

AVALANCHE AIRBAGS AND RISK COMPENSATION:
AN EMPIRICAL INVESTIGATION

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ABSTRACT: Avalanche airbags have dramatically increased in popularity over recent years and so the question has emerged concerning the influence they have on our risk judgment and behavior in avalanche terrain. There is widespread public opinion that avalanche airbags provide a sense of security that leads people to take higher risks. We conducted an online questionnaire, in which 387 participants judged 19 different potential avalanche slopes by avalanche risk, and willingness to ride or ski the slope. Additionally, we asked about demographic data, safety equipment, use of risk management strategies and the Bremer Sensation Seeking Scale for measuring the participants predisposition for seeking novel and intensive sensations or experiences and their influence on judgment and behavior. While we did not find evidence for risk compensation for airbag users, we found Sensation Seeking as the strongest predictor whether respondents ski a slope or not. However, due to the setting of this study we relate our findings to a planning situation and further research is necessary to evaluate these results in real backcountry trip situations.

KEYWORDS: human factors, risk behavior, risk perception, risk management, simulation.

1. INTRODUCTION

There is a wide belief that safety equipment can lead to risk compensation. This belief is based on Wildes (1994) risk homeostasis coming from the field of traffic safety research. As avalanche airbags are a relatively new addition to the traditional avalanche safety tools, many questions have arisen concerning the risk compensation qualities and role of avalanche airbags in decision-making and risk perception. Avalanche airbags are only one of many factors that possibly influence our behavior in avalanche terrain, for example, ones habitual seeking of risky situations or in other terms a person's context-independent risk-taking tendency is likely to have an impact as well (Zuckerman, 2007; Tschiesner, 2012). The large number of possible influencing factors makes this field difficult to investigate, but nevertheless important.

After an evaluation of different methods, a form of simulation seemed appropriate for this research and allowed to put important influencing factors, including avalanche airbags in relation to each other. Simulations are a well-approved and widely applied method in the field of risk taking, while driving in traffic research (see, e.g., the Wiener Risk-Taking Test from Hergovich et al., 2005). Pascal Haegeli has used Discrete Choice Experiments – a similar approach – to investigate travel behavior of snowmobile riders (Haegeli et al., 2012). In contrast to this study, existing research on the influence of avalanche airbags on risk behavior is based on direct questioning (Haegeli, 2012; Christie, 2012).

2. METHODS

The study at hand is based on a questionnaire, which investigates perceived avalanche risk, use of risk management strategies, willingness to ride or ski a slope and the personality trait, Sensation Seeking (Zuckerman, 1979; Gniech, 2002). Since participants of the study answered the questionnaire online and are unlikely to have been in the field we related the results more to a planning type situation and not to a go/no go decision in front or on top of a slope.

In the first step of the questionnaire, participants had to declare their demographic data as well as

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their safety equipment. Following this, they examined 19 different skiing situations in avalanche terrain visualized by pictures and described with words (example see Figure 1). Every situation was rated by perceived risk of avalanches and their willingness to ride or ski the slope. Following the evaluation of the 19 different situations, participants were asked if they had used risk management strategies like Munters “3 x 3” (1992) or Larchers “stop or go” (1999) and completed a test

to measure their personal trait of Sensation Seeking.

The questionnaire was mainly distributed through the websites of the Swiss Alpine Club (SAC), the Austrian Alpine Club (ÖAV) and different topic related online forums as well as among the website of WSL Institute for Snow and Avalanche Research SLF.

1. How high would you rate the risk of avalanche in this slope?
Please set the mark were it explains your perception the best.

