# Exploring New Design Factors for Electronic Interventions to Prevent College Students from Excessive Drinking by Using Personal Breathalyzers

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## Abstract

*Excessive drinking among college students is a significant public health issue. Electronic Screening and Brief Intervention (e-SBI) has been shown to be an effective prevention device, and it has been instrumented on personal computers, web, mobile phones, and social networking platforms. In this research, we asked college students to discuss their perception of BACtrack Mobile Pro, the first FDA-approved personal smart breathalyzer. We recruited 15 college students who consume alcohol regularly and asked them to use the smart breathalyzer for two weeks. We conducted online surveys and in-person interviews. We identified five main issues of the smart breathalyzer from the participants: (1) Support from immediate family members or close friends, (2) Personalized results, (3) Intuitive display of results, (4) Attachment to users, and (5) Quicker access. Future mobile and smart wearable e-SBIs targeted toward college students should take these design considerations into account.*

## Introduction

Excessive drinking among college students is a serious public health issue. According to the Centers for Disease Control and Prevention, excessive drinking includes heavy drinking, which is defined as drinking 15 drinks or more per week for men and 8 for women, and binge drinking, which is defined as a pattern of drinking that causes the blood alcohol concentration (BAC) level to exceed 0.08%[1, 2]. A national survey shows that, about 60 percent of college students age 18 to 22 have consumed alcohol excessively in the previous month[3]. Excessive drinking could bring serious risks to students' health and safety that could result in car accidents, sexual-assaults, bodily injuries, and long-term liver and kidney damage. About 1,800 students between 18 and 24 years old die annually from alcohol-related accidents[4]. Although problems related to excessive drinking are well publicized, many college students perceive drinking as a part of their college life and subsequently establish drinking habits when they attend college[5].

With recent advances in information and communication technologies, electronic Screening Brief Intervention (e-SBI) has been found to have the potential to reduce the amount and frequency of drinking and is considered to be an effective prevention mechanism for young adults[6]. In this paper, we first introduce existing literature on traditional SBI and e-SBI studies. We then describe the results of our user inquiry involving the BACtrack Mobile Pro, the first FDA-approved personal smart breathalyzer, as an intervention in a series of surveys and interviews with college students who consume alcohol regularly. We report five issues related to current smart breathalyzer design and propose future work in this area.

## Related Work

The screening and brief intervention (SBI) is designed to assess a person's alcohol consumption behavior with a series of questions about a person's drinking patterns. Traditional SBI is typically provided by health care professionals in face-to-face settings with in-person feedback, which includes information about one's alcohol consumption, its risks, the benefits of lower alcohol consumption, and suggestions for adjusting drinking patterns. If appropriate, the health care professional may provide a referral to treatment[7, 8, 9]. Although SBI has been found to be effective in reducing alcohol consumption and related problems based on the 34 randomized controlled trial studies[10], there are several limitations that prevent health care professionals from deploying the intervention effectively. According to one report, health care staff suffered from a lack of skills, knowledge, time, and resources for conducting SBI[11, 12]. When it comes to adoption of SBI among college students, research has shown that they are sensitive to assessment by a health care practitioner about drinking, and they tend to be more interested in receiving personalized feedback[6].

Unlike traditional SBI that includes face-to-face feedback, e-SBI could provide personalized feedback about excessive drinking via an electronic medium such as the Web, text messages, mobile phone apps, and social network platforms. With e-SBI, it is possible to offer more anonymity and flexibility to the subjects, and dissemination through a digital medium has the potential to reach more people who may benefit from SBI. For young adults, the anonymity afforded by e-SBI with its electronic alcohol risk assessment and personalized feedback is preferred over direct intervention with face-to-face assessment and in-person feedback from a health care professional[6]. Recent systematic reviews of

e-SBI show that e-SBI is effective in reducing alcohol consumption[13, 14]. Internet-based SBIs are cheap to implement and deploy, are widely accessible at any time, and could mitigate concerns about stigma among one's social circle[15]. The wide adoption of smartphones provides an additional platform for e-SBI, and research has pointed to its potential to impact drinking disorders[16, 17] While research shows there are many positive effects of e-SBI, some studies find that the intervention does not result in any significant changes in one's behavior[18, 19, 20], and it may not be effective after a period of 12 months or longer[21].

