Review of «Impact of information presentation on interpretability of spatial hazard information: Lessons from a study in avalanche safety» by Fisher et al.

The manuscript presents the results from a survey exploring the effectiveness of different graphic designs to communicate the location of avalanche problems. I consider the presented work of good quality requiring only minor revisions.

I particularly appreciate the well-designed structure of the survey, a structure which permitted to explore the influence of prior knowledge or previous experience a participant had with different graphical designs. The methods applied to analyze the responses are appropriate, the results are presented in an understandable way. Finally, I agree with the statement that the findings presented may help avalanche warning services to improve the way location information is communicated in avalanche forecasts.

I have a few minor recommendations / questions.

1 General comments

Numbers indicate line numbers.

1.1 Survey Design

As I said before, I consider the survey well-designed. However, there is one point, which I would like to address:

166-167: You state that participants were explicitly asked not to include the danger rating provided with the avalanche problem information when making their assessment. - I understand that the focus in this study was on applying location information relating to avalanche problems in the route-ranking task. However, I wonder, whether asking participants to ignore the danger rating in the assessment could convey a wrong message, namely that the location of the avalanche problems is more important than the severity of the hazard? After all, the severity of the avalanche hazard is summarized by the danger level, while the avalanche problems by themselves only answer the question «What is the problem?». The severity of the avalanche hazard, the danger level, also correlates much stronger with avalanche risk compared to the avalanche problem, and should therefore weighed more when planning routes[1].

For instance, in scenario 2, it seems that the storm-slab problem is much more severe (danger level *3 - Considerable* at the indicated elevation bands) - and thus the most relevant to consider, compared to the wet-loose problem (*2 - Moderate* below

[1] At least in Switzerland, we see a much stronger correlation between danger level and risk compared to the correlation between avalanche problems and risk (Techel et al., 2015; Winkler et al., 2021).

treeline). Another such example is scenario 4, where the wet-loose problem leads to a danger level *4 - High* below treeline, the wind-slab problem to a *3 - Considerable*. - I am not questioning the findings from your study, but I wonder why you chose this approach, and whether the danger rating, which was shown in the route-ranking exercise (Fig. 1) may actually have influenced some of the choices made. - Could you elaborate on this?

1.2 Type of feedback given between route-ranking tasks

The *type of feedback* provided between route-ranking tasks is mentioned several times (153, 186-187, ...). It is also explored as a main effect (Tab. 2, 394-396). - While I understand that the type of feedback will be analysed in a separate manuscript, maybe you could still provide a little more detail, otherwise the reader is left to speculate. Currently, the only explanation are the four classes mentioned on line 193.

1.3 Recommendations regarding survey design

Beside the actual findings regarding the design of location information in avalanche forecasts, I feel that the experience gained when designing this study may also help other avalanche warning services to design future user surveys, particularly when users from different forecast areas are expected to participate. - Maybe it would be worth adding some key recommendations in this regard in the Discussion section?

2 Specific comments

53-54: Rather than saying that European warning services use a *less-formalized terminology* to describe avalanche problems, I feel that the way of communicating the location and nature of avalanche problems *varies* in Europe. There are some warning services that use a highly formalized terminology to explain the location and nature of the avalanche problem. Such an example is the forecast in Norway, where the avalanche problem, the aspects and elevation, but also the expected avalanche size, the frequency of potential triggering spots and the trigger are specified (e.g. https://varsom.no/snoskredvarsling/varsel/Nord-Troms/2021-04-09). In contrast, there are many others where it is indeed much less formalized (e.g. in Switzerland or France).

53: note that in Europe the *avalanche problem types* are called *avalanche problems*

56: *structure* rather than *structures*?

72-82: maybe of interest in this context is the recent study by (Hutter et al., 2021), where the consistency in describing avalanche danger in public avalanche forecasts is analyzed for Swiss avalanche forecasts

112-128: Very useful overview on how aspect-elevation plots are currently used in forecast products.