No risk Highest risk

0 1 2 3 4 5 6 7 8 9

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Risk posed by avalanches

2. Would you ski or ride this slope under the given circumstances?
Please set a mark.

☐ Yes
☐ No

Today's avalanche report:
Current avalanche risk level for this area: Level 3
Danger points: In all aspects above approximately 2000m.
(the run ends at 2000m)
Risk pattern: Windslab, old snow
Last snowfall: 40 cm, 2 days ago
Skied frequently: No
Exposure: South-East
Steepness of slope: Approx. 37°
Wind: Wind effects visible
Avalanche activity heard: No
Temperature: -2°
Time of day: 2:00 p.m.
Visual avalanche activity: signs visible

Figure 1: Example of a situation as found in the questionnaire with a picture and the intended line to ski. Additional information on the avalanche situation such as fresh avalanches or whoomping sound have been given in words.

2.1 *Sensation Seeking*

Zuckerman's (1979) well acknowledged personality trait Sensation Seeking was measured via the Bremer Sensation Seeking Scale 2000 (Gniech, 2002). The Bremer Sensation Seeking Scale consists of four subscales and a total scale. In this study sensation seeking was not only used as a presumed factor of influence, but also as a way to verify our literature based hypothesis with findings

supporting the sensation seeking model and thus the validation of the constructed questionnaire.

2.2 *Statistical methods*

The relationships between the suspected influencing factors were determined by analysis using Spearman's rank correlation coefficient and Pearson's product-moment correlation coefficient.

The t-test and u- test was applied to identify differences between groups, for example airbag users and non-users.

Based on the correlations found in this study, selected predictors of the willingness to ski a slope were analyzed by applying a logistic regression. The logistic regression models the relationship between a dependent and one or more independent variables, and allows us to look at the fit of the model as well as at the significance of the relationships between dependent and independent variables. A binomial logistic regression, was chosen due to the fact that the dependent variable (willingness to ski a slope) is binary scaled. The R^2 values set the "Zero" model in relation with the model chosen, it shows how much variance our model can explain. Chi-square indicates whether the model with the variables is different from the zero hypothesis (Bühner, 2009)

3. RESULTS

Only participants who stated they ski or snowboard out of bounds and completed the questionnaire to the last page were considered in the study.

3.1 Gender

The examined group (n=387) consisted of 66 (17.1 %) woman and 321 (82.9 %) men.

3.2 Age

The average age was approximately 35 years, with a standard deviation of 11.0 years.

3.3 Airbag use

155 (40.1%) of the people stated they use an airbag. In this group 123 (79.3%) always wear an airbag when they move in the backcountry, which still corresponds to 31.8% of the population (n=387). 18 (11.6%) of the airbag users stated that they only wear their airbag when conditions are particularly dangerous. The remaining 9.1% (14 individuals) stated other reasons why they don't always carry their airbag with them.

3.4 Risk management strategies

217 (56.1%) of the 387 participants in this study stated that they used strategies like Munters "3 x 3" (1992), Larchers "stop or go" (1999) or similar strategies to evaluate the situations and make their decisions. 170 (43.9%) of the respondents stated that they did not use a specific tool or method to evaluate the situations.

3.5 The willingness to ride or ski a slope

87 (22.5%) participants showed a high willingness to ski or ride a slope (n=387)

3.6 Risk perception and the willingness to ride or ski a slope

In the population (n=387) the measured avalanche risk perception and willingness to ride or ski a slope correlated significantly negative (Spearman $r=-.375$; $p=.001$).

3.7 Sensation Seeking and the willingness to ride or ski a slope

The Sensation Seeking total scale and the willingness to ride or ski a slope correlated significantly (Spearman $r=.427$; $p=.001$) positive (n=387).

3.8 Sensation Seeking and risk-perception

The significant negative correlation (Spearman $r=-.108$; $p=.034$) between the Sensation Seeking total scale and avalanche risk-perception means that people with higher Sensation Seeking scores judge the same slopes as less risky compared to individuals with lower Sensation Seeking scores (n=387).

3.9 Airbag and Sensation Seeking

The examined people who use an airbag (n=155) have significantly ($t=-2.291$; $p=.023$) higher Sensation Seeking scores in the subscale *Thrill and Adventure seeking* compared to people without an avalanche airbag (n=232).

