# Evaluating the Avaluator$^{TM}$ – First reflections on the Canadian decision aid

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ABSTRACT: In 2006, the Canadian Avalanche Centre introduced the Avaluator, a decision support tool that offers amateur backcountry recreationists decision guidance based on expert opinion and historic avalanche accident records. Simultaneous with the launch, the curriculum of the standard introductory avalanche course (Avalanche Skills Training 1 – AST1) was revised to include the Avaluator as a central component.
In this paper, we will take a first look at the reception of the Avaluator and its impact on the decision process and recreational behavior of AST1 course graduates. In a series of surveys, a conjoint rating task was used to assess the decision preferences of participating students before their AST1 course, right after the course, and after considerable additional personal experience in avalanche terrain. In addition, the Theory of Planned Behavior was used to identify the most influential factors for the use of the Avaluator on private winter backcountry trips among AST1 graduates. The preliminary results provide interesting first perspectives for the further development and delivery of the decision aid.

KEYWORDS: Avaluator, decision-making, education, evaluation

## 1. INTRODUCTION

In the fall of 2006, the Canadian Avalanche Centre introduced the Avaluator (Haegeli and McCammon, 2006) to winter backcountry recreationists in Canada. The Avaluator is a rule-based decision aid that offers amateur backcountry recreationists tangible decision guidance based on historic avalanche accidents and expert opinion when planning for and traveling in avalanche terrain.

The Avaluator consists of two main components. The Trip Planner (TP) is a graphical tool (Fig. 1) that assists recreationists in choosing appropriate trip objectives under different avalanche conditions. Recreationists using the TP combine the current avalanche danger rating of the regional avalanche bulletin with the avalanche terrain rating of the intended trip destination (see Statham et al., 2006 for definitions of terrain ratings). The colors on the chart provide the user with recommendations about the experience necessary to safely travel under these conditions. Completing an introductory avalanche awareness course should provide sufficient avalanche safety knowledge to safely travel under conditions labeled as Normal Caution (green). Traveling in the yellow area (Extra Caution) requires more advanced training to manage avalanche hazard. Backcountry travel is not recommended for amateur recreationists in the red area of the chart.

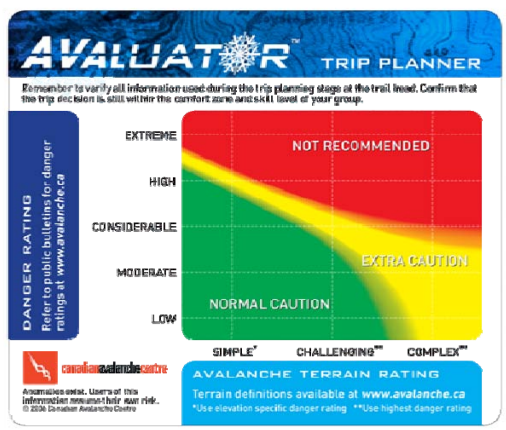


*Figure 1: Avaluator Trip Planner*

The second component of the Avaluator, the Obvious Clue Method (OCM; McCammon, 2000, 2002), is a checklist for evaluating avalanche hazard while traveling through avalanche terrain. The OCM works by adding the number of avalanche-hazard related clues (Table 1) present in the situation at hand. The more clues present, the more similar is the current situation to conditions that have led to avalanche accidents in the past. Normal Caution is recommended when less than three clues are present. Extra Caution is recommended with three or four clues, and back-

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*Table 1. The Obvious Clue Method for making decisions in avalanche terrain.*

| *Clue* | *Description* |
|---|---|
| Avalanche | Signs of slab avalanche activity in the area within last 48 h |
| Loading | Loading by snow, wind or rain in the area within last 48 h |
| Path | Avalanche path or starting zone. |
| Terrain Trap | Gullies, trees or cliffs that would increase the consequences of being caught |
| Rating | Avalanche danger rating considerable or higher |
| Unstable snow | Signs of unstable snow, such as whumpfing, cracking or hollow sounds |
| Thaw instability | Recent significant melting or the snow surface by sun, rain or warm air. |

country travel is not recommended for situations with five or more clues.

Neither the TP nor the OCM estimate avalanche risk or the likelihood of an avalanche accident happening. Instead, they are awareness tools that alert users in situations that have commonly been observed in historic avalanche accidents. For a more detailed description of the Avaluator and its development, the interested reader is referred to Haegeli et al. (2006) and McCammon and Haegeli (2006).

With the introduction of the Avaluator, the Canadian Avalanche Centre also revised the curriculum of the introductory avalanche skills training courses (AST1 and 2; CAC, 2007a, b), which now include the Avaluator as a mandatory core component. Every year, independent avalanche course providers across Canada educate approximately 4000 students in basic avalanche awareness following this general curriculum.

