours that match my interests and are **as close as possible to my risk threshold**.

On average, the first impression statement was rated highest (mean rating 4.2), followed by lowest possible risk (3.7), validation (3.2) and closest to personal risk threshold (3.1). There is a small negative correlation between responses to the first impression and validation question (Kendall's tau: -0.09; p-value = 0.003), and a small positive correlation between the two risk related questions (Kendall's tau: 0.11; p-value < 0.001).

Our LCA analysis grouped the sample into four distinct classes (lowest AIC at 5, BIC increases continuously, mainly based on interpretability) (Fig. 1). Class 1 (45% of sample, 0.85 median assignment probability, red dot) uses STG mainly to get first impressions in their trip planning and aims to choose trips with the lowest possible risk. This class exhibits the biggest differences in their responses to the two sets of questions (first impression versus validation and lowest possible risk versus closest to personal risk threshold). Class 2 (32%, 0.75, blue dot), the second most prominent class, showed equally high responses for first impression and validation. The responses for the two risk questions are similar and close to the average ratings. Class 3 (14%, 0.75, green dot) is the only class that rated the validation statement higher than all other statements, where this class consistently gave the lowest ratings. The final Class 4 (9%, 0.71, purple dot) rated all statements the highest.

4.4 *Reliance of STG assessments and trust in trip planning skills*

When asked about the average reliance on STG risk assessments during trip planning, the median rating was 67 on a scale from 0 (not at all) to 100 (completely) with an interquartile range from 50 to 77. However, the response distribution (Fig. 2) shows a dramatic spike around 50 (approx. 25% of sample), and a second, much wider peak between 55 and 94 with its maximum around 75 (60% of sample). Only 10% of our sample indicated that they rely less than 45 on STG assessments, and 5% indicated that they completely rely on them (> 94).

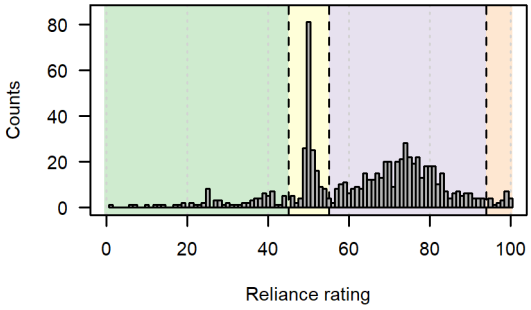

Figure 2: Average reliance on STG risk assessment for trip planning. Different background colors indicate the identified distributions.

However, 89% reported that their reliance on STG depends on other factors. Overall, 77% stated that their reliance depends on how well they know the trip. The median reliance for unknown trips was 78, whereas it was 50 for trips they know very well (Wilcoxon test; p-value < 0.001).

Two thirds (67%) stated that their reliance depends on the danger rating, where the median reliance increases monotonically from low to high

- low to moderate: 51 to 58
  (n = 412; Wilcoxon test: p-value < 0.001)

- moderate to considerable: 58 to 72 (437; p-value < 0.001)
- considerable to high: 72 to 79 (170; p-value < 0.001)

It is worth noting, however, that the number of participants still considering backcountry skiing decreases dramatically at a high danger rating, which means that the character of the sample for these comparisons might be substantially different. STG does not provide any route risk ratings at very high/extreme danger levels.

4.5 Benefits of using STG

One of the key potential benefits of STG is to increase users' confidence in their trip planning skills. To assess the potential benefit, we asked survey participants about their general confidence before and after consulting STG. Across the entire dataset, the median confidence before consulting was 67 on a scale from 0 (not confidence at all) to 100 (completely confident) and increased by 15 points to 82 after STG has been consulted (Wilcoxon test: p-value < 0.001). However, there are distinct groups within our sample (Fig. 3).

For the initial confidence before consulting STG, we observe four distinct distributions (Fig. 3a). We see a relatively small group of participants (9% of sample) with low confidence (< 40 on the scale from 0 to 100), followed by a larger group (27%) with medium initial confidence and a marked peak around 50 (40-60). The bulk of the sample (61%) has higher initial confidence without STG (61-94), and at the end we have a small group (3%) with close to perfect confidence (> 94) in their trip planning skills without STG.

