THE GERMAN ALPINE CLUB (DAV) SKI TOURING STUDY: MINDSET, RISK ASSESSMENT AND DECISION-MAKING PROCESSES AMONG SKI TOURING GROUPS IN THE ALPS

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ABSTRACT: This study investigates the decision-making processes of ski touring groups in avalanche-prone areas. Existing research has primarily explored specific aspects of decision-making or employed non-field designs, leading to a need for a comprehensive field study. This study aims to fill that gap by examining how ski touring groups make decisions in real-world conditions, particularly in light of rapidly evolving avalanche information tools. Moreover, a qualitative survey of DAV instructors in 2018 revealed a discrepancy between recommended decision-making strategies and actual practices, underscoring the importance of this field study. The study was conducted by the DAV Safety Research Department during the winters of 2019/20 and 2021/22 in the Austrian Alps, involving 112 ski touring groups (345 individuals). The research utilized structured interviews before and after tours, terrain risk analyses, and expert evaluations to assess the decision-making processes of these groups. Key questions addressed included the factors guiding decision-making, the role of probabilistic tools, and the appropriateness of the decisions made.

Results showed that while 91% of tours were conducted at moderate to considerable avalanche danger levels, probabilistic methods were seldomly used in the field. The study also revealed that nearly half of the hazardous spots identified by risk analyses were overlooked by the groups both before and during the tour. Despite high self-reported competence, many groups demonstrated gaps in avalanche-specific knowledge and risk management practices. Overall, the findings suggest that although ski touring groups often make acceptable decisions, there is room for improvement in their use of decision-making tools and in recognizing hazardous terrain. This highlights the ongoing need for education and the potential benefits of integrating more advanced tools into ski tour planning and execution.

KEYWORDS: Tour planning, equipment, risk assessment, decision making, backcountry skiing

1. INTRODUCTION

Most existing studies on how ski touring groups make decisions either focus on specific aspects of the decision-making process like the adherence to a specific strategy (e.g., Landro & Pfuhl, 2020) or use a non-field research design (e.g. Ellert et al. 2010).

Moreover, availability, accessibility, and quality of avalanche relevant information for ski touring and freeride groups has seen a rapid change over the last years. For example, an online tool like the so-called *Skitourenguru* already incorporates a great deal of strategic avalanche information in a user-friendly manner. Without much speculation, even more elaborate assessments of the danger of specific slopes or even complete tours will be available in the near future. This raises the question whether existing tools like the German Alpine's (DAV) strategic tool *Snowcard* or the DAV's tool for structured decision making - the so-called *avalanche mantra* - are still relevant as planning and decision-making tools for groups. On a broader perspective, this calls for an empiric study on how ski touring groups make their decisions.

The need for a broadly based field-study was confirmed by a qualitative survey conducted among the DAV instructor team in fall 2018. The instructors identified a discrepancy between the actual decision-making behavior of ski tourers and the application of existing and recommended decision-making strategies. In their experience, decision-making strategies were not applied in practise for the following reasons: lack of knowledge, inertia to apply them, early fixation of tour destinations, and tour planning based on familiarity or on information retrieved from social media. The instructor team thus confirmed the importance of a field-study on the decision-making processes of ski touring and freeride groups.

Generally speaking, the need for a broad field-study stems from the fact, that a survey without reference to the terrain and the decisions actually made by groups is subject to possible distortions: On the one hand, an attitude-behavior discrepancy and a tendency towards socially desirable answers might bias the results when the groups are generally asked for probabilistic decision aids without direct reference to a tour. On the other hand, an avalanche-related evaluation of the planned and completed tour is a precondition to evaluate the decision-making process of the

groups. After all, ski tourers seem to make acceptable decisions even without the use of probabilistic decision tools. In addition to the lack of scientific field studies, this line of arguments urge for a field study.

Our study comprises a survey of ski touring and freeride groups as well as avalanche-related terrain aspects, which were evaluated by a team of experts. In this paper, we only report the results for the ski touring groups.

