DIFFERENCES BETWEEN AVALANCHE EXPERTS AND NOVICES

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ABSTRACT: Differences between avalanche experts and novices have long been cited as a key issue in designing effective avalanche education, yet few investigations have quantitatively explored these differences. In this study, we examine how self-reported training, knowledge, skills, and behavior differ between avalanche experts and novices. From 2002 to 2004, we surveyed 300 avalanche professionals and winter recreationists regarding their demographics, risk taking, experience, training, involvement in avalanches, knowledge of someone killed, seeking feedback about stable and unstable conditions, reviewing of prior frequency of carrying rescue gear, use of avalanche bulletins, and ranking of signs of instability and stability. We received 161 responses, and found numerous differences between avalanche professionals and recreationists across varying levels of expertise. Surprising was the similarity in both groups' ranking of signs of instability and stability, suggesting that recreationists and professionals had similar basic knowledge regarding avalanche hazard. Correlation analysis of rankings and rank variances suggests that much of the professional respondents' learning took place through personal experience in avalanche terrain, whereas almost all of the learning by recreationists was the result of training. Recreationists' apparent lack of success in learning through direct experience suggests a gap between their technical knowledge about avalanches and their ability to apply what they know. These results have important implications for recreational avalanche programs that intend to equip their students for making effective decisions in the backcountry.

KEYWORDS: expertise, expert, novice, avalanche education, training, experience, decision making

1. INTRODUCTION

Compared to avalanche novices, very few avalanche experts are injured or killed in avalanches despite spending considerable time in avalanche-prone terrain. In disciplines ranging from chess, physics, and music to computer programming and medicine, experts consistently out perform novices. Researchers from De Groot's (1965) original study of chess players in 1946 to the present (Chase and Simon, 1973; Kundel and Nodine, 1975; Larkin et. al., 1980; Chi, et. al., 1988; Dreyfus and Dreyfus, 1986; Klein, 1998) have sought to learn "What do experts know that novices do not know? And "How do experts and novices learn to make decisions."

Research has been conducted in many disciplines to answer these questions. A number of studies cited by Mayer (1992) reveal that in terms of factual knowledge, experts and novices may have about the same base levels of knowledge, but it is the vast accumulation of experience that allows experts to use their knowledge faster and in more diverse and beneficial ways.

Experts develop expertise and Mayer (1992) summarizes the research by writing that experts acquire a great deal of domain-specific knowledge from many years of intensive experience. Work by Dreyfus (1986) and Klein (1998) reveals that experts tend not to reason with rational or analytical processes. Instead experts rely on intuition: experts just know. In naturalistic decision-making settings (Klein, 1998) such as avalanche terrain (Atkins, 2002), experts tend to know almost immediately what actions are appropriate. Often they cannot give specific reasons for their decisions (Dreyfus, 1998; Klein, 1998).

The differences between avalanche experts and novices have long been cited as a key issue in designing effective avalanche education, yet few investigations have quantitatively explored these differences. Our aim was not to test hypotheses but to

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gather insight to the similarities and differences of avalanche experts and novices. These results have important implications for recreational avalanche programs that intend to equip their students for making effective decisions in the backcountry.

In this study, the term avalanche *expert* is generally synonymous with *professional*. These participants are people who work in avalanche-prone terrain. Likewise, the term *novice* is generally synonymous with *recreationist*. The *novice* is someone with at least some avalanche-awareness training and experience but visits avalanche-prone terrain to play rather than work.

2. OBJECTIVES

The goal of this study was to quantitatively evaluate differences in how experts and novices judge avalanche hazard. While we suspected at the outset that professionals had greater levels of expertise than recreationists, we also wanted to see what differences, if any, there were between these two groups as they gained more experience and training. Such differences, if they exist, would be important factors in designing effective avalanche education for recreationists and avalanche novices.

