

HAZARD PERCEPTION AND PREPARATION BY CROSS-COUNTRY SKIERS IN UTAH

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ABSTRACT

The growing use of wildlands for recreation in winter has placed increasing demands on resource management agencies. Winter hazards are substantial, and agencies must confront the difficult task of how to maximize the safety of visitors, while providing the opportunities that bring substantial public benefit.

The objectives of this study were to determine how well present avalanche warning systems work in relaying avalanche information to cross-country skiers; to determine in what ways awareness of hazard will alter skier behavior; and to examine the influence of risk-seeking in the cross-country ski experience.

Throughout three winters we administered 419 questionnaires to skiers in both the Bear River and the Wasatch ranges of northern Utah. Sixty-one different ski locations were represented in the sample. Of the skiers surveyed, 68% were beginners or intermediates, and 32% were advanced or experts. Information-seeking, experience and risk attractiveness all had strong associations with hazard perception and preparation.

INTRODUCTION

The Wasatch mountains of Utah provide cross-country skiers with a range of experiences, from level terrain for the novice, to extremely challenging ski mountaineering for the experienced. People have been skiing this backcountry since the early part of this century. Reasons for this tradition are probably many, but as Howe (1988) pointed out, the main reason is the existence of Salt Lake City. It is a major population center

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that nurtures large numbers of cross-country skiers whom, on a busy day, can outnumber all the ski resorters combined. Another reason might be that skiing is attractive for many, and Salt Lake City is a place that harbors these unique lifestyles.

So it is no surprise that there is the potential for many human-triggered avalanches. In fact, the Utah Avalanche Forecast Center reported an average of over eighty-five avalanche incidents per year since 1980 (Tremper et al., 1989). This study examines the relationships that affect how skiers perceive and prepare for winter hazards.

Objectives

Any agency taking an active role in providing both benefits as well as safety information for the public should be aware of several concerns. First, if cross-country skiers are rational, and are informed about the current hazards likely to be encountered, and specific skiing precautions which could help minimize the likelihood of harm, they will adopt those precautions. At least this is the assumption that underlies the service which agencies like the UAFC provide.

However, assuming that all cross-country skiers seek to avoid avalanche hazards might not be accurate. On the contrary, many cross-country skiers actively seek the challenges associated with the winter environment and hazard information, while helpful, might not change skier behavior.

Usually the areas that provide the most difficult and challenging slopes for skilled skiers are those that have the highest avalanche potential. Given this situation, there is a relationship that must be better understood: to what degree do people put themselves at risk in the winter environment due to lack of information, as opposed to placing themselves at risk through the desire to actively seek and confront nature's challenges and dangers?

This proposed study is aimed at the above question. More specifically, it addresses the issue of winter hazard perception (mainly that of the avalanche hazard) and preparation, and the variables that affect this relationship. Do skiers perceive winter hazards? Are skiers prepared for these hazards? Finally, how do skiers value risk-seeking as a legitimate quest when they go out on tours? Answers to these questions may provide useful guidelines to avalanche forecasters, snow safety personnel and educators.

METHODS

A model of skier hazard perception and preparation

A model of behavior in response to hazards is shown in Figure 1. The model is by no means comprehensive in that it doesn't include all possible variables. However, the model incorporates the major variables which the author believes may influence perception of and preparation for winter backcountry hazards. The terms and relationships of the model are defined below.

The model consists of five basic terms:

1. "Previous Ski Experience" will be a measure of how much previous contact skiers have had with the specific area they are skiing as well as with similar environments.