3.10 Airbag and the willingness to ride or ski a slope

People who use an avalanche airbag (n=155) were significantly ($u=-15235.5$; $p=.011$) more likely to ride or ski a potential avalanche slope compared to those who do not use a Airbag (n=232).

3.11 Direct questioning of risk compensation

Of the 155 people who use an airbag, 28 (18%) stated that they have at least once, ridden a slope they would not have ridden without an airbag.

3.12 Avalanche airbag and risk perception

The two groups Airbag (n=155) and No Airbag (n=232) did not show any significant ($t= 0.92$; $p=.365$) difference in their perception of risk.

3.13 Risk management strategies and avalanche airbags

Avalanche airbag users (n=155) applied significantly ($t = -3.907$; $p = .001$) more risk management strategies than people without avalanche airbags (n=232).

3.14 Risk management strategies and Sensation Seeking

The usage of risk management strategies correlates significantly (Spearman $r = -.157$; $p = .002$) negative with the Sensation Seeking subscale *Social Risk* (n=387).

3.15 Risk management strategies and the willingness to ride or ski a slope

If participants used risk management strategies they were significantly (Spearman $r = -.158$; $p = .002$) less willing to ride or ski the portrayed slopes (n=387).

3.16 Predictors of the willingness to ride or ski a potential avalanche slope

In the applied regression, the sensation seeking subscale *Thrill and Adventure seeking* proved to be a significant predictor ($OR = 1.132$; $p = .001$). However, the factor avalanche airbag was not a significant ($OR = 1.183$; $p = .522$) predictor whether recreationists ski a slope or not ($\chi^2 = 44.639$, $p = .001$; Nagelkerke $R^2 = .167$; Cox & Snell $R^2 = .109$). Hence there is no evidence for risk compensation with the use of avalanche airbags in our data.

4. DISCUSSION AND CONCLUSION

By comparing choices and evaluations of respondents over the 19 different situations, personal tendencies in decision making and avalanche risk perception could be assessed and compared with presumed influencing factors such as the use of avalanche airbags, the use of risk management strategies and the personality trait Sensation Seeking (Zuckerman, 1979).

4.1 Risk perception and the willingness to ride or ski a slope

Perception builds the base for the decision to ski a potential avalanche slope or not. The negative correlation between avalanche risk perception and the willingness to ride or ski a slope simply means, that if a slope is perceived as more risky people will be less likely willing to ski or ride it and vice

versa. This finding indicates that the questionnaire is measuring what it is intended to evaluate.

4.2 Sensation seeking and risk-perception

Risk perception negatively correlates with Sensation Seeking. This means a person with higher sensation seeking scores judged the same slopes as less risky and vice versa. This corresponds with findings from psychology studies which conclude perception, and risk perception in particular, to be subjective and dependent on individual factors (Asch, 1951; Chauvin, Hermand, & Mullet, 2007; Lindell & Hwang, 2008). The finding is consistent with Zuckerman's (1994) finding that high sensation seekers compared to low sensation seekers tend to underestimate risks and again implies that the questionnaire was measuring what it was intended to do.

4.3 Sensation seeking and the willingness to ride or ski a slope

Our finding that recreationists with higher Sensation Seeking scores will be more likely to ski or ride a potential avalanche slope is consistent with Zuckerman's model. The tendency that a person is willing to take risks in search of novel, varied, complex and intense situations in other life situations seems also to apply to the avalanche environment. It seems possible to measure and predict ones tendency to underestimate risks or ride a potential avalanche slope via the Bremer Sensation Seeking Scale 2000 and probably also by related test instruments.

4.4 Airbag and Sensation Seeking

In analogy to Gniechs (2002) description of Thrill and Adventure Seeking (TAS), one can conclude, that airbag users (in contrast to non users) tend to seek stimuli in the field of risky, but socially approved activities. The stimuli they are looking for are characterized by high speed, potential threat to physical integrity, very fast stimulus sequence or by the charm of the unknown (Gniech, 2002, p 56). At first glance, this seems to show risk compensating behavior in airbag users. But the question remains if this behavior is due to the fact they use an airbag or perhaps their personality. It seems plausible that the knowledge of their own risky tendencies lead them to take higher safety measures and thus to buy an airbag.

