Team BAC to the Future

Final Write-Up

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Abstract (Overview of the Group Project):

It is no secret that people of all ages tend to drink a bit more than they should from time to time. Sometimes, this can lead to bad decisions, injuries or drunk driving, but often, when going out with friends a designated driver is selected. Most people try to estimate their blood alcohol levels by counting the drinks they have had or basing it off of their physical or mental state, yet these methods are inexact. There are many devices out there that can help people gain a more specific idea of what their blood alcohol levels are, but these devices are often intrusive and difficult to use. We would like to take blood alcohol level information and create a seamless socially-acceptable integration of it into people's lives to promote responsibility when drinking. We would like to design a ubiquitous application focused on helping people monitor their consumption of alcohol by tracking blood alcohol levels.

While our design is not intended to encouraging drinking, we believe it can help people understand and monitor their drinking levels more efficiently. Incorporating ubicomp technology into people's night out can shape the way our society perceives drinking, especially in college. This application could help shift perceptions around drinking by making it more of a norm for people to monitor their alcohol consumption and drink responsibly. Optimistically, this shift could contain a ripple effect of lowering the amount of binge drinking and drunk driving that occurs.

Other questions and constraints we are keeping in mind are: How will it measure a user's BAC? Who has liability if things go wrong? How do we prevent users from turning our application into a drinking game? How will people adopt it? Where will we integrate the technology first? Can we make it subtle while also showing people how helpful it can be?

Lit Review:

Through our review of previous literature, we were able to find three main categories of work that were applicable to our project: the impacts of drinking, social factors, and technology. Within the first category, we found research reviewing advances in the epidemiology of alcohol's role in health and illness, the treatment of alcohol use disorders in a public health perspective, and policy research. The second category, social factors, focused on women and safety while at bars. These articles were a great addition to our research as it kept us in check as we proceed forward with this research to ensure that the differentiating factors that females must focus on were included within our iterations and prototypes. We also reviewed literature that focused on the bartender/server intervention as a way to prevent alcohol-impaired driving. It listed strategies designed to alter the drinking environment, which helped us stay wary of the environment in which we prototyped.

In previous studies, most of the approaches did not orient their approach to the individual. The second article explored alcoholism, addiction and the statistics of people seeking treatment using low-fidelity apps and technology. It also discusses how app-based help is more effective due to social pressure and social aspects.

A different technology we researched was wearables. BACtrack Skyn, the Buzz Bracelet, and the Biosensor Patch were all marketed wearables that could determine a person's alcohol consumption while being compatible with a digital app and/or the Apple Watch. This quick reading for users is an important aspect of our design, as we attempted to design a technology that worked quickly in an already fast-paced environment. A second paper focused on using ECG and PPG heart monitoring to predict BAC where the researchers found that PPG is a convenient option as it is non-invasive.

However, a lot of the literature we found was either heavily focused on the actual technologies or the social implications of those technologies. Our research focused on a middle ground between these two aspects. Ideally using the social aspects to influence the technical design decisions that we make.

Anticipated audience:

Our audience includes anyone who drinks, but specifically, our group will be exploring how our BAC monitoring device can be integrated into college students and those less familiar with drinking alcohol. Anyone who drinks, whether casually or regularly will be able to benefit from having quantifiable blood alcohol level information easily available to them. We anticipate that this will be especially useful to designated drivers to make them aware of how much they can drink before they can no longer drive. This device would also be useful for people who want to drink but make sure that they are remaining within healthy levels and pacing themselves. Our device could also be used with bartenders/servers, as they could monitor and keep track of customers, cutting them off if they have had too much, and as a reward, could offer members discounts. Our goal is not to make these people quit drinking, but rather make them more aware of how they are consuming alcohol and ensure that they are doing so responsibly with the help of quantifiable data.

Ethnographic fieldwork process:

For our ethnographic fieldwork process, we observed people who were out drinking, conducted formal interviews, engaged in casual conversations, and looked at the physical layout of bars and restaurants. This fieldwork allowed us to gain a variety of opinions from a diverse set of people each possessing different relationships with drinking. While we were at the various drinking locations we examined the layout of each place and brainstormed how our product would perform in that specific environment. For the formal interviews, the conversation included topics such as their current drinking habits, how they believed a BAC monitoring device would work its way into their current behaviors, if they had any ideas or hesitations about our project, and then presented various liability hypotheticals. We also were able to reach out to freshmen in dorms who are underage and a bartender.