Outcome evaluations are a crucial aspect in the development of behavioral intervention programs such as the Avaluator or avalanche safety courses in general. Insightful evaluation studies can provide important information to help determine whether an intervention program achieves the intended effect and what improvements could be made in the design and delivery of the intervention program to further improve its effectiveness (U.S. Department of Health & Human Services, 2002; 2005). However, evaluations of avalanche safety programs are relatively rare. A recent exception is the study by Pfeiffer and Foley (2006), which examined the recall of avalanche safety knowledge and self-reported safe travel practices among students of introductory avalanche awareness courses in the United States. While their results were encouraging, McCammon (2000) suggests that knowledge alone does not necessarily lead to safer choices when traveling in avalanche terrain. While assessing student's recall of knowledge can certainly provide insight, it might be more meaningful to examine how students apply this knowledge in actual decision situations.

The goal of this study is to provide a comprehensive assessment of AST1 students' response to the Avaluator and the effect of the Avaluator on students' recreational behavior during private trips into avalanche terrain after completing the course. We conducted a series of surveys which were specifically targeted at examining the decision skills and preferences of AST1 graduates by presenting them with hypothetical, but realistic decision situations (i.e., conjoint analysis). In addition, we applied the Theory of planned Behaviour to examine the factors that facilitate or impede the use of the Avaluator among AST1 graduates. Together, the results of these analyses can provide useful information for the further development of the Avaluator and its delivery through the AST program.

## 2. METHODS

The surveys conducted for this study included two intercept surveys, which were administered in collaboration with numerous AST providers in western Canada and one online follow-up survey. The first intercept survey was conducted at the beginning of the AST course (pre-course) to collect basic demographic information and baseline data about the students' assessment and decision skills. The second intercept survey was carried out at the end of the course (post-course) to directly assess its effect on the decision skills and to get immediate feedback about the course material and delivery. At the end of either the first or second winter season following their course, interested AST graduates were invited to participate in an online follow-up survey. The focus of the follow-up survey was to learn more about the experiences and use of the Avaluator on personal trips after the course and to reassess their decision skills.

### *2.1 Theory of planned Behavior*

The Theory of planned Behavior (TpB; Ajzen and Fishbein, 1980; Ajzen, 2005) is a psychological framework commonly used in health education (see, e.g., Glanz et al., 2003; Conner and Norman, 2005) to explore the relationship between a specific behavior and the underlying beliefs, attitudes and intentions (Fig. 2). According to this model, behavioral intention, which is deemed to be the most important determinant of behavior, is influenced by a person's attitude toward the behavior in question, the beliefs about whether individuals who are important to the person approve or disapprove of the behavior (subjective norms) and the person's perception of his or her ability to have direct influence on whether he or she can perform the behavior in the given circumstances (perceived behavioral control).

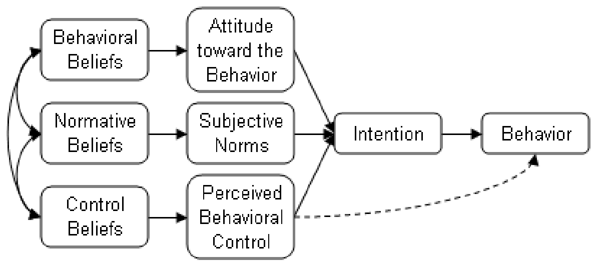


*Figure 2: Theory of planned Behavior (after Ajzen and Fishbein, 1980)*

In a study, the attitude towards a specific behavior can be examined by assessing participants' beliefs regarding different outcomes of that behavior and weighing the beliefs according to their evaluation of those outcomes. Relevant subjective norms can be assessed by examining participants' beliefs about social standards and participants' motivation to comply with those norms. Perceived behavioral control is determined by the frequency and perceived effect of factors or circumstances that make it either easier or more difficult to perform the behavior in question.

The development of the TpB component for the online survey followed the guidelines of Francis et al. (2004) and Ajzen (2002). In a first step, an exploratory survey was developed to identify the primary contributing factors to the three predictive beliefs. Based on the responses from the exploratory survey, two separate sets of Likert scale questions were developed to quantitatively assess the detailed aspects of the types of beliefs responsible for the use of the TP and OCM. Information about past use and future intention of use of the TP and OCM were elicited by asking participants what percentage of past/future backcountry trips they have/are planning to incorporate the two methods into their decision process.

### 2.2 Conjoint decision task

Following the tradition of conjoint analysis (Louviere, 1988), decision preferences were assessed by presenting each survey participant with hypothetical, but realistic decision situations (Fig. 3), which consisted of the clues included in the OCM. Each scenario provides information about the presence or absence of the different clues through a terrain photo and a short description. The scenarios used in the surveys follow a statistical design to ensure even representation of all clues and their combinations across the entire survey sample. Where possible, clues were represented in the design in at least two different ways to minimize potential biases toward individual photos or clue descriptions. While students were presented with two different decision scenarios in the pre-and post course surveys, each assessed a total of six different scenarios in the online survey.