4.5 Airbag and the willingness to ride or ski a slope

By way of analogy to Sensation Seeking, people who use an avalanche airbag are also more likely to ski or ride a potential avalanche slope. However, the question of whether the avalanche airbag has a risk compensating effect or ones personality trait (Sensations Seeking) is responsible for such behavior remains unanswered by these correlations and group differences. For this reason we conducted a regression described in point 4.10.

4.6 Airbag and risk perception

People with an airbag did not show a different perception of risk compared to individuals without an airbag. This is another hint, that the avalanche airbag may not be the only factor influencing risk behavior.

4.7 Risk management strategies and avalanche airbags

People who use an airbag are more likely to use risk management strategies and vice versa. We assume that the correlation between these two factors is due to a large group in our population that is very concerned about their safety and thus include both possibilities to reduce their own risk in avalanche terrain.

4.8 Risk management strategies and Sensationseeking

The usage of risk management strategies correlates negatively with the sensation seeking subscale *Social Risk (SR)*. Gniech (2002) describes *SR* as the preference for uninhibited, but at the same time illegal or not socially accepted practices. We assume that the usage of risk management strategies is widely seen as socially appropriate and conclude that people, who have a preference for socially unaccepted practices in other areas of life, also tend not to use these vital tools for assessing risk in avalanche terrain. On the other hand people who score low in the subscale *SR* will be likely to use risk management strategies.

4.9 Risk management strategies and the willingness to ride or ski a slope

People who used risk management strategies tended to be less likely to ride the shown slopes. It seems that these strategies helped the users to identify potential risks and helped them to make safer decisions. This finding is consistent with find-

ings from other researchers who identified the effectiveness of these tools (Haegeli et al., 2010; Haegeli & Haider, 2008).

4.10 Predictors of the willingness to ride or ski a potential avalanche slope

In our sample the personality trait Thrill and Adventure seeking (TAS) was able to predict the willingness to ski or ride a slope. However the Airbag was not able to predict the willingness to ski a slope within our accepted probability of error.

Perhaps risk compensation could not be found due to the fact that the airbag was not actually carried while answering the questionnaire and thus could not show its risk compensating properties. This is analogous to Hedlunds (2000) four factors that lead to risk compensation, namely: Visibility, effect, motivation and control as cited by Haegeli (2012). It is important to understand that the results of this study are more representative for decisions and behaviors in a planning situation and not for go/no go decisions or behaviors in front of a slope. Nevertheless these findings are important since proper planning is crucial for safe travel in avalanche terrain (Harvey et al., 2012; Munter, 2003; Volken et al., 2007).

4.11 Limitations

The decision making process in a real mountain situation is complex and highly variable. Developing a realistic and thus valuable simulation is therefore challenging. Due to its setting, we consider our study to be representative for the decision and perception process during the planning phase, rather than actually on the slope. Further, one should critically analyze the sample of this survey. As Haegeli and colleagues (2012, p. 806) concluded in their study "voluntary surveys about avalanche safety issues have the inherent potential to primarily attract participants who already have a special interest in avalanche safety and the context of a safety survey can further cause participants to provide answers that are biased towards more conservative behavior (i.e., social compliance)".

5. CONCLUSION

We investigated risk compensation effects of backcountry skiers and snowboarders associated with avalanche airbags. To our knowledge this is the first empirical study on this topic. Considerable methodical challenges limited our findings, to the planning stages of a backcountry trip. In this planning or preparatory phase we did not find evidence

for risk compensation among avalanche airbag users. In contrast, studies on risk compensation from other fields (Hedlund, 2000) suggest risk compensation also to be present among avalanche airbag users. Further research is necessary to evaluate our results. It would be of high interest, if intercept surveys taken in the field yield the results consistent with those found in our setting.

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