Avaluator's Obvious Clues Prevention Values Are Inflated: Evidence From Canadian Avalanche Accidents

Bob Uttl[1]*, Kelly Kisinger[2], Mekale Kibreab[2] and Jan Uttl[3]
[1] Mount Royal College, Calgary, AB, Canada
[2] University of Calgary, Calgary, AB, Canada
[3] Avidata.ca, Cochrane, AB, Canada

ABSTRACT: The Avaluator Avalanche Accident Prevention Card (Haegeli & McCammon, 2006) was designed to help recreationists to avoid avalanche accidents, and therefore, reduce the overall number of avalanche accidents in Canada involving recreationists. It consists of two parts – the Trip Planner and Obvious Clues -- and is marketed by the Canadian Avalanche Center as a "made in Canada" "science based" decision tool. However, the research has revealed that (a) the data behind the Avaluator's Obvious Clues are not available for inspection (Haegeli and McCammon has repeatedly refused to provide access to their data) (Uttl, Uttl, & Henry, 2008a; Floyer, 2008), (b) Haegeli and McCammon (2006) inappropriately excluded over 1,148 avalanche accident reports from their sample due to missing values and based the prevention values on only 252 accidents; (c) several independent studies found that the Obvious Clues prevention values published in the Avaluator are grossly inflated (e.g., Uttl, Henry, & Uttl, 2008b; Floyer, 2008). Moreover, the Obvious Clues prevention values published in the Avalauator are based on only US rather than Canadian accidents. Our study examined for the first time prevention values (i.e., risk reduction values) of the Obvious Clues in a sample of Canadian avalanche accidents. Our results show that the prevention values published in the Avaluator are grossly inflated, falsely informing users that slopes they are about to cross are relatively safe.

KEYWORDS: Avaluator, Obvious Clues, risk reduction, missing values.

1 INTRODUCTION

The Avaluator Avalanche Accident Prevention Card (Haegeli & McCammon, 2006) was designed to help recreationists avoid avalanche accidents, and therefore, reduce the overall number of recreational avalanche accidents in Canada. It consists of two parts – the Trip Planner and Obvious Clues – and is marketed by the Canadian Avalanche Center (CAC) as a "made in Canada" "science based" decision tool. However, the Obvious Clues prevention values are based on US rather than Canadian accidents.

Using the US accident samples, our prior research (Uttl, Henry, & Uttl, 2008a,b) demonstrated that the prevention values for Obvious Clues published in the Avaluator are inflated, giving users a false sense of security in the stability of the slopes they are about to cross. Thus, the Avaluator may lead to more rather than fewer accidents, injuries and deaths. Our current study examined prevention values of the Obvious Clues in a sample of Canadian avalanche accidents.

Corresponding author address: Bob Uttl, Psychology Department, Mount Royal College, 4825 Mt. Royal Gate SW, Calgary, AB, T3E 6K6, Canada; email: buttl@mtroyal.ca; web: www.docbob.ca.

1.1 Avaluator's Development: An Overview

Avalanches kill roughly 15 people a year in Canada. However, 29 people were killed during the 2002/2003 season (principally because of two accidents that killed 7 people each instead of the more usual 1 or 2 persons). In response, Parks Canada commissioned a report that recommended the development of a "made in Canada" decision tool to help users avoid avalanches (O'Gorman, 2003). Subsequently, the National Search and Rescue Secretariat, Canada, funded the development of the new tool, called the Avaluator Avalanche Accident Prevention Card (Haegeli & McCammon, 2006) as part of the ADFAR project headed by Dr. Pascal Haegeli.

Haegeli and McCammon (2006) reviewed records of avalanche accidents and for each record they determined whether each so called Obvious Clue (avalanches, loading, path, terrain trap, rating, unstable snow, thaw instability) was present, absent, or indeterminate from the record. Next, they summed up the number of Obvious Clues to obtain the frequency of avalanche accidents that occurred when 0 to 7 Obvious Clues were present. Finally, using the frequency distribution they calculated the percentage of accidents prevented if users had limited themselves to a certain number of clues (i.e., risk reduction).

Thus, to evaluate local conditions, the user adds up the number of Obvious Clues present and the Avaluator informs the user what proportion of historical accidents would have been avoided if people limited themselves to slopes with a given number of clues. For example, the Avaluator claims that the "4 or less (sic)" clues limit would have prevented 77% of historical accidents (i.e., 77% risk reduction).