3. METHODS

We surveyed 300 avalanche professionals and winter recreationists from 2002 to 2004 regarding their demographics, risk taking, experience, training, involvement in avalanches, knowledge of someone killed, seeking feedback about stable and unstable conditions, reviewing of prior frequency of carrying rescue gear, use of avalanche bulletins, and ranking of signs of instability and stability. (Figures A1 and A2 show the survey form.) The list of avalanche experts was prepared from randomly selected (and stratified by geographical region) Professional members of the American Avalanche Association. Surveys were also presented to Canadian and Alaskan helicopter ski guides, U.S. National Park Service rangers, and members of the American Mountain Guides Association. The list of novices was prepared from past students of selected avalanche courses held in Colorado, Idaho, and Wyoming. Surveys were generally mailed to participants but some surveys were hand delivered and completed at the start of advanced-level recreation avalanche courses. We received 161 responses.

Part of the survey asked experts and novices about their bias toward risk-*seeking* (item 3) and risk-*avoidance* (item 4). To calculate a dominance score participants were asked to judge how often they are in the risk-seeking and risk-avoiding states. Subtracting item 4 from 3 gives a dominance score. Subtracting also cancels out any response tendency, as people tend to subjectively rate either high or low whatever the subject (Apter, 1992). A positive dominance score signifies a risking-*seeking* tendency; while a negative score signifies a risk-*avoiding* tendency. A score of zero means one is neither especially risk-*seeking* or risk-*avoiding*. This dominance score offers a very simple indication of attitudes towards risk.

In comparing data across groups, we used parametric statistical methods whenever possible. When distributions deviated significantly from normality ($P < 0.05$ by the D'Agostino-Pearson test), we used nonparametric methods, which are noted in the text.

4. RESULTS

We received 161 usable responses to the survey. Ninety-one were from avalanche professionals and 70 were from winter recreationists. Sections of the survey that were incompletely filled out were omitted from the analysis.

4.1 General comparisons

Comparisons between the responses of recreationists and professionals are shown in Table 1. In general, professionals surveyed were more likely to be male, older, and have a higher risk dominance score (i.e. they were more prone to risk taking) than recreationists. As one would expect, the number of seasons in avalanche terrain and the number of hours of formal avalanche training were significantly greater for professionals than for recreationists.

Roughly equal numbers of respondents came from the three avalanche climates (Mock and Birkeland, 1999), with no significant differences in the home climates of professionals or recreationists. The majority of recreational respondents identified themselves as backcountry skiers, whereas most professionals identified themselves as forecasters, ski patrol or ski guides. Professionals had triggered many more avalanches (median 31–40 avalanches) than recreationists (median 1–5 avalanches), and were significantly more likely to have been partially buried. Remarkably, full burial and injury rates were not significantly different between professionals and recreationists.

Professionals were more likely to seek feedback regarding both stability and instability, and were more likely to review past experiences than were recreationists. Both professionals and recreationists carried rescue gear with about the same frequency. Professionals consulted the avalanche bulletin significantly more frequently (an average of 5–6 times per week) than recreationists (average 3–4 times per week). Professionals also consulted the bulletin significantly more frequently as their number of seasons in avalanche terrain increased (Spearman rank $r_s = 0.250$, $P = 0.040$). There was no similar correlation among recreationists ($r_s = 0.082$, $P > 0.50$). Finally, both groups placed about the same importance on the avalanche bulletin rating, when it was available. There was no significant (Spearman rank) correlation between bulletin importance and the number of seasons in avalanche terrain for recreationists ($r_s = - 0.203$, $P = 0.10$) or professionals ($r_s = 0.119$, $P = 0.40$).

