

Virtual Alcohol Use Disorder Therapy: a PACT Analysis and Two Focus Groups

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ABSTRACT

In this paper, a PACT (people, activities, contexts, and technologies) analysis for alcohol use disorder (AUD) therapy in virtual reality (VR) is provided. Based on this analysis, a gamified VR-based AUD therapy application is developed which consists of three mini-games and employs Approach Avoidance Training (AAT) and Cue-exposure Therapy (CET) methods in the context of a virtual supermarket. This application and its evaluation by clinical experts and AUD patients during two focus groups will be presented as well.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; • **Applied computing** → **Consumer health**.

KEYWORDS

PACT analysis, virtual reality therapy, alcohol use disorder, approach avoidance training, cue exposure therapy.

1 INTRODUCTION

Alcohol use disorder (AUD) is characterized by compulsive use of alcohol despite knowing its harmful physiological and psychiatric consequences [4, 5]. In Germany, AUD is diagnosed as the most common subcategory of the mental

and behavioral disorders among adults [6]. In 2015, over 100.000 men and 36.000 women were diagnosed with AUD. The highest rates for risky alcohol consumption were among 55-64 and 18-24 years old men and 45-54 years old women. Underage drinking is also quite common. In 2015, acute intoxication was reported for both males and females under 18 with the highest rate reported for 15-17 years old males. However, only about 17% of AUD patients in Germany seek therapy. The biggest obstacles for starting therapy are the lack of awareness of the problem, shame, and the desire to solve the problem alone. In the end, only 2-4% of the patients complete a rehabilitation program [6]. Therefore, it is important to not only increase the awareness about this problem but also improve the current therapy methods.

Different cognitive behavioral therapy (CBT) methods can be used to treat AUD. Cue-exposure Therapy (CET) is one of these methods in which patients are confronted with certain stimuli which trigger their craving for alcohol. The goal of CET is to let the patients learn to control their approaching behavior towards these stimuli [7]. Another CBT method is Approach Avoidance Training (AAT) by which the patients learn to avoid alcohol by repeatedly performing avoidance behaviors towards alcohol. For example, in an explicit AAT, patients use a joystick to push the images of alcoholic beverages on a computer screen away and pull the images of non-alcoholic beverages towards themselves [10].

Implementation of these CBT methods in virtual reality (VR) can offer additional advantages such as increasing accessibility as well as intrinsic motivation through gamification [9]. Furthermore, in order to create an optimal user experience for such applications, it is essential to understand the user groups and the way they interact with the system [3].

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Therefore analyzing the people, activities, contexts, and technologies (PACT) beforehand can help understand the needs and elicit requirements.

This article presents a PACT analysis for AUD therapy in VR. In addition, a gamified VR-based AUD therapy application will be briefly presented. In the end, the outcomes of two focus groups with clinical experts and AUD patients will be explained.

2 PACT ANALYSIS

The PACT analysis framework considers the contexts in which people use different technologies to perform activities [8]. Therefore, it can help understand the users' needs and elicit requirements prior to the implementation of a gamified AUD therapy application in VR. In consultation with the clinical experts at the University Hospital Hamburg-Eppendorf, CET and AAT methods were chosen to be employed in the application, since these methods are widely used in therapy sessions. Moreover, we decided to realize the application in a virtual supermarket as supermarkets are relapse-risky environments. Based on this concept, a PACT Analysis was done which is presented in this section.

People

The user group of a VR-based AUD therapy application is rather heterogeneous as AUD patients can have different demographic characteristics, levels of addiction, and motivation for seeking treatment. Nevertheless, they might have some aspects in common. For example, their behavior might be more impulsive and alcohol-driven [4]. Also, the level of attention when alcohol is in sight, might be lower. Because of the impulsive behavior, short term rewards will be preferred over long term rewards [4]. Not only alcohol is perceived as rewarding, but so is money [2]. Furthermore, alcohol consumption alters the brain structure in a way that impedes behavioral control, encouraging more alcohol consumption and neurodegeneration (death of neurons) [4]. Therefore, not only does alcohol destroy brain cells, but also inhibits neurogenesis (creation of new neurons) [4], resulting in a smaller brain size in AUD-patients [4]. Moreover, if they pursue a therapy for their AUD, we might be able to assume that they have a higher motivation to fight their addiction and change their behavior. Of a VR-based AUD therapeutic application, they might be a frequent user for a certain amount of time. In the beginning of a therapy program in a rehab facility, they might use it on a daily-basis. Once discharged, the frequency of usage is up to their condition. Most likely they would not have the freedom of choosing a therapeutic application from a range of various systems, since the treatment plan is decided on by the therapists.