Other interventions involve peer support such as receiving notification messages from family and friends. Research has shown that this type of intervention is more effective when it is delivered over the Web or through individual face-to-face sessions over periods shorter than 3 months. However, peer support intervention via e-mail did not yield significant long-term effects in a long-term follow-up study[22]. Research shows that for smartphone applications that calculate BAC levels, there is in fact a significant increase in drinking frequency and BAC levels among participants. Researchers of the study attributed the findings to the fact that more male participants were represented in the study, and that they were more likely to treat the BAC level as a competitive social game[19]. Furthermore, interactive interventions have been found to be effective at behavior change[23]. It is suggested that appealing design and contents with low user burden and more interactive elements should be considered for alcohol-related devices and services[24].

In general, while several studies have pointed to the potential of e-SBI for reducing alcohol consumption among young adults due to its ease of access and anonymity, there is very little research into the use of smartphone and wearable devices. To our knowledge, there has been no prior reporting on a consumer-oriented breathalyzer device. In this paper, we describe an exploratory study that involves the use of a personal breathalyzer device that can be used with one's smartphone.

**BACtrack Mobile Pro**

The BACtrack Mobile Pro is the only consumer breathalyzer that has been developed and released by the FDA-approved company BACtrack. It is designed to monitor and manage one's BAC and drinking habits by linking to a smartphone or a smartwatch. It has additional functions such as calling Uber[25]. The Figure 1 shows a BACtrack Mobile Pro that was given to a participant for this research.



**Figure 1.** BACtrack Mobile Pro

**Methods**

The goal of this research is to understand college students' culture of alcohol consumption and how the smart breathalyzer could influence them. In addition, this study considers ways that the design of the device and application could potentially be improved to prevent college students from drinking excessively. We selected the BACtrack Mobile Pro as the device to use for our research because it is the first, and currently the only, company to obtain FDA approval to manufacture and market breathalyzers for consumer use. Consumer reviews on Amazon.com also show higher user satisfaction than other competing products. The BACtrack Mobile Pro can connect to the BACtrack smartphone app via Bluetooth. A user can blow into a mouthpiece on the device and check her/his BAC with the app[25]. The app can store BAC levels, and users can retrieve and compare them over time. Moreover, depending on the BAC level, the app also displays a user's status and provide suggestions when the BAC results appear. Figure 2 shows screenshots of the app.
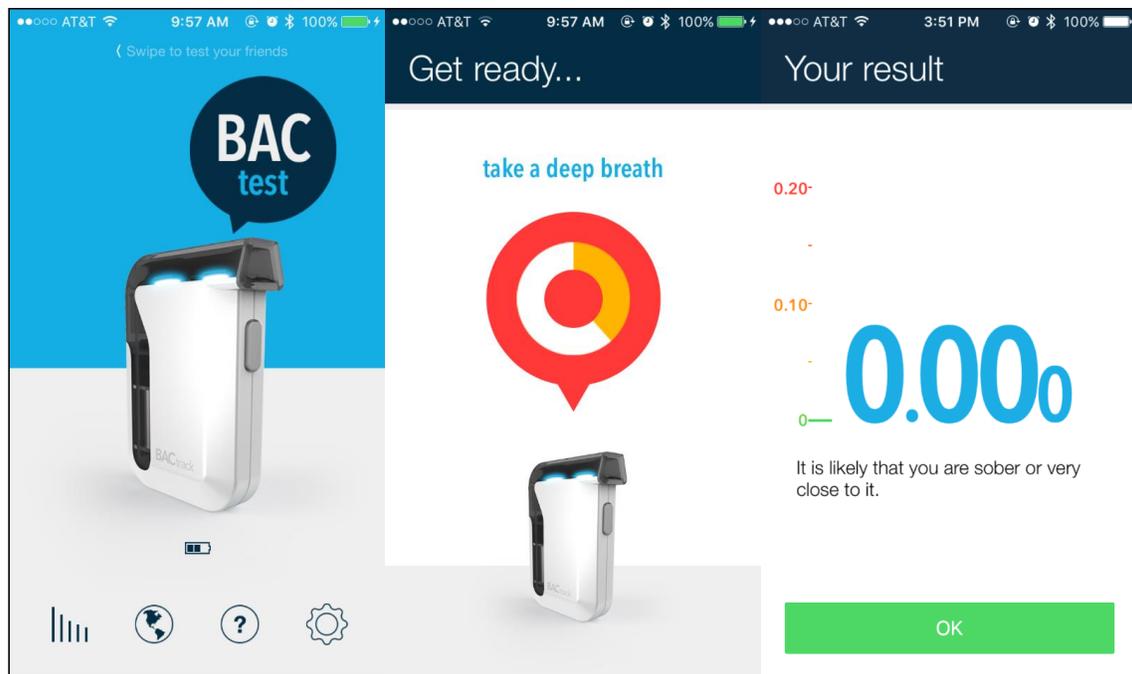
**Figure 2.** Screenshots of BACtrack application

