

University of Colorado Boulder
Information Science and Strategic Communication

Booze Clues: The Integration of Technology into the
College Social Scene to Promote Responsible Drinking

Hannah Weber

Thesis Advisor: Dr. Lecia Barker, Information Science

Committee Member: Dr. Jason Zietz, Information Science

Committee Member: Dr. Erin Willis, Strategic Communication

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Abstract

Alcohol is prevalent in the social lives of many college students; however, my research suggests the endeavors to promote responsible drinking through the current research and education efforts are failing. Binge drinking remains synonymous to the college social scene, people continue to practice irresponsible drinking behaviors, and students remain uninformed about alcohol and its effects. The purpose of this research was to understand how wearable technology could be integrated into the college social scene to encourage people to drink more responsibly. The study included interviews and a survey. My research suggests alcohol consumption is commonplace in many college students' lives, but the majority of people remain uninformed about the consequences of drinking. These findings were used in combination with principles of User-Centered Design to inform a prototype of Booze Clues. Booze Clues is an integration of a wearable device and mobile application. The integration of this technology into people's social lives can educate the users on the consequences of their alcohol consumption in real-time. Booze Clues will not only present the user's current blood alcohol concentration reading as detected by a wearable device; it will also be an educational tool to inform people about blood alcohol concentration and alcohol's impact on the body and mind. It is time for college administrators and researchers who are responsible for educating students on safe drinking practices to reevaluate their efforts. Designed for the college social scene, Booze Clues is the new way to encourage students to practice responsible drinking behaviors.

Key words: college drinking, blood alcohol concentration, wearable technology, responsible drinking practices, Booze Clues

Introduction

“I’m old enough to know better, but I’m still too young to care” (Hayes, 1995). This quote sums up the relationship many people have with drinking in college. The majority of young people have been educated on the risks associated with alcohol, whether it was by parents, high school teachers, or college administrators. Despite the fact many of these educational efforts emphasize the negative consequences of consuming alcohol, the majority of people still choose to drink. According to the 2016 Monitoring the Future Study, 81% of college students have tried alcohol at least once in their life, 67% have reportedly been drunk, and 32% had participated in binge drinking at least once in the two-weeks prior to completing the survey (*College Binge Drinking Statistics*, n.d.).

The idea of establishing a quantified self is not new, however, it has become increasingly easier to do with the recent advancements in technology. Wearable technology, in particular, collects data about people’s everyday lives and gives them the ability to monitor their bodies beyond what is perceived by their senses. The current demand for wearables is vast, and it will only continue to increase as the technology is improved upon in the future. This technology has been adapted to many fields including entertainment, education, health, and gaming. Fitness trackers, such as Fitbit and Garmin, have revolutionized the health and wellness industry since they came to market.

Attempting to take advantage of the success of fitness trackers, a new wave of devices was introduced to the health and wellness industry. Blood alcohol concentration (BAC) monitoring wearables are new and innovative. These devices are able to provide continuous tracking of a user’s BAC to monitor their current intoxication levels. Although this technology

has not yet been widely adopted, it is in the early stages of development with great potential for success in the future.

My research explores how wearable technology could be integrated into the college social scene to promote responsible drinking behaviors. Wearable technology can provide people with a new kind of information, an objective BAC reading to their otherwise subjective feelings of intoxication. Instead of shining a negative light on alcohol and shaming college students who drink, my research aims to help people better understand their drinking behaviors and how alcohol consumption is affecting their bodies. Additionally, I will introduce Booze Clues, a BAC monitoring wearable device and mobile application designed to have a seamless integration into the college social scene.

This paper will begin by exploring past research related to alcohol consumption and BAC monitoring technology. Next, I will discuss the findings of my primary research which consisted of several interviews and a survey. I will then explain the opportunity for wearable technology to encourage college students to practice safer drinking behaviors. Finally, I introduce Booze Clues and explain the potential it has to be integrated into the college social scene.

Literature Review

Prevalence of Alcohol Use

Humans have been consuming alcohol for over 10 million years. Scientists believe the first discovery of alcohol occurred in northern China between 7000 and 6650 BC. At the time, alcohol was used moderately to prevent various illnesses, but was mainly enjoyed during mealtime. It wasn't until the 17th century that the production and distribution of alcohol soared, and drinking in excess with the goal of becoming intoxicated began (Misachi, 2017).

Alcohol use is just as prevalent today as it was centuries ago. According to the 2018 National Survey on Drug Use and Health, 87% of people over the age of 18 have consumed alcohol during their lifetime, 70% have drunk alcohol in the past year, and 55% have drunk alcohol in the past month. Among this same age group, excessive drinking is also still common with 27% of people reportedly binge drinking in the past month, and 7% participating in heavy alcohol use in the past month (*Alcohol Facts and Statistics*, 2019). Binge drinking can be defined in many ways. The most common definition is consuming four or more drinks for women, or five or more drinks for men, within a two-hour time period (“What Are the Dangers of Binge Drinking & Alcohol Blackout?”; Kanny et al.).

An extensive collection of research related to alcohol consumption uses numerous techniques. Standard practice is to conduct controlled experiments where the researchers dictate the drinking behaviors of the participants (*Virtual Bar and BAC Calculator*, n.d.). Another common approach is to rely on the participants’ self-reporting the amount of alcohol consumed throughout the duration of the study (Bae et al., 2017; Northcote & Livingston, 2011). In addition, several qualitative research methods frequently used to understand people’s experiences with alcohol are questionnaires, interviews, and focus groups (Brooks, 2008; Northcote & Livingston, 2011; White et al., 2004). Observations have been a beneficial technique for researchers as well, whether they are observing their participants’ actions in person (Northcote & Livingston, 2011) or through their cell phone activity during a night out (Bae et al., 2017).

Finally, the area of research dedicated to alcohol consumption is already saturated. Therefore, several comprehensive research studies have been conducted to evaluate this preexisting information. This research includes analyzing 500 alcohol-related smartphone

applications in the Apple and Android application stores (Weaver et al., 2013) and the comprehensive Global Burden of Disease Study. This study was conducted to gain a better understanding of alcohol use and its effects globally from 1990 to 2016. In total, researchers examined 1,286 studies conducted during that time frame and analyzed their results. It was found that in 2016 alone, alcohol use resulted in 2.8 million deaths worldwide. It also accounted for 10% of the premature death and disability cases among people aged 15-49 years old, making it the leading risk factor for that age range. The study concluded the safest level of drinking is none (Griswold et al., 2018).

College Students' Use of Alcohol

Drinking is highly integrated into the social lives of many people during their time in college. College is the first time most people experience the consequences of unrestricted free time and a lack of adult supervision. Couple this newfound freedom with the widespread availability of alcohol and varying amounts of social pressure, and many students will choose to drink (*Fall Semester—A Time for Parents To Discuss the Risks of College Drinking*, 2019).

According to the 2018 National Survey on Drug Use and Health, full-time college students between the ages of 18 and 22 years old are more likely to drink than their peers who do not attend college. The survey found in the past month, 55% of college students have consumed alcohol, 37% have engaged in binge drinking, and 10% have reportedly experienced heavy alcohol use (*Fall Semester—A Time for Parents To Discuss the Risks of College Drinking*, 2019).

Over the last few decades there has been a shift in the college social scene, as students have started to consume alcohol with the intent of getting drunk rather than just to socialize. As a result, hard liquor has experienced an increase in popularity over beer (Carol Galbicsek, 2019). This shift comes with a new wave of issues as hard liquor has a higher alcohol content than beer.

Hard liquor when consumed irresponsibly can cause a rapid rise in BAC levels and result in blackouts. Durham VA Medical Center surveyed 772 undergraduate students on their experiences with alcohol-induced memory blackouts. According to the survey, 51% of college students have reportedly experienced at least one blackout. During these blackouts, most students consumed either liquor only, or a combination of liquor and beer; while only one student experienced a blackout after only drinking beer (White et al., 2004).

During the first six weeks of freshman year, students are experiencing the highest-risk period for binge drinking. Many students are longing to have the “college experience” and are striving to fit in. Oftentimes, this results in people drinking excessively at parties, sporting events, and other social events with their new friends (Carol Galbicsek, 2019).

Binge drinking and college have become synonymous over the years, despite the efforts of parents and college administrators to promote safe drinking practices. Several individual-level intervention efforts have tried to educate students on alcohol use and its consequences. These have been commonly implemented by parents and college administrators for students at a higher-risk for drinking such as Greek life, first-year students, and student athletes. Environmental-level strategies are also implemented to change the campus and surrounding community where the drinking activities commonly occur. Oftentimes, the main goal of these efforts is to reduce the availability of alcohol to the students (*College Drinking Fact Sheet*, n.d.).

An example of a college’s efforts to encourage safe drinking practices is the University of Michigan’s Stay in the Blue campaign. The goal of the campaign is to promote drinking in moderation on their campus by launching a free mobile application. The application has an estimated BAC calculator, a tracker to monitor the number of drinks consumed over a specified time period, a feature to call nearby cabs, and a local events calendar. It also has an educational

feature that informs students on various topics including proper serving sizes of different types of alcohol and how to minimize hangovers (*It Takes Time to Sober Up* | *University Health Service*, n.d.).

The Importance of Understanding Blood Alcohol Concentration

Blood alcohol concentration (BAC) is a measurement of how much alcohol is in a person's bloodstream (*Blood Alcohol Content (BAC) Levels*, n.d.). A person's BAC level is dependent on several biological factors including body mass, gender, age, ethnicity, genetics, metabolism, and alcohol tolerance (*Content*, n.d.). These biological factors explain why a group of people could consume the same number of drinks but experience different levels of BAC and intoxication. BAC is typically broken down into different levels ranging from completely sober (0.00%) to lethal levels (0.40% and over). Figure 1 shows an estimation of BAC and its effects based on the amount of alcohol consumed (*Calculate Your Blood Alcohol Level* | *Office of Student Support and Wellness Promotion*, n.d.).

Blood Alcohol Concentration	Changes in Feelings and Personality	Physical and Mental Impairments
0.01 – 0.06	Relaxation Sense of Well-being Loss of Inhibition Lowered Alertness Joyous	Thought Judgment Coordination Concentration
0.06 – 0.10	Blunted Feelings Disinhibition Extroversion Impaired Sexual Pleasure	Reflexes Impaired Reasoning Depth Perception Distance Acuity Peripheral Vision Glare Recovery
0.11 – 0.20	Over-Expression Emotional Swings Angry or Sad Boisterous	Reaction Time Gross Motor Control Staggering Slurred Speech
0.21 – 0.29	Stupor Lose Understanding Impaired Sensations	Severe Motor Impairment Loss of Consciousness Memory Blackout
0.30 – 0.39	Severe Depression Unconsciousness Death Possible	Bladder Function Breathing Heart Rate
=> 0.40	Unconsciousness Death	Breathing Heart Rate

Figure 1: BAC ranges and its effects.

BAC is one of the most accurate indicators of the level of impairment an individual is experiencing due to alcohol (“What Is BAC and Why Is It Important?,” 2016). When a person is drinking, it can be beneficial for them to be aware of their approximate BAC and how the alcohol is currently affecting their body. This awareness can help them reach their desired level of intoxication and protect them from the regrettable consequences that come from drinking too much at one time.

People who intend on driving after drinking need to be aware of their BAC level and their current physical and mental impairments. It is illegal to drive with a BAC of 0.08% or higher in every state (excluding Utah, where the legal limit is 0.05%) (*Comparing State DUI Laws*, n.d.).

At this BAC, the law has determined the level of impairment a driver is experiencing is too much to safely operate a motor vehicle (“What Is BAC and Why Is It Important?,” 2016). In 2018, the highest percentage of drunk drivers were between the ages of 21 to 24 years old. That same year, 10,511 people were killed in car accidents involving drunk drivers, accounting for approximately one-third of all traffic crash fatalities in the United States (*Drunk Driving*, 2016).

A common misconception is there are ways to speed up the metabolism of alcohol and sober up quicker, but these claims are not true. Some of the myths include drinking black coffee, drinking water, eating food, and taking a cold shower. These activities may give the illusion that the person is sobering up, however, the only way to reduce blood alcohol content is time (“Myths About Sobering Up,” 2011). On average, the liver is only able to metabolize one standard drink per hour. A standard drink contains 0.6 ounces of pure alcohol; which includes 12 ounces of regular beer, eight ounces of malt liquor, five ounces of wine, and one-and-a-half ounces of hard liquor (*Blood Alcohol Content (BAC) Levels*, n.d.).

Testing for Blood Alcohol Concentration

Five standard BAC monitoring tests exist that vary in accuracy and are useful in different contexts. The five tests measure balance, breath, blood, urine, and hair. The balance test is not standardized but assesses if a person is currently intoxicated by checking their vision, spatial awareness, and body’s equilibrium. A breath test can be conducted with a breathalyzer device to determine the amount of alcohol in the person’s lungs. This is beneficial as the amount in the lungs correlates with the amount in the bloodstream. A breath test can typically measure if a person has drunk alcohol within the past 24 hours. A limitation of a breath test is it can only provide a reading for the person’s BAC at that specific moment. Blood tests directly measure a person’s blood alcohol concentration. However, a drawback is that alcohol remains in the

bloodstream for a relatively short time, making the tests effective only up to 12 hours after the last drink. Urine tests are useful in detecting metabolized alcohol which is also correlated to the amount in the bloodstream. Urine tests are beneficial between 12 to 48 hours after the last drink. The last test is rarely used, however, hair tests can detect if a person has consumed alcohol within the past 90 days (*How Do BAC Alcohol Monitoring Tests Work?*, n.d.).