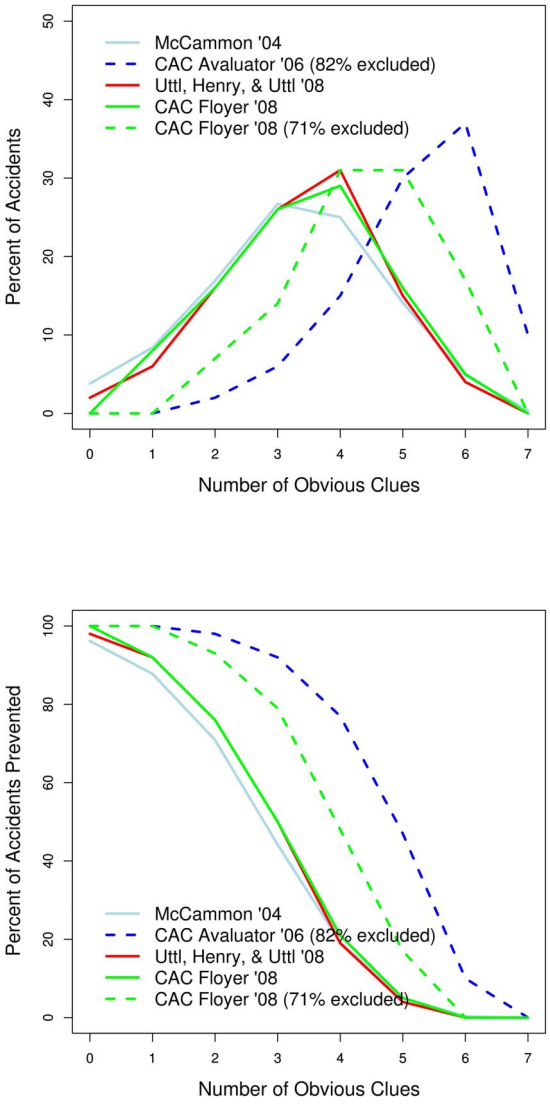

Figure 1. Distributions of Obvious Clues (top panel) and associated prevention values (bottom panel) when accidents with missing values are either included (solid lines) or excluded (dashed lines)

1.2 Problem of Missing Values

Haegeli and McCammon never considered the issue of missing values; they simply excluded 82% of their sample of 1,400 accidents because they could not establish the presence or absence of all clues from the records. Moreover, they did not inform Avaluator users they excluded 82% of their accidents prior to calculating the prevention values (see Uttl, Uttl, & Henry, 2008, for more details).

However, exclusion of 82% of the data due to missing values is extremely unlikely to produce unbiased results (see generic *Research Methods 101* or more advanced texts such as Little & Rubin, 1987; Schaffer & Graham, 2002). Moreover, scientists have an ethical responsibility (1) to report missing values and massive data exclusions and (2) to consider how treatment of missing values impact the resulting statistics (e.g., Wilkinson and the Task Force On Statistical Inference, 1999). Unfortunately, a quick survey of research reports published by avalanche safety researchers suggests that they seem to be unaware that missing values are a serious problem. To illustrate, responding to our criticism of Haegeli and McCammon's failure to report and to consider missing values in developing the Avaluator, Albi Sole, avalanche safety educator and researcher at University of Calgary, stated that this criticism was "a little, picky academic debate (about) extremely dense, technical question." (*Calgary Herald*, April 20, 2009, *Is there a problem with the Avaluator?*). However, the problems arising from missing values and basic remedies are taught to undergraduate students worldwide in their introductory behavioral research methods course, if not earlier.

Using external weather and avalanche bulletin data, Uttl, Henry, and Uttl (2008) demonstrated previously that at least for Thaw and Unstable Snow clues, missing values arose because the records did not mention the absence of these absent clues. Moreover, Uttl and Kisinger (2009) recenty showed that when eyewitnesses recall accidents, they are far more likely to mention the presence rather than absence of "obvious" clues. Eyewitnesses reported the presence of present obvious clues in about 90% of accident records, but they reported the absence of absent obvious clues for only about 5% of accident records.

1.3 Avaluator's Obvious Clues Prevention Values Are Not Replicable

Figure 1 (top panel) shows the distributions of Obvious Clues in the US accident samples reported by previous studies: McCammon (2004) for all accidents; Uttl, Henry, and Uttl (2008b) for all accidents (Yes+Weak Yes, liberal criteria); CAC Floyer (2008) for all accidents; CAC Floyer (2008) for 29% of accidents after 71% of accidents were excluded due to missing values; and CAC Avaluator (Haegeli & McCammon, 2006) for 18% of accidents after 82% were excluded

due to missing values. Figure 1 (bottom panel) shows associated prevention (risk reduction) values.

When no accidents are excluded due to missing values (solid lines; assumes missing values occur because records did not mention absence of clues), the prevention value of 4 obvious clues is only about 20% according to all data sets (i.e., McCammon, 2004; Uttl, Henry, & Uttl, 2008b; Floyer, 2008).