Overall, our findings fell into three different themes: privacy, social repercussions, and habits. Some people brought up concerns about other people knowing their blood alcohol levels and their state of drunkenness. Because BAC is an exact number, it tended to concern people most when other people gained access into their drinking habits, whether it be with friends, or the bartender. While privacy is a concern, there are always situations where privacy may take the back seat. In our fieldwork, we found that people were often fine with someone's BAC being

disclosed if they were in danger, either from alcohol poisoning or if they were in an unwanted sexual encounter.

Along with the privacy factor of BAC levels, there are often social repercussions when information that is not usually available all of a sudden becomes available. Based on our fieldwork, we were worried that if friends had access to each other's BAC levels, it could turn into a drinking competition. Because of a culture that encourages drinking as much as possible, using a system or device that helps one monitor their drinking habits could be seen negatively by a person's friends. Many people said that they were much more likely to use a device that had this functionality if it remained discreet where they could self-regulate.

Design Constraints:

Our fieldwork uncovered many design constraints that we had not originally considered during our brainstorming. The main constraints that we learned as a result to talking to potential users were need for discreteness, accuracy, compensation for lack of engagement, and integration with existing devices like smartphones. Discreetness became an important constraint after multiple participants mentioned the social implications of tracking their BAC. Many of them reported the judgement that might be passed by others because they were tracking their drinking habits.

As with many BAC measuring systems, accuracy is key. Because blood alcohol is measured on the order of fractions of a percent, there is not much room for error. There has been research into predicting BAC based on sweat and heart rate, but the accuracy of these can be disputed. Before settling on a method, we would need to do extensive testing to ground truth our readings and ensure accuracy.

For similar reasons to the discreteness design constraint, encouraging use of the design will be a challenge. Since most people drink without the intention of keeping track of how much alcohol they drink, it will be difficult to encourage people to start tracking their drinking habits. However, our original idea of incentivizing use with discounts on alcohol is not ideal. This could quickly turn into a bad-habit forming design that would not be received well. So, we focused on finding other ways to encourage use.

Requiring people to invest significant amounts of money for a separate device that tracks their BAC levels is a hard sell, so integration with other devices is key. Many people already own devices that would be very capable of displaying BAC levels in a way that meets our other design constraints. This would drive costs down and make it an easier sell for most people while also making our design and evaluation process easier. By evaluating on familiar screens, it makes the concept easier to grasp for most and better represents the inconspicuousness that these screens afford.

Design Evaluation

For our design evaluation we presented our final presentation at the Information Science Showcase and received good, constructive feedback from the INFO faculty as well as our peers. There were a lot of people who were excited about our product and could see how it would benefit their lives if they were to integrate it into their nights out. Typically people who are the designated driver (DD) try to gauge their blood alcohol level based on a subjective measurement

of how they think they feel physically and mentally, but there is always a level of uncertainty present with this type of estimation. A common feedback we received was that people saw how the device could be beneficial if they were the DD because it would provide them with a concrete measurement of their intoxication level.

During our evaluation process, many people had questions concerning how the BAC device would be incorporated into the bartending station and how the bartender would be able to interpret the readings they receive. We think that if a user does not want the bartender to have access to their BAC readings then they don't have to scan in when they order their drink. We considered adding an opt in or opt out button for the bartender accessing the user's information, however, we ultimately decided it was not necessary to include. Another concern that was brought up was, at what point does the bartender know to cut off someone who is using our BAC device? After discussing this concern amongst our group, we decided that it is not the bartender's job to babysit the user and we do not want our device to add an extra burden to their already chaotic job. Rather, we would like our device to be utilized as an assistive tool for the bartender to be able to quickly verify that the user remains in a safe range of intoxication. The last piece of feedback we received concerning the bartenders were, why would the bartenders take time out of their already busy work shift to worry about the BAC levels of their customers? After an interview we had with a current bartender, as well as a group discussion, we feel that having some sort of bonus included (money-wise) with the use of the app would give the bartenders a bit more incentive to use it. Although the use of the application would be a straightforward process, the incentive would allow the bartenders to make a bit more money while making sure no one is going over their limits for the night.