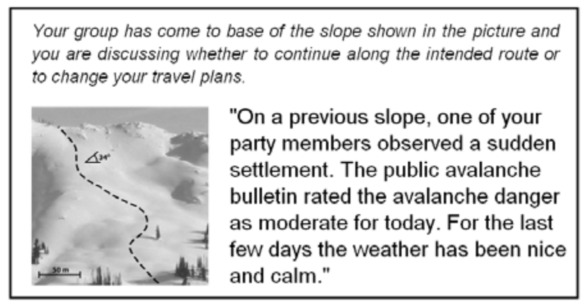


*Figure 3: Example scenario for assessing decision skills*

While these scenarios are not able to completely replicate the complexity of real decisions in avalanche terrain, they allow a quantitative assessment of the decision preferences. The underlying statistical design facilitates the examination of the decisions across the full range of potential conditions, something which would be difficult to accomplish in the real world environment. A number of recent studies (e.g., Haener et al., 2001; Grijalva et al., 2002) confirmed that behavioral models based on stated preference models have predictive value for actual behavior in the recreational context.

To assess each step in the decision-making process, participants were asked to rate the seriousness of each decision scenario on a scale from 1 (no hazard) to 9 (very serious), rate their confidence in their assessment in a scale from 1 (not confident) to 5 (very confident), and state whether they would personally enter the slope under the given conditions. For a subset of scenarios, participants of the post-course and online survey were also asked to explicitly identify the relevant clues present. Our hypothesis is that better decision skills are reflected by a) an increased correlation between the OCM score and the seriousness assessment of the scenario and

b) an improved hit rate (Wilks, 1995) for the individual clues.

Social cognition theory suggests that self-efficacy is one of the main determining factors regarding whether people decide to apply an acquired skill to attain a certain goal (Bandura, 1997). High confidence in their assessment skills at the end of the AST1 course can therefore be interpreted as a preliminary indicator that students might apply the methods learned in their course on private winter backcountry trips.

*2.3 Implementation*

Intercept surveys were conducted during the winters of 2006/07 and 2007/08. During the first winter, a total of 892 and 798 AST students participated in the pre- and post-course surveys respectively. In the second winter, we used a slightly modified survey design, where we replaced numerous pictures in the decision scenarios and added additional questions to study students' perception of the Avaluator in the post-course survey in more detail. During this winter, 658 and 572 AST students participated in the pre- and post-course surveys.

Among the AST students who completed the pre- and/or post-course surveys, 1036 (approx. 60%) indicated interest in participating in a long-term study on avalanche awareness education. The online survey was developed during the winter of 2008 and a preliminary version including the exploratory TpB questions was launched in March. Invitations for the preliminary online survey were sent to a representative sample of 98 interested intercept participants from the 2006/07 season. The responses to the exploratory questions were used to develop the Likert-scale TpB questions for the final online survey. To minimize the burden for the participants, they were randomly assigned to complete the TpB section for either the TP or the OCM.

The final version of the online survey was launched on April 14, 2008 for the participating AST graduates of the 2006/07 season and on May 1, 2008 for graduates of the 2007/08 season. In total, 938 email invitations were sent out. One set of reminder emails was sent out to non-responding participants approximately two weeks after the initial invitations. Data collection for this study was completed on June 15, 2008. The overall response rate for the online survey was 39%.

3. ANALYSIS AND RESULTS

The present analysis focuses on AST1 graduates, who completed all three surveys (pre- and post-course intercept surveys, online follow-up survey). This results in a survey sample of 303 participants for this study, of whom 27 completed the exploratory version of the online survey. This sample approximately represents 4% of the entire AST1 student population of the two winters.

*3.1 Character of survey sample*

The median age of the sample population is 29 (range 18 to 64) and the majority of the participants are male (68%). The education level of the sample is relatively high with 70% having completed a university or post-graduate degree.

Years of experience in avalanche terrain prior to the AST course ranged from 0 to 35 years with a median of 1.5 years. 69% of the sample spends on average between 0 and 10 days in avalanche terrain per winter. The main recreational activities represented in the sample are backcountry skiing, out-of-bounds skiing and snowmobile riding.

Eighty-eight percent of the participants stated that this AST1 course was their first exposure to formal avalanche awareness training. Still, three quarters of the participants reported in the pre-course survey that they significantly contribute to the decision-making process (primary decision-maker, share decision with few others, everybody in the group contributes equally to the decision) when traveling privately in avalanche terrain (Fig. 4). A quarter of the sample indicated that they had heard about the Avaluator prior to the AST course.