Similarly, we see distinct groups in the distribution for improvement with confidence (Fig. 3b). A very small group of participants (3%) indicated that their confidence decreases with the use of STG (< -5), whereas 22% of participants reported that their confidence roughly stays the same (between -5 and 5). However, confidence increases (> 5) for most participants (75%).

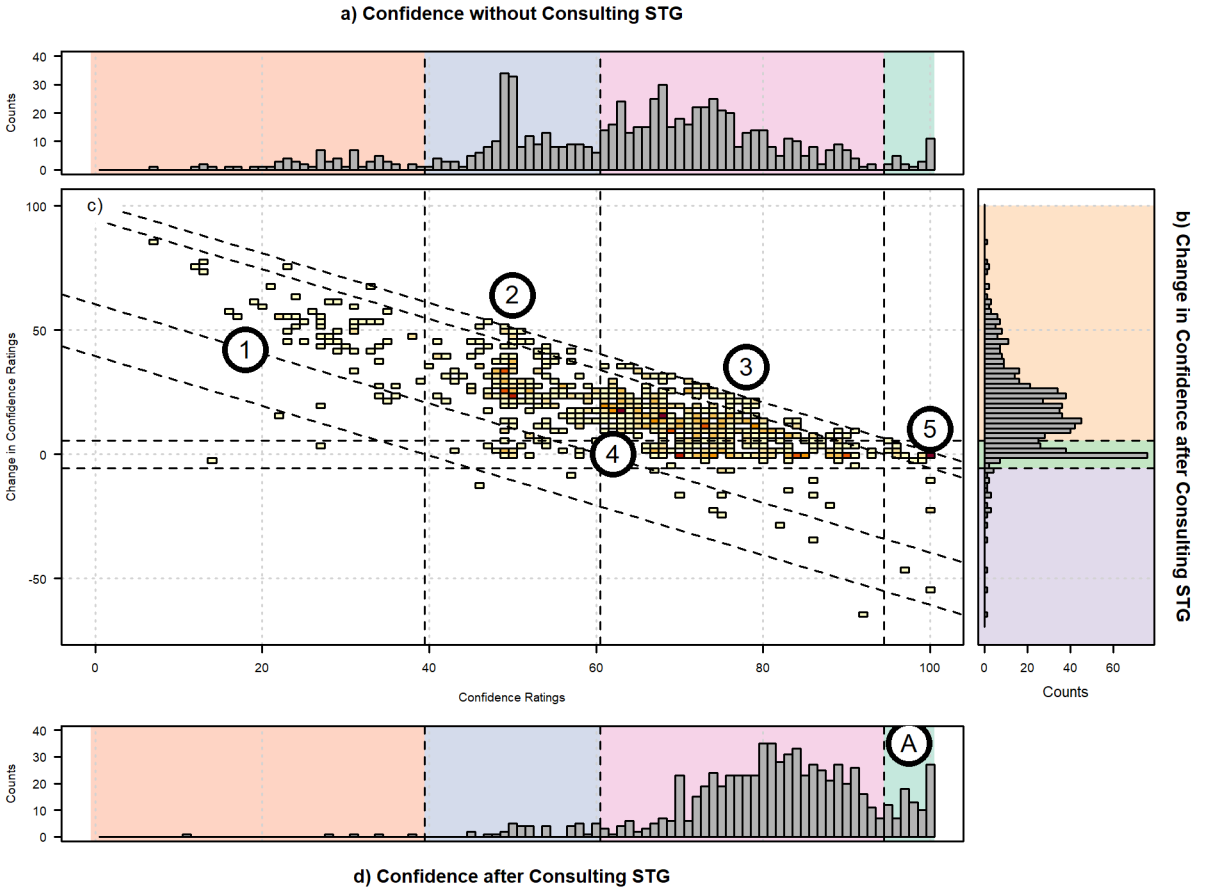

Figure 3: Confidence in trip planning skills before consulting STG (panel a), change in confidence after consulting STG (panel b), and confidence after consulting STG (panel d). The central panel c shows the joint distribution of the initial confidence and the change in confidence. Labels mark subpopulations with distinct combinations of characteristics.