Finally, the most popular question we got during our design evaluation was about the science behind the blood alcohol tracking device. There are devices that are in the research development stage now that we discovered during our literary research that are able to measure a person's BAC levels through non-invasive methods including analyzing a user's sweat and heart rate. In order to maximize the discreteness of our application and device, we want to utilize this technology type of technology.

Designs:

Situational Interactions

(*Pseudo Names used)

For a part of the sketches, we wanted to explore what we call the middle ground, the bartender. The bartender's role can be very crucial for individuals or groups, however, after interviewing a bartender, Joe*, it was prevalent that they are busy and do not have time to babysit every single one of their customers. With that in mind, we attempted to find a way to seamlessly incorporate the customer's individualized tolerances via an app. When a customer comes up to order a drink or food, they can scan their phone (while opening a tab as well). Every time the bartender enters in a drink that has been ordered, the drinks get added onto the user's app, which can then begin pre-calculating their tolerance levels.

The first scenario shows a user being above or below the BAC level. Joe mentioned that while they do not want to stop a customer's drinking- as that would be crossing boundaries- it would be nice to know when a person may just need some more food in their system. By having a user's phone hooked up, every time they want a drink, a popup could show up showing their

current tolerance and whether or not they are safe to have a drink. Bartenders have the right to not serve someone. For example, if someone became extremely inebriated, then they have the right to serve them food but not a drink. If you rationalize it and lay it out in a logical sense people are usually are understanding. Having a quantitative number could help rationalize it for some people.

The second scenario shows the incentives we can use to help encourage people to drink and get home responsibly. Joe brought up the point that most people drink to forget their issues so while we can notify them of their current state of mind, that would not necessarily make people want to use the app/device. Therefore, he suggested we offer our members incentives for being a member, such as free appetizers or discounted Ubers and Lyfts. Offering free or discounted drinks would be counter-intuitive to our app.

The final scenario shows the buddy system. Joe said that he observed the middle of the night being an ideal time for using this app to get home as that is when most people are still able to make logical decisions. By syncing phones and grouping together, he thought it would be a nice way for him as a bartender to notify a buddy if someone else in their group is not doing well. Because they are working pretty quickly, they do not have time to watch over a person, but having a notification so they could notify someone would be helpful.

Fitbit/Apple Watch Integration

Of the people that we interviewed that would most likely be using this on their smartwatch or Fitbit-like device, most of them said that they would prefer their friends not know that they used an app to track their drinking habits. Therefore, discreetness became a priority when designing the tracking software on these devices. On an Apple Watch implementation, discreetness actually becomes fairly easy, as one's BAC level could be added as a "complication" to almost any watch face. As long as the user knows that the complication represents BAC level, there is no need to have any icon or textual indication that the complication is indeed depicting someone's BAC level.

Also, since the screens on Apple Watches, Fitbits, etc. are fairly small, they already have a small inherent privacy aspect. It is much harder for someone to read over one's shoulder when the screen is small and pointed directly at one's face. This works in our favor in this case. On a FitBit, there is typically even less screen real estate to work with than an Apple Watch, so one can look at their BAC stats by simply tapping through the other stats (steps, exercise time, heart rate) that are already displayed on the Fitbit. To indicate that it's a person's BAC level they are looking at, a small martini glass icon would be used as it's a fairly universal icon used to indicate alcohol. There would also be a screen that would indicate how many drinks they have had and if they are above or below their average drinking rate for the evening. It would also be simple for one to figure out whether or not they are too impaired to drive using a simple steering wheel icon with a cross through it.

While it is easy to lump Apple Watches and Fitbits into one design category, the devices actually pose significantly different design challenges. For example, it would be possible to represent BAC level on an Apple Watch using colors, but not on the Fitbit since many Fitbit models have monochrome displays. The Apple Watch also has the ability to run full apps

whereas the Fitbit is highly reliant on the phone. On a Fitbit, there is much less screen real estate to work with as well with only space for a small icon and a few characters of text.