112-137: Maybe of interest here (or in the Discussion section): In Europe, on the private www.skitourenguru.ch-platform, the information presented in the avalanche forecast (danger level, aspect and elevation) is directly applied to the map (considering aspect, elevation, terrain classification). Given a valid avalanche forecast, the user can obtain a rating for ski-touring routes. - Maybe it is worth mentioning that there are developments which go further than simply showing the location information using aspect-elevation graphs, as used in the public bulletins?

129-137: would it be possible to provide a figure with some examples to highlight the variety in graphical designs to support this section?

156: maybe add *(a)* after *the first research question*?

157: Would it be possible to provide references to these manuscripts already?

235: comma rather before *6,789* than afterwords?

286: the variable *n* is not explained

324: should it maybe read *consisted of 3,056 participants* rather than *consisted 3,056 participants*

378: the median and interquartile range of completion times are much lower than the mean and 95% confidence interval shown in Fig. 3 or the mean values mentioned later on in the text. - Can you please check whether this is an error. Maybe it would be helpful to report the mean value as well if it deviates a lot from the median.

403: should it read *without any training* rather than *with any training*

410: should it read *completed* rather than *complete*?

411: here is a reference to age classes, but these have not been introduced before - Consider presenting a small table in the Data Analysis section where all the variables and their classes are shown. This table could then also be used to highlight variables which were used in the models as main effects. I personally would have found this useful.

421-422: the p-values shown are < 0.05, which is considered significant (299); here it is described as *not significant* - please check this statement

428: I found this sentence hard to read. Is the first comma necessary?

428-429: In this sentence the name for the *Combined* is not in italics a is normally the case throughout the manuscript.

426: *decreased* rather than *decrease*?

445: *participants* rather than *participant*?

518: delete one of the two *that*

565: delete *for* prior to *during*?

2.1 Figures

The figures are clear and of good quality.

Please consider the following points as suggestions. However, I feel that addressing these could make it easier for the reader to link text statements to (sub)figures.

Fig. 1: maybe additionally show an example with complex routes beside this plot? This might make it easier understandable when you speak about simple and complex routes (185-186).

Fig. 2: could you maybe add *separate*, *aspect-elevation rose* and *combined* in the three subfigures?

Sect. 3.1: I personally would have liked a figure which would summarize the most important demographics of the participants, like the distribution of the classes for avalanche safety training, the type of activity, backcountry experience, and particularly bulletin user types. After all, and as you correctly point out, surveys tend to reach a very particular range of users.

Fig. 3: consider adding (a) to (d) to the four sub-figures. This would allow referencing the specific subfigure in the text.

Fig. 4: consider adding (a) to (c) to the three sub-figures. This would allow referencing the specific subfigure in the text.

2.2 Tables

As you write (307-308), the parameter estimates for the GLMM are hard to directly interpret due to the logit-link. - Maybe consider moving these tables to the appendix, and show plots with the main effects for all parameters instead (as you have already done in Fig.s 3 and 4 for some of the parameters)? As a reader, I found the Figures more helpful than the numbers themselves.

I hope these comments help to improve the manuscript.

Frank Techel

References

Hutter, V., Techel, F., and Purves, R.: How is avalanche danger described in public avalanche forecasts?Analyzing textual descriptions of avalanche forecasts in Switzerland, Natural Hazards Earth System Sciences Discussion, 2021.

Techel, F., Zweifel, B., and Winkler, K.: Analysis of avalanche risk factors in backcountry terrain based on usage frequency and accident data in Switzerland, Nat. Hazards Earth Syst. Sci., 15, 1985–1997, https://doi.org/10.5194/nhess-15-1985-2015, 2015.

Winkler, K., Schmudlach, G., Degraeuwe, B., and Techel, F.: On the correlation between the forecast avalanche danger and avalanche risk taken by backcountry skiers in Switzerland, Cold Regions Science and Technology, 188, 103 299, https://doi.org/https://doi.org/10.1016/j.coldregions.2021.103299, https://www.sciencedirect.com/science/article/pii/S0165232X2100080X, 2021.