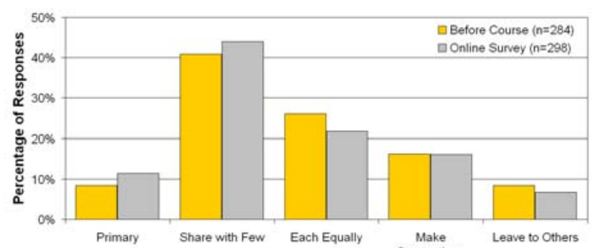


*Figure 4: Distribution of decision contributions among survey participants.*

To assess potential biases in the responses in the online survey, we compared the characteristics of the survey sample to participants of the intercept survey who did not respond to the online survey (n=398). The only demographic variable that was significantly different between the two populations was the level of education where participants of the online survey tended to have completed higher levels (Wilcox rank sum test; p-value: 0.025). The online sample also consisted of a higher percentage of backcountry skiers (Pearson's chi-squared Test; p-value: 0.025) and lower percentage of snowmobile riders (Pearson's chi-squared Test; p-value: <0.001). Participants of the online survey rated usefulness of the Avaluator booklet and card at the end of the AST course slightly higher than the non-responders (Student t-Tests; p-values: 0.098 and 0.133). However, no statistical difference was detected in the degree of intended use of the TP or OCM. A comparison of the two subsamples that completed the TpB section for either the TP or the OCM did not reveal any relevant statistical differences.

*3.2 Backcountry experience after AST course.*

In the online survey, 62% of the sample spent between 0 and 10 days in avalanche terrain per winter, which is comparable to the pre-course assessment (Fig. 5). Only 5% of the survey participants reported to have engaged in more advanced avalanche awareness training since completing their AST1 course.

The majority of the survey sample (89%) recreated primarily in simple and challenging terrain (Fig. 6). No significant difference was detected in the distribution of how much participants contribute to the decision-making process between the pre-course (Fig. 4) and subsequent online assessment.

A total of twelve survey participants (4%) reported to have had potentially serious incident experiences involving avalanches of size 2 or larger according to the Canadian size classification (CAC, 2007). While no serious consequences were reported, it is worth noticing that one participant reported to have been partially buried in an avalanche and three reported to have triggered size 3 avalanches.

To relate the reported backcountry activity directly to the Avaluator, participants were asked to state the most serious conditions under which they would still feel comfortable traveling in avalanche terrain with respect to the TP and OCM (Fig. 7). The analyses of both decision aids exhibit a similar pattern. While there are individuals who are comfortable with traveling under almost all conditions, the majority of participants travel only under conditions labeled with Normal Caution (green) and Extra Caution (yellow). Haegeli and McCammon (2006) suggest that while a basic introductory avalanche awareness course

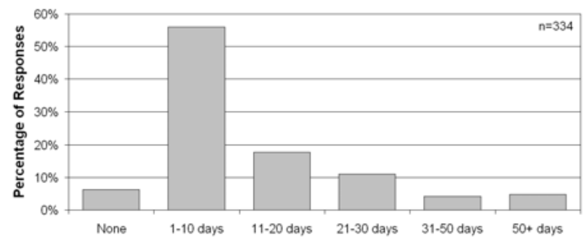


*Figure 5: Distribution of days in avalanche terrain per winter after AST1 course.*

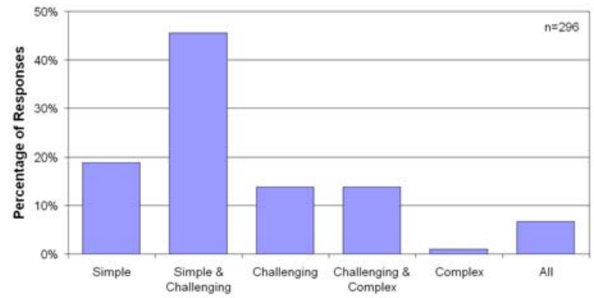


*Figure 6: Distribution of terrain choices.*

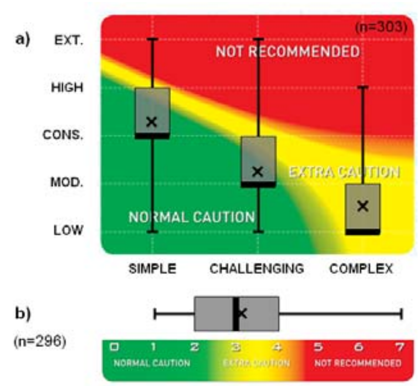


*Figure 7: Distribution of maximum acceptable conditions for backcountry travel displayed as box plots on a) TP chart and b) OCM scale (black bar - median; grey box - interquartile range; whiskers - extreme values; x - mean ratings).*