Survey item	*REC*	*PRO*	*Test*	*P*
1. Sex: M/F (*n*)	51/19	79/12	χ^2	0.026
2. Age (*M* ± QD)	31.0 ± 5.5	42.0 ± 7.0	M-W	< 0.0001
3,4. D (mean ± SD)	- 0.1 ± 1.0	- 0.5 ± 1.3	*t*-test	0.047
5. No. seasons (*M* ± QD)	8.0 ± 4.0	20.0 ± 8.5	M-W	< 0.0001
6. Hrs training (*M* ± QD)	62.0 ± 30.0	100 ± 66.3	M-W	< 0.0001
7. Region (*n*)			χ^2	0.13
Maritime	23	18		
Intermountain	17	30		
Continental	28	43		
8. Activity (*n*)			-	-
BC skiing	49	0		
OB skiing	5	0		
Mtn climbing	5	0		
Mtn guide	0	9		
Av forecaster	0	12		
Hwy forecaster	0	6		
BC snowboarding	4	0		
OB snowboarding	1	0		
Ski patrol	0	17		
Ski area forecaster	0	14		
Snowshoeing	1	0		
Ski guide	0	22		
Other	5	10		
9. Aval. triggered (*n*)			M-W	< 0.0001
0	21	7		
1–5	33	16		
6–10	5	6		
11–20	3	8		
21–30	2	6		
31–40	0	3		
41–50	0	1		
> 50	6	44		
10. Partly buried: Y/N(*n*)	17/53	44/47	χ^2	0.002
11. Fully buried: Y/N(*n*)	2/68	6/85	χ^2	0.28
12. Injured: Y/N(*n*)	4/66	8/82	χ^2	0.45
13. Know fatality: Y/N(*n*)	32/36	74/15	χ^2	< 0.0001
14. Fdbk – instab (*M* ± QD)	6.0 ± 0.5	6.0 ± 0.5	M-W	0.0005
15. Fdbk – stab (*M* ± QD)	5.0 ± 1.0	6.0 ± 0.5	M-W	0.004
16. Review exp (*M* ± QD)	4.0 ± 0.5	5.0 ± 1.0	M-W	< 0.0001
17. Rescue gear (*M* ± QD)	6.0 ± 0.5	6.0 ± 0.0	M-W	0.79
18. Consult bulletin?			M-W	< 0.0001
0	6	3		
1–2	21	11		
3–4	15	11		
5–6	18	17		
7+	6	32		
N/A	4	17		
19. Imp. of rating (*M* ± QD)	4.0 ± 1.0	4.0 ± 0.5	M-W	0.66

Table 1. Summary of survey results comparing recreationists and professionals. Here, *n* is sample size, *M* is the median value, SD is the standard deviation and QD is the quartile deviation. M-W denotes the Mann-Whitney test used to compare sample sets that are not normally distributed.

4.2 Judging instability

In Part II of the survey (Figure A2), we asked professionals and recreationists to rank 14 signs of instability by their relative importance. As shown in Figure 1, median rankings of the two groups were remarkably similar. Pair-wise comparisons of the rankings using the Mann-Whitney test showed that recreationists tended to rank item (b) – recent heavy drifting – as slightly less important (higher ranking) than did professionals ($P_{M\text{-}W} = 0.0032$). All other pairwise comparisons showed no significant differences in rankings between the two groups ($P_{M\text{-}W} > 0.05$).

For both recreationists and professionals, we examined two factors that seem to play key roles in developing expertise in interpreting signs of instability: training and experience. As these factors increase in magnitude, they can have two possible influences on rank distributions. First, median rankings for a particular sign may shift up or down as individuals improve their skill at interpreting signs of instability. For example, as professionals gain more experience in performing and interpreting stability tests, they may place greater importance on their test results than would a less-experienced individual. Such a tendency would manifest itself as rank values of test results that generally decrease (become more important) with experience. To detect the presence of such trends, we used a Spearman rank correlation

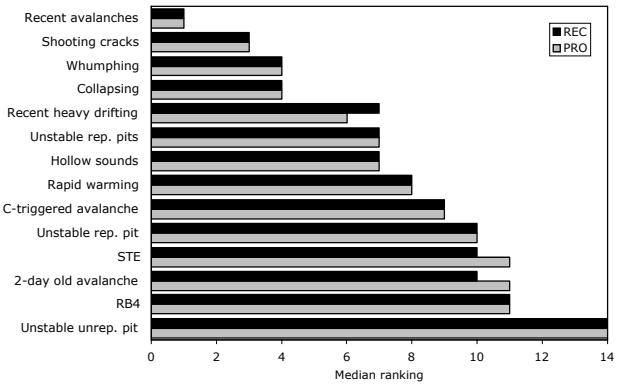

Figure 1. Signs of instability ranked by professionals and recreationists. Median rankings were almost identical between the two groups, differing significantly only for recent heavy drifting. See survey for the full description of each of the instability signs.

between the level of training or experience and the rank values for the instability signs.