The following questions were addressed:

- *Which factors guide ski touring groups when making avalanche-related decisions?*
- *What kind of tour decisions do they make in a specific avalanche situation?*
- *What is the role of probabilistic decision tools?*
- *How appropriate are the decisions of the ski touring groups?*

In the winters of 2019/20 and 21/22, the DAV Safety Research Department conducted a field study inter alia at two typical ski touring locations (Kelchsau in the Kitzbuehel Alps and Namlos in the Lechtal Alps) in the Austrian Alps, querying 112 ski touring groups including 345 people. Locations for the surveys were chosen to allow for varying riskiness of tours, especially on the days with an avalanche danger level 3 ("considerable").

2. STUDY DESIGN

Prior to the survey a terrain analysis was carried out (see also 3.2) in order to identify all potential hazardous spots, which could turn into hazardous spots on according days. This resulted in an avalanche-related terrain model for every survey location. At the Namlos location the model identified 104 terrain points within 15 ski tours and in the Kelchsau location 86 terrain points within 12 ski tours.

Based on this model a risk analysis was carried out for survey days prior to data collection of groups. A systematic procedure for each terrain point was used to determine whether it was a hazardous spot on that day and what behavioral recommendations should be issued for it: Spots that were not hazardous could be passed in a group. Depending on the avalanche situation, "appropriate" could have been: keep a safe distance, go individually, circumvent the spot or avoid it and abandon the tour. The risk analysis is the basis for assessing the risk potential of a tour and the quality of the avalanche-related risk assessment and risk management of the groups.

On the day of the survey, a pre-trained survey team interviewed the randomly arriving ski touring groups at the respective parking lots at two times. First, upon arrival and before they started the tour (t1); second, when groups returned from tour (t2).

The study design is shown in Figure 1.

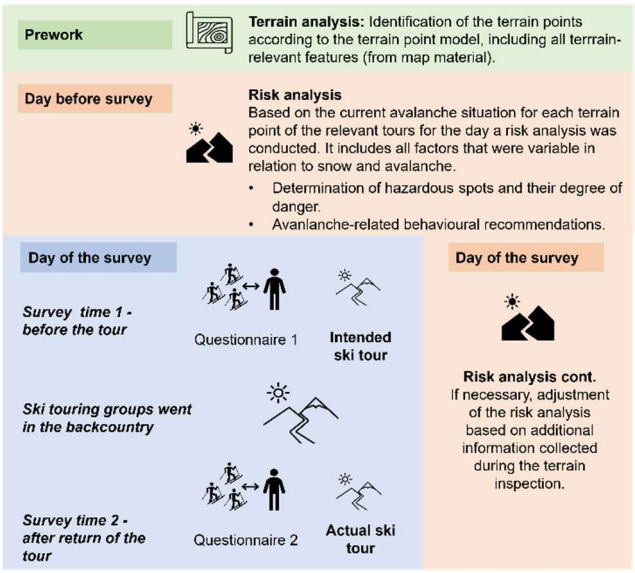

Figure 1: Study design of the 2019 to 2022 ski touring study.

3. METHOD

The two survey locations were selected due to the high amount of ski touring, the regional distribution and the representativeness both of the terrain and the difficulty of conditions of the ski tours.

The survey unit "survey group" refers to the social unit in which people where on tour. Survey groups can therefore also be individuals. Survey groups were excluded from the second survey if they did not have an avalanche transceiver with them, chose a tour that was considered too dangerous by the risk analysis or were given too much information about the avalanche situation by the person conducting the survey. Survey instruments and procedure of the group survey

Interviews followed two structured questionnaires (Q1 & Q2), which were developed especially for the study. The questionnaires contained both open exploratory questions, which were coded using a category system, as well as questions with a categorical response format as well as Likert scales.

Q1 consisted of the following question categories: socio-demographic information of the group, tour selection, motivation and avalanche-related considerations for the selected ski tour, questions on heuristics, sources of information for the tour, equipment, airbag knowledge, ski touring experience and, at the end, an assessment by the surveyors of the terrain perception and guiding behavior. In order not to influence the group's prospect of the tour, at t1 the groups were deliberately not asked about the terrain points of the terrain model, but were instead asked the following open question: "Are there any hazardous

spots that need to be considered in relation to avalanches and if so, where are they?", with the request to mark them on a prepared map.