Together, these two distributions result in five distinct groups with different gains (Fig. 3c):

- Group1: Low initial confidence and biggest improvement (median: +51 points)
- Group 2: Medium initial confidence and substantial improvements (+27 points)
- Group 3: Above medium initial confidence and smaller improvements (+15 points)
- Group 4: Above medium initial confidence and no improvement
- Group 5: Close to maximum initial confidence and no improvement

The overall distribution of confidence after STG has been consulted (Fig. 3d) is substantially different from the initial distribution (Fig. 3a). While there are hardly any participants with low and medium confidence anymore, the bulk of participants is now in the high confidence range between 60 and 95 (82% of sample). A particularly interesting group to examine is the participants who did not have full confidence initially (Groups 1, 2, & 3) but reached it after consulting STG (marked with A in Fig. 3d). This group consisted of 87 participants.

In addition to improving confidence, the use of STG can also have other benefits (Fig. 4). We explicitly asked participants whether the use of ST has improved their trip planning in four different aspects: a) Faster/optimized trip planning, b) improves users' understanding on how to apply the information from the public avalanche to terrain, c) enables users to plan trip into more advanced terrain, and d) allows trip planning during higher avalanche danger levels. On average, the benefits of faster/optimizer trip planning and improved understanding were rated higher than the ability to plan trips into more advanced terrain or during higher danger levels. Our LCA revealed four distinct response patterns (BIC: 2 or 3 classes; AIC: 4 or 5 classes; final choice mainly based on interpretability): Class 1 (50% of sample; 0.80 median assignment probability, red dot) generally follows the average ratings. Class 2 (20%, 1.00, blue dot) reported similar benefits for the speed of trip planning and their general understanding, but also highly values the benefit of planning trip into more advanced terrain and at higher danger levels. Class 3 (15%, 0.97, green dot) provided the lowest ratings and did not report any benefit for trip planning into more advanced terrain or at higher danger levels. Finally, Class 4 (16%, 0.72, purple dot) exhibits a response pattern that is between Class 1 and 3.

4.6 Impact on interest in further avalanche safety education

A key question of interest in our study was to better understand how STG affects participants' interest in pursuing further avalanche safety education. To examine this question, we asked survey participants whether the use of STG has increased or decreased their interest in avalanche safety education. Of the 709 participants who answered this question, nobody reported that STG strongly decreased their interest, and only 3 (< 1%) stated that it decreased their interest slightly. Fifty-four percent stated that it did not affect their interest, and 26% and 20% reported that it has slightly or strongly increased their interest.

The people who stated that it slightly decreased their interest in avalanche education were distributed across different levels of completed avalanche training (Fig. 5): one without any training, one with introductory training, and one with advanced training. Overall, the interest in further training was highest among participants who had only concluded a seminar and then gradually decreased with higher training levels.

5. DISCUSSION

5.1 Representativeness of sample

According to the latest population survey from 2020, there are approximately 250k backcountry skiers in Switzerland (Bürgin et al., 2021). Based on their characterization of the Swiss backcountry skiing population, we judge our sample to be relatively older, more experienced, and more active than the average backcountry skier in the European Alps.

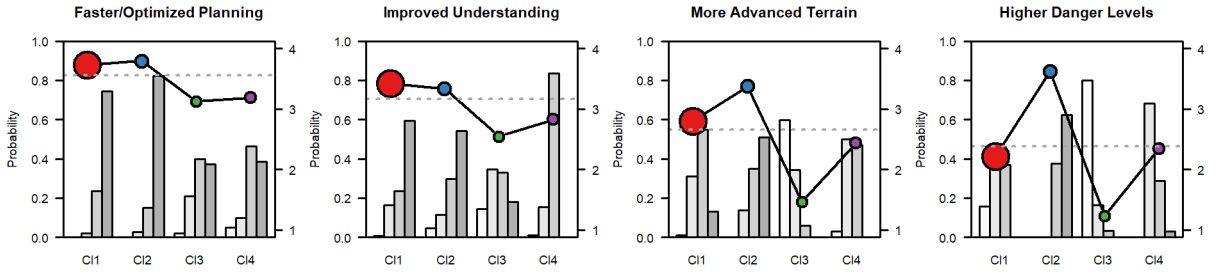

Figure 4: Results of LCA for how the use of STG improves personal trip planning practice. Bars indicate probabilities for the different response options: (1) Not at all, (4) To a large extent.