A second influence that training and experience may have on interpreting signs of instability is that they may act to normalize the relative importance of a particular sign. In other words, as a group of respondents gains more experience in avalanche terrain, their opinions of the ranking of a particular sign might tend to become more similar (convergent) or more dissimilar (divergent). Convergent opinions, measured as a variance between rank scores by individuals of similar training or experience, represents consensus among those individuals about the relative importance of the signs. In other words, convergence is a rough measure of judgment consistency for a particular group of individuals, and is a trait correlated with expertise (Shanteau et al. 2004). Divergent opinions, on the other hand, reflect a dynamic state of learning about complex phenomena that is generally a precursor to developing expertise (Weiss and Shanteau, 2004). No significant change between rank scores across groups of people with varying levels of training and experience indicates that the perceived importance of the signs remains relatively unchanged.

To assess possible convergence and divergence of rank values with growing expertise, we divided rankings of respondents into groups based on ascending amounts of experience (Table 2a) and training (Table 2b). Convergent rankings were those that showed a significant negative linear correlation between the median rankings of each group and the rank variances. Divergent rankings were those that showed a significant negative correlation between these factors.

Results for the change in median rankings and rank variance of instability signs are shown in Table 3. As their level of training increased, recreationists tended to rank item (f) – cornice triggered avalanche – as more important (r_s = - 0.30, P = 0.021) and item (m) – easy shovel shear– as less important (r_s = 0.36, P = 0.0053). As recreationists gained more experience, however, rank variances for item (f) – cornice triggered avalanche – tended to increase (diverge), indicating that differences in opinions about the relevance of this sign increased with the experience of recreationists.

	Recreationists		*Professionals*	
Group	*n*	*M* ± QD	*n*	*M* ± QD
1	12	3.0 ± 0.8	16	7.0 ± 2.3
2	12	5.0 ± 0.3	16	12.0 ± 1.0
3	12	8.0 ± 0.5	16	19.0 ± 1.5
4	12	11.5 ± 1.8	16	25.0 ± 1.8
5	11	25.0 ± 3.0	16	31.0 ± 4.3

(a)

	Recreationists		*Professionals*	
Group	*n*	*M* ± QD	*n*	*M* ± QD
1	12	26.0 ± 12.0	15	50.0 ± 6.0
2	12	50.0 ± 1.0	15	80.0 ± 15.0
3	12	64.5 ± 5.0	15	100.0 ± 0.0
4	12	100.0 ± 2.5	15	200.0 ± 25.0
5	11	160.0 ± 25.0	16	318.0 ± 200.0

(b)

Table 2. Groupings of professionals and recreationists by (a) increasing experience (seasons) and (b) increasing training (hours), where *n* is the group size, *M* is the median, and QD is the quartile deviation.

Professionals showed a significantly different pattern of ranking the signs of instability as their experience and training increased. Rankings for item (k) – unstable representative pit results – diverged with greater training (r_s = 0.89, P = 0.045), and item (c) – rapid warming – diverged with greater experience (r_s = 0.88, P = 0.050). Rankings by professionals for item (i) – unstable representative pit results – tended to increase (become less important) with experience (r_s = 0.31, P = 0.00059) and rankings for item (e) – unstable unrepresentative pit results – tended to decrease (become more important) with greater experience (r_s = - 0.30, P = 0.076).