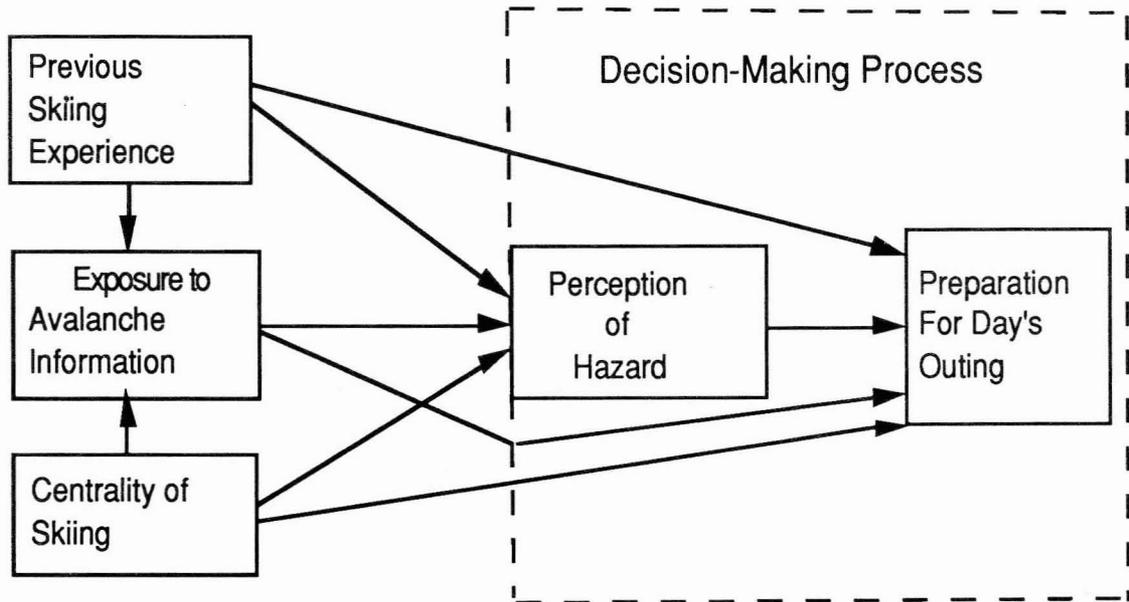


Figure 1. A model of hazard perception and subsequent preparation.
(Adapted from Rentz, 1977)

2. "Exposure to Avalanche Information" will be a measure of hazard information available to skiers. Skiers, for example, may call the Avalanche Forecast Center or inquire at a local ski shop to get current hazard information.

3. "Centrality of Skiing" will be a measure of how important skiing is to an individual's life interests.

4. "Perception of Hazard" is a measure of a skier's perception of the hazard in the area they went skiing.

5. "Preparatory Behavior" will measure what level of preparation skiers have chosen to take.

Hypotheses

Most of the relationships in the model have been empirically established in hazard situations. Only a few studies, however, have been conducted in leisure environments (Rentz, 1977). Eight causal relationships are indicated in Figure 1. These can be translated to the following hypotheses:

1. Skiers exposed to avalanche hazard information will exhibit a higher perception of the avalanche hazards than skiers not exposed hazard information.

2. Skiers exposed to avalanche hazard information will exhibit a higher level of preparation for the avalanche hazards than skiers not exposed to hazard information.

3. Skiers with a high level of experience will exhibit a higher perception of the hazards than skiers with a low level of experience.

4. Skiers with a high level of experience will exhibit a higher level of preparation for the hazards than skiers with a low level of experience.

5. Skiers with a high perception of the hazards will take more preparations than skiers with a low perception of the hazards.

6. Skiers who rate skiing central to their life interests will have a higher level of information-seeking than skiers who rate skiing less central to their life interests.

7. Skiers who rate skiing central to their life interests will have a higher perception of the hazards than skiers who rate skiing less central to their life interests.

8. Skiers who rate skiing central to their life interests will take more preparations than skiers who rate skiing less central to their life interests.

Additional hypotheses

1. Skiers with a higher orientation toward risk will exhibit a lower level of information-seeking than skiers with a lower orientation toward risk.
2. Skiers with a higher orientation toward risk will exhibit a lower level of preparation than skiers with a lower orientation toward risk.

Study Areas

To test the hypotheses, two northern Utah study areas were selected. One was the Logan area mountains of the Bear River range east of Logan, and the other was the mountains of the Wasatch range east of Salt Lake City. These study areas were selected because they provide diversity with respect to both avalanche hazards and visitor populations.

The Logan area mountains, specifically the Logan Canyon area, harbor the bulk of the cross-country skiing population in the Logan area. Skiers in the mountains east of Salt Lake City were contacted at a variety of trailheads, most of which are easily accessible via Millcreek and Big and Little Cottonwood Canyons. Compared to the Logan area, most of these trailheads service steeper, more avalanche-prone terrain. Typically, skiers observed in this study area tended to reflect a less diverse population of cross-country skiers compared to the Logan area.

The research instrument

To successfully assess skiers' perceptions and preparatory behavior, the survey was implemented using a self-completion questionnaire, delivered personally to skiers as they returned to their vehicles. Fieldworkers briefly introduced themselves, stated the purpose of the study, the length of time required to fill in the questionnaire, and asked each person(s) in the touring party to help out by completing the questionnaire before they left the area. The questionnaire was kept short in length to encourage participation, because most skiers were tired and/or cold. This implementation strategy proved successful, as very few of those contacted refused to participate.