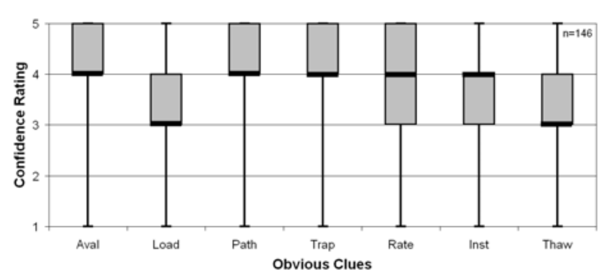


*Figure 8: Distribution of confidence ratings for recognizing obvious clues presented in box plots (y-axis: 1 - not confident; 5 - very confident; Box plots: see description of Fig. 7)*

provides sufficient knowledge for safely traveling in avalanche terrain under Normal Caution, more advanced training is recommended for Extra Caution.

An important prerequisite for the appropriate use of the OCM is the reliable recognition of the seven obvious clues in the field. While responses of survey participants indicate a generally high level of confidence (Fig. 8), the ratings for the clues Loading and Thaw Instability were considerably lower than for the other clues.

*3.3 Use of Avaluator*

Survey participants reported a wide range of Avaluator use on private trips after their AST course (Fig. 9). While 59% used the OCM in at least 80% of their trips, only 31% included the TP to the same degree.

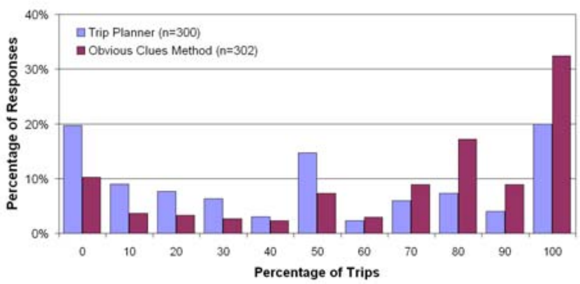


*Figure 9: Percentage of trips where TP and OCM were incorporated in decision-making process since AST course.*

Based on the responses to the open-ended TpB questions in the exploratory survey, we identified the six primary behavioral beliefs for both the TP and OCM. The Avaluator provides a systematic approach to decision-making in avalanche terrain, focuses the decision process, offers a platform for discussing decision options, provides a perspective based on historic avalanche accidents, and – on the negative side – potentially restricts the ability to find enjoyable or challenging terrain for backcountry skiing or snowmobile riding. Immediate family members, recreational partners and AST instructors were mentioned as the most important individuals influencing the use of the Avaluator.

Obviously, different control beliefs emerged for the two decision aids. Key controls that make it more difficult to use the TP are the lack of terrain and avalanche danger ratings and difficult or impossible access to the necessary ratings during the planning process (e.g., when choosing the final destination during the drive to a trailhead). Simple access to the Avaluator card was mentioned to facilitate the use of the TP. Key control beliefs for the OCM are lack of time to use the OCM, inaccessibility of the Avaluator card during backcountry travel; and weather conditions or low visibility making it difficult to observe the relevant clues in the field.

The assessments of the various beliefs and their relationship to the past use of the TP and OCM are presented in Table 3. The right-hand column shows that, consistent with the TpB, attitude, norms and perceived behavioral controls are all significantly correlated with past use of the TP and OCM. While the perceived behavioral control construct had the highest correlation in the case of the TP, subjective norms exhibited the highest correlation with past usage of the OCM.

The second column from the right contains the correlation coefficients for the various individual attitudes and subjective norms. For both the TP and OCM, all items show significant correlations, with the exception of accident perspective and the two restrictiveness items. The second result is particularly interesting as it shows that the perceived restrictiveness of the Avaluator, a commonly heard criticism when the Avaluator was introduced, did not have a significant influence on its use by the AST graduates.

When the individual attitudes are split into their two components (belief and outcome evaluation), only the behavioral beliefs show significant correlations with the use of the TP and OCM. While most students consider a systematic and focused approach to decision-making to be important (high mean ratings of outcome evaluation), it is their belief that the Avaluator will help them achieve these objectives that makes them use the TP and OCM. This means that future initiatives to improve the adoption of the Avaluator among AST1 students will have to primarily target students' belief in the Avaluator.

The situation is similar for the subjective norms, where is it primarily the normative beliefs that show significant correlations. The observed correlations are considerably higher for the OCM indicating a stronger influence on the use of this decision aid. Correlations with the motivation to comply only emerged as significant for the AST instructors. Judging from the correlation coefficients of the subjective norms, AST students seem to use the TP because they believe that their family thinks it is useful, while they tend to use the OCM due to their normative beliefs about their partners' and AST instructor's opinions.