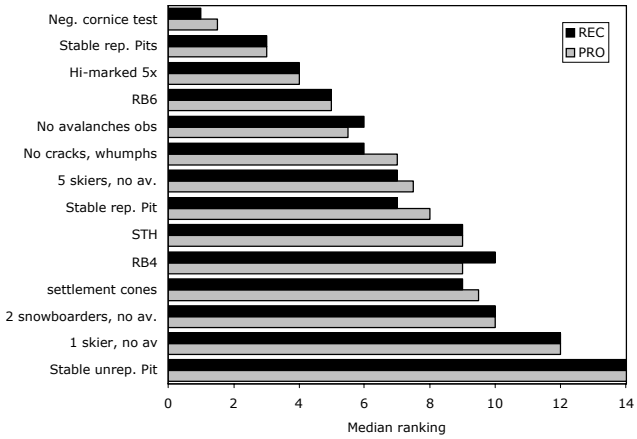

Figure 2. Signs of stability ranked by professionals and recreationists. Median rankings were statistically identical between the two groups. See survey for the full description of each of the stability signs.

4.3 Judging stability

In Part III of the survey, respondents ranked 14 signs of stability by their relative importance (Figure 2). Again, there was remarkable agreement between professionals and recreationists on the relative importance of these signs. Paired comparisons of the rankings using the Mann-Whitney test showed no significant differences between the two groups ($P_{M\text{-}W}$ > 0.05).

		Recreationists		*Professionals*	
Survey item	*Median rank*	*Training*	*Exper.*	*Training*	*Exper.*
(d) Recent avalanches	1.0				
(n) Shooting cracks	3.0				
(g) Collapsing	4.0				
(j) Whumphing	4.0				
(b) Recent hvy drifting*	6.0				
(h) Hollow sounds	7.0				
(k) Unstable rep. pits	7.0			Diverge	
(c) Rapid warming	8.0				Diverge
(f) Cornice-trig. aval.	9.0	Decrease	Diverge		
(i) Unstable rep. pit	10.0				Increase
(a) RB4	11.0				
(l) 2-day old avalanche	11.0				
(m) STE	11.0	Increase			
(e) Unstable unrep. pit	14.0				Decrease

* Ranked higher by recreationists

Table 3. How professionals and recreationists ranked signs of instability depended on the extent of their training and experience. Rankings that decreased became more important and rankings that converged became more similar among more trained/experienced individuals. Signs are listed in order of their median ranking by all respondents.

Differences in median rankings and variances of the signs of stability were assessed in the same way as for signs of instability. Table 4 shows the rank effects among stability signs for professionals and recreationists. As their level of training increased, recreationists tended to see stable representative pit results as more important (r_s = - 0.39, P = 0.00041 for several representative pits and r_s = - 0.34, P = 0.014 for a single representative pit) and settlement cones as less important (r_s = 0.32, P = 0.021). Opinions about the relative importance of a rutschblock score of six also tended to converge (r_s = - 0.98, P = 0.0042) with greater training. As experience increased among recreationists, opinions about the importance of results from a single representative pit also tended to become more uniform (r_s = - 0.95, P = 0.014).

Once again, professionals showed a very different learning pattern compared to recreationists regarding signs of stability. As their level of training increased, professionals' opinions changed about only one item – no avalanche following the first skier on a slope (r_s = 0.94, P = 0.017). In contrast, their opinions about stability signs changed significantly with greater levels of experience. Stable results from a single representative snow pit (r_s = 0.32, P = 0.0049) and a hard shovel shear result (r_s = 0.24, P = 0.040) were

perceived to be less important as professionals' experience increased. In contrast, no avalanches following the descent of five skiers (r_s = -0.33, P = 0.0043), no avalanches following two snowboarders (r_s = -0.33, P = 0.0042), and no avalanches following the descent of a single skier (r_s = - 0.25, P = 0.035) were perceived to be more important as professionals' experience increased.

		Recreationists		*Professionals*	
Survey item	*Median rank*	*Training*	*Exper.*	*Training*	*Exper.*
(a) Neg. cornice test	1.0				
(c) Stable rep. pits	3.0	Decrease			
(e) Hi-marked 5x	4.0				
(b) RB6	5.0	Converge			
(f) No avalanches	6.0				
(k) No cracks, whumphs	6.0				
(l) 5 skiers, no av.	7.0				Decrease
(g) Stable rep. pit	7.0	Decrease	Converge		Increase
(d) RB4	9.0				
(i) STH	9.0				Increase
(n) Settlement cones	9.0	Increase			
(h) 2 snowbds, no av.	10.0				Decrease
(j) 1 skier, no av	12.0			Diverge	Decrease
(m) Stable unrep. pit	14.0				

Table 4. How professionals and recreationists ranked signs of stability depended on the extent of their training and experience. Signs are listed in order of their median ranking by all respondents.