At the second survey time, the following question categories were surveyed with Q2: Feel-good scale in the group, execution or deviation of the tour according to plan, recognition and assessment of hazardous spots, behavioral measures that were taken during ascent and descent, questions on the decision-making aids for assessing avalanche dangers, aspects of personal ability, training in avalanche beacon search and equipment and, last but not least, knowledge on the current avalanche bulletin. The groups were also asked to indicate which hazardous spots they saw before (t1) and while on the tour and what risk management they practiced (t2).

Survey training sessions for interviewers were held before each survey season. This ensured that all interviewers were informed about the survey process, the handling of the questionnaires and the site and risk analyses.

Before the survey began, the groups were informed about the research institution, the purpose of the study, voluntary participation, the procedure and how to deal with risk aspects of the tour. All groups gave informed consent and were offered full disclosure of study design and purposes.

3.1 Survey instruments and procedure for terrain and risk analysis

Beforehand, typical ski tours were defined at the locations prior to the surveys. This was done in location teams, each of which included area experts. There were 12 tours in Kelchsau and 15 tours or connections of tours in Namlos.

The terrain analysis was prepared and completed before the start of the survey by certified IFMGA mountain guides familiar with the locations.

For each tour, the avalanche-relevant terrain points (called terrain point model) were identified according to two rules. A passage is avalanche-relevant if it:

a) has a steepness of at least 30° with an extension of at least 20 * 20 meters of terrain (direct terrain point) or

b) lies below such a terrain point, i.e. in a run-out area. The run-out area was defined as twice the horizontal distance of the height (in meters) of the terrain point.

c) A terrain point above 30° according to the first rule, which is also a run-out area according to the second rule, is referred to as a run-out and direct terrain point.

For these terrain points all the terrain-relevant features that could be clearly identified from the map material were reported: Run-out area, slope exposure, altitude, slope dimension, steepness, terrain description, vegetation and location.

On the day of the survey itself, the risk analysis of the relevant terrain locations was carried out. The terrain points of the selected locations and tours were evaluated based on the current avalanche situation. The risk analysis listed all factors that were either variable in relation to snow and avalanches or could only be clearly assessed on site or through local knowledge. All observations and assessments were recorded using an additional form for assessing the regional avalanche situation, e.g. avalanche bulletin, hazard signs, snow pack information or information derived from snow profiles or stability testing.

The first step of the risk analysis consisted of an assessment of each terrain point according to the DAV *Snowcard*. This involved determining whether or not the terrain point in question represented a hazardous spot given the avalanche situation on that day and the amount of risk of that spot. The Snowcard evaluates the risk integrating three aspects: avalanche danger level, steepness and whether the aspects of the spot are marked as "unfavorable" according to the avalanche bulletin. In a second step the experts were asked to refine the risk assessment based on the expert assessment and the terrain inspection with current local information. In the end they arrived at a final risk assessment according to the scheme by Harvey (2017). Finally, a four-stage behavioral recommendation was developed:

- Keep distance between group members
- Climb/ski individually (including safety distance)
- Avoidance/Bypass of the hazardous spot
- Do not continue the tour - renounce

An area of terrain that is not classified as a hazardous zone can be approached as a group.

To compare the terrain points named by the groups from questionnaires 1 and 2 with those from the terrain and risk analysis, three matching matrices were created. These matching matrices summarized all relevant data of the terrain and hazardous spots of the intended tour (t1) and the actual ski tour (t2). These data were then used to calculate the risk parameters such as risk potential, risk assessment and behavior for the intended and actual tours.

4. RESULTS

4.1 Characterization of surveyed groups

Generally, the ski touring groups chose tours that were travelled regularly and had approx. 850 to 1200 vertical meters to climb. They led through ski terrain

that required stable and safe skiing skills. They included sections of terrain that could become dangerous in corresponding avalanche situations. 91% of the tours were skied at a danger level of either “moderate” or “considerable”. The distribution of avalanche danger levels roughly corresponds to the long-term profile (compared to the 10-year danger level distribution in Switzerland up to the 22/23 season (WSL Institute of Snow and Avalanche Research SLF 2024).