We recruited undergraduate students by advertising the research through social media and snowball sampling. Our target population was college students who are over the age of 18 and consume alcohol at least once per week.

We conducted in-person interviews to learn more about the drinking culture of college students. Participants were informed about the research process and signed an informed consent form approved by Indiana University's Institutional Review Board. Participants were given a short tutorial on how to use the device and the smartphone application, and they were given the breathalyzer to use for 2 weeks. After the end of each week, we sent short surveys to query their usage experience in the previous week. Finally, we implemented a post-study questionnaire and conducted follow-up interviews to explore how the device have influenced their alcohol consumption perception and behaviors and to uncover issues with device usage. The interviews were audio-recorded and transcribed for analysis. We then conducted open coding and iteratively refined the emerging themes[26].

**Results**

We recruited 9 female and 6 male college students with ages ranging from 19 to 27 years old. They used the device 2 to 7 times during the two-week period. We identified five main issues relating to breathalyzer usage as a form of electronic intervention for drinking: *(1) Support from immediate family members or close friends, (2) Personalized results, (3) Intuitive status display, (4)* Accessorizing the form *factor, and (5) Quicker access.*

*Support from immediate family members or close friends*

The BACtrack Mobile Pro provides functions such as calculating BAC level, calling Uber, and sharing the data anonymously. At the beginning of the study, we expected that participants might not want to share any alcohol-related information (e.g., BAC, status, or location) with others. However, the college students said they were fine with sharing it with their immediate family members and close friends. According to participants, they want to use the sharing functions to both get help from and provide support to their family and friends through the app. For instance, if a user registers their family members or friends on the app, the friends and family will receive notifications if the app detects an abnormally high BAC level for the user.

> *P-02 "If I see one of my friends has a high BAC level, I will call and check on them to make sure they are ok."*

> *P-11 "If I show my BAC level and status when I feel drunk, I can show it to my friends and let them know I should stop drinking. Then, they might not give me more shots."*

> P-15 *"I can share my BAC level with my friends when we drink together. Sometimes I may look fine to my friends, but I was actually drunk. So this BAC level would help me prove that I am drunk and that I won't be pressured into drinking more."*

Participants also mentioned that they needed more meaningful representation of their BAC level; some of them have trouble understanding the meaning and difference between readings such as 0.08 and 0.12. A more meaningful visual representation is needed to help those participants understand their alcohol consumption habits.

*Personalized results*

Because each person is different and could react to alcohol differently, the BAC level shown on the app might not exactly indicate the precise risk level for each person. Although the BAC level and corresponding color could indicate risk level to a certain degree, many of our participants reported that they did not feel drunk when their BAC level exceeded the legal threshold of 0.08 and the color indicator was red. On the other hand, some participants reported feeling drunk with a BAC level far below the 0.08 threshold with the app showing green.