As technology has become ubiquitous in our society, advancements in BAC technology have emerged as researchers are trying to move beyond the five standard BAC tests. This technology has taken the form of both wearable and non-wearable devices.

Technology for Detecting Blood Alcohol Concentration (Non-Wearable)

Researchers have been experimenting with many forms of non-wearable technology. Typically, non-wearable devices are not able to accurately track a user's BAC level; rather, they provide the user with a rough estimate of their BAC given the limited information the user inputs. The goal of these devices is to track the user's alcohol consumption by monitoring different factors in their immediate environment.

As of 2013, a study conducted by researchers in Australia discovered 35 mobile applications that relied on self-reporting to estimate the user's BAC. Of the available applications, 94% calculated the user's BAC based on their gender, weight, and number of drinks consumed. However, the parameters for the amount of alcohol that classified as one drink varied between applications. Fifty-nine percent of applications had the user report the alcohol content and volume of each drink, 31% didn't specify the definition of one drink, and 14% defined it as one standard drink (Weaver et al., 2013). The lack of parameters as to what is defined as one drink is concerning because any misunderstanding can lead to inaccurate self-reporting, and consequently, inaccurate estimations of the user's BAC.

An example of a self-reporting mobile application was proposed by researchers at Queensland University. This proposed application would contain three key features: a drink counter, peer support, and quick dial. The drink counter would allow users to track the number of drinks they consumed throughout the night to monitor their level of intoxication. Peer support would be a social networking feature that allows friends to link up and monitor each other's drinking behaviors. The last feature, quick dial, would enable the user to easily contact their friends, public transportation, and emergency contacts within the application (Lee et al., 2012).

The Virtual Bar is a unique self-reporting mobile application primarily used before the user begins consuming alcohol. The goal of the Virtual Bar is to enable users to outline their intended drinking activities for the night. The focus of application is to inform people about how their BAC is affected by different variables. The calculator enables exploration through adjusting variables such as number of drinks, type of alcohol, time to finish drink, food consumed, gender, age, weight, and height. The Virtual Bar also advises the user about how they would potentially be feeling physically and mentally at each intoxication level. Additionally, the application provides an estimation for the necessary amount of time to completely sober up (*Virtual Bar and BAC Calculator*, n.d.).

Because smartphones are ubiquitous in today's society, several researchers have come together to explore ways smartphones can be used to foster safe drinking practices, beyond just using them as a tool for self-reporting. In one study, the participants downloaded an AWARE-based mobile application that has the ability to detect 14 different activities and interactions users have with their smartphones. Additionally, the participants completed a daily survey asking if they had experienced a drinking episode the previous day. If so, they were then presented with additional questions pertaining to the episode. The researchers then created a behavior model to

examine various aspects of their smartphone activity - such as screen status, network usage, and mobility state. After analyzing the data, the model predicts the occurrence of drinking episodes based on changes in the participants' phone usage. The objective of this model was to prompt "Just in Time intervention," an intervention strategy attempting to slow or stop a drinking episode before it occurs (Bae et al., 2017).

Smartphones are not the only non-wearable devices that have been experimented with for monitoring the alcohol consumption of the user. At the University of Tokyo, researchers conducted experimental research to test the accuracy of a smart ice cube device that would detect the alcohol concentration of various alcoholic products. The research was executed by recreating and expanding upon the Bene's alcohol content determination method. This method utilizes infrared light waves to measure the alcohol concentration of a liquid. After re-executing the Bene's method, the researchers' device was able to detect with high accuracy the alcohol content of 13 commercially-available alcoholic products (Matsui et al., 2018).

Another non-wearable device is the IllumiMug, proposed by researchers at the University of Oldenburg, Germany. The IllumiMug is a concept for a content-aware, interactive cup that could detect the temperature and amount of alcohol present inside. This would be a beneficial device because it could notify the user of the amount of alcohol in a drink and, if necessary, when the liquids are at a safe drinking temperature (Poppinga et al., 2014).

Technology for Detecting Blood Alcohol Concentration (Wearable)

In addition to the advancements in non-wearable devices that monitor alcohol consumption, there has been a breakthrough in wearable technology that can detect a user's BAC through their skin.

In 2014, a patent was granted for a discreet transdermal alcohol sensor that would monitor a user's BAC levels. The patent also included a mobile application that would receive the data from the wearable technology, analyze it, and display the data to the user. Additionally, the mobile application would perform an analysis to predict the user's future BAC levels. However, the patent was abandoned in June 2019 (Baldwin, 2014).

Although not yet available on the market, one study explored the effectiveness of measuring participants' BAC based on readings from three wearable sensors. The electrocardiogram (ECG) sensor monitors a person's heart rate; the photoplethysmography (PPG) sensor measures light absorption by the skin to detect blood volume changes; and the intoxilyzer is a tool to test breath alcohol content. The data was collected by the sensors before and after the participants consumed alcohol. This data was then analyzed individually utilizing three different machine learning models to determine which sensor would be optimal to measure a person's level of intoxication. The study concluded the PPG data would be the best input for a machine learning model because it generated the highest accuracy and only one sensor was required to collect the data (Wang et al., 2018).

Three wearable devices currently on the market are BACtrack Skyn, Buzz Bracelet, and Biosensor Patch. BACtrack Skyn and Buzz Bracelet are BAC monitoring wristbands that provide constant measurement of the user's transdermal alcohol content. The Biosensor Patch is a temporary biosensing patch that monitors a user's alcohol levels through the stimulation and examination of their perspiration (*Alcohol Observer*, n.d.).

Shortcomings of Existing Research

A shortcoming of the extensive research on alcohol consumption and BAC tracking devices is that it is not practical. The studies are often conducted in a highly controlled setting

where the researchers have complete authority. They control what the participants eat, what alcohol they consume, and the proceeding of events. Researchers also direct their participants to remain sedentary, as any excessive movements could affect how the alcohol is metabolized and potentially impact the results of the study. Another weakness of this body of work is it tends to frame alcohol in a negative light and as a villain. The majority of research comes to the conclusion that alcohol is harmful and people should abstain from drinking completely.

In an ideal world (as portrayed in these controlled studies), college students would eat a hearty meal, slowly consume a reasonable amount of alcohol, and be in bed by 10:00pm. Not surprisingly, the college social scene does not resemble these controlled studies. A typical night out involves inconsistent drinking, varying food consumption, and frequent movement. Rather than adapting the same idealistic views as many researchers in the field, I have to be realistic about how wearable technology can be integrated with the unruly alcohol consumption behaviors of college students.

It is evident that college students are aware of the research regarding the harmful effects of alcohol, but it has been relatively ineffective in changing their drinking behaviors. The intent of my research is to promote responsible drinking by informing young people about the effects of alcohol on their bodies. This will be done not through the scare tactics commonly used by researchers, but by providing an objective BAC reading to their otherwise subjective feelings of intoxication.

Methods

For this study, I used a multi-dimensional approach to research that applied various methods for data collection, data analysis, and designing a prototype. The study included

interviews and a survey. The findings were used to inform a prototype of a mobile application and a wearable device.

Interviews

Data Collection

Qualitative research for this study was initially conducted through interviews with University of Colorado Boulder students. The objective of the interviews was to collect information related to college students' relationships with alcohol to gain a better understanding of their drinking behaviors. The participants were composed of three men and three women between the ages of 21-22 years old. People under 21 years old were excluded from the study because I did not want to obtain information regarding their current illegal activities.

I created the interview questions based on my review of literature related to alcohol use, and my personal experiences with the college social scene over the past three-and-a-half years. The interview questions covered five broad topics - basic introductory information, general alcohol use, drinking in college, drinking and driving, and blood alcohol concentration technology. Each interview lasted approximately 20 minutes. The interview protocol can be found in the appendix.

Participation in the interviews was completely voluntary and the subjects received no compensation. I recruited the participants from a convenience sample composed of students in the Department of Information Science at the University of Colorado Boulder, in addition to several of my peers from outside of the department. The participants were recruited in person and through email. I captured an audio recording of the interviews, but I did not fully transcribe the session. During the interviews, I took written notes of the main takeaways of the responses and used these notes for my data analysis.

Data Analysis

To analyze the interview data, I conducted a thematic analysis. I reread my notes from each interview session, combined all of the responses into one document, and identified any patterns that emerged from the collection of interviews. By performing the thematic analysis, I wanted to determine any similarities in the drinking behaviors and practices of my sample of college students. After the thematic analysis, I used my findings to inform the design of the prototype. In addition, these findings provided further evidence of the demand for a product like Booze Clues.

Survey

Data Collection

The interviews suggested that most people have little knowledge of blood alcohol concentration. To understand whether I should generalize this finding, I launched a survey to assess people's knowledge of blood alcohol concentration. The goal of the survey was to show the extent people are informed about BAC and how alcohol affects the body. A total of 86 people responded to the survey. 44 of the respondents were currently in college, and 42 respondents were not. The survey, which can be found in the appendix, was composed of general knowledge questions unrelated to people's personal experiences with alcohol.

I designed the survey under the guidance of an expert using best practices. I also piloted the survey with a member of my target demographic to address any biases, misunderstandings, and errors before launching to a wider audience. In total, there were 16 questions on the survey associated with four topics - basic knowledge, scenarios, definitions, and demographic information. I left the survey open for 17 days, and it took approximately 5 minutes to complete.

Participation in the survey was completely voluntary and participants received no compensation. I sent the survey to my peers in the Department of Information Science and the Department of Advertising, Public Relations, and Media Design. The survey was also sent to my friends and family, and it was posted on Facebook. The collected responses were anonymous.

Data Analysis

For the responses to the multiple-choice questions, I analyzed the data using descriptive statistics. My analysis was guided by several questions including: How much do people know about blood alcohol concentration? What is the distribution of knowledge? What is the average number of correct answers on the survey? Per question, what is the percentage of people that answered correctly? Per question, what were the most frequently guessed wrong answers?

Two questions on the survey were open-ended which resulted in qualitative data. For the qualitative survey data, I performed a thematic analysis on the text to identify the patterns that emerged from the responses. I executed two rounds of thematic analysis. During the first round, there were 21 themes that emerged from each of the questions. During the second round of analysis, I narrowed it down to six themes per question.

I conducted a further analysis of the data by comparing the survey results of the respondents who are currently in college, to those who are not in college. By comparing these two groups, I wanted to determine if there was a difference in their mean correct answers and their overall performance on the survey. I performed a t-test to measure the difference between these two groups.

Prototype

Based on the results of the information collected while conducting primary and secondary research, I created a prototype of a mobile application. I crafted the proposed application using a

three-part iteration and design process. Completing three iterations of the design allowed me to view the interface features from various perspectives. As the design progressed, I was able to shift the interface features and play with the design elements until I was pleased with the results. Viewing the design from different perspectives also prompted me to consider the various use cases of how people could use the application during a night out.

First, I sketched the application interface design on a whiteboard. The simple nature of the whiteboard enabled the creativity I needed to manifest the initial prototypes of the mobile application. My sketches provided a rough outline of the interface features and spurred my creative thinking process.

Second, I transferred the sketches to a Google Slides presentation as a form of wireframing. Converting the sketches to a digital form allowed me to develop a more detailed interface and explore the spacing of the design elements. Wireframing also prompted me further consider how people would interact with and navigate through the application.

Lastly, I created a polished version of the prototype using the digital design toolkit, Sketch. This version of the interface design was complete with the finishing touches and design elements of the wireframing. The colors were added, the fonts were carefully selected, and the small details were refined. The images in Figure 2 show an example of how an interface design was advanced throughout the three-part iteration and design process.