On average, the groups consisted of 3.08 members (SD = 1.94). 61% of the sample consisted of gender-heterogeneous groups (n = 68), 35% consisted of men only (n = 39) and n = 5 (4%) were women-only groups. The average age of the groups was 42.55 years (SD = 11.34). Most of the ski tourers were out with friends/buddies (46%) or with family (38%). Only n = 9 were individual skiers. Over half of the groups (60%) skied together regularly or very frequently. Therefore, it can be assumed that the group members knew each other very well. The majority of respondents (66%) were DAV members. On average, the people had traveled 96.60 (SD = 79.50) kilometers from home to the starting point of the ski tour and were out and about in this area monthly (40%) or less frequently (31%).

It should also be mentioned that 21% of those surveyed stated that they had no avalanche-related training. A practical avalanche transceiver course was stated for 38% of the groups, and 20% had training from an Alpine club. 10% of the groups stated official expert training (state-certified mountain guide or mountain rescue). The groups' ski touring experience averaged 16 years (SD = 10.26); by the time of the survey they had completed an average of 9 tours (SD = 6.10) in the current season. The many years of ski touring experience correlated with the high self-reported ski skill ascent technique (r = .26, p = .014), the high self-reported ski skill create ascent track (r = .22, p = .044), the high self-reported ski skill orientation (r = .22, p = .041) and the self-reported avalanche risk competence (r_s = .27, p = .005).

4.2 Results on self-assessment of avalanche competence, technical skiing ability and willingness to take risks

The self-reported competence in assessing avalanche risk showed a significant but low correlation with the assessment of the interviewers regarding the correct indication of hazardous spots (r = .21, p < .05), with groups indication of hazardous spots on the map (r = .22, p < .05) and with having a largely complete mental picture of the terrain (r = .27, p < .01).

The descriptive results of self-reported assessment of avalanche risk competence, ski touring skills, the willingness to take risks as well as the rated questions by the interviewers are showed in Table 1.

	N (%)	*M (SD)*
Self reported avalanche risk competence (1 = inexperienced; 4 = very experienced)	107	2.96 (.60)
Self-reported ski touring skills* (1 = not at all; 4 = absolutely)		
Downhill technique	86	3.46 (.51)
Ascent technique	86	3.59 (.53)
Avalanche avoidance behavior	86	3.56 (.61)
Create ascent track	86	3.34 (.72)
Orientation in the terrain	85	3.35 (.66)
Operating the avalanche transceiver	86	3.66 (.47)
Searching for and locating buried victims	84	3.24 (.68)
Tour planning	84	3.26 (.73)
Self reported willingness to take risks (1 = low; 4 = high risk appetite)	94	1.98 (.69)
Tour knowledge (rated by interviewer) (1 = incomplete; 4 = complete)		
Indicate hazardous spots	108	3.09 (1.12)
Mark hazardous spots on the map	105	2.94 (1.10)
Mental terrain conception	108	3.12 (.93)
Familiarity in the group	102	3.54 (.69)

Table 1: Frequencies, means for self-reported risk competence, ski skills *and* willingness to take risks *tour knowledge rated* by interviewers.

4.3 Safety equipment

The avalanche transceiver continues to be the standard emergency equipment: 98% of respondents carried it, closely followed by the probe and shovel with 97% each. Looking at the group level, it is noticeable that 92% of the groups were fully equipped with the avalanche safety gear. This is a clear improvement compared to a field study from 2003/05, which reported only 60% out of 122 persons being equipped: 94% avalanche transceivers, 86% shovel, but only 60% probe (Gallenmüller & Schwiersch, 2008).

95% of the respondents used a modern 3-antenna device; only 10 people had been on tour with an analog or 2-antenna device. However, only 28% had completed a search exercise with avalanche transceivers, shovel and probe in the current season. For almost a third, the last search exercise was more than 2 years ago or had never been carried out. Looking at the figures at group level, it is noticeable that 48% of the groups had carried out a search exercise more than 2 years ago.