5. DISCUSSION

Viewed as a whole, our results suggest a number of important differences between respondents based on their amount of training and experience and whether they were recreationists or professionals.

Similar rankings – We found it striking that there was little difference between the rankings of signs of instability or stability by recreationists and professionals. This suggests that both recreationists and professionals as a whole have the same basic knowledge about the relative importance of these factors. Systematic changes in the rankings with training and experience indicate that both groups were actively adapting their knowledge as they gained more training and experience.

Degree of adaptation – The recreationists surveyed showed statistically significant ranking trends for six items; professionals for nine items. Thus, across the spectrum of training and experience that we surveyed, professionals as a whole seemed to be actively adapting their knowledge about more signs than recreationists. Most notably, recreationists' rankings diverged (a sign of dynamic learning) on only one survey item, whereas professionals diverged on three items. This result isn't entirely surprising given the amount of time that professionals spend in avalanche terrain compared to recreationists.

What novices learned – As they gained experience and training, recreationists and professionals appeared to learn about very different things. As shown in Table 5, recreationists showed ranking trends for cornice triggered avalanches, easy shear results, pit results and settlement cones. Professionals showed ranking trends for signs involving pit results, warming, and skier triggering. It is notable that, as recreationists gained training and experience with instability, they did not seem to change their perceptions of the relative importance of snow pit results. This finding seems consistent with the frequent observation that recreationists dig snowpits much less frequently than do professionals. Both groups appeared to learn much about how stability relates to snow pit results, although there is remarkably little overlap.

How novices learned – Perhaps the most striking difference between the recreationists and professionals responding to this survey relates to where most of their learning occurred. Recreationists showed almost all of their rank changes in conjunction with training, whereas professionals showed the majority of their rank changes as a result of personal experience. In other words, recreationists didn't seem to be learning effectively thru their experiences. This disquieting trend is reflected in several other survey items: Recreationists sought feedback about snow conditions less often than professionals (survey questions 14 and 15) and they reviewed their experiences less frequently (question 16). The very serious consequence of this tendency can be seen in survey items 9, 11, and 12: Recreationists

had the same rates of full burial and injury as professionals, yet they triggered far fewer avalanches than professionals. In short, Recreationists learned about avalanches through their training, but as a group did not seem to be developing the ability to apply their knowledge in avalanche terrain.

	Instability	*Stability*
Recreationists	Cornice-trig. avalanche (f) STE (m)	Pit results (b,c,g) Settlement cones (n)
Professionals	Pit results (e,i,k) Warming (c)	Pit results (g,i) Skier triggering (h,j,l)

Table 5. Survey items for which recreationists and professionals showed the most active rank changes as they gained more experience and training. See Figure A2 for a full description of the items.

6. CONCLUSIONS

We've seen that the experts surveyed gained most of their knowledge through experience, whereas novices gained most of their knowledge through training. Even though both groups appear to have the same base knowledge for prioritizing signs of instability and stability, recreationists appeared unwilling or unable to apply what they knew to reduce their chances of being buried or injured in avalanches.

This result has important implications for avalanche education. While the avalanche classes taken by recreational respondents appear to have done a fine job of communicating information, they have not, in general, prepared recreationists to consistently identify hazards and make decisions in avalanche terrain. McCammon (2004) suggests that simple, heuristic-based tools may be more effective than knowledge-based training in preparing novice recreationists to make decisions in avalanche terrain.