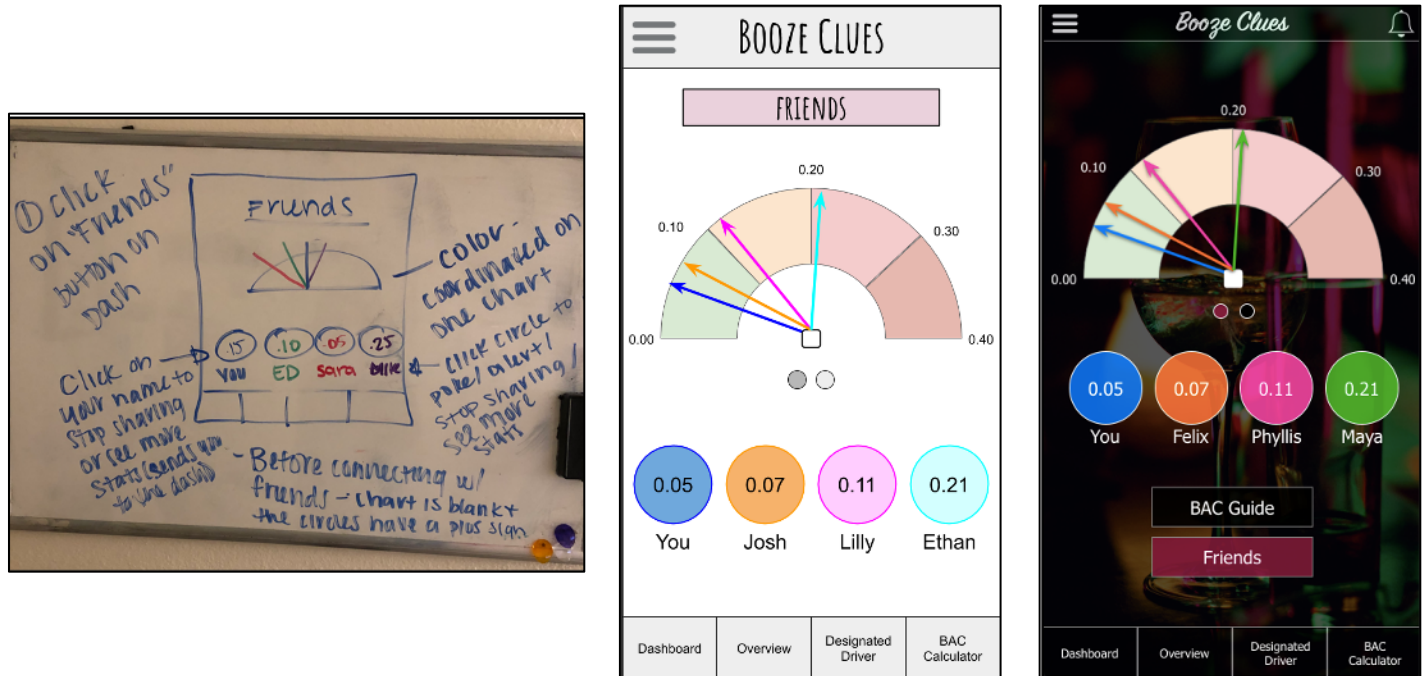


Figure 2: Three-part iteration and design of the Friends feature. Whiteboard sketch (left), wireframing (middle), and Sketch (right).

Results

Interview Themes

By conducting interviews, I wanted to gain a deep understanding of college students' current drinking behaviors. Two of the interviewees began drinking on a regular basis before starting college, two began drinking during their freshman year of college, and two waited until they were 21 years old (legal drinking age). Based on the results of my interviews, I was able to infer the six participants have differing experiences but similar motivations regarding alcohol use in college. Below I present the interviewees' initial exposures to drinking in college, their similar drinking routines, how they all avoid drunk driving, and their social motivations for drinking.

Underage Versus Legal Age Exposure to Drinking

The participants described two types of initial exposures to college drinking. For the four interviewees who were drinking during their freshman year, their first memorable experiences with alcohol in college involved drinking in the dorms with a mix of old and new friends. All four people remember drinking cheap hard liquor, and two of the participants recalled they were inexperienced with alcohol and drank too much. For the two participants who waited until they were 21 years old to drink, their first memorable experiences of drinking in college were more sensible. They recalled going to a house party and the bars on Pearl Street with their friends; and although they were not experienced with alcohol, neither participant recalled drinking too much.

Drinking Routine

After sharing their first memorable experiences, the participants were asked to describe a typical night out they have with their college friends. Interestingly, all six interviewees described similar routines and agendas for when they go out drinking with friends. The interviewees begin their night by “pregaming” with friends at someone’s house. Pregaming is when people drink before going to an event or social situation with the intention of becoming intoxicated. People usually drink heavily at a pregame so they do not have to purchase as many drinks while out, typically in an effort to save money (Mike Koutsoudakis, 2006). The participants then either go to the bars on Pearl Street or to a house party. Once there, they will have a few more drinks and socialize with friends. Two interviewees also mentioned they enjoy going dancing because the alcohol allows them to feel more carefree when they are out.

Avoiding Drunk Driving

Four of the participants’ stated their preferred mode of transportation during a night out is either walking or taking a rideshare service. One participant uses rideshare exclusively, and the

other interviewee always walks. Rarely will one of the interviewees drive after consuming alcohol because they do not want to risk the consequences of driving while intoxicated. Five of the interviewees responded they have driven after consuming alcohol, but they only had one or fewer drinks and then waited some time before driving. One participant has never driven after consuming alcohol. Despite their hesitation to drink and drive, only three interviewees knew what the legal BAC limit was in their state of residence.

Social Motivations to Drink

When asked about their motivations for drinking alcohol, all six interviewees responded with the same answer: it improves their enjoyment of social situations. The participants reported alcohol enables them to be more at ease, let their guard down, and have a good time during a night out with friends. My participants' responses were consistent with other studies which focus on the motivations for social drinking. Research has shown that alcohol allows people to be more present and less affected by their past. Another effect of alcohol is it narrows people's attentional focus, making it easier to ignore their worries and anxieties. Lastly, research has found drinking alcohol increases social bonding and positive emotions, especially in extroverts and men (Christian Jarrett, 2017).

The answers were slightly more divided when the interviewees were asked how much of their social life in college involves alcohol. Two people responded that alcohol is involved with most of their interactions with college friends. One person said the majority of their social interactions when they were under 21 years old revolved around alcohol because it was rebellious, whereas alcohol is involved about half the time now that they are of legal drinking age. Another interviewee responded that only some of their social interactions involve alcohol, while the majority of them do not. The other two participants explained they have different

friend groups for different situations. They have friends they drink with and friends they do other activities with, and they know these people almost exclusively in those contexts.

After talking to numerous people about my research project, I realized people were lacking a considerable amount of knowledge regarding blood alcohol concentration and the effects of alcohol on the body. As one of my peers said so eloquently, “I drink because I like it, not because I understand it.” I was curious to find out whether the small sample of people I discussed my project with were representative of a larger group of people. As a result, I launched a survey with the intent of finding out.

Survey Results

I created a survey with quiz-like questions to see if people were informed about BAC and the effects of alcohol. The survey was divided into four sections: basic knowledge, scenarios, definitions, and demographic information. There were eight multiple choice questions on the survey that exclusively had one correct answer. The results of the multiple-choice questions are presented below in Table 1.

Table 1: Survey questions and results. The correct answers have an asterisks ().*

	Question	Response Categories	Number of Responses
1	Which factors listed below affect your blood alcohol concentration levels? Choose all that apply.	Weight*	84
		Age*	45
		Alcohol tolerance	43
		Percentage of body fat*	69
		Emotions	15
		Race*	19
2	A person is completely sober and has not consumed alcohol in a couple of days. What is their current blood alcohol concentration level?	0.00%*	69
		0.07%	16
		0.50%	0
		3.00%	0
		15.00%	0
		100.00%	0
3	What blood alcohol concentration level will typically kill about half of all adults?	0.00%	0
		0.40%*	22
		0.80%	18
		1.00%	19

		5.00%	25
		42.00%	1
4	To drive a car in the state you currently live, what is the legal limit for blood alcohol concentration?	0.05%*	18
		0.08%*	58
		0.31%	9
		5.00%	0
		16.00%	0
5	Felix, a man of average build, went to happy hour with friends. He consumed two beers in one hour. Felix is planning to drive home right after drinking his beers. Would his blood alcohol concentration be under the legal limit to drive?	Yes*	43
		No	42
6	Phyllis, a woman of average build, was drinking at a party. Within the first hour, she had consumed three drinks. If she didn't consume any more alcohol, how long would it take Phyllis to completely sober up?	0-1 hours	1
		1-2 hours	8
		3-4 hours*	45
		5-6 hours	16
		7-8 hours	4
		8+ hours	11
7	Maya has just finished playing a drinking game when she begins to slur her speech and experience slow reaction times. What is her approximate blood alcohol concentration level?	0.05%	21
		0.15%*	36
		0.25%	15
		0.50%	10
		2.50%	3
		5.00%	0
		15.00%	0
8	Javier and his friends were drinking at the bar last night. At 11:00 PM, Javier began vomiting and experiencing feelings of disorientation. When he woke up this morning, he did not remember what had happened the night before. What was his approximate blood alcohol concentration level at 11:00 PM?	0.05%	1
		0.15%	13
		0.25%*	33
		0.50%	21
		2.50%	15
		5.00%	2
		15.00%	0

On average, the respondents answered three of the eight questions correctly, receiving a 41 percent on the survey. The distributions of the survey results are shown below in Figure 3 and Figure 4.

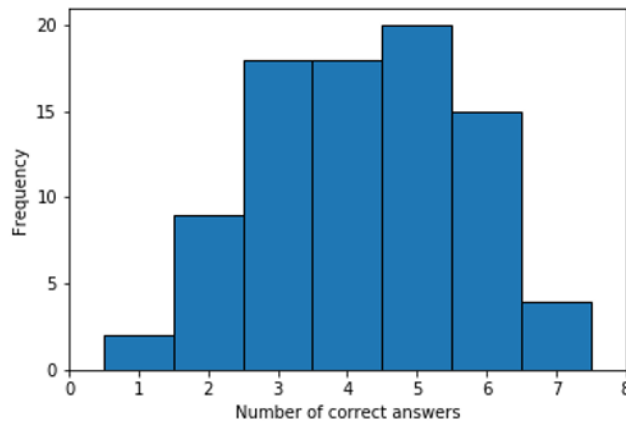


Figure 3: Distribution of the number of correct answers on the survey.

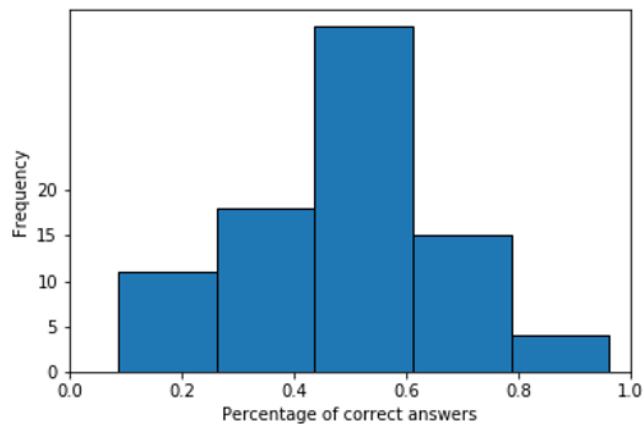


Figure 4: Distribution of the percentage of correct answers on the survey.

Of the 84 people who responded to my survey, the largest age category was 21 - 30 years old with 43 respondents, followed by 51 - 60 years old with 17 respondents. The majority of participants currently reside in Colorado (73), with the other respondents living in Arizona (4), Minnesota (3), Nebraska (2), Florida (1), and Pennsylvania (1). When asked about their gender identification, 56 respondents identified as female, 25 identified as male, and three respondents identified as non-binary or preferred not to disclose.

In a question seeking to determine how much participants know about the factors that could potentially impact a person's BAC level, only two respondents (2%) selected all of the correct answers. The correct answers were: weight, age, percentage of body fat, and race. The most commonly selected wrong answer was "alcohol tolerance," which has an impact on the perceived effects of alcohol; however, it does not affect a person's BAC.

The participants were then presented with two questions related to the BAC of an individual who was completely sober, and the legal limit to drive in the state they currently live. Sixty-nine people (82%) correctly identified 0.00% as the BAC of a person who has no alcohol in their system, and 58 respondents (69%) correctly answered that the legal limit to drive in their state is 0.08%. The legal limit is 0.08% in every state except Utah; however, none of the survey participants were currently living in Utah.

One of the most concerning outcomes of a question was when participants were asked to identify the blood alcohol concentration level that will typically kill about half of all adults. Of the 84 responses, only 22 people (26%) answered correctly with 0.40%. The most concerning aspect of this question regards the most commonly selected wrong answer, 5.00%, which 25 people (30%) selected.

The scenario section of the survey tested the participants' knowledge of BAC by presenting real-life situations. The first question was a scenario where Felix consumed two drinks within an hour, and he was planning to drive immediately after. The question was a general yes-no question that asked if Felix would be under the legal limit to drive. Of the 85 people who responded to this question, 43 respondents (51%) correctly answered yes, while 42 respondents (49%) incorrectly answered no. The second scenario involved Phyllis, who had consumed three drinks within one hour. The question was asking how long it would take for her

to completely sober up. This question was multiple choice with 45 respondents (54%) answering correctly that it would take her three to four hours, and 40 respondents (48%) incorrectly selected one of the other options.

The final two questions of the scenario section asked the respondents to estimate the person's BAC based on the symptoms they were experiencing. The first scenario described a situation where Maya was slurring her speech and experiencing slow reaction times; 36 respondents (43%) correctly estimated that her BAC was approximately 0.15%. The second scenario asked the respondents to estimate Javier's BAC when he began vomiting, experiencing an alcohol-induced blackout, and feelings of disorientation. 33 participants (39%) answered 0.25% which was the correct response.