Other rescue equipment: Almost everyone carried an emergency call device (93%). 56% of the people had a first aid kit in their rucksack; in 13% of the groups none of the group members had either one with them. Moreover, 34% of the groups lacked a bivouac sack.

Orientation aids: With a percentage of 40% digital maps were clearly more popular than the classic analog map (12%). However, only 50% of the groups had a map with them at all. 13% of the groups had neither a map nor GPS with them.

Helmet and airbag: 48% of respondents had a helmet and 36% had an airbag rucksack with them.

4.4 *Motivation, feasibility and terrain aspects to determine the risk for the selected tours and information sources*

The icebreaker question to the groups was why they had chosen the tour they intended (Question 1, Q1, open question). The avalanche situation, the snow quality and the weather were stated as the most important reasons to choose the indicated tour. Looking only at the first two reasons, the snow quality category even beat the avalanche situation as the decisive motivation for the tour with 42%. 56 (50%) groups mentioned other aspects of the avalanche situation and 31 (28%) groups mentioned other quality features relating to the weather.

When asked about the feasibility of the tour (Question 2, Q1, open question), the order of the reasons for the selected tour changed. Once again, the ski touring groups gave an average of M = 2.16 reasons, but now at 79% the avalanche situation was the decisive reason for choosing the tour. 17 ski tour groups (15%) did not mention the avalanche situation in either question 1 or question 2. 82% of the groups proactively gave detailed answers about the avalanche situation. On closer inspection of the reasons given at Q1 and 2, snow quality no longer played a major role (25%) as it did when looking only at answers given for Q 1. Results are shown in figure 2. The ski touring groups were familiar with the tours with an average of M = 2.25 (SD = 1.12) on a 4-point scale. Accordingly, 37% of groups indicated to “already know the tour”. 49% of the tours surveyed in winter 2020 were carried out at an avalanche danger level 2. In winter 2022, on the other hand, most tours (64%) were undertaken at an avalanche warning level of 3. The groups had no preference for skiing a particular slope and did not expect to be on untracked terrain.

An avalanche danger level A (higher level in case of a split danger level, e.g. level 2 ‘moderate‘ below 2200m and level 3 ‘considerable‘ above) was indicated by 73 of 112 groups (39 groups did not provide any information) with 93% correct specifications (not correct = 5 groups). Only 50 groups then stated danger level B (no information = 62 groups) and of these 86% were able to correctly state danger level B (not correct = 7 groups). 41 groups also stated a division criterion with 85% correct reasons for the division (not correct = 6 groups; no information = 71 groups). The results of the avalanche knowledge surveyed at t2, i.e. after the tour, were similar: 91% of the groups (86 groups) correctly stated the avalanche danger level and 80% the division criterion.

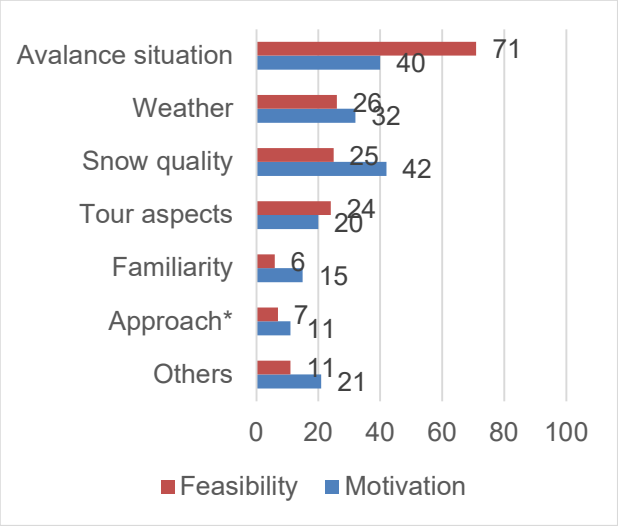

Figure 2: Motivation and feasibility aspects in percentage for the selected ski tour by the group(*)

To sum up, the aspects of avalanche danger level, steepness, given avalanche problems were mentioned by more than 50% of the groups; the majority of these groups were correct in terms of content and necessary conclusions (values between 73% and 92%). However, there was little knowledge reported with regard to more detailed information such as wind, tracks or consequences.