Data analysis

After the data were collected the individual variables were coded into

categories. The variables were ordinal in nature so they could be divided into categories ranging from "low" to "high." For example, the "centrality of skiing" variable is ordered in that someone could have a "low" level of interest in skiing or a "high" level of interest in skiing.

In order to test the significance of the correlations between the variables, the Chi-square (χ^2) test was used. This is done by computing the cell frequencies which would be expected if no relationship is present between the variables given the existing row and column totals. The greater the discrepancies between the expected and actual frequencies, the larger the chi-square becomes (SPSS User's Guide, 1983).

While some small deviations can be expected due to chance, large deviations, i.e., large χ^2 values, are unlikely. A small χ^2 value indicates the absence of a relationship, while a large χ^2 value implies that a systematic relationship of some sort exists between the variables (SPSS User's Guide, 1983).

Another way of determining the significance of relationships is to examine the strength of relationships. In the present analyses, two statistical measures, gamma and tau *b*, will be used.

Gamma and tau *b* values range from -1.0 to +1.0 with positive values indicating a direct relationship, and negative values indicating an inverse relationship. A direct relationship is when one variable increases and the other also increases. An inverse relationship is when one variable increases and the other variable decreases (Rentz, 1977).

We used chi-square, gamma and tau *b* values to identify significant and insignificant relationships. Also, the significance level we will use is $p=.05$. Values falling below this level will indicate a significant relationship; in such instances the research hypothesis would be accepted and the *p* values listed. Values above this level will indicate an insignificant relationship; the research hypothesis will be rejected and the *p* value will be "N.S.", or not significant.

RESULTS

The effects of information

In each questionnaire, skiers were asked whether or not they sought information about the avalanche hazards of the day. For those that sought information that day or within the past few days, we followed up with a close-ended question that directed responses into seven categories. Table 1 shows that almost half of the sample (49%) sought information either on

the day surveyed or within the past few days.

Table 1. Avalanche information-seeking by respondents.

Response	% Naming That Response
No	51.0%
No, but within last few days	20.0
Yes	29.0

Note. n = 404 Missing observations = 15

For those that sought information, the most frequently used sources of information were the avalanche forecast center (AFC) and personal observations, as shown in Table 2.

Table 2. Sources of avalanche information.

Source	% Naming That Source
Avalanche Forecast Center	35.2
Personal observations	27.9
Information from friends	18.9
News media	14.6
Ski shop	4.9
Ski resort or touring center	2.4
Other	1.9

Note. Skiers could check more than one source. Therefore, the total does not add to 100%.
n=412 Missing observations = 7

Hypothesis tests

Table 3 summarizes the results from the tests run for each of the hypotheses mentioned previously. Only two of the tests resulted in insignificant relationships. Those that sought hazard information were much more likely to perceive and prepare for the hazard. Experience also had a strong association with perception and preparation. Perception of the hazard was positively associated with preparation. Finally, those that believed skiing to be central to their life interests were much more likely to perceive and prepare for the hazard.

Effects of risk-seeking on preparation

The original model did not include any assessment of the effects of risk-seeking on skier preparedness. However, the questionnaire did contain questions regarding risk-seeking and it seemed possible that this rather loose term might affect what precautions skiers take. For example, persons that are more attracted toward risk might not take avalanche rescue equipment or alter their choice of travel because of avalanche conditions.

Two questions were used to measure a person's "attractiveness" toward risk. Each measure was correlated with two preparation variables. Both tests fail to support the reasoning stated above. Respondents oriented toward risk were more likely to carry avalanche rescue equipment. Furthermore, both tests indicate a moderately strong association between "risk-orientation" and "preparation".

In addition, analyses were conducted to determine the association between risk orientation and the other preparation. The results proved similar to the previous tests. Both risk orientation variables were positively correlated with preparation.

General and personal risk

We included a series of questions in the Salt Lake City area regarding a respondent's rating of the risk to the general skiing public as well as the risk to the respondent. We speculated that skiers would rate the risks to them lower than the risk to the general public.

The results support this line of reasoning. On average, skiers rated

Table 3. Summary of hypotheses and test statistics.