In addition to the eight multiple choice questions that had one correct answer, there were two open-ended questions that asked the respondents to type in an answer. I did not analyze these questions in terms of there only being one correct answer; rather, I was curious to know how people interpret the terms "binge drinking" and "drinking in moderation" in their own words. For each question, six themes emerged after two rounds of thematic analysis. The themes I uncovered from the thematic analysis of both questions are presented in Table 2 and Table 3.

Table 2: Themes for the question: In your own words, define binge drinking.

	Theme	Explanation	Example	Frequency
1	More than X number of drinks	Consuming more than a specified number of drinks in one night.	"Drinking more than 5 shots in one sitting."	19
2	Drinking a lot in a short time frame	Drinking an excessive amount of alcohol within a short amount of time.	"Binge drinking is when someone drinks a lot at one time very quickly... You don't pace yourself and just go for it."	17
3	Excessive drinking	Drinking an excessive amount of alcohol without specifying a timeframe.	"Excessive drinking that leads to a consistent state of being drunk."	14
4	Uncontrollable consumption	Consuming alcohol without any regard to its harmful effects.	"Drinking with no regard to how many drinks you've consumed or what might happen the next day."	13

5	Drinking excessively over several days	Drinking an excessive amount of alcohol for several days in a row.	“Several days in a row until drunk or blacked out.”	11
6	Drinking until intoxicated	Consuming alcohol with the intent of becoming intoxicated.	“I consider binge drinking when someone is drinking to get very intoxicated or blacked out.”	7

Table 3: Themes for the question: In your own words, define drinking in moderation.

	Theme	Explanation	Example	Frequency
1	X number of drinks in one night	Consuming a specified number of drinks in one night.	“1 to 2 drinks in an evening.”	24
2	Drinking occasionally	Not consuming alcohol regularly, rather only for certain occasions.	“Having a drink or 2 every once in a while.”	17
3	Pace yourself	Drinking at a slow pace throughout the night.	“Drinking under self-control.”	14
4	Drinking but not getting drunk	Drinking without the intention of becoming intoxicated.	“Drinking small amounts for pleasure, but not enough to impact you.”	10
5	X number of drinks per week	Consuming a specified number of drinks per week.	“A couple of drinks every week, no or very little hangover. Not drinking when you have other responsibilities like work or school.”	9
6	X number of drinks X times per week	Consuming a specified number of drinks on a certain number of days each week.	“1-2 drinks per day, but only 3-4 days per week.”	7

In addition to analyzing the results of all respondents of the survey, I compared the difference in performance by people who indicated they are in college versus those who are not. The results of my comparison found a significant difference between the two groups, with college students performing significantly better than non-college students. On average, college students answered four out of the eight questions correctly, receiving an average score of 45 percent. Respondents not in college answered three out of the eight questions correctly, receiving an average of 36 percent on the survey. I performed a t-test on these two groups and found a significant difference in these means ($t(N-2) = 2.22, p = 0.03$). The effect size of this difference using Cohen’s D shows a medium effect ($r=0.49$), suggesting college students had a somewhat greater understanding of BAC than did the respondents in the older age group. The distributions of the scores are shown below in Figure 5 and Figure 6.

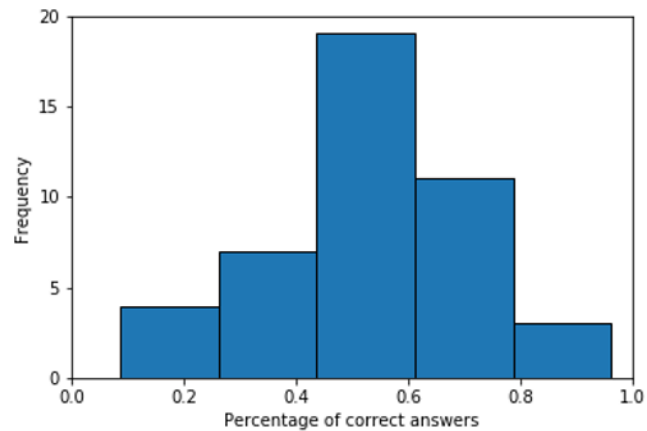


Figure 5: Distribution of the percentage of correct answers on the survey for college students.

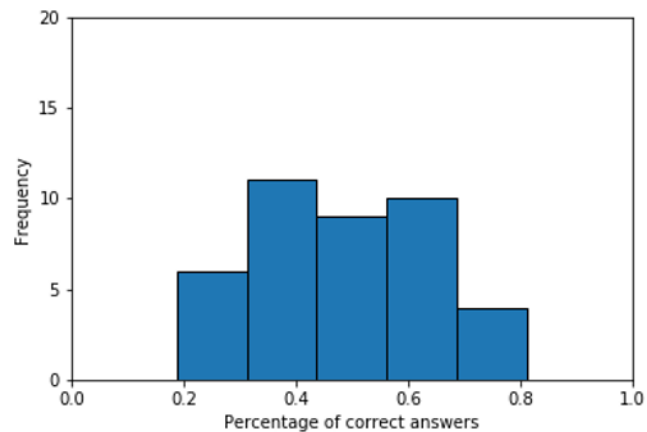


Figure 6: Distribution of the percentage of correct answers on the survey for people not in college.

Discussion

The results of my research suggest alcohol consumption is commonplace in many college students' lives, but the majority of people remain uninformed about the consequences of drinking.

College students have social interactions that do not involve alcohol; however, drinking is exceedingly prevalent in their social lives. Most people enjoy consuming alcohol because of the social aspect of drinking with friends. Alcohol helps people to loosen up, let their guard

down, and have a good time with their peers. The college social scene provides a nice juxtaposition for the hard work and energy students devote to their schoolwork.

Drinking freshman year of college is considered rebellious, which is a large part of the appeal. In tandem with this rebellion comes immaturity, leading students to practice irresponsible drinking behaviors such as drinking too much at one time. Many drinking episodes during the first few months of college occur alongside new friends who are also inexperienced with the college social scene. As a result, peer pressure is intense as students are longing to fit in and have that stereotypical college experience.

For upper classmen who are of legal drinking age, the rebellion has lessened, and most people have a better understanding of their limits with alcohol. Binge drinking is still customary with these students, but it has become a part of their weekly routine. The term “controlled binge drinking” is ironic; however, the term provides an honest description of a typical night out for the students who are of legal age to consume alcohol.

A common practice for people of all ages in college is to pregame events and social situations. Students will typically front load their drinking by consuming a lot of alcohol at the beginning of the night, and then taper off or stop drinking completely for the remainder of their night out. This method of drinking is troublesome because alcohol-induced black outs, vomiting, and alcohol poisoning commonly occur as a result of the rapid increase of BAC in a short amount of time.

One of the most reassuring findings from my research was college students rarely drive after consuming alcohol. Their preferred methods of transportation for a night out are rideshare services, such as Uber and Lyft, and walking. If they do find themselves in a situation where they have to drive after consuming alcohol, people will wait until they are confident they are sober

enough to safely drive a vehicle. It was also encouraging that most people were familiar with the legal BAC limit to drive in the United States. The hesitation to drink and drive suggests the efforts to warn people of the harmful consequences of such actions are proving to be successful.

People do not have to pass a test to prove they are smart enough to consume alcohol, although it would not be a terrible idea. The effects of alcohol on the body and blood alcohol concentration are relatively foreign concepts to many people who drink. The lack of knowledge regarding alcohol is not exclusive to college students. As evident by my research, older adults tend to know less about alcohol and its effects than people in college.

The results of my research build on the existing evidence as seen in the literature review. The college social scene is not like lab experiments that are operated under perfect conditions. No two nights of consuming alcohol are the same - especially in college. Numerous factors impact a person's BAC level and how alcohol will affect an individual at that specific time. It is difficult enough for researchers, who have dedicated their life to studying alcohol, to understand the abundance of factors that affect a person's BAC, and it is nearly impossible to predict. So why do we rely on the average college student to practice safe drinking behaviors when, as evident by my research, they hardly understand the effects of alcohol?

My research suggests the endeavors to promote responsible drinking through the current research and education efforts are failing. Heavy alcohol consumption remains synonymous to the college social scene, people continue to practice irresponsible drinking behaviors, and students remain terribly uninformed about alcohol and its effects. It is deeply concerning how uneducated people are on the basics of alcohol consumption; such as how much one standard drink affects a person's BAC level, and how many drinks the average person can consume before it becomes a serious health threat. The current research and education efforts are not having a

profound enough impact on people to truly make the difference that is needed to change the unruly drinking culture in college. In the next section I introduce Booze Clues, a prototype application to help students drink more responsibly.

Booze Clues

My goal is to encourage people to drink more responsibly by providing them with a new perspective of their current drinking behaviors and how alcohol is affecting their body. BAC monitoring wearable devices are exposing users to a new dimension of drinking by providing continuous tracking of a user's BAC to monitor their intoxication levels during a drinking session.

In order for people to adopt such technology, it needs to meet several criteria. First, it needs to accurately reflect their night out and drinking behaviors for the information to be deemed credible and relevant to the users. Second, the wearable device has to provide the user with information they do not already have, such as an accurate measurement of their BAC during a night out. Third, the product needs to be discreet and blend in with the social environment. The design of the wearable should be consistent with the look and feel of the jewelry and other clothing items being worn by the user to parties and to the bars. The device should be comfortable for the user to wear so that lack of comfort does not become a distraction to the user or a reason why they do not use the product. Fourth, the wearable device needs to be compatible with existing technologies already in use during a night out. The product should not require any additional work for the user, rather there should be a seamless integration of the product into the user's drinking routine. Finally, we live in a society where technology is ubiquitous and people are being exposed to an overwhelming amount of information each day. As a result, users demand a convenience of information in order for them to decipher between what is important

and what is not. In the following, I will explain how my product, Booze Clues, is designed to meet all of these criteria.

Booze Clues is an integration of a wearable device and mobile application. The integration of this technology into people's social lives can educate the users on the consequences of their alcohol consumption in real-time. Booze Clues will not only present the user's current BAC reading as detected by a wearable device, it will also be an educational tool to inform people about the different levels of BAC and its impact on the body and mind. I envision that Booze Clues could inform people about their current drinking practices and encourage them to adopt more responsible drinking behaviors to the same degree that fitness trackers inform users of their current habits and encourage them to adopt a healthier lifestyle.

Interviewees described their typical night out and related drinking behaviors, including their initial exposures to drinking in college, their similar drinking routines, how they all avoid drunk driving, and their social motivations for drinking. These experiences served as the use cases for my intended users. The use cases allowed me to consider how I could maximize the potential of Booze Clues to be most impactful for college students.

Similar to other types of wearable technology, Booze Clues will enable users to monitor their bodies beyond what is perceived exclusively by their senses. This advantage of wearable technology is what differentiates Booze Clues from the current educational tools that are failing to encourage college students to drink responsibly. Currently, the educational efforts attempt to intervene when people are sober and have the best intentions to drink responsibly. The promise of Booze Clues is that the continuous BAC tracking provides evidence of the users' drinking behaviors and it catches people in the act. Oftentimes, people make poor decisions when they are intoxicated. Additionally, they are not analyzing their drinking sessions to determine if they are

following the responsible drinking protocol. By allowing users to easily track their BAC in real time, Booze Clues can help people make smarter decisions even while intoxicated.

In the next sections, I describe a prototype for Booze Clues, which combines wearable technology with a mobile application. The prototype was designed using Sketch, a digital design toolkit primarily used for the user interface and user experience design of websites and mobile applications (*Sketch*, n.d.).

Wearable Device

When a person consumes alcohol, their body is able to metabolize approximately 90% of it. The remaining 10% of the alcohol is unchanged and is removed from the body through breath, perspiration, urine, and saliva. As a result of technological advancements in recent years, measuring the alcohol content in the skin's perspiration through transdermal measurement is now possible. The alcohol excreted through the skin's perspiration provides an accurate measurement of a person's blood alcohol concentration (J. Robert Zetl, 2002).

Ideally, the Booze Clues wearable device would be an interchangeable wristband on a smartwatch or fitness tracker. The wristband would be able to detect the user's BAC simply by making contact with the skin. However, a discreet product with these features is currently not found in the marketplace or in the advanced stages of research.

I evaluated numerous BAC monitoring wearable devices currently in research and development. I determined the alcohol monitoring device that would best integrate with the college drinking environment would be BACtrack Skyn (Figure 7). This device is a sleek, black alcohol biosensor that is worn on the wrist and can track transdermal alcohol content in real time (*BACtrack Skyn™—The World's 1st Wearable Alcohol Monitor*, n.d.). In 2016, BACtrack Skyn took first place in the "Wearable Alcohol Biosensor Challenge" that was hosted by the National

Institute on Alcohol Abuse and Alcoholism. The wearable device is non-invasive and has the ability to track the ethanol molecules escaping through the skin using an electrochemical sensor. It also is Bluetooth compatible and can connect to the user's smartphone (Stacey Sachs, n.d.). BACtrack Skyn is available for research use only and is not cleared or approved by the FDA.



Figure 7: BACtrack Skyn wearable device.