55 groups carried out the tour as planned. 55 other groups gave one or more reasons for their deviation. Snow quality and avalanche-related reasons were the main reasons why the ski tour groups changed their plans on the tour. Adapting flexibly to the conditions on site is essential for good behavioral measures, especially in constantly changing contexts such as alpine terrain in winter. Overall, the tours were rated by the respondents (on a scale from 1=much less tricky to 5 much trickier as assumed), as less tricky (M = 2.71; SD = .67) and 18 groups stated that they had recognized new hazardous spots on the tour.

4.5 *Decision-making aids for ski touring groups*

Probabilistic methods for risk assessment are still rarely used or are partly unknown, e.g., the DAV-*Snowcard* was used by 37% of the ski touring groups;

* the aspect approach includes as well the following aspects: landscape, tracks, group suitability.

35% of the groups were using 'Stop or Go' of the Austrian Alpine Club.

On the other hand analysis with the help of typical avalanche problems, the strategy of following existing tracks, determining checkpoints, and inquiring with friends are still the decisive measures for most of the tour groups observed when deciding whether to ski a slope. See results in figure 3.

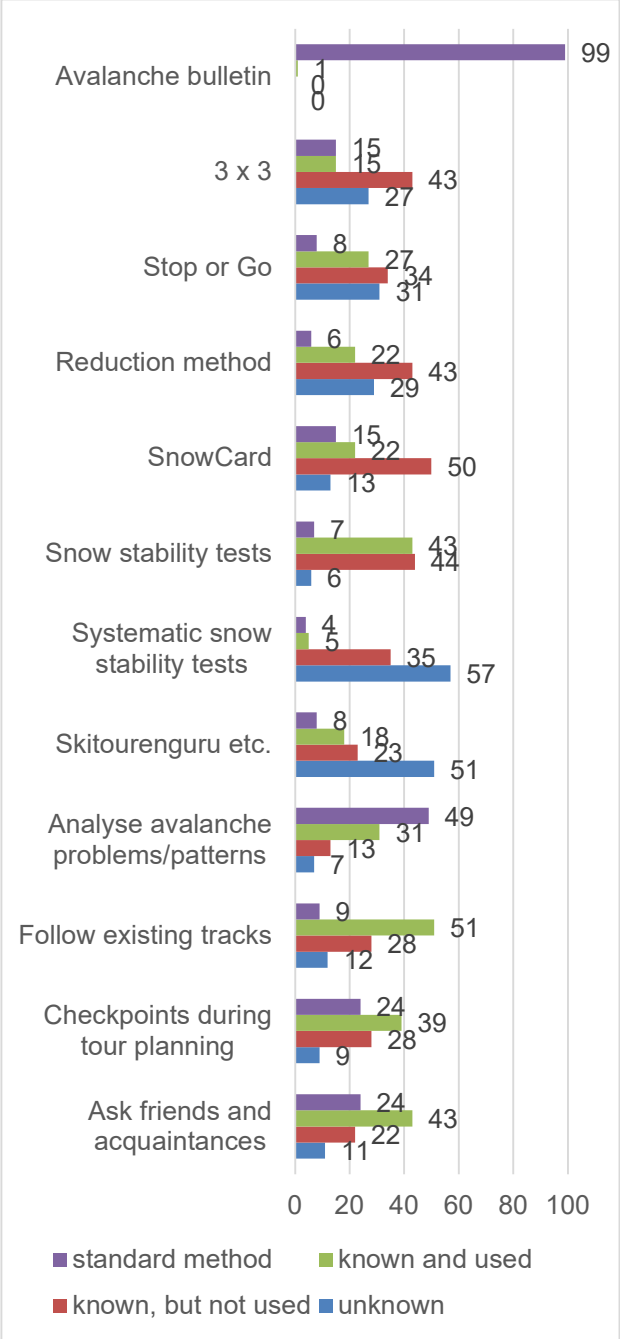

Figure 3: decision making aids for ski touring groups in percentageAlthough the *Snowcard* is known, it is not used in the field. This was also shown by the question on which specific decision-making aids were factually used to determine the risk of a hazard in the terrain. Only 2 groups mentioned the *Snowcard*. With 30% the most popular measures were group discussion and snowpack assessment. However, 29% of the groups did not carry out any measures to make their assessment of a danger zone at a given spot on tour.