While experts and novices posses similar base knowledge, novices do not think like experts. Technical and safety training—which includes avalanche-awareness education— teaches facts, rules, and procedures (Kletz, 1994). Klein (1998) states this strategy works well for simple, procedural tasks, but it does not lead to greater expertise or better judgment. The problem for novices is that they lack the domain-specific knowledge and experience to put those facts, principles, rules, and procedures into context. Instead of teaching novices to think like experts, novices should learn like experts (Klein, 1998). People become experts through experience, and there are ways to build up a person's experience base. In other words, novices should be guided toward expertise.

Our survey suggests avalanche experts think or perceive of avalanches differently than novices. Davis (1998) observed that experienced avalanche workers discuss avalanches very differently in an informal setting than they do in a classroom setting. Experts rely on feelings, perceptions, and intuition, and this ability is garnered from their experience.

In addition to McCammon's heuristics mentioned earlier, other effective methods to enhance experience include the concept of situational awareness, which is being able to recognize what is typical and what is not typical. Experience can also be improved using stories and case histories especially early in the training. Kletz (1994) suggests starting with the stories first and drawing out the facts and principles. A story can put the facts, principles, rules, and procedures into a context that is easier and faster to interpret and learn.

Of course, these conclusions come with several caveats. First, the number of respondents in this study was relatively small, so we cannot be certain that the results from this survey are truly representative of recreationists and professionals in general. Similarly, the vast majority of respondents to this survey were skiers, and so we cannot be certain that these results apply equally to other forms of winter recreation. Finally, because we used no other methods of assessing avalanche knowledge, we cannot be certain that the responses to this survey accurately reflect the way that respondents would actually make decisions in avalanche terrain. Nevertheless, we feel that these results support the need for different techniques and better decision tools in avalanche training programs, particularly those aimed at recreationists. We believe that the development of those techniques and tools will be a fruitful area for future investigations.

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Avalanche Survey

The purpose of this survey is to learn how avalanche professionals differ from recreationalists in regard to risk taking, training, experience, and evaluation of stable and unstable avalanche conditions.

Please complete this survey by yourself, without assistance from friends, books, or other training materials. When done, return this survey to the CAIC using the included stamped-addressed envelope.

About you:

1. Sex: ❑ male; ❑ female

2. Age _____

How often do you:	NEVER	SELDOM	SOME-TIMES	OFTEN	VERY OFTEN	ALWAYS
3. Try to do exciting things	1	2	3	4	5	6
4. Take the safe course of action	1	2	3	4	5	6

About your training and experience:

5. Number of seasons spent working and/or recreating in avalanche terrain: _____

6. Number of hours of formal (structured classroom and field) avalanche training: _____

7. Where do you primarily recreate (pick one):

❑ Alaska - interior	❑ Alberta - Rockies	❑ Southern Rockies - CO
❑ Alaska - coastal	❑ Pacific Northwest - WA, OR	❑ Sierras - CA
❑ British Columbia - coastal	❑ Intermountain - UT, NV	❑ Southwest- AZ, NM
❑ British Col. - interior	❑ Northern Rockies - ID, MT	❑ New England
❑ British Col. - Rockies	❑ Central Rockies - WY	❑ Eastern Canada
❑ other _____		

8. Primary wintertime activity or occupation (pick one):

❑ backcountry skiing	❑ backcountry snowboarding	❑ snowmobiling
❑ off ski-area skiing	❑ out-of-area snowboarding	❑ snowshoeing
❑ mountain climbing	❑ ski patrol	❑ ski guide
❑ mountain guide	❑ snowmobile guide	
❑ regional avalanche forecaster	❑ ski-area avalanche forecaster	
❑ highway/railway avalanche forecaster	❑ other _____	

9. Number of avalanches you have triggered while traveling on snow (skiing, walking, snowboarding, snowmobiling, etc. Do not count explosive-triggered avalanches.)

❑ none	❑ 11 to 20	❑ 41 to 50
❑ 1 to 5	❑ 21 to 30	❑ more than 50
❑ 6 to 10	❑ 31 to 40	

Avalanche Survey

10. Have you ever been partly buried in an avalanche? ❑ no; ❑ yes, number of times _____

11. Have you ever been buried in an avalanche? ❑ no; ❑ yes, number of times _____

12. Have you ever been injured in an avalanche? ❑ no; ❑ yes, number of times _____

13. Do you personally know someone who died in an avalanche? ❑ no; ❑ yes

14. How often do you seek feedback (clues, e.g., avalanches, collapsing, shooting cracks, stability tests, etc.) regarding unstable snow conditions.