Mobile Application Prototype

Overall Design

When considering the overall interface design of the Booze Clues mobile application, simplicity is key. The application is intended to be used by people who are intoxicated; therefore, a simple and intuitive interface is crucial. The simplistic design of the Booze Clues mobile application compliments the convenience of the BACtrack Skyn monitoring device.

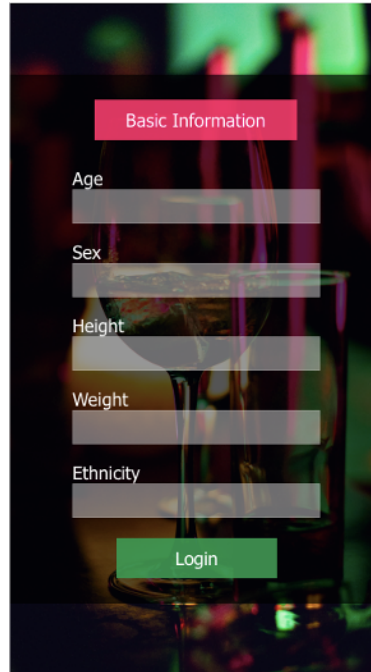
For the prototype design, I used a darker color scheme because it will allow the users to feel comfortable opening the application when they are at bars, restaurants, or parties that tend to have darker lighting. If the interface had bright colors or a white background, it may attract the attention of the people around the user which may not be desirable.

Although the darker colored interface is consistent throughout the prototype design, three interface features were purposely designed with brighter colors. The gauge graph and line chart that are present on the Dashboard and the Designated Driver pages are designed with a green to

red gradient. Below the visualizations is a box that displays the user's current BAC reading. The colors of the box mirror the colors of the gauge chart and line chart. These three interface features are purposefully designed to contrast with the darker interface design because the user would benefit from being able to quickly scan this information when they are using the application.

Basic Information

When the user purchases Booze Clues and signs up in the mobile application, they will be presented with a screen that asks them to input their basic information (Figure 8). This basic information includes the user's age, sex, height, weight, and ethnicity. Collecting information regarding all of the factors that affect a user's BAC is impossible; however, the limited information given by the user will enable Booze Clues to provide a more accurate estimation of the user's BAC. In addition, these inputs are relatively easy for the user to report and they remain fairly stable, unlike many of the other factors that affect a person's BAC. The user will be able to update their basic information at any time by clicking on "Profile" in the drop-down sidebar menu.



Basic Information

Age

Sex

Height

Weight

Ethnicity

Login

Figure 8: Basic Information feature.

Dashboard

The default screen when the user logs into the application is the Dashboard. This page will present the user with all of the information they need to know regarding their current BAC. The Dashboard is made up of several features including the gauge chart, line chart, current BAC text box, an estimated time until sober counter, and buttons to access the BAC Guide and Friends page (Figure 9).

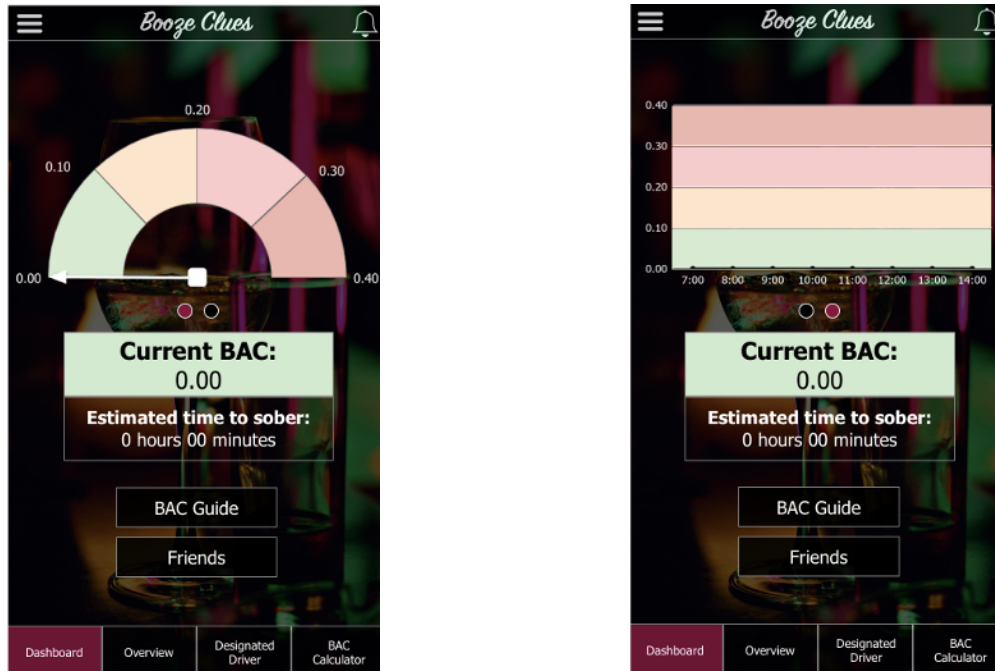


Figure 9: Dashboard feature. Gauge chart (left) and line chart (right).

The gauge chart informs the user of how their current BAC compares to the minimum BAC (0.00%) and the maximum BAC that will kill approximately half of adults (0.40%). The gauge chart is designed with a gradient of green to red, to depict the level of safety of the user's current BAC level. If the user swipes left on the gauge chart, the line chart will appear. The intent of the line chart is to show an overview of how the user's BAC has changed throughout the current drinking session. The line chart has the same color gradient as the gauge chart to maintain consistency across the screen's interface.

Below the charts, the user's current BAC reading is presented in a text box. The color of the box mirrors the color of the charts. For example, if the user's BAC was 0.12%, the arrow on the chart would be in the yellow area and the color of the box would also be yellow (Figure 10). I have the same BAC information presented in the charts and as text to provide the user with information quickly and in a convenient format.

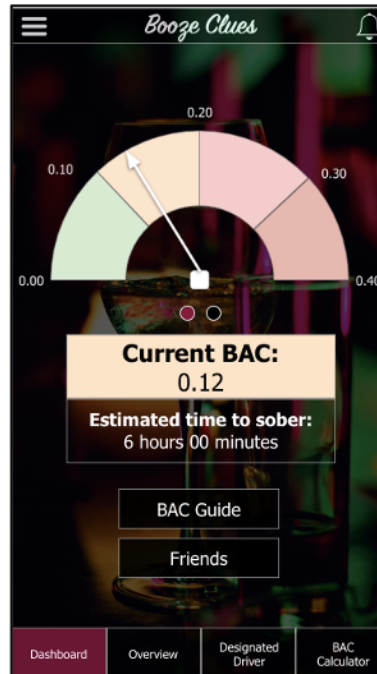


Figure 10: Dashboard feature with a 0.12% BAC.

In addition to the user's current BAC reading, the Dashboard has an Estimated Time to Sober countdown counter. This countdown is calculated by dividing the user's current BAC reading by 0.02, which is the average rate at which a person's BAC decreases per hour. The intent of this countdown counter is to encourage people to recognize how long it takes to sober up after consuming alcohol, especially in large quantities.

Finally, through the Dashboard the user can access the BAC Guide and Friends features. Both of these features will be discussed in more detail later.

Designated Driver Dashboard

Ideally, people would never drink and drive; however, that is not always the case. If the user is planning to drive after consuming alcohol, they can start a session on the Designated Driver dashboard. This dashboard is intended to provide people with the necessary information to know if their BAC level is within the legal limits to drive a car. As explained by the

Disclaimer, the information presented by Booze Clues should not take the place of the user's responsible decisions regarding their perceived intoxication and its impact on their ability to drive. I will further explain this Disclaimer in a later section.

The interface design for the Designated Driver dashboard is similar to the default Dashboard to ensure the application remains simple, familiar, and useful for people who are mentally impaired (Figure 11). However, the Designated Driver dashboard differs in three ways. The gradient used on the charts is brighter and contains more red to emphasize how serious the consequences are if people drive despite having a BAC in those red zones. Next, below the user's current BAC reading is a red text box that contains the legal limit to drive. This text is displayed in the center of the screen in a bright red box to be a constant reminder to the user that they need to remain below that BAC if they want to drive. Finally, a red indicator line was added to both the gauge chart and the line chart to clearly mark the legal limit. Similar to the default Dashboard interface, the legal limit text box and the red indicator lines present the same information in two formats to highlight its importance and to allow the convenience of information.

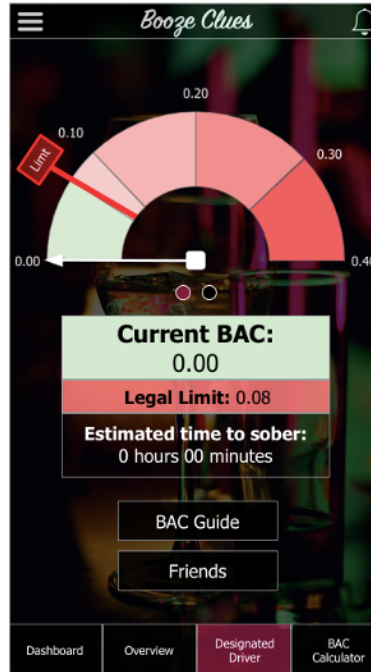


Figure 11: Designated Driver dashboard feature.

The intended use of the Designated Driver dashboard is for people to remain below the legal limit at all times during the drinking session to ensure they are safe to drive home. Regardless of the intended use, there will be times when the user's BAC exceeds the legal limit. When this occurs, the user needs to become aware that they are no longer at a safe level to drive. As a result, Booze Clues has a pop-up that appears when the user's BAC goes over the legal limit (Figure 12). The pop-up message will alert the user: *"Warning: You are over the legal limit to drive. Please use caution."* The purpose of this message is to warn the user that if they are still planning to drive home, they need to allow enough time to pass for their BAC to drop below the legal limit.

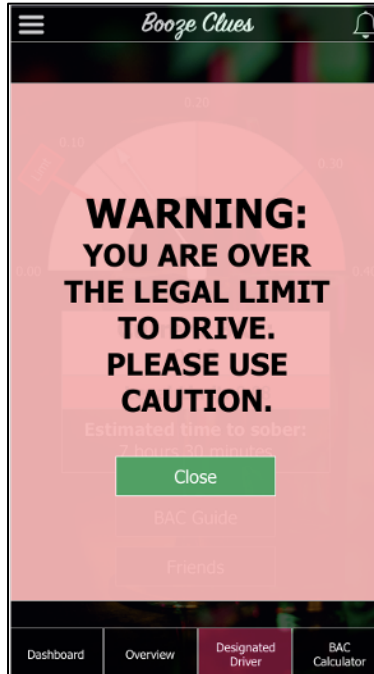


Figure 12: Designated Driver dashboard warning message.

Friends

As suggested by the results of my interviews, drinking in college is propelled by social motivations. When discussing their drinking behaviors, the interviewees mainly focused on their interactions with their friends and peers. Because of the prevalence of alcohol in the social lives of college students, I designed the Friends feature that allows them to connect with up to three friends in the Booze Clues application (Figure 13).

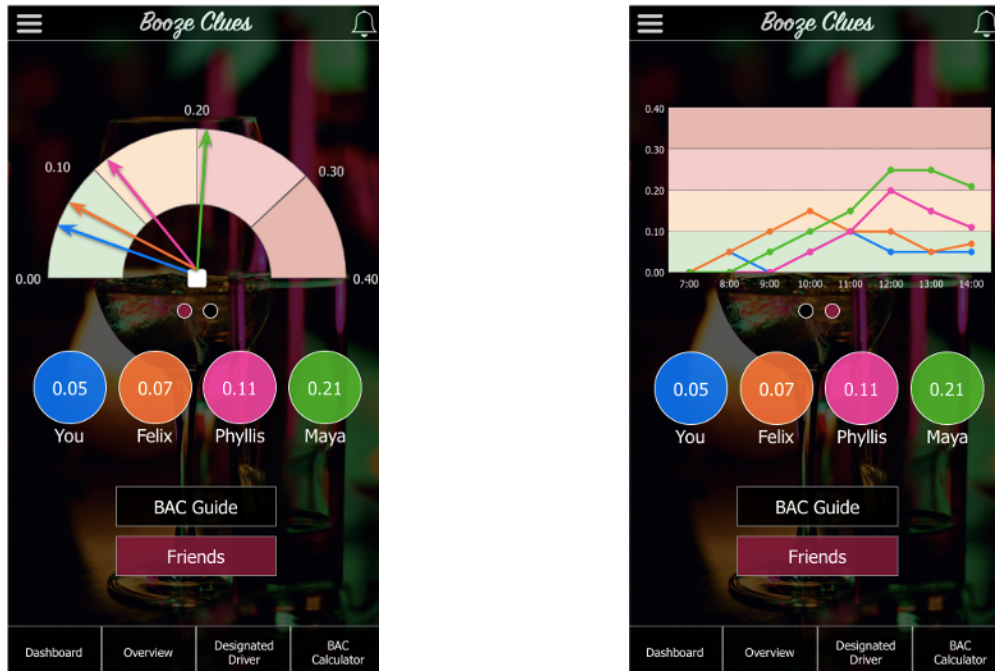


Figure 13: Friends feature. Gauge chart (left) and line chart (right).