4.6 Decision-making processes

At t1, as soon as a group had indicated which tour they would roughly go, they were asked about the terrain points they would pass. By the risk analysis each terrain point had been labelled as either a hazardous spot or not for that day, and in case of a hazardous spot behavioral recommendations for each hazardous spot had been allocated (see also 3.2).

Two groups were snowshoe hikers for whom no terrain & hazardous spots could be surveyed. The remaining 110 ski tour groups selected tours with a total of 652 intended terrain points, of which 218 were assessed as actual hazardous spots by the risk analysis. 19% of the groups (i.e. 21) selected a ski tour for which no hazardous spots were identified according to the risk analysis; one group selected a tour for which a no-go was recommended.

52.3% (114 out of 218) of the hazardous spots were recognized as such by the groups for the *intended tour*, i.e. before the start of the tour - almost half of the hazardous spots were overlooked before the start of the tour. The groups were able to correctly identify 78.6% of the non-hazardous terrain points (383 out of 487) for the intended tour, and they incorrectly identified 11.8% of the non-hazardous terrain as dangerous.45.9% (84 out of 183) of hazardous spots were recognized by the groups on tour. More than half of the hazardous spots were overlooked, though. The groups were able to correctly identify 89.4% of the non-hazardous spots (296 out of 331) on tour. During the tour they incorrectly identified 10.6% of the non-hazardous slopes as dangerous.

The „non hazardous spots" were more easily recognized by the groups than actual hazardous spots. Taking into account the avalanche bulletin knowledge (Streicher et. al., 2024) two assumptions can be formulated: (1) the knowledge is available, but that the transfer to the current terrain continues to cause difficulties for the ski touring groups; (2) groups do not analyze the tours in detail on the basis of the avalanche conditions report.

It should be mentioned that the groups achieved a correct risk assessment of 76% (correct identification of non hazardous and hazardous zones). But the unrecognized hazardous spots could be the hotspot or weak point for an avalanche. Nevertheless, the groups showed appropriate behavior in 69% of the terrain points. For further results see Table 2. T-tests between intended and actual ski tours for risk potential, risk assessment 1 and 2 were not significant.

	Intended ski tours for actual ski tour	Actual ski tour
	M (SD)	*M (SD)*
Risk potential	5.73 (4.35)	6.26 (4.55)*
	% (SD)	*% (SD)*
Risk assessment 1 *Percentage of correctly identified hazardous spots*	61.94 (39,56)	55.47 (41.16)
Risk assessment 2 *Proportion of correctly identified hazardous spots and correctly identified NON hazardous spots in all terrain locations*	76.77 (21.02)	74.69 (21.50)
Appropriate behavior in %		69.10 (20.81)
Overcautious behavior in %		12.24 (17.35)
Risky behavior in %		18.66 (18.20)

Table 2: Means and percentages for risk potential, risk assessment and behavior (n = 86)

107 hazardous spots for which the experts had recommended keeping distances between group members were passed by the groups in a body (see Table 3). In 56 cases, clearly inappropriate behavior could be identified: the experts recommended passing individually at 35 resp. 21 hazardous spots, but the spot was walked either in a body or – at least – by keeping distances. Special attention must be paid to the question of appropriate behavioral measures at hazardous spots. There were a total of k = 279 hazardous spots that were passed by the groups during ascent and/or descent. The groups practiced appropriate behavior at 54 (43+11+0+0) hazardous spots (19% of 279 hazardous spots). If one allows an extended appropriate behavior by granting the groups a deviation of 1 (e.g. having passed a passage as a group for which distances had been recommended) 184 out of 279 cases of appropriate behavior resulted (at 66% of the terrain points). A vast majority of them was accounted for the case as described above: Keeping distance would have been recommended at 107 points, but the group walked the passage in one body. In other words, this measure alone could improve appropriate behavior by 107 out of 279 cases = 38%). Results are shown in table 3.