Mobile Application

Based on the interviews and research that we conducted in our preliminary stages we were able to craft up multiple lo-fi prototypes of the BAC mobile application. It was important for us to integrate the BAC device into a pre existing technology and so we decided on a mobile app. Once the device is connected to the user's Apple Watch of Fitbit via Bluetooth, they would be able to pull up the BAC app and view their data. To maintain the discreetness of the device, we want the app to be easy-to-use and feature all of the important data from the home screen. This would be done through the use of a gauge that would visually show the user their level of intoxication and place them in one of three ranges - sober, safe drunk, and dangerous. Underneath this gauge would be your BAC presented as a number, providing another means to quickly view your BAC levels.

Something that kept coming up in interviews and discussions within our team was the issue of liability. If something were to go awry and a user was arrested for a DUI while using our product, who would be responsible? It also came to our attention that a significant design problem that needs to be addressed is the lag time between alcohol consumption and absorption into the bloodstream. To combat these liability concerns we found it important to include a liability warning on the home page of our app that addresses any liabilities, product warnings, potential problems that may occur, a margin of error, and any other inaccuracies that may arise. This information would be accessible by just clicking the liability button on the home screen.

One user group we continuously referred to in our prior stages of research were the designated drivers for the night. We feel like our device would be beneficial for these people because ideally, the DD would not drink that night. However, if they were to drink it is crucial that they do so responsibly and in moderation. To ensure that these people do not overindulge, we wanted to include a DD option for our app. This would adjust the display so that it would still show the gauge but the labels would change to - sober/ legal, can not drive, and dangerous. There would be a bright red line on the gauge at 0.08% which is the DUI level in Colorado which would serve as a visual warning for what the person needs to stay under to safely drive. If at any point the device senses a BAC level of above 0.08 there would be a popup that appears which would warn the user that they are no longer able to drive. Once it is detected that the user has sobered up enough to be under the legal limit, another popup will appear to alert them of this. We understand that this feature of the app has an additional level of liability added on to it because we would not be able to measure the cognitive level of intoxication, only the BAC levels. It was also brought to our attention during the critique that a police officer can still arrest you for a DUI or DWI if your BAC is below 0.08% and they believe that you are too impaired to drive. These two things will need to be taken into further consideration during our next stages of design.

Finally, we thought it would be useful to have a manual entry option for alcoholic beverages consumed to help the user pace themselves throughout the night. This feature would allow a user to input what type of drink they consumed, how much, and at what time they drank it. The app would then be able to calculate an estimated remaining number of drinks that could be consumed over a certain amount of time to help the user drink responsibly. Over time, this

could be used to predict one's BAC level more accurately as a person used the device so that they are able to learn their personal limits.

Next Steps

Although we were able to design and receive feedback on this design, there is still a lot of research that would need to be done to make this technically and ethically feasible. While there is a possibility that heart rate could be used to calculate BAC, this method has only been tested on medical-grade equipment with much higher accuracies than consumer-grade heart monitors. There would need to be extensive research done in the feasibility of using consumer heart monitors for this purpose in the context of accuracy, battery use, and alcohol metabolization lag time. It is also possible to measure BAC levels using sweat, but this would require another device outside of an existing smartwatch or fitness tracker. Again, research would be needed to see if this technology is feasible on a small, inconspicuous scale as our design constraints demand. This would also pose a challenge to potential users, who would likely have to pay a significant amount of money to get a device with this tech.

A further ethics study would need to be conducted in terms of insurance purposes and law enforcement. Consuming alcohol is done at one's risk, and toying with it too much can be harmful. Ethics has been at the heart of this research since the beginning as we constantly cross-checked our design choices to ensure we were designing an assistive tool, not an end-all tool. Regardless, it would be important to discuss with other demographics what the implications could be of a faulty or inaccurate app.

High Fidelity Prototypes (all of them can be found at the below Google Drive link):

https://drive.google.com/drive/folders/16i07jjigLSEtJjEsNt5FFVRM9STFt038?usp=sharing

Mobile App Prototype: https://pr.to/Q6OYDC/ (PDF attached if site does not work)
Bartender Prototype: Attached as separate file
Apple Watch Prototype: Attached as separate file