In order to connect, the user will send an invitation via the Booze Clues application and the other user will have to accept the invite to join their Friends session. Once connected, the Friends dashboard will appear and show each of the users' BAC information on the gauge chart and line chart. Each friend is represented by a color that corresponds to a colored circle displayed below the charts. These circles also contain the friend's current BAC levels written out as text. As stated before, displaying the BAC readings in two places on the screen allows for quick and easy access to information.

The Friends feature enables people to track their friends' BAC so they can be mindful of each other's intoxication levels throughout the night. This is a powerful tool for people to have access to during a night out because it provides the user with information that cannot be accessed elsewhere. The real-time BAC reading can inform the user of their friends' current blood alcohol concentration and alert the user if these BAC levels are especially concerning or harmful.

Information presented by the line chart can inform the user on the progression of their friends' intoxication levels throughout the drinking session. If there are any spikes in the data that indicate a rapid increase in BAC, the Friends feature can also alert the user of these instances.

If users drink too much and begin to vomit or experience other symptoms related to excessive alcohol consumption, Booze Clues can inform their friends of the person's current BAC level and how their BAC has changed throughout the drinking session. Having access to this kind of information can help people to decide if they should seek medical assistance for their friend, or if those types of extraordinary measures are not necessary. Ideally, Booze Clues would help to prevent situations like this from occurring by allowing friends to monitor each other and take action before their BAC rises to these dangerous levels.

Overview

Most of the features in Booze Clues are designed to present the users with their BAC information in real-time. While this is of utmost importance, I added the Overview feature that presents a recap of the user's past drinking sessions (Figure 14). The default screen will show the user's drinking activity for the current month, but they will also be able to explore sessions from past months as well.

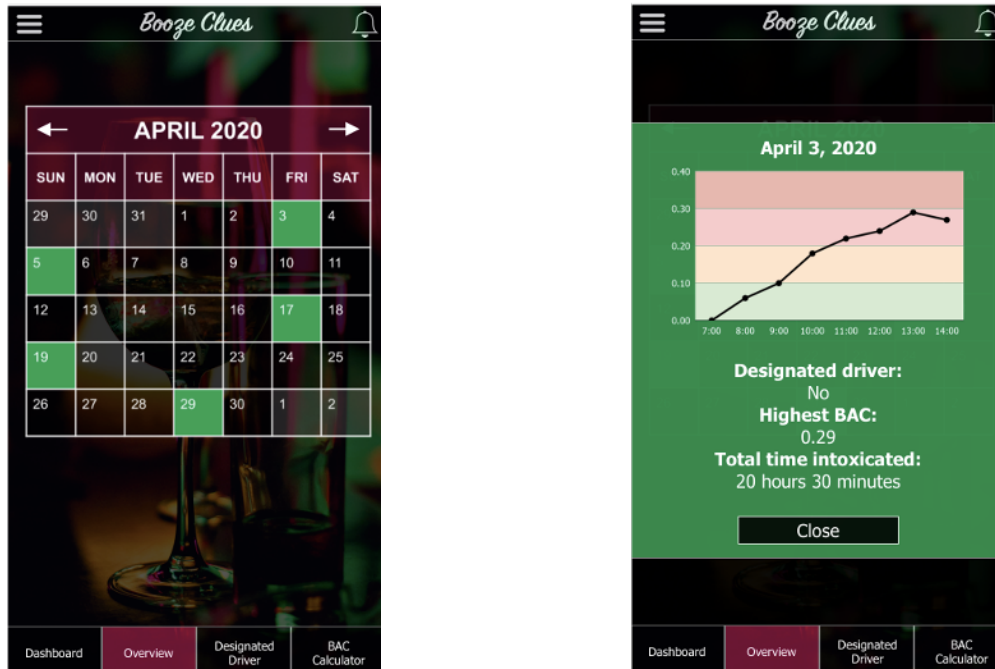


Figure 14: Overview feature monthly view (left) and daily recap (right).

The purpose of the Overview feature is to provide the user with a different perspective of their drinking behavior. Visualizing their drinking sessions over time may cause users to detect concerning drinking patterns, leading them to change their behavior. The application itself will not determine if the user has concerning drinking patterns, rather, it will simply present the user with all of the necessary information to make that determination for themselves.

When presented with the calendar view of the Overview feature, the days the user drank will be green and the others will be black. The user can click on a day to display a recap of their drinking session. The Overview recap will display a line chart showing how the user's BAC changed throughout the drinking session. In addition to the chart, the recap will show whether they had started a Designated Driver session, their highest BAC reading for the day, and the total time they were intoxicated from that drinking session.

BAC Calculator

In addition to the BAC reading provided by the wearable device, I wanted to incorporate a feature into Booze Clues that allows the user to manually calculate their BAC (Figure 15). The BAC Calculator can be used to plan out the user's drinking activities for the night before going out. It can also be used to keep the user informed of their approximate BAC if they are not using their wearable device.

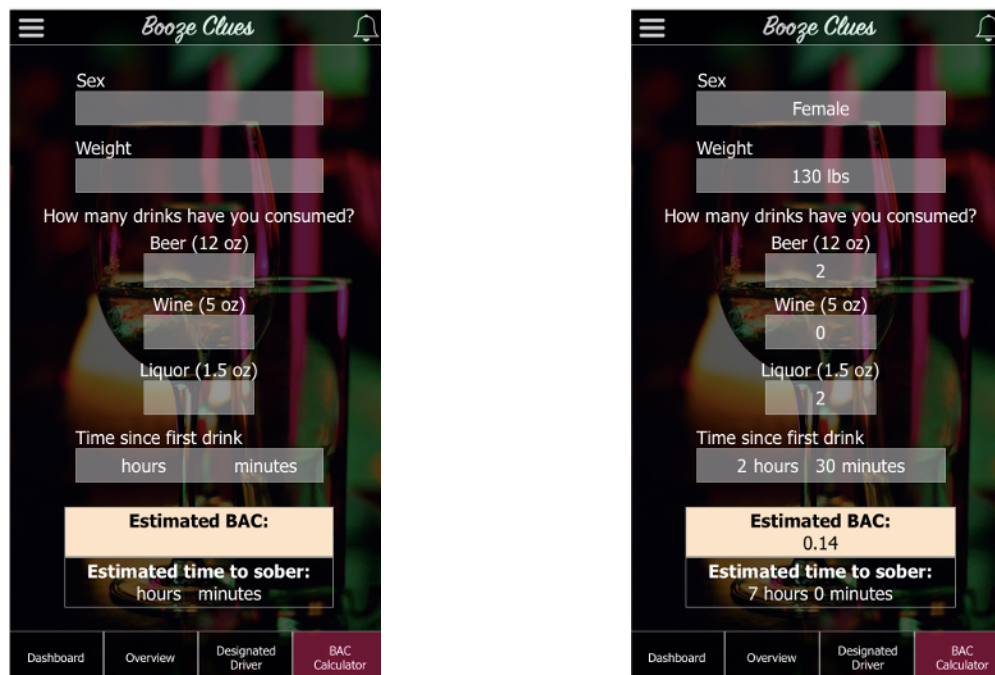


Figure 15: BAC Calculator default interface (left) and after the user adds their inputs (right).

The interface design was influenced by the BAC calculator on the Alcohol.org website (*Blood Alcohol Content (BAC) Calculator*, n.d.). The calculator requires the user to input several factors including their sex, weight, the number of standard drinks consumed, and the amount of time that has passed since their first drink. After the user enters these factors, the calculator will estimate their BAC and time until sober. Because of the numerous factors that impact a person's

BAC that the user did not input, the calculator will provide a rough estimation of the user's BAC; however, it can still be beneficial information.

BAC Guide and BAC Information

As previously mentioned, it is important for Booze Clues to serve as an educational tool to inform users about BAC and the effects of alcohol. To address the lack of knowledge as evident by my survey results, I added two interfaces to Booze Clues with the sole purpose of educating users: the BAC Guide and the BAC Information page (Figure 16).

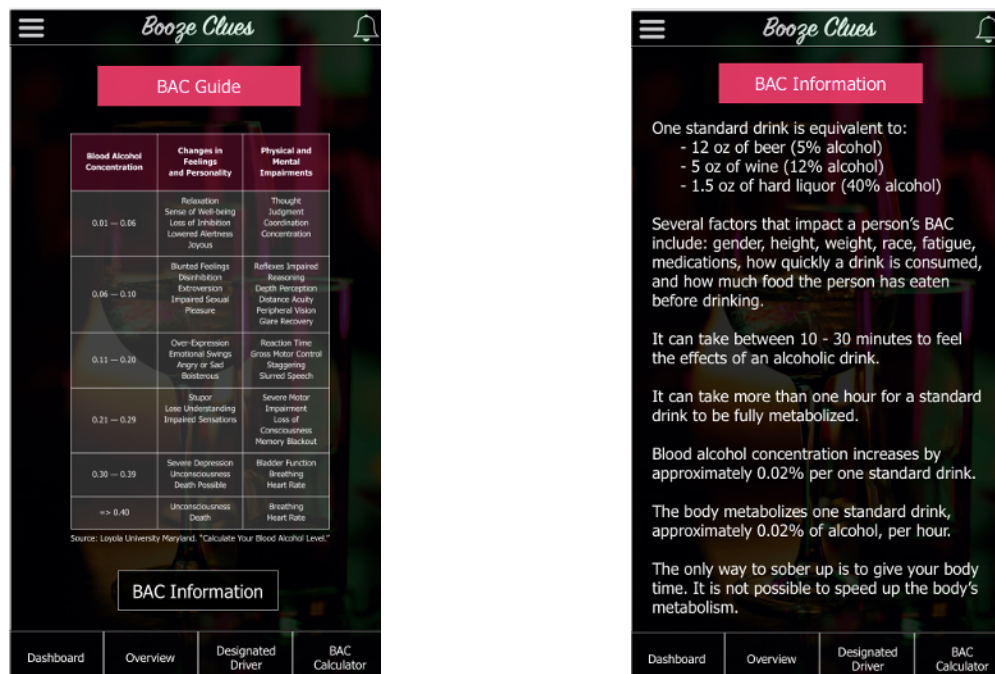


Figure 16: BAC Guide feature (left) and BAC Information page (right).

One way I incorporate an educational component into Booze Clues is by providing the BAC Guide (Table 4). I researched several guides that explained the effects of alcohol at different BAC levels. The guide that presented the necessary information in the most simple and clean format was created by the Office of Student Support and Wellness Promotion at Loyola University Maryland (*Calculate Your Blood Alcohol Level* | *Office of Student Support and*

Wellness Promotion, n.d.). The BAC Guide presents a table that lists the changes in feelings and personality, as well as the physical and mental impairments people experience at various BAC levels. This feature can be accessed from the default Dashboard, the Designated Driver dashboard, and the Friends page. It can also be accessed from the sidebar menu.

Table 4: BAC Guide table.

Blood Alcohol Concentration	Changes in Feelings and Personality	Physical and Mental Impairments
0.01 — 0.06	Relaxation Sense of Well-being Loss of Inhibition Lowered Alertness Joyous	Thought Judgment Coordination Concentration
0.06 — 0.10	Blunted Feelings Disinhibition Extroversion Impaired Sexual Pleasure	Reflexes Impaired Reasoning Depth Perception Distance Acuity Peripheral Vision Glare Recovery
0.11 — 0.20	Over-Expression Emotional Swings Angry or Sad Boisterous	Reaction Time Gross Motor Control Staggering Slurred Speech
0.21 — 0.29	Stupor Lose Understanding Impaired Sensations	Severe Motor Impairment Loss of Consciousness Memory Blackout
0.30 — 0.39	Severe Depression Unconsciousness Death Possible	Bladder Function Breathing Heart Rate
=> 0.40	Unconsciousness Death	Breathing Heart Rate

Another incorporation of education into the Booze Clues application is the BAC Information page. The BAC Information page can be accessed from the BAC Guide and from

the sidebar menu. This page equips the users with a few fast facts that people should know about BAC and the effects of alcohol. The BAC Information page reads:

- *One standard drink is equivalent to:*
 - *12 oz of beer (5% alcohol)*
 - *5 oz of wine (12% alcohol)*
 - *1.5 oz of hard liquor (40% alcohol)*
- *Several factors that impact a person's BAC include: gender, height, weight, race, fatigue, medications, how quickly a drink is consumed, and how much food the person has eaten before drinking.*
- *It can take between 10 - 30 minutes to feel the effects of an alcoholic drink.*
- *It can take more than one hour for a standard drink to be fully metabolized.*
- *Blood alcohol concentration increases by approximately 0.02% per one standard drink.*
- *The body metabolizes one standard drink, approximately 0.02% of alcohol, per hour.*
- *The only way to sober up is to give your body time. It is not possible to speed up the body's metabolism.*

Disclaimer

One of the most important features of the Booze Clues application is the Disclaimer message. The Disclaimer addresses any liabilities Booze Clues may be responsible for, and ensures the users are aware of their own liabilities when using the application and wearable device. The Booze Clues Disclaimer message was inspired by the disclaimer messages present on the webpages for The Virtual Bar (*Virtual Bar and BAC Calculator*, n.d.) and the BAC Calculator on Alcohol.org (*Blood Alcohol Content (BAC) Calculator*, n.d.). The Disclaimer message reads:

Booze Clues is intended to be an educational tool to help adults of legal drinking age practice responsible drinking behaviors. It is not a scientific tool for measuring the precise blood alcohol concentration (BAC) of users.