NEVER	SELDOM	SOME-TIMES	OFTEN	VERY OFTEN	ALWAYS
1	2	3	4	5	6

15. How often do you seek feedback (clues, e.g., stability tests, previous tracks, lack of avalanches, etc.) regarding stable snow conditions.

NEVER	SELDOM	SOME-TIMES	OFTEN	VERY OFTEN	ALWAYS
1	2	3	4	5	6

16. How often do you review prior experiences (by yourself and/or with colleagues/friends):

NEVER	SELDOM	SOME-TIMES	OFTEN	VERY OFTEN	ALWAYS
1	2	3	4	5	6

17. How often do you carry at least an avalanche transceiver, shovel, and probe:

NEVER	SELDOM	SOME-TIMES	OFTEN	VERY OFTEN	ALWAYS
1	2	3	4	5	6

18. How often do you listen to or read the current avalanche danger bulletin from a regional avalanche information center?

❑ 0 times per week	❑ 5 to 6 times per week
❑ 1 to 2 times per week	❑ 7 or more times per week
❑ 3 to 4 times per week	❑ no bulletin available for your area

19. How important is the local avalanche information center's danger rating when deciding where to travel in the backcountry?

NOT	SELDOM	SOMEWHAT	FAIRLY	VERY	EXTREMELY
1	2	3	4	5	6

Figure A1. Survey form, pages 1 – 2.

Avalanche Survey

Part II

Judging Instability in Dry Snow

Please rank the following signs of instability from highest significance (1) to lowest significance (14). Use the table at the bottom of this page to rank the signs of stability. If you are unfamiliar with a sign, please use a question mark (?).

a. A "moderate" shear from a Rutschblock test (RB=4).

b. Recent heavy wind-drifting of snow.

c. Rapid warming of a cold, fresh snow.

d. Recent avalanche activity on similar slopes.

e. One snow pit in an unrepresentative spot showed unstable snow.

f. A cornice test with a car-sized block of snow produced an avalanche.

g. Collapsing snow as you cross a slope.

h. Hollow-drum like sound as you cross a slope.

i. Several representative snow pit tests show unstable snow.

j. Whumpfing-sound as you cross a slope.

k. One snow pit in a representative spot showed unstable snow.

l. Two-day-old avalanche activity.

m. An "easy" shear from a shovel shear test.

n. Long-running cracks shoot out from underfoot.

14	13	12	11	10	9	8	7	6	5	4	3	2	1

least significant — most significant

Please go to next page for Part III.

Avalanche Survey

Part III.

Judging Stability in Dry Snow

Please rank the following signs of stability from highest significance (1) to lowest significance (14). Use the table at the bottom of this page to rank the signs of stability. If you are unfamiliar with a sign, please use a question mark (?).

a. A cornice test with a car-sized block of snow trundles down the slope without triggering an avalanche.

b. A "hard" shear from a Rutschblock test (RB=6).

c. Several snow pits from representative areas show stable snow.

d. A "moderate" shear from a Rutschblock test (RB=4).

e. Five snowmobilers just high-marked the slope without incident.

f. No observable avalanches.

g. One snow pit from a representative spot shows stable snow.

h. Two snowboarders just descended the slope without incident.

i. A “hard” shear from a shovel shear test.

j. One skier just descended the slope without incident.

k. No shooting cracks or whoompfing sounds.

l. Five skiers just descended the slope without incident.

m. One snow pit from an unrepresentative spot shows stable snow.

n. Settlement cones around trees and bushes.

14	13	12	11	10	9	8	7	6	5	4	3	2	1

least significant — most significant

Thank you for taking the time to complete this survey.
Please return to the CAIC using the stamped-addressed envelope.

Figure A2. Survey form, pages 3– 4.