*Table 3: Average ratings and correlations of behavioral determinants with reported past use of TP and OCM.*

a) Trip Planner (n=128)

| Attitude | *Behavioral beliefs Bb* | | *Outcome Evaluation Oe* | | *Bb*Oe* | *Σ(Bb*Oe)/6* |
|---|---|---|---|---|---|---|
| | *mean* | *cor*[1] | *mean* | *cor* | *cor* | *cor* |
| Systematic approach | 5.37 | .51 *** | 1.89 | .03 | .21 ** | |
| Focus on decision-making | 5.52 | .48 *** | 2.18 | .07 | .27 *** | |
| Platform for discussion | 5.49 | .47 *** | 2.52 | -.04 | .30 *** | .23 *** |
| Accident perspective | 5.62 | .51 *** | 2.06 | -.06 | .14 | |
| Restricts enjoyable rec.[R] | 5.60 | -.10 | 2.41 | .00 | -.05 | |
| Restricts challenging rec.[R] | 5.05 | .05 | 1.09 | -.08 | -.10 | |
| Possible Ranges | (1 – 7) | | (-3 – 3) | | | |
| **Subjective Norm** | *Normative beliefs Nb* | | *Motivation to comply Mc* | | *Nb*Mc* | *Σ(Nb*Mc)/3* |
| | *mean* | *cor* | *mean* | *cor* | *cor* | *cor* |
| Family | 1.76 | .29 *** | 5.12 | .03 | .33 *** | |
| Rec. partners | 2.16 | .23 *** | 5.70 | .12 | .25 *** | .35 *** |
| AST instructors | 2.48 | .20 ** | 5.83 | .31 *** | .26 *** | |
| Possible Ranges | (-3 – 3) | | (1 – 7) | | | |
| **Perceived behavioral control** | *Control beliefs (Cb)* | | *Perceived power Pp* | | *Cb*Pp* | *Σ(Cb*Pp)/4* |
| | *mean* | *cor* | *mean* | *cor* | *cor* | *cor* |
| No terrain ratings[R] | 4.98 | .06 | 1.01 | .43 *** | .40 *** | |
| No danger ratings[R] | 5.81 | .06 | 0.89 | .40 *** | .36 *** | .49 *** |
| Decision time[R] | 5.52 | .18 ** | 1.72 | .30 *** | .33 *** | |
| Has card availability | 4.79 | .56 *** | 1.98 | .21 ** | .35 *** | |
| Possible Ranges | (1 – 7) | | (-3 – 3) | | | |

b) Obvious Clue Method (n=126)

| Attitude | *Behavioral beliefs Bb* | | *Outcome Evaluation Oe* | | *Bb*Oe* | *Σ(Bb*Oe)/6* |
|---|---|---|---|---|---|---|
| | *mean* | *cor* | *mean* | *cor* | *cor* | *cor* |
| Systematic approach | 5.37 | .55 *** | 1.91 | .11 | .31 *** | |
| Focus on decision-making | 5.70 | .43 *** | 2.41 | .08 | .29 *** | |
| Platform for discussion | 5.59 | .50 *** | 2.48 | .10 | .33 *** | .30 *** |
| Accident perspective | 5.65 | .53 *** | 0.63 | .07 | .06 | |
| Restricts enjoyable rec.[R] | 5.27 | -.06 | 1.92 | .04 | .03 | |
| Restricts challenging rec.[R] | 5.05 | -.11 | .56 | .01 | .02 | |
| Possible Ranges | (1 – 7) | | (-3 – 3) | | | |
| **Subjective Norm** | *Normative beliefs Nb* | | *Motivation to comply Mc* | | *Nb*Mc* | *Σ(Nb*Mc)/3* |
| | *mean* | *cor* | *mean* | *cor* | *cor* | *cor* |
| Family | 1.90 | .41 *** | 4.30 | .09 | .33 *** | |
| Rec. partners | 2.11 | .48 *** | 5.47 | .02 | .45 *** | .49 *** |
| AST instructors | 2.44 | .40 *** | 5.84 | .33 *** | .45 *** | |
| Possible Ranges | (-3 – 3) | | (1 – 7) | | | |
| **Perceived behavioral control** | *Control beliefs (Cb)* | | *Perceived power Pp* | | *Cb*Pp* | *Σ(Cb*Pp)/3* |
| | *mean* | *cor* | *mean* | *cor* | *cor* | *cor* |
| Time pressure[R] | 5.35 | .15 * | 0.10 | .20 ** | .21 ** | |
| Has card availability | 4.37 | .37 *** | 1.82 | -.07 | .15 * | .23 *** |
| Lack of visibility[R] | 4.06 | -.07 | 1.35 | .18 ** | .14 | |
| Possible Ranges | (1 – 7) | | (-3 – 3) | | | |

[1] Statistical significance of correlation coefficient: ***: $p < 0.01$, **: $0.01 \le p < 0.05$, *: $0.05 \le p < 0.10$

[R] Belief ratings of negatively affecting attributes and perceived behavioral controls where coded in reverse (e.g., Restricts enjoyable recreation: high rating values indicate low restrictiveness) to ensure that ratings consistently correlate positively with past usage.