Booze Clues is able to provide an estimation of the user's BAC based on limited information given by the user. The BAC readings presented are not 100% accurate because the effects of alcohol are dependent on many variables. Several factors that impact a person's intoxication level include: gender, height, weight, race, fatigue, medications, how quickly a drink is consumed, and how much food the person has eaten before drinking.

It can take between 10-30 minutes to feel the effects of an alcoholic drink. However, it can take more than an hour for the alcoholic drink to be fully metabolized. The information presented by Booze Clues should not take the place of the user's responsible decisions about drinking alcohol.

The intent of the Booze Clues application is to provide the user with BAC information that is reliable and accurate. I have limited control over what the user does with the information I present; it is up to the user themselves to take the information provided by Booze Clues and make responsible informed decisions. If the user does not use the application as it was intended and finds themselves in an undesirable position, whatever that may be, the Disclaimer message will clear Booze Clues of any responsibilities.

After logging into the Booze Clues application, the Disclaimer pop-up will appear (Figure 17). In order for the window to close, the user has to select the "Agree" button to consent to the information presented in the Disclaimer message. This message will appear each time the

user logs into Booze Clues to remind them they are ultimately responsible for their own actions while using the application.

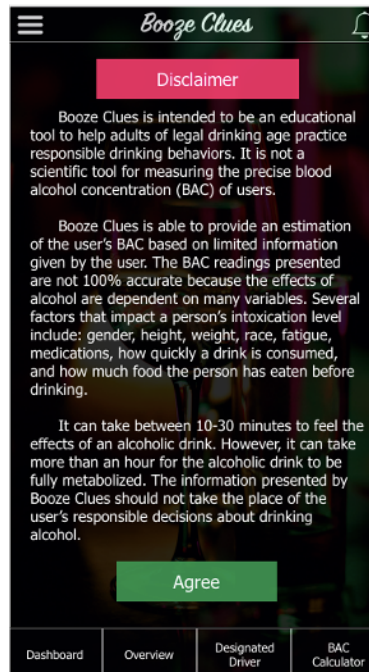


Figure 17: Disclaimer message.

Booze Clues Creative Brief

As evident by the results of the primary and secondary research, there is a high demand for an intervention tool that could promote responsible drinking behaviors for college students. Currently, college students are being educated on the consequences of consuming alcohol and how to practice safe drinking behaviors, but these efforts are being proven unsuccessful. As learned from these failed efforts, simply telling people to practice responsible drinking behaviors because it is the “right” thing to do is not enough; instead, it is crucial for wearable technology to show them and manifest its importance.

Ultimately, the Booze Clues wearable device and mobile application has the potential to be that desired facilitator for responsible drinking. By presenting a visual aid to show the effects

of alcohol on the body and the consequences of their current actions, the user will likely develop safer drinking practices.

It is important to consider the ethical role of advertisers and technologists with respect to influencing behavior in society. As technologists of BAC monitoring devices, our role is to provide users with a new dimension of information that will enable them to make responsible decisions regarding their alcohol use. Technologists are not able to control the actions of the users, especially when they are intoxicated. However, through targeted messaging that intervenes in real-time, Booze Clues can effectively influence the users to change their drinking behaviors. As advertisers, our role in influencing behavior in society is similar to the role of technologists. Advertisers cannot force people to buy certain products and use them. Rather, advertisers use targeted and strategic messaging to deliver information to the right consumer, at the right place, at the right time. In other words, Booze Clues has to reach college students on a platform they frequently use and pay attention to; and make enough of an impression to influence the person to purchase the products and integrate them into their night out.

Nevertheless, as the “Father of Advertising” David Ogilvy said, “In the modern world of business, it is useless to be a creative, original thinker unless you can also sell what you create.” A number of activities need to be considered and aligned in order for a product to be marketed successfully. I will be focusing on the advertising component of marketing, and more specifically, the strategic advertising of the Booze Clues products.

Will Burns, CEO and Creative Director of virtual-idea company, Ideasicle, referred to the creative brief as the “most sacred of sacred ad documents.” The creative brief serves as the foundation of a creative campaign. It translates the ideas and vision of the client into a simple document that can be referred to throughout the duration of the campaign. The brief also supplies

the creatives with everything they need to know to design an original, innovative campaign that is unique to the client and their specific needs.

The creative brief for the Booze Clues wearable device and mobile application is presented on the following pages. The creative brief addresses the main questions that need to be answered for an advertising campaign to be successful - why are we advertising, who are we advertising to, and why should they believe us. In practice, this brief would be presented to the creative team at an advertising agency who would then create the vision for the Booze Clues campaign.

Booze Clues

CREATIVE BRIEF

WHY ARE WE ADVERTISING?

Booze Clues is a new wearable device and mobile application. The integration of the products into the college social scene is intended to promote responsible drinking behaviors. They want to emphasize the benefits of wearing a blood alcohol concentration monitoring device as the user is consuming alcohol throughout the night.

WHO ARE WE TALKING TO?

Our target audience is David and Sarah who are juniors at the University of Colorado Boulder. They started drinking at the beginning of their freshmen year and are affiliated with Greek Life at CU. Drinking is a huge part of their college experience, and most of their social life revolves around consuming alcohol with friends. David and Sarah can usually be found going out to the bars on Pearl Street. They also enjoy going to house parties, happy hours, sporting events, and having game nights with friends. On average, they consume alcohol three times per week, and binge drink two of those times. Typically after a night out, Sarah and David will Uber home; however, they will occasionally drive if they feel they are sober enough to do so.

WHAT DO PEOPLE CURRENTLY THINK?

"Drinking with my friends and going out is one of my favorite things to do in college. Binge drinking is a big part of the college experience, especially Greek Life. All of my friends usually drink a lot when we go out, so I tend to drink a lot too. I have been drinking for a couple of years now, so I have a pretty good grasp as to what my limits are. However, a couple times per month, I get out of control and end up drinking too much. Nonetheless, I am young and usually bounce back quickly the next day so I can do it all over again."

WHAT WOULD WE LIKE THEM TO THINK?

"Tracking my blood alcohol concentration levels is not a concept that I have thought about before; however, I would be curious to see the effects of the alcohol on my body. I usually drink a lot during a night out, and I tend to feel pretty drunk, but it would be interesting to see how intoxicated I really am. Booze Clues would be really helpful for the nights when I plan on driving after I have a few drinks, so I could know for sure that I am under the legal limit and am not at risk for a DUI."

Booze Clues

CREATIVE BRIEF

WHAT IS THE SINGLE MOST IMPORTANT IDEA?

Booze Clues will provide an objective blood alcohol concentration reading to a person's otherwise subjective feelings of intoxication.

WHY SHOULD THEY BELIEVE IT?

- According to the 2018 National Survey on Drug Use and Health, full-time college students between the ages of 18 and 22 years old are more likely to drink than their peers who do not attend college. The survey found that in the past month, 55% of college students have consumed alcohol, 37% have engaged in binge drinking, and 10% have reportedly experienced heavy alcohol use. (National Institute on Alcohol Abuse and Alcoholism)
- In 2018, the highest percentage of drunk drivers were between the ages of 21 to 24 years old. That same year, 10,511 people were killed in car accidents involving drunk drivers, accounting for approximately one-third of all traffic crash fatalities in the United States. (National Highway Traffic Safety Administration)
- Blood alcohol concentration is one of the most accurate indicators of the level of impairment an individual is experiencing due to alcohol. (Meldon Law)

WHAT IS THE BRAND'S PERSONALITY?

Booze Clues is like the shoulder angel of wearable devices. It is the angel on your left that represents your conscience; while the intoxicated version of yourself is full of temptations and is represented by the devil on your right. Your angel is someone who always has your back and their goal is to try and keep you out of trouble, even when you are not looking out for yourself. Ultimately, you have the ability to make your own decisions, but your angel will provide you with all of the information and guidance that is necessary to make the right decisions.

WHAT ARE THE MANDATORIES?

- "Booze Clues"
- Logo
- Image of the wearable device and/or the mobile application

Conclusion

The purpose of my project was to understand how technology could be integrated into the college social scene to encourage people to drink responsibly. Shortcomings of the extensive research on alcohol consumption and BAC monitoring devices are that it is not practical or aligned with college students' typical drinking practices. The studies are often conducted in a highly controlled setting where the researchers have complete authority. They control what the participants eat, what alcohol they consume, and the proceeding of events. Not surprisingly, the college social scene does not resemble these controlled studies. A typical night out involves inconsistent drinking, varying food consumption, and frequent movement.

Binge drinking and college have become synonymous over the years, despite the efforts of parents and college administration to promote safe drinking practices. Several individual-level intervention efforts implemented by parents and college administrators for students at a higher-risk for drinking, such as Greek life, first-year students, and student athletes. Environmental-level strategies are also implemented to change the campus and surrounding community to reduce the availability of alcohol to the students.

My research suggests the current endeavors to promote responsible drinking through the research and education efforts are failing. Heavy alcohol consumption remains synonymous to the college social scene, students continue to practice irresponsible drinking behaviors, and people remain terribly uninformed about alcohol and its effects.

The current educational efforts attempt to intervene when people are sober and have the best intentions to drink responsibly. The promise of Booze Clues is that continuous BAC tracking can catch people in the act. The integration of this technology into people's social lives can educate the users on the consequences of their alcohol consumption in real-time. Booze

Clues will not only present the user's current BAC reading as detected by a wearable device; it will also be an educational tool to inform people about the different levels of BAC and its impact on the body and mind.

There were several limitations to my study that should be addressed. The interviews and surveys were conducted with a small sample size. The participants were also recruited from a convenience sample of people in my majors in addition to my friends and family. Additionally, the interviewees and many of the survey participants were associated with the University of Colorado Boulder. From this limited sample, I attempted to generalize the relationship these people have with alcohol and their drinking behaviors to all college students. It was difficult to generalize these behaviors because each university's student body has its own relationship with alcohol. The University of Colorado also has a reputation for being a party school which has an impact on my generalization. Lastly, due to time-restrictions and the limitations of the 2020 COVID-19 pandemic lockdown, I was unable to recruit people to evaluate the interface and user experience design of Booze Clues.

Future research would include widening the scope of the project to other colleges to gain a deeper understanding of the drinking behaviors and the relationship with alcohol students have at various universities. It would be interesting to compare alcohol's presence in the social lives of students at large universities versus smaller colleges, in college towns versus non-college towns, and at party schools versus non-party schools. Future research would also include developing the Booze Clues mobile application and wearable device. Once developed, Booze Clues could be tested by students at various colleges to assess its impact on their drinking behaviors. The ultimate test for Booze Clues would be a three-way comparison of the drinking behaviors of people who just used Booze Clues, people who were only exposed to the current educational

efforts for how to drink responsibly, and people that had exposure to both. I would be curious to determine if there was a difference between the drinking behaviors of the three groups and which method results in the most responsible drinking practices.

It is time for college administrators and researchers who are in charge of educating students on safe drinking practices to reevaluate their efforts. BAC wearable technology needs to be integrated into the college social scene to show, firsthand, the effects of alcohol on the body. Designed for the college social scene, Booze Clues is the new way to encourage students to practice responsible drinking behaviors.