Hypothesis		Gamma/ Tau b	χ^2	p
1.	Effects of Information on Perception	+	6.80	.009
2.	Effects of Information on:			
	a. No. of Avalanche Rescue Items	+	81.54	<.0001
	b. Altered Choice of Travel	+	81.01	<.0001
	c. No. of Hypothermia Items	+	18.94	<.0001
3.	Effects of Experience on Perception			
	a. Previous Trips on Perception	+	3.78	.05
	b. Skill Level on Perception	+	18.60	<.0001
	c. Years Skied on Perception	+	4.97	.03
	d. Different Areas Skied on Perception	+	17.63	<.0001
4.	Effects of Experience on Preparation			
	a. Previous Trips on Rescue Items	+	3.5	N.S.
	b. Skill Level on Rescue Items	+	55.26	<.0001
	c. Years Skied on Rescue Items	+	16.09	<.0001
	d. Diff. Areas Skied on Rescue Items	+	56.06	<.0001
5.	Effects of Perception on Preparation			
	a. Perception on Rescue Items	+	4.15	.04
	b. Perception on Choice of Travel	+	12.41	.0004
	c. Perception on Hypothermia Items	+	2.69	N.S.
6.	Effects of Centrality of Skiing on: Information-Seeking	+	10.03	.002
7.	Effects of Centrality of Skiing on: Perception	+	6.20	.01
8.	Effects of Centrality of Skiing on:			
	a. No. of Avalanche Rescue Items	+	36.87	<.0001
	b. Altered Choice of Travel	+	21.08	<.0001

the risk to themselves less than half of what they rated the risk to the general public. On a scale ranging from a zero chance of being caught and/or killed in an avalanche to a 100% chance, skiers gave the general public an average of 48%, while the probability to themselves averaged 22%.

DISCUSSION

Adequacy of the original model

The original purpose of the study was to test the hypotheses generated by the model. This was done and resulted in some useful generalities. Table 3 summarizes the hypotheses tests and resultant statistics. Seventeen out of the nineteen tests resulted in significant differences, giving support to both the hypotheses and the underlying model.

The model suggested that preparation was the end result of a conscious decision-making process that took place prior to each skiing experience. Skiers, however, might be prepared simply from habitual processes in which little decision-making effort is required. One can argue, though, that such a habit must have originally resulted from a decision-making process. Rentz (1977) suggested that this process may have been set in motion by a perception of hazards or it may have resulted from the subtle pressures of a social group.

In fact, Rentz (1977) stated there may be many influences (comfort, socialization, personality differences, to name a few) which can affect preparatory behavior. These influences may interact with each other as well as with preparatory behavior. Thus, such behavior does not appear to result from a decision-making process that takes place immediately prior to going skiing.

It is important to note that even if the model was not one hundred percent adequate, certain generalities emerged from the analyses that are useful to avalanche forecasters and educators.

Information had a strong association with the perception of, and preparation for, the avalanche hazard. This would suggest that current avalanche information systems are related to avalanche perception and preparation. Additionally, previous knowledge about avalanches had a large effect on preparation. Avalanche classes and workshops usually provide information that is different than information acquired by calling the AFC. Classes offer stories, films and narratives which may help evoke strong images of the power of avalanches. These images may have a large effect on preparation.

Those that were found to be the most prepared were also more oriented toward risk. This would suggest that risk is a major factor in the enjoyment of skiing in avalanche-prone terrain. Risk-seeking, however, does not imply that skiers are deliberately seeking to trigger

avalanches to fulfill a need. It may, in fact, simply suggest that skiing in avalanche terrain is challenging. And the challenge results from the balancing of how to ski in potentially dangerous terrain without getting avalanched.

Since this study supported the reasoning that those who were more exposed to information were also more likely to be aware of and prepared for avalanches, more effort should be placed on information decimation. Resource agencies should explore and experiment with a multitude of information techniques. Combining different media outlets such as T.V., radio, newspaper, telephone and signs would most likely result in a higher hazard awareness.

More research should be done in exploring the definition of preparation. More specifically, preparation is a dynamic behavioral trait. Preparation for avalanche hazards changes throughout the season as the avalanche hazard itself changes. A person could be considered prepared even without a rescue beacon if his/her knowledge and experience dictates this precaution is not necessary, i.e., if the slopes being skied are less than twenty-five degrees.

To explore these relationships, personal interviews and other naturalistic inquiries should be used. Even personal observations from the backcountry might be helpful. Follow skiers around and watch them to observe how they make decisions, what safety equipment they have, what kind of skiers they are, etc.

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