The correlation patterns for the perceived behavioral controls show a more mixed pattern. Overall, the correlations for the TP are considerably larger than for the OCM. This result is consistent with the fact that the use of the TP relies more heavily on external factors, such as the availability of terrain and avalanche dangers ratings or convenient access to this information. The visibility constraint did not show a significant correlation with the use of the OCM. While card accessibility exhibited a strong correlation for the TP, it was only marginally significant for the OCM.

### *3.4 Decision skill*

This analysis exclusively focuses on survey participants who completed their AST1 course during the first winter of the survey study. Modifications in the design of the decision scenarios do not allow a combined analysis of the two subgroups. The sample for this analysis therefore consists of only 175 individual survey participants, which represents 58% of the entire sample population. While the two survey groups are similar in most aspects, participants from the first season tend to have more years of experience in avalanche terrain (Student t-Test; p-value: 0.086) and spend more days in avalanche terrain per winter (Wilcox rank sum test; p-value: 0.001). In addition, the percentage of snowmobile riders is significantly higher in this sample (Pearson's chi-squared Test; p-value: 0.006).

A correlation analysis of the seriousness assessment and the OCM score of the scenario confirms our hypothesis. The correlation coefficient increased significantly from the pre- to the post-course assessments (Table 4). The correlation coefficients for the post-course and online tasks are essentially the same.

*Table 4: Correlation coefficients between Avaluator score of decision scenario and seriousness assessment for the three different surveys*

| *Survey* | *n* | *Coefficient* | *90% CI* |
|---|---|---|---|
| Pre-course | 329 | 0.30 | 0.22-0.38 |
| Post-course | 336 | 0.43 | 0.35-0.50 |
| Online | 258 | 0.45 | 0.36-0.52 |

An examination of the assessment distributions in the three surveys shows that participants generally rated the situations more seriously than warranted by the OCM scores (Fig. 10). While the assessments in the post-course survey are significantly higher than in the pre-course survey (Wilcox rank sum test; Pre-Post p-value: 0.014), the assessments in the online survey are lower again (Wilcox rank sum test; Post-Online p-value: 0.023).

While the assessment of a slope is a necessary first step in the decision-making process in avalanche terrain, the percentage of no-go decisions as a function of the OCM score of the scenario provides insights closer to the actual decision (Fig.11). The responses in the pre-course survey exhibit a small but gradual increase of no-go decisions across the entire range of OCM scores. Although the values in the post-course survey are not statistically different, the pattern is more distinct. The gradual increase of the no-go decisions is limited to OCM scores below four and the percentage of no-go decisions is constant beyond. However, the overall percentage of no-go decisions is still quite high, indicating generally conservative choices. The same pattern can be observed in the responses of the online survey, but the percentages of no-go decision are significantly lower, particularly at low OCM scores. This suggests that, through practical experience, survey participants became more comfortable making the decision to enter a slope. The observed break at an OCM score of four is consistent with the reported maximum number of clues under which most participants feel comfortable.

The average hit rate increased from 74% in the post-course survey to 82% in the online survey. The most significant increase can be observed in the Danger Rating clue. Obvious Path and Terrain Trap exhibit distinctly lower hit rates than the other clues. These observations were confirmed with the 2007/08 AST1 graduates who had different images in their decision scenarios.

Participants' confidence in their assessment skills rose dramatically between the pre- and post course surveys (Fig. 13; Wilcox rank sum test; p-value: <0.001). This improvement is critical for the application of the learned assessment and decision skills beyond their course. The online follow up survey, two winter seasons later, showed that participants' confidence in their assessment skills remained at this high level.

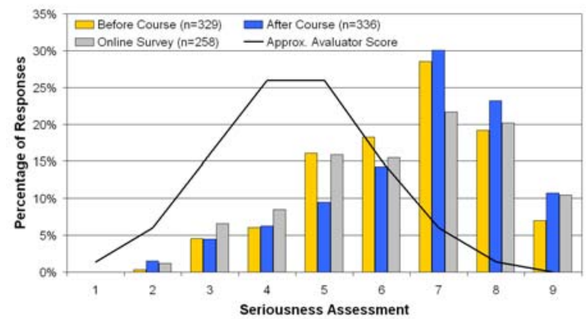


*Figure 10: Seriousness assessment of participants for decision scenarios presented in the three surveys. Black line shows approximate distribution of Avaluator scores of the scenarios presented.*