		Behavior indicated by group				
Behavior: risk analysis / group	Group	Keeping a distance	Go alone	Bypass	Renounce
Recommendation by risk analysis					
Group	529	39	12	3	0
Keeping a distance	107	43	17	7	12
Go alone	35	21	11	15	3
Bypass	5	0	2	0	1
Renounce	0	0	0	0	0

Tabel 3: *Frequency - behavioral measures of the ski touring groups on the tours carried out*

5. CONCLUSIONS

Ski touring groups usually make defensive decisions and go on tours with few and usually not high-risk hazardous spots.

Mindset of feasibility

Ski touring groups enter an avalanche-related unsecured area and feel that way. Findings show that the ski touring groups have an attitude towards a feasible and avalanche-related safe tour. The decision-making process is motivated, among other aspects, by the basic need for safety: ski touring groups do not set off without a sufficient sense of safety. They transform the uncertainty of the backcountry ski site into perceived safety by: Choosing familiar or standard and fashionable tours, processing the avalanche conditions report, asking acquaintances, orienting themselves about possible hazardous spots, being willing to do checks, and by not committing themselves to specific slopes.

The feeling of safety is further increased if the group finds existing tracks in the terrain. This creates a feeling of feasibility: "We are careful and do consider dangers. What we are planning is possible and safe. Others see it that way too." The group sets off with this inner attitude. However, results indicate that hazardous spots are not sufficiently recognized during

route planning and that there is no systematic approach to individual slope decisions. Existing tracks form an important basis for the groups' decisions, but their significance is not considered in sufficient detail.

The feasibility mindset usually correctly reflects the avalanche-related reality of the chosen tour. However, if hazardous spots have been overlooked in the planning, they will on average not be recognized on tour.

As the course for recognizing hazardous spots is set in the planning process, we want to take a closer look at this.

How can potential avalanche terrain be identified?

Logically, hazardous spots are identified in two stages. First, it must be clarified which terrain is potentially suitable for releasing avalanches. Secondly, it must be checked whether a single slope is dangerous on the day of the tour and what action is required to reduce the risk of triggering.

Such a process takes place holistically in terms of perception and decision-making psychology (Kruglanski et al, 2012) and not step by step. The starting point for the question: "What could be possible?" or "Where do we want to go?" is a tour in its entity, not a sequence of individual slopes or terrain points. To determine where it could be dangerous, we have to "zoom into" the tour and "fly over" it. But tours are not traversed point by point from the starting point to the summit: Probabilistic decision-making procedures, which require precisely this, are little known and rarely used. This could explain why only 55% of all hazardous spots are recognized.

How can the recognition of hazardous spots be improved?

Route planning must be as low-threshold as possible to identify all relevant spots and be based on solid information. Simple planning rules of thumb are one possibility, e.g:

1. use a map with a steepness layer to identify all places steeper than 30° on and above your passages on tour as potential avalanche terrain!
2. all these places are hazardous spots if they are assessed as unfavorable according to the avalanche conditions report or appear at least as "yellow" according to the DAV-*Snowcard* or any other probabilistic assessment tool.

Although this method lowers the entry threshold due to its simplicity, it still requires a sequential approach to planning. Thus, during planning stage, it can help having an algorithm which transmits the information of the avalanche conditions report into the terrain to automatically determine hazardous spots and the probability for triggering (e.g. Skitourenguru). However, such an algorithm is decisive for the quality of the tour planning. If this algorithm displays the relevant information of the avalanche bulletin for each terrain point (e.g. as a pop-up), it makes itself transparent and can be a learning tool for beginners as well as a reflection aid for the experienced.

Nevertheless, ski touring groups are prepared to review their mental representation of the intended tour on tour. However, they lack a systematic approach on the individual slope scope. An assessment aid that can be given to the groups on the individual slope can be based on the avalanche problems, as these are present and widely accepted according to our study.

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