After exclusion of cases with missing values (dashed lines; assumes missing values occur due to some completely random process), the prevention (risk reduction) value of 4 Obvious Clues is 77% according to the Avaluator (82% of accidents excluded) but only 47% according to CAC Floyer (71% of accidents excluded). Thus, the CAC Floyer data do not agree with the CAC Avaluator data.

1.4 Objectives

What is the extent of missing values in Canadian avalanche accident records coded for the presence or absence of Obvious Clues? What prevention values are associated with Obvious Clues in Canadian accidents?

2 METHOD

We attempted to replicate the prevention values published in the Avaluator using the sample of recreational avalanche accidents compiled in *Avalanche Accidents in Canada, Vol. 4., 1984-1996* (Jamieson & Geldsetzer, 1996). In contrast to Haegeli and McCammon (2006), we coded the presence or absence of obvious clues using a 5-point scale: Yes (clue is present), Weak Yes (clue is probably present), Unknown/DNK (presence or absence of clue cannot be established), Weak No (clue is probably absent), and No (clue is absent) (see Uttl, Henry, & Uttl, 2008).

3 RESULTS

Figure 2 shows the extent of missing values in Canadian avalanche accident records. The individual records are stacked above each other and the colors indicate the status of each clue: Yes/Present=White, Weak Yes/Probably Present=Light Grey, DNK/Missing=Red, Weak No/Probably Absent=Dark Grey, and No/Absent=Black. The figure highlights that the presence or absence of Obvious Clues is indeterminate from the accident records in the vast majority of cases.

Figure 3 shows the prevention values of Obvious Clues based on the Canadian avalanche records examined in the present study vs the Avaluator under liberal criteria and the assumption that missing values indicate the absence of the clues (see Uttl, Henry, & Uttl, 2008b, and Uttl & Kisinger, 2009, for verification of this assumption). For four or fewer clues, the Avaluator claims a prevention value of 77% whereas current data suggest a prevention value of only 9% (cf., 18% in US sample using liberal criteria; see Uttl, Henry, & Uttl, 2008a,b).

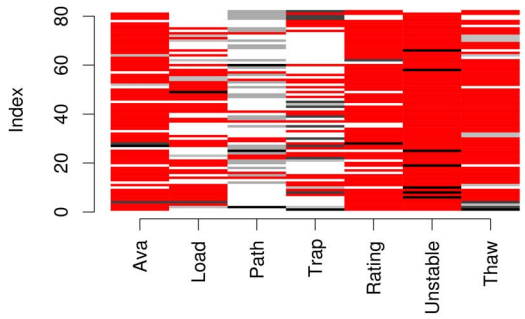

Figure 2. The extent of missing values in Canadian avalanche accident records for each of the seven Obvious Clues. Red color signifies missing values, that is, accidents where the presence or absence of clues could not be established from the records.

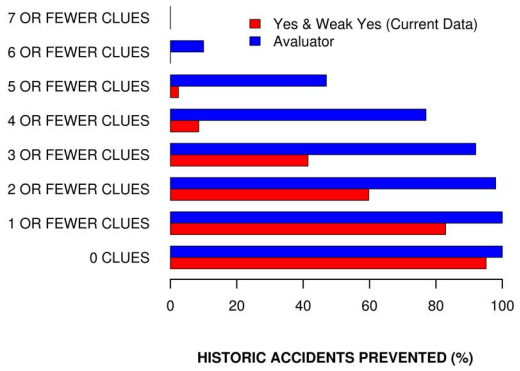

Figure 3. Prevention values of Obvious Clues for the current (Canadian) data and the Avaluator.

4 DISCUSSION

The presence of Obvious Clues is indeterminate from the record in a large proportion of Canadian accidents. However, external objective (weather) and subjective (avalanche bulletins) data indicate that the missing values mean absence of the clues (Uttl, Henry, & Uttl, 2008). Moreover, recent evidence demonstrates that eyewitnesses to accidents are far more likely to report presence rather than absence of obvious clues (Uttl & Kisinger, 2009), and that the absence of the obvious clues caused the vast ma-

jority of the missing values in analyses of accident records.

The Obvious Clues prevention values published in the Avaluator were based on only US accidents (see Uttl, Uttl, & Henry, 2008, for details). Consistent with the findings based on the US avalanche accident reports, our current data show for the first time that the Avaluator's prevention values are inflated with respect to Canadian avalanche accidents.

As we argued previously (Uttl, Henry, & Uttl, 2008a,b; Uttl, Uttl, & Henry, 2008), the Obvious Clues prevention values published in the Avaluator are inflated, give users a false sense of security, and are likely to lead to more rather then fewer accidents. Although the Avaluator was ostensibly designed to reduce the number of recreational avalanche accidents, the number of accidents has increased sharply to the highest levels since at least 1995 (Uttl, Kibreab, Kisinger, & Uttl, 2009).

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