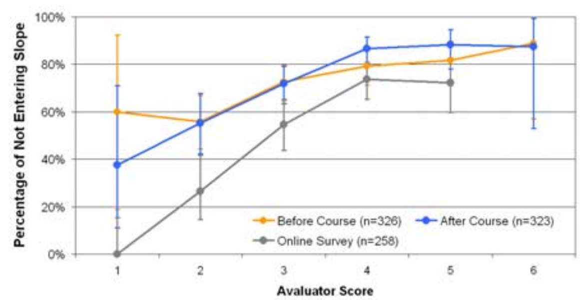


*Figure 11: Percentage of decisions not entering the slope for the scenarios presented in the three different surveys. Vertical bars show 90% binomial confidence intervals.*

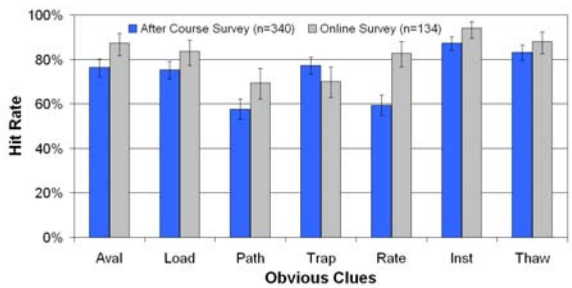


*Figure 12: Hit rates for obvious clues in post-course and online surveys with 90% binomial confidence intervals.*

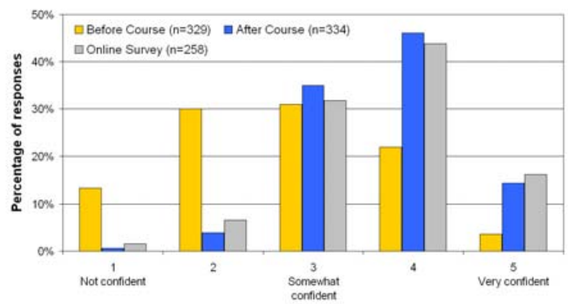


*Figure 13: Confidence rating of participants for the seriousness assessment of the decision scenarios presented in the three surveys.*

## 4. DISCUSSION

The goal of this study was to provide first insights on the use of the Avaluator among AST1 course graduates and its effect on their recreational behavior in avalanche terrain. The multi-method approach used in this study offered a realistic and comprehensive perspective on the benefits and challenges surrounding the use and delivery of Avaluator. However, since there are no comparable pre-Avaluator studies available in Canada, we are unable to isolate the effect of the Avaluator from the avalanche awareness curriculum in general.

The analysis of participants' backcountry activities after the AST1 course indicates that most recreationists spend less than 10 days in avalanche terrain per winter. This is clearly insufficient for the development of meaningful experience-based decision approaches and highlights the need for tangible decision aids, such as the Avaluator, for this target audience.

The Theory of planned Behavior offered a useful theoretical framework for examining the influence of factors that facilitate or impede the use of the Avaluator among AST1 graduates. While the present correlation analysis is preliminary and does not necessarily imply causation, the analysis provides a beneficial first perspective. Overall, the analysis highlighted the importance of the AST instructors in the delivery of the Avaluator. Not only do they influence the behavior of their students through their normative beliefs and motivation to comply, they most likely also play a significant role in shaping the behavioral beliefs of their students. While we only presented correlation coefficients for past use of the TP and OCM, the results are similar for intended future use.

The analyses of the use of the Avaluator after the AST1 course and the hypothetical decision tasks draw an interesting picture. The generally improved assessment and decision skills observed in the online survey highlights the importance of experiential learning for decision-making in avalanche terrain. However, since traveling in avalanche terrain poses a wicked learning environment (Hogarth, 2001) where relevant feedback is often lacking, practical experience can also make recreationists too comfortable with traveling under conditions that are in reality beyond their level of expertise. The considerable fraction of participants who feel comfortable in the yellow area of the Avaluator (Fig. 7), the significant decrease in the seriousness assessment between the post-course and online survey (Fig. 10) and the fact that 25% of the participants presented with a decision scenario with four or more clues still decided to enter the slope (Fig. 11), could be interpreted as possible indicators of this trend. Decision aids, such as the Avaluator, could provide a valuable asset for the decision tool box of this segment of recreationists as they can provide an external validation or reality-check for personal decision preferences in avalanche terrain. The suggested AST2 curriculum (CAC, 2007b) does indeed suggest the use of the Avaluator as a filtering tool to determine when additional planning or travel techniques are required for safe travel.

## 5. CONCLUSIONS

This paper gave a brief overview of the preliminary results of a series of surveys conducted among AST1 students since the introduction of the Avaluator. This study is part of a bigger initiative that is currently conducted by the Canadian Avalanche Centre to evaluate the effect of the Avaluator on amateur recreation in avalanche terrain. Results of this initiative will provide important information for the further development of the Avaluator and its delivery. These efforts will help to make the Avaluator as effective as possible and to keep it current with the latest trends in winter backcountry travel.

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