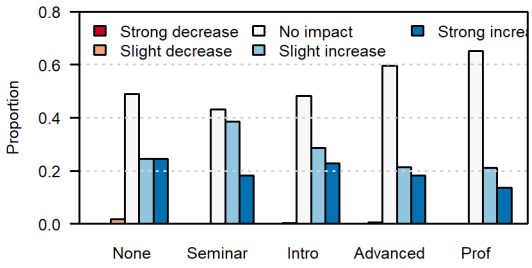

Figure 5: Responses to question on interest in further avalanche safety education in relations to completed avalanche safety training.

Furthermore, we suspect our sample to have more avalanche safety training than the average. Hence, our analysis dataset is likely not a representative sample for backcountry skiers and typical STG users, which is a common for online surveys without elaborate recruitment strategies.

5.2 Main preliminary insights

Based on the information presented in this paper, we draw the following preliminary insights into the use of STG.

Among the participants of this study, **STG does so far not seem to divert traffic away from the websites of local avalanche warning services**. Only 6% indicated that they mainly or only use STG to inform themselves. However, the complete forecast information has only been integrated in STG for one year, and information seeking patterns may shift as users become more aware of what is presented in STG.

Overall, participants use STG **more for first impressions in their trip planning process and finding low-risk trips** than validating their personal assessments and finding trips close to their personal risk threshold. However, we identified four groups with distinct preferences.

Participants **rely considerably on the risk assessments of STG for their trip planning, but there are distinct groups**. Furthermore, participants' reliance depends on other factors including familiarity with trip and avalanche danger level. This indicates that STG might not help to combat the familiarity trap described in the human factors avalanche safety literature.

Overall, there is a **substantial increase in trip planning confidence due to STG, but we see distinct patterns** in participants' confidence in their trip planning skill with and without STG, and the effect of STG. The benefit of using STG depends heavily on their personal confidence prior consulting STG. As expected, the impact is larger for participants with below medium and medium confidence. Among users with above medium initial confidence, there is a considerable portion of users who did not report an increase in trip planning confidence with STG use.

The other main benefit of using STG is faster/optimized trip planning, and improved understanding on how to apply the information from the forecast to terrain. The benefits of planning trips into more advanced terrain or during higher danger levels were rated lower, but there are distinct groups who particularly value these benefits. This observation should not be used against STG as all avalanche safety education and equipment enables users to go into the backcountry under conditions they would otherwise not.

Overall, the use of STG seems to boost users' interest in avalanche safety education. Interestingly, the effect was higher among those how only participated in seminar, had the highest gain in trip planning confidence, and did achieve close to maximum trip planning confidence. Hence, based on the present analysis, STG does not seem to negatively affect users' interest in further avalanche safety education. In fact, it seems to boost interest more among participants who either need education the most or have gained the most from using STG.

5.3 Limitations

While the present study offers interesting first insights, several limitations need to be considered. Like in most online survey studies, our sample is biased towards individuals who are more committed to their backcountry activity and more avalanche aware. Hence, our survey sample cannot be viewed as a representative sample of STG users. Furthermore, self-reporting of personal attitudes and behaviours has inherent challenges. While we did our best to word questions neutrally to facilitate accurate and honest responses, it is not possible to eliminate potential discrepancies between self-image and reality. Hence, the present results should only be interpreted in the context of the characteristics of the current survey participants, and caution is advised when generalizing the presented insights beyond.

6. CONCLUSION

This study contributes to a growing body of research that aims to better understand the effectiveness of avalanche risk communication tools and provide scientific evidence to guide further improvements and future developments.

Using an online survey, we studied how STG users integrate the website in their trip planning process, what benefits they draw from it, how much they rely on the risk assessments provided by the website, and how it affects their interest in further

avalanche safety education. Our preliminary results offer first insights into typical STG use patterns, but the next step in this research is to explore the relationships between the identified patterns and link them to participant characteristics to develop rich user profiles. Our future surveys on users' understanding of the STG risk assessment algorithm and drivers of trust in automation will offer additional perspectives for an even more comprehensive and informative user characterization. Furthermore, targeted comparisons with click records on the STG website will reveal how the patterns identified in the survey responses relate to real-world behaviour.

The development of automated avalanche risk assessment and trip planning tools has the potential to completely change how people approach the backcountry and how avalanche safety is taught. It is therefore critical to develop a detailed understanding of what features are used in what ways by different types of users, and it is important to understand both the benefits and potentially unintended consequences of these new tools for the full range of users. All this information is important for understanding the true benefits of these tools and making better informed and more transparent about future developments (St. Clair et al., 2026).

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