> P-07 *"I am a lightweight compared to other people. When I began to feel a headache from drinking too much and blew the breathalyzer, the color of BAC level was green. The device stated that my status is OK, but I wasn't. So I felt this is not helpful for me."*

> P-10 *"It would be good if the device knows my condition and gives some alerts to prevent me from having bad symptoms."*

> P-11 *"It should provide personalized information about my drinking in detail. You know, degree of excessive drinking might be different, so if I just get BAC level without any detailed information, it does not have enough value."*

Future design could allow participants to annotate their BAC levels to indicate their personal comfort level, and that could be used to personalize the individual's status display. For example, the app could display a red color if a user sets the threshold to 0.05 as opposed to the normative 0.08.

*Intuitive status display*

The device shows BAC level, texts, and graph on the app. However, many participants stated that they were confused when they saw the results. They did not know what was considered a high BAC and thus dangerous for operating a motor vehicle. Also, although the app shows what the BAC level means, such as the user's possible status, and provides suggestions with texts, they said the messages were too small and lengthy to read and understand, especially when they were drinking or were already drunk. They suggested that if the results showed visual images or emoticons that correspond to someone's physical condition, such as passing out, it would help them process the status much more intuitively.

> P-02 *"If the device shows pictures of someone who is passed out or police officer who hands out ticket, it would encourage me to stop drinking. If you are drunk, you might not be able to read the words, but you can see the pictures."*

> P-13 *"I wanna see what each BAC status means. When I used the device and saw the value, I thought 'Is this BAC level enough for my body? Is this dangerous to drive?' I don't understand intuitively."*

*Accessorizing the form factor*

The size of BACtrack Mobile Pro is small enough to be held in one hand. It is convenient to carry in one's purse or bag, but almost every participant mentioned that they were worried about losing the device because of its size, especially when they were less cognizant of their surroundings when drinking. Also, some participants suggested different shapes for the device, such as a watch, a neckless, or a bracelet, that could better fit their lifestyle and aesthetic preferences.

> P-01 *"I had it in my purse, but I don't think it would be easy to carry for male students. It would be better if it could be attached to my cellphone."*

> P-05 *"I don't wanna lose it.. so I didn't bring it sometimes."*

> P-13 *"At first time, I brought and used it. But the next day I was drunk, I almost could not find the device. Then I became really worried if I really lost it… so I always leave the device at home."*

Therefore, a future design that investigates different ways of accessorizing the appearance of the breathalyzer and how it can be worn or carried could significantly affect wider adoption of the device.

*Quicker access*

To retrieve the BAC level, the user must turn on Bluetooth, open the app, and click on the device to link to the app. When a connection is established, the user has to wait for the device to "warm up" before s/he can blow into it to get the BAC reading. The device needs to capture enough air that contains alcohol before a reading can be registered. This process could take up to 1 minute. Some participants expressed that the process took too long and it was inconvenient and burdensome to use.

> P-09 "It was not easy to check my BAC because I was drunk. Why can't they monitor automatically?"

> P-12 "I usually forgot to use it while I was drinking. It took quite a long time for me to set it up and check my BAC."

> P-15 "You know, my device was really slow to turn on the app and Bluetooth. I was trying to check my level in the middle of drinking with my friends, but it took a long time. It was obvious that it disrupted our conversation."

Today's smartphone is capable of location detection. It may be possible to program the breathalyzer and the app to enter "hibernation" mode so that it could be accessed quicker if the app detects that a user is located in the vicinity of a bar. If automatic detection is not possible, it may be possible to create a manual mode that allows the user to set the connection state manually if they know that they plan to drink that evening.

**Conclusion**

This ongoing research has explored the issues of using a smart breathalyzer as a potential e-SBI prevention and intervention device to prevent excessive drinking among college students. Some limitations of the study include the short usage time (2 weeks) and a relatively small number of users (15 college students). However, the interviews identified many promising design opportunities to improve the app interface and device form factor to allow for better user experiences. We plan to design and implement a different smartphone app that integrates with the breathalyzer and to conduct a longer-term deployment study to understand the potential impact on college students' perception of and behavior with alcohol consumption.

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