Activities

The main features used to characterize activities are the temporal aspects, whether the system is used cooperatively or alone, how complex the interaction is, the displayed content itself, and if it's safety critical. The temporal aspects cover the frequency of usage, the time pressure and whether it's used continuously or interrupted frequently [3]. The objective of the application is to support the user in learning to avoid alcohol in a shopping context to reduce the risk of a relapse. The application is rather complex, as it employs two therapeutic methods namely AAT and CET. It consists of serial tasks but one main objective. Each time the user interacts with the entire application, the story will be played continuously through from start to end. In the beginning of a therapy, the application will be used on a daily basis and later on less frequently. The length of the game can vary depending on the speed of the user. The application is used individually and not cooperatively, but it could be interesting and motivating to see the scores or achievements of other users in the rehab center in a ranked table, which is not possible due to the General Data Protection Regulation. The displayed content is a supermarket environment consisting of various products, shelves, shopping carts etc. It is important to let users personalize the application with their favorite drink.

Contexts

According to Dey and Abowd [1], any information describing a situation is context. This includes the users of an application, where the interaction takes place and the application itself. For the purpose of a PACT analysis, this can be divided into different factors: the physical environment, the social context, the organizational context. In the beginning of a therapy, users are at a rehab facility, where they interact with the application in a room which is equipped with VR systems. Due to the cost factors, it is safe to assume that the physical space for each user within that room will be limited. Multiple users can interact with the application simultaneously, as long as each user has a separate computer and VR head-mounted display (HMD). The group is most likely supervised by a therapist. After being discharged, the users can continue interacting with the system at home once the required technology is installed.

Technologies

Input and output possibilities, communication and content support vary in technologies, resulting in different user experiences. To create a user experience that is as immersive as possible, the application should be implemented as a VR application. The data input is through motion: The user moves in the virtual environment by actual movement and can

interact with objects by moving arms and then pressing buttons on the controllers. A suitable hardware for instance is the HTC Vive. In this VR application 3D models are needed. These models should be as realistic as possible, so that the application feels realistic and triggers craving in the patients. Various different 3D Models are needed, ranging from bottles of alcohol to shelves. Additionally, a supermarket background noise can be helpful to strengthen the feeling of presence. A HMD with ear- or headphones is needed. The application can be started by patients themselves or their therapist.

3 GAMIFIED ALCOHOL USE DISORDER THERAPY IN VR

We developed a VR-based AUD therapy game which is realized in a supermarket. The context of a supermarket can cause a high risk of relapse since the AUD patients have to visit it on a regular basis in their everyday life and encounter exposed alcoholic beverages in the supermarket shelves. The situation might get more difficult if the supermarket has special offers on their favorite kind of alcoholic beverages. Therefore, patients need to be prepared for this scenario.

The game consists of three different mini-games based on CET and AAT therapy methods. The story of the game goes as earning virtual money by sorting alcoholic beverages during the first two games: placing the alcoholic beverages into a trash bin and the non-alcoholic beverages in a shopping cart (AAT, Figure 1(a)) and placing alcoholic beverages from a crate into a shelf (CET, Figure 1(b)). The user is then allowed to buy the items on a shopping list with the earned money by playing the third mini-game (Shopping, Figure 1(c)).

4 FOCUS GROUPS WITH PATIENTS AND CLINICAL EXPERTS

Members of different clinics attended the focus group meeting: The Universtiy Hospital Hamburg-Eppendorf, the Rehab Hospital Hansenbarg, and the Clinic Bremen-Ost. In the meeting, each participant tried the three VR mini-games. They generally liked the AAT and Shopping mini-games best. During the discussions for a potential clinical study design, a preference towards the AAT mini-game emerged, since it is highly comparable with the 2D implementation of the AAT and therefore the effect of VR and gamification can be validly analyzed. Prior to discussing further changes, it was decided that the Rehab Hospital will conduct the clinical study with