Works Cited

- Alcohol Facts and Statistics*. (2019, April 25). National Institute on Alcohol Abuse and Alcoholism (NIAAA). <https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/alcohol-facts-and-statistics>
- Alcohol Observer*. (n.d.). Cassandra Daily. Retrieved March 19, 2020, from <https://cassandra.co/tech/2019/02/07/alcohol-observer>
- BACtrack Skyn™—The World's 1st Wearable Alcohol Monitor*. (n.d.). BACtrack Skyn. Retrieved March 14, 2020, from <https://skyn.bactrack.com/>
- Bae, S., Ferreira, D., Suffoletto, B., Puyana, J. C., Kurtz, R., Chung, T., & Dey, A. K. (2017). Detecting Drinking Episodes in Young Adults Using Smartphone-based Sensors. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.*, 1(2), 5:1–5:36. <https://doi.org/10.1145/3090051>
- Baldwin, J. A. (2014). *Wearable Blood Alcohol Measuring Device* (United States Patent No. US20140365142A1). <https://patents.google.com/patent/US20140365142/en>

Blood Alcohol Content (BAC) Calculator. (n.d.). Alcohol.Org. Retrieved March 17, 2020, from <https://www.alcohol.org/bac-calculator/>

Blood Alcohol Content (BAC) Levels: Side Effects, Risks. (n.d.). Alcohol.Org. Retrieved October 30, 2019, from <https://www.alcohol.org/effects/blood-alcohol-concentration/>

Brooks, O. (2008). Consuming Alcohol in Bars, Pubs and Clubs: A risky freedom for young women? *Annals of Leisure Research*, 11(3–4), 331–350.
<https://doi.org/10.1080/11745398.2008.9686801>

Calculate Your Blood Alcohol Level | Office of Student Support and Wellness Promotion. (n.d.). Loyola University Maryland. Retrieved February 27, 2020, from <https://www.loyola.edu/department/sswp/students/calculate>

Carol Galbicsek. (2019, July 24). *College Alcoholism and Binge Drinking.* Alcohol Rehab Guide. <https://www.alcoholrehabguide.org/resources/college-alcohol-abuse/>

Christian Jarrett. (2017, March 10). 5 Studies That Help Explain Why Social Drinking Is So Rewarding [The British Psychological Society]. *Research Digest.*
<https://digest.bps.org.uk/2017/03/10/five-studies-that-help-explain-why-social-drinking-is-so-rewarding/>

College Binge Drinking Statistics. (n.d.). Responsibility.Org. Retrieved November 26, 2019, from <https://www.responsibility.org/college-binge-drinking-statistics/>

College Drinking Fact Sheet. (n.d.). Retrieved January 6, 2020, from <https://www.collegedrinkingprevention.gov/NIAAACollegeMaterials/FactSheets/college-drinkingfactsheet.aspx>

Comparing State DUI Laws. (n.d.). Findlaw. Retrieved January 10, 2020, from <https://dui.findlaw.com/dui-laws-resources/comparing-state-dui-laws.html>

Content: Biological Factors Influence Alcohol Intoxication – The Alcohol Pharmacology

Education Partnership. (n.d.). Retrieved October 29, 2019, from

<https://sites.duke.edu/apep/module-2-the-abcs-of-intoxication/content-biological-factors-influence-alcohol-intoxication/>

Drunk Driving. (2016, October 4). [Text]. NHTSA. <https://www.nhtsa.gov/risky-driving/drunk-driving>

Fall Semester—A Time for Parents To Discuss the Risks of College Drinking. (2019, April 25).

National Institute on Alcohol Abuse and Alcoholism (NIAAA).

<https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/time-for-parents-discuss-risks-college-drinking>

Griswold, M. G., Fullman, N., Hawley, C., Arian, N., Zimsen, S. R. M., Tymeson, H. D.,

Venkateswaran, V., Tapp, A. D., Forouzanfar, M. H., Salama, J. S., Abate, K. H., Abate,

D., Abay, S. M., Abbafati, C., Abdulkader, R. S., Abebe, Z., Aboyans, V., Abrar, M. M.,

Acharya, P., ... Gakidou, E. (2018). Alcohol use and burden for 195 countries and

territories, 1990–2016: A systematic analysis for the Global Burden of Disease Study

2016. *The Lancet*, 392(10152), 1015–1035. [https://doi.org/10.1016/S0140-](https://doi.org/10.1016/S0140-6736(18)31310-2)

[6736\(18\)31310-2](https://doi.org/10.1016/S0140-6736(18)31310-2)

Hayes, W. (1995). *Old Enough to Know Better.*

<https://open.spotify.com/track/4DWRy8uwyNcRcISJxwyiEY?si=xv2FpP7rSKuRzPTg>

WTxzdg

How Do BAC Alcohol Monitoring Tests Work? (n.d.). Alcohol.Org. Retrieved October 22, 2019,

from <https://www.alcohol.org/alcoholism/bac-monitoring-test/>

It Takes Time to Sober Up | University Health Service. (n.d.). Retrieved November 26, 2019,
from <https://uhs.umich.edu/time-to-sober-up>

J. Robert Zetl. (2002). *The Determination of Blood Alcohol Concentration by Transdermal Measurement*.

Kanny, D., Naimi, T. S., Liu, Y., Lu, H., & Brewer, R. D. (2018). Annual Total Binge Drinks Consumed by U.S. Adults, 2015. *American Journal of Preventive Medicine*, 54(4), 486–496. <https://doi.org/10.1016/j.amepre.2017.12.021>

Lee, L. L.-Y., Ren, J., & Tjondronegoro, D. (2012). Mobile Social Tool for Supporting Responsible Drinking in Young Women. *Proceedings of the 10th International Conference on Advances in Mobile Computing & Multimedia*, 9–12.
<https://doi.org/10.1145/2428955.2428964>

Matsui, H., Hashizume, T., & Yatani, K. (2018). AI-light: An Alcohol-Sensing Smart Ice Cube. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.*, 2(3), 126:1–126:20.
<https://doi.org/10.1145/3264936>

Mike Koutsoudakis. (2006, November 2). *Pre-gaming: A college pastime under attack*. The GW Hatchet. <https://www.webcitation.org/6B20hPyu9>

Misachi, J. (2017, August 1). *How Long Have Humans Been Drinking Alcohol?* WorldAtlas.
<https://www.worldatlas.com/articles/how-long-have-humans-been-drinking-alcohol.html>

Myths About Sobering Up. (2011, July 7). *Educational News & Tips - EDUInreview.Com Blog*.
<https://www.eduinreview.com/blog/2011/07/myths-about-sobering-up/>

Northcote, J., & Livingston, M. (2011). Accuracy of Self-Reported Drinking: Observational Verification of ‘Last Occasion’ Drink Estimates of Young Adults. *Alcohol and Alcoholism*, 46(6), 709–713. <https://doi.org/10.1093/alcalc/agr138>

- Poppinga, B., Fortmann, J., Müller, H., Heuten, W., & Boll, S. (2014). IllumiMug: Revealing Imperceptible Characteristics of Drinks. *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational*, 923–926.
<https://doi.org/10.1145/2639189.2670241>
- Sketch | *The Digital Design Toolkit*. (n.d.). Sketch. Retrieved March 19, 2020, from <https://www.sketch.com/>
- Stacey Sachs. (n.d.). *BACtrack® Wins “Wearable Alcohol Biosensor Challenge” Issued through National Institutes of Health (NIH)*. BACtrack. Retrieved March 14, 2020, from <https://www.bactrack.com/blogs/press-releases/117630917-bactrack-wins-wearable-alcohol-biosensor-challenge-issued-through-national-institutes-of-health-nih>
- Virtual Bar and BAC Calculator*. (n.d.). Responsibility.Org. Retrieved September 25, 2019, from <https://www.responsibility.org/drink-responsibly/virtual-bar-and-BAC-calculator/>
- Wang, W.-F., Yang, C.-Y., & Wu, Y.-F. (2018). SVM-based classification method to identify alcohol consumption using ECG and PPG monitoring. *Personal and Ubiquitous Computing*, 22(2), 275–287. <https://doi.org/10.1007/s00779-017-1042-0>
- Weaver, E. R., Horyniak, D. R., Jenkinson, R., Dietze, P., & Lim, M. S. (2013). “Let’s get Wasted!” and Other Apps: Characteristics, Acceptability, and Use of Alcohol-Related Smartphone Applications. *JMIR MHealth and UHealth*, 1(1), e9.
<https://doi.org/10.2196/mhealth.2709>
- What Are the Dangers of Binge Drinking & Alcohol Blackout?* (n.d.). Alcohol.Org. Retrieved October 30, 2019, from <https://www.alcohol.org/effects/dangers-of-blackouts/>
- What Is BAC and Why Is It Important? (2016, October 11). *Meldon Law*.
<https://www.meldonlaw.com/blog/what-is-bac-and-why-is-it-important/>

White, A. M., Signer, M. L., Kraus, C. L., & Swartzwelder, H. S. (2004). Experiential Aspects of Alcohol-Induced Blackouts Among College Students. *The American Journal of Drug and Alcohol Abuse*, 30(1), 205–224. <https://doi.org/10.1081/ADA-120029874>

Appendix

Interview Questions

Basic Introductory Information

1. What academic year are you?
2. At what age did you have your first drink?
3. At what age did you begin drinking on a regular basis?
4. On average, how many drinks do you consume during a night out?
5. On average, how many times do you drink per week?
6. Do you prefer hard alcohol or beer/wine?
7. What is your go-to drink during a night out?

General Alcohol-Related Questions

8. Have you ever had your blood alcohol content tested? If so, what was that like?
9. What motivates you to consume alcohol? (why do you drink?)
10. Can you explain what binge drinking is?
11. Can you explain what drinking in moderation is?

Drinking in College

12. How much of your social life in college involves alcohol?
13. Could you walk me through one of the first memorable experiences you had with alcohol in college?

14. Could you walk me through a typical night out you have with your college friends?

Drinking and Driving

15. What is your go-to mode of transportation on a night out?

16. How often are you the designated driver?

17. How often do you drive after consuming alcohol?

18. How do you determine if you are sober enough to drive after consuming alcohol?

BAC Technology:

19. Can you explain what your blood alcohol content is?

20. Do you know what the BAC reading is when you are completely sober?

21. Do you know the legal BAC level to drive?

22. Do you know what BAC level becomes deadly for the average person?

23. Would you be interested in wearing a device that could monitor your intoxication levels during a night out?

Survey Questions

How Much Do You Know About Blood Alcohol Concentration?

Hi! I am an undergraduate student at CU Boulder working on completing my honors thesis. I am researching how technology can be integrated into a night out to promote responsible drinking for college students.

Although the project is targeted towards college students between 18-23 years old, people under 18 years old and over 23 years old are welcome to participate in the survey.

This survey contains questions related to blood alcohol concentration. The goal of the survey is to assess how much people know about blood alcohol concentration because I am genuinely curious. Many of the people who fill out this survey will not know the correct answers to these

questions. Please try not to use Google or outside help while completing the survey. The answers will be revealed at the end of the survey.

Your participation is voluntary. You can stop taking the survey at any time. The survey will take about 5-10 minutes to complete.

This survey is anonymous. While I will collect demographic information, no names or other identifiers will be collected. By agreeing to take the survey, you are agreeing to give consent to participate in the study.

If you have any questions related to this survey or the research, contact Hannah.L.Weber@colorado.edu.

Thank you for your time.

Basic Questions

To begin, the survey will start with a few questions to assess your basic understanding of blood alcohol concentration.

Q1 Which factors listed below affect your blood alcohol concentration levels? Choose all that apply.

- Weight
- Age
- Alcohol tolerance
- Percentage of body fat
- Emotions

- Race

Q2 A person is completely sober and has not consumed alcohol in a couple of days. What is their current blood alcohol concentration level?

- 0.00%
- 0.07%
- 0.50%
- 3.00%
- 15.00%
- 100.00%

Q3 What blood alcohol concentration level will typically kill about half of all adults?

- 0.00%
- 0.40%
- 0.80%
- 1.00%
- 5.00%
- 42.00%

Q4 To drive a car in the state you currently live, what is the legal limit for blood alcohol concentration?

- 0.05%
- 0.08%
- 0.31%
- 5.00%
- 16.00%

Scenarios

Next, there is a series of questions related to evaluating the level of intoxication of the people in the given scenarios.

Q5 Felix, a man of average build, went to happy hour with friends. He consumed two beers in one hour. Felix is planning to drive home right after drinking his beers. Would his blood alcohol concentration be under the legal limit to drive?

- Yes
- No

Q6 Phyllis, a woman of average build, was drinking at a party. Within the first hour, she had consumed three drinks. If she didn't consume any more alcohol, how long would it take Phyllis to completely sober up?

- 0-1 hours
- 1-2 hours
- 3-4 hours
- 5-6 hours
- 7-8 hours
- 8+ hours

Q7 Maya has just finished playing a drinking game when she begins to slur her speech and experience slow reaction times. What is her approximate blood alcohol concentration level?

- 0.05%
- 0.15%

- 0.25%
- 0.50%
- 2.50%
- 5.00%
- 15.00%

Q8 Javier and his friends were drinking at the bar last night. At 11:00 PM, Javier began vomiting and experiencing feelings of disorientation. When he woke up this morning, he did not remember what had happened the night before. What was his approximate blood alcohol concentration level at 11:00 PM?

- 0.05%
- 0.15%
- 0.25%
- 0.50%
- 2.50%
- 5.00%
- 15.00%

Definitions

To conclude this section of the survey, we are curious to know how you define these two terms.

Q9 In your own words, define binge drinking.

- Short answer

Q10 In your own words, define drinking in moderation.

- Short answer

Demographic Information

Finally, I want to learn a little bit more about you.

Q11 Are you currently a college student?

- Yes
- No

Q12 How old are you?

- Under 21
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- Over 70
- Prefer not to answer

Q13 What gender do you identify as?

- Male
- Female
- Non-binary/ third gender
- Prefer to self-describe
- Prefer not to answer

Q14 What state are you currently living in?

- Short answer

Q15 On average, how many times per week do you consume alcohol?

- I never drink
- 0 - 1
- 2 - 3
- 4 - 5
- 6 - 7

Q16 On average, how many drinks do you consume during one drinking session?

- 0
- 1-2
- 3-4
- 5-6
- 7-8
- 8+

Thank you for completing the survey. Go to the next page to see the correct answers.