DESIGNING A WEARABLE PERSUASIVE AVALANCHE WARNING SYSTEM

Sabine Prezenski[1]*, Nele Russwinkel[1], and Khin Tan Win[3]

[1] *Technische Universität, Berlin, Germany*
[2] *University of Wollongong, Wollongong, Australia*

ABSTRACT: Accidents in backcountry skiing, such as getting caught in avalanche are partly due to bad decision-making during climbing or descending. Currently, technical systems that support the decision-making process during skiing are not available. Our research is aiming to change this. We are working on a project that is analyzing the psychological aspects important for aiding decision-making in the dynamic setting of backcountry skiing. Qualitative methods are used to investigate decision-making during skiing. Adequate persuasive messages are currently developed and tested in a VR- study. The messages with the highest efficiency and a high acceptance rating will be tested in a field study.

KEYWORDS: persuasion; avalanche; warnings; companion-system

1. INTRODUCTION

Most victims of avalanches have been aware of the immediate risk but did not properly relate it to themselves. This is supported by reports of avalanche survivors verifying that the survivor`s estimation of avalanche risk before the accident was accurate (Atkins, 2000). However, awareness of the risk did not prevent them from entering dangerous areas.

Other factors besides the mere knowledge of avalanche risk, influence people's decision of whether to enter a high-risk area.

One set of such errors are well known "human factors" errors, such as diffusion of responsibility and overconfidence in one's luck (Atkins, 2000). By now, the causal influence of human factors on avalanche accidents is an essential part of modern avalanche training (McCammon 2004).

Avalanche training includes not only situational and technical assessment of avalanche danger, but emphasizes the human factors in avalanche accidents, e.g., group thinking, diffusion of responsibility and divergence of subjective and objective risk perception.

2. TECHNICAL SUPPORT SYSTEMS

However, most technical support systems for the backcountry do not address the human factors. Instead, systems target aspects helpful for recognizing avalanche risks or support emergency rescue. Furthermore, backcountry skiers use apps to inform their decisions before going skiing on whether to take a certain route or not. For more information, an overview of apps for backcountry skiing is given by Charrière and Bogaard (2016). Up to today, a lack of technical support systems that aid the decision-making process during skiing exist.

3. AIM & CONCEPT

Our research aims to investigate if it possible from a human factors point of view to design systems that support backcountry skiers while skiing by providing persuasive messages in case of danger during climbing and descending.

Because of the dynamic setting, such a system would need to be implemented as a wearable companion system. Examples of wearable companion systems are vibrating wristbands, augmented reality glasses as well as headphone.

The system needs to warn its user before they enter dangerous terrain. The warnings need to be issued in a manner, that the user can prosses them while skiing. Here for, the decision-making process as well as the acceptance of warnings need to be investigated empirically.

4. DECISION-MAKING DURING SKIING

Our research follows a user-centered approach. Thus, to address the needs and cognitive skills of potential users they are studied extensively.

To identify the most effective point at which warnings should be issued, people's decision-making process is investigated during skiing. Of interest is, how fixed participants plans are where to go down and how participants react to unexpected aspects (snow quality, obstacles).

Hereby participants took video footage of themselves skiing down a slope using a helmet camera. Directly afterwards the participants watched their video footage and were asked report their thoughts and decisions post-hoc. The data is analyzed using qualitative content analysis.

First results reveal, that most skiers follow an initial plan while skiing, but flexible adapt this plan if conditions require them to.

Thus, decision made during skiing can be described as dynamic decision-making (Edwards,1962). Hereby decisions can be characterized as a series of decision which are made under time-constraints in a changing environment (Prezenski et al, 20017).

Since the decision while going down a slope are not completely fixed and the skiers are ready to alter them when needed it is possible to influence the path the skiers take.

5. PERSUASIVE WARNINGS

Persuasive communication aims at influencing people's behavior by applying specific strategies. Using technology to change behavior has become more common in recent years (Hassenzahl and Laschke 2015), (Roubroeks, Ham and Midden 2011). For example, fitness applications use persuasive communication methods to convince users to exercise. Modern car-assistance systems tell their users to take a break and have a coffee. Thus, persuasive technology can be used to influence people to make better decisions in the moment of decision-making (not going down a dangerous slope) but also more long-lasting (e.g. living a healthier life by exercising more regularly).

