



Calculating alcohol risk in a visualization tool for promoting healthy behavior

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ABSTRACT

Objective: To investigate effective methods for communicating the *personalized* risks of alcohol consumption, particularly to young people.

Methods: An interactive computerized blood alcohol content calculator was implemented in Flash based on literature findings for effectively communicating risk. Young people were consulted on attitudes to the animation features and visualization techniques used to display personalized risk based on disclosed alcohol consumption.

Results: Preliminary findings reveal the calculator is relatively enjoyable to use for its genre. However, the primary aims of the visualization tool to effectively communicate personalized risk were undermined for some users by technical language. Transparency of risk calculations might further enhance the tool for others. Worryingly, user feedback revealed a tension between accurate presentation of risk and its consequent lack of sensationalism in terms of personal risk to the individual.

Conclusion: Initial findings suggest the tool may provide a relatively engaging vehicle for exploring the link between action choices and risk outcomes. Suggestions for enhancing risk communication include using intelligent techniques for selecting data presentation formats and for demonstrating the effects of sustained risky behavior.

Practice implications: Effective communication of risk contributes only partially to effecting behavior change; the role of the tool in influencing contributing attitudinal factors is also discussed.

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1. Introduction

There is no shortage of literature on the risks of drinking, and it is beyond doubt that, as an individual's alcohol intake increases, so does their likelihood of fatality [1–3]. There is a wealth of evidence, including a meta-analysis of studies of alcohol-drinking, showing a strong dose–risk relation between alcohol and cancers [4], and between alcohol and trips to the emergency department [5,6]; while the World Health Organization (WHO) reports that typically 20% of injuries involve alcohol, and these mostly involve patients were under the age of 35 [7].

Recent research [8–10] suggests that personal salience plays a special role in alcohol-related risks. While risks are acknowledged for members of their peer group, people tend to disassociate this from the risks to themselves. Young people who drink more tend to be optimistic about personal risk, to live more ‘for the moment’, and perceive themselves as having high self-control.

A study of college students' perceptions of problems due to alcohol showed a strong positive relationship between subjects' ‘unrealistic optimism’ and the number of alcohol-related negative events (hangovers, missed classes, and arguments with friends) that they experienced six months, one year and 18 months later [11]. These are confirmed in a study of undergraduates' perspectives about time and in relation to health behaviors, including alcohol consumption: students who had a hedonistic ‘enjoy life now’ perspective reported greater alcohol use than those who gave more consideration to the future [12].

This paper describes preliminary work on the development of a visualization tool for calculating and communicating to young people the long- and short-term risks of alcohol consumption (see Fig. 1). Its purpose is to inform the relation between their drinking behavior and national guidelines, and the health risks that they personally face. It forms part of a study concerned with curbing the damaging health consequences of binge drinking in young adults and teenagers. Key elements include:

- informing individuals about the consequences of their behavior in a manner that supports motivation and perceived self-efficacy;
- identifying methods to communicate risk that are effective for the target audience of teenagers and young adults; and

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Fig. 1. 'Jim the bartender' graphical interface for drinks selection in the Alcohol Risk Calculator [22].

- identifying features of potential visualization tools that will engage the target audience, lead them to discover the impact of their drinking habits on their own health and to explore the potential consequences of changes in their drinking pattern.

Binge drinking can be hard for doctors, parents and teachers to diagnose as they are often not around during the event. We hypothesize that teenagers will be more willing to expose their binge drinking behavior to a computer program and that they will be more truthful in their responses if they are confiding to a computer program in private rather than communicating with an authority figure, with or without the presence of their peers. Using the information provided by a user, as well as known data on risks, a system can calculate risks faced by an individual.

The idea of a risk calculator is not new. The Harvard Cancer Risk Index, first printed in 1997, has been developed into 'Your Disease Risk', a calculator that works out the risk of developing a range of cancers [13]. Similar calculators link more directly to alcohol consumption, calculating aspects of the user's drinking habits such as blood alcohol concentration (BAC), the number of calories consumed, or how much money is spent [14–17]. However, none of these inform the user of the risk of personal injury based on the amount they drink. Many of the existing alcohol calculators are also unexciting for young people. We believe that a calculator is more likely to engage young people, and thus have a better chance of influencing their behavior, if it can be made to be entertaining and interesting.

1.1. Influencing health-related behavior

There is general agreement that human behavior is goal-directed; actions are controlled by intentions. The most influential theoretical accounts of this relationship are provided by Ajzen and his colleagues. The theory of reasoned action (TRA) proposes that actions can be traced through causal links from beliefs, through attitudes and intentions to the resulting behavior [18].

The TRA assumes that human beings largely behave in a sensible manner; they consider available information and implications; and individuals' intentions determine actions. The determinants of intentions themselves are twofold:

Personal: the individual's evaluation of, and attitude toward, the behavior in question. These are said to arise from 'behavioral beliefs'.

Social: the individual's perception of the social pressures put upon them, particularly their views on whether trusted others

would approve or disapprove of their behavior. Ajzen [18,19] terms this the 'subjective norm' giving rise to 'normative beliefs'.

Their relative weights can vary by person and by behavior. According to the theory, the beliefs of a given individual represent the information that he or she has about the world. Therefore, by changing information, it is possible to change behavior.

Irvine and colleagues [20] used TRA and self-efficacy theory to inform the design of an interactive multimedia system that included video modeling vignettes and testimonials. Their system was designed to encourage users to overcome barriers to healthy eating. The TRA informed the system's authors' use of video testimonials that "offered encouragement to try recommended behaviors" [20, p. 293].

The TRA theoretical account was later extended to include consideration of the individual's behavioral control in realizing their intentions, in the theory of planned behavior (TPB) [19], giving rise to a third determinant of intention:

Behavioral: the individual's perceived self-efficacy in realizing an intention. The TPB addresses the individual's control over external factors that facilitate or impede their intentions. Crucially, behavioral control is tempered by the individual's beliefs about their ability to perform the given behavior; they may be able but believe they are not. Ajzen [19] terms this 'perceived behavioral control' giving rise to 'control beliefs'.

1.2. Support for understanding statistics

'Collective statistical illiteracy', is a phenomenon with serious consequences for health, relevant to patients and health professionals. In an influential study, Gigerenzer and his colleagues [21] claim that at the root of the problem is the use of non-transparent statistics. According to them, statistics should be presented in terms of *natural frequencies* instead of the commonly used *conditional probabilities* (see Table 1), since natural frequencies facilitate computation.

2. Methods

2.1. Calculating risk

We summarize briefly here the accepted methods for calculating the risk of acute and chronic outcomes of alcohol consumption. These methods are employed directly in our tool.

For acute risk we adapted a formula developed by Rehm et al. [1] for the probability of death (PoD), per 1000 people (see Eq. (1)), based on a baseline level of risk (*BR*), a relative level of risk (*RR*) based upon how much the person drinks, a risk period (*RP*), also based on alcohol consumed, and the number of drinking occasions per year (*N*):

$$Pod = 1 - \left(\frac{1 - (BR \times RR)}{RP} \right) N \quad (1)$$

The baseline risk (*BR*) is the number of people who would suffer a specific injury without including the alcohol-attributable fraction (*AAF*) of injuries. The relative risk (*RR*) increases based on the amount of alcohol drunk and was similarly adapted by Bissett [22] from the original calculations in Rehm et al. [1]. The risk period (*RP*) is based on the time it takes for a person's alcohol levels to return to 0, based on the amount drunk and their age, height and weight.

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