The PSD model (Oinas-Kukkonen and Harjumaa, 2009) sets the standard for designing persuasive technology. In accordace persuasive technology should be designed in respect to the content of use. The content of use needs to reflect on the intent (attitude change vs behavior change); the event (situation of use and user characteristics) and the strategy (method and message used). Our system targets immediate behavior change (intent). The event is the dynamic activity of backcountry skiing (use); important for the user context is respecting the information processing of the users. Thus, the users need to be able to process the message. Here for, timing and modality issues need to be respected. Finally, the persuasive strategy consists of effective messages (warnings) which are issued via a direct route. To design effective warnings specific criteria, such as salience, wording, layout and placement, pictorial symbols need to be respected. (Wogaltera, et al, 2002). As for all other warning systems, it is important that the system is used adequately. Therefore, the level of acceptability of the warnings need to be looked at. Misuse and disuse need to be avoided. On the one hand, the user should not blindly rely on the systems warnings (misuse). It is crucial that the user processes and reacts to cues and warning signs for potentially dangerous situations. On the other hand, if the system issues warnings in situations that are not perceived as dangerous or if its sensitivity is too high, this can lead to the user ignoring it (disuse). To avoid disuse and misuse, such systems should be designed in a way that situation awareness of users is supported (Endsley, 2016). This can be achieved by not blocking important signal processing channels (e.g. use auditory warning instead visual ones in a visual task) and allowing the user to quest information at any timepoint (e.g. users can query the current avalanche danger).

6. TESTING WARNINGS

Currently, the warning messages are tested in a simulation study. Hereby, the timing of the different warnings, possible modalities (visual, aural, tactile, combinations), as well as intensity of the warning messages are tested.

Here for, a virtual reality (VR) snowboard game (Mefisto, 2018) in which participants can freely snowboard down a mountain is used. This game is played using Wii-balance board as a method of steering method.

The most successful strategies will be evaluated in a second field-study. Albeit, the VR snowboard game induces high-immersion. During, playing one almost has the impression of an actual descent on a snowboard. However, this does not necessary imply that warnings are taken seriously. People are aware that they are playing a game, they do not experience adrenalin rushes or actual anxiety as in real skiing. Persuasive systems need to be designed for and tested in the environment they are opted at. Thus, in the following winter the most promising warnings will be tested on ski-routes using augmented reality glasses, vibrating wristbands and headphones.

7. OUTLOOK

This research focuses on the human factors relevant for designing a persuasive avalanche warning system. The technical aspects of adequate avalanche simulation and aspects such as portability, adequate data updates, low coverage need to be dealt with as well. Here for a larger scope cooperation is needed and partners are welcome to contact us.

Finally, the concept and persuasive strategies underlying the system are applicable in other high-risk contexts, such as rock climbing or cycling in city or even surfing.

* *Corresponding author address:*
Sabine Prezenski, Technische Universität Berlin, 10623 Berlin, Germany.
tel: +49 30 314 29628
email: sabine.prezenski@tu-berlin.de

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REFERENCES

Atkins, D., 2000. Human factors in avalanche accidents, in *Proceedings of the International Snow Science Workshop*, Big Sky, MT, USA, pp. 46-51.

Charrière, M.K. and Bogaard, T.A., 2016. Smartphone applications for communicating avalanche risk information–a study on how they are developed and evaluated by their providers. Natural Hazards and Earth System Sciences, 16(5), pp.1175-1188.

Edwards, W.,1962. Dynamic decision theory and probabilistic information processing. Hum. Factors 4, pp. 59–73. doi: 10.1177/001872086200400201

Endsley, M. R., 2016. “Designing for situation awareness: An approach to user-centered design,” CRC press, FL, USA.

Hassenzahl, M., and Laschke, M., 2015. Pleasurable troublemakers. The gameful world: Approaches, issues, applications, pp.167-195.

Mefisto, Luca, 2018. Perpetual snowslide. VR-Game https://lucamefisto.itch.io/perpetual-snowslide

McCammon, I. ,2004. Sex, drugs and the white death: lessons for avalanche educators from health and safety campaigns, in Proceedings of the International Snow Science Workshop, Grenoble - Chamonix Mont-Blanc, France, pp.423-427.

Oinas-Kukkonen, H. and Harjumaa, M.,2009. Persuasive Systems Design: Key Issues, Process Model, and System Features, Communications of the Association for Information Systems: Vol. 24, Article 28.

Prezenski, S., Brechmann, A., Wolff, S. and Russwinkel, N., 2017. A Cognitive Modeling Approach to Strategy Formation in Dynamic Decision Making. Frontiers in psychology, 8, pp.1335-.

Roubroeks, M. A. J., 2014. Understanding social responses to artificial agents: building blocks for persuasive technology Eindhoven: Technische Universiteit Eindhoven DOI: 10.6100/IR774470

Wogaltera, M.S., Conzolaa, V.C., Smith-Jacksonb, T.L., 2002. Research-based guidelines for warning design and evaluation. Applied Ergonomics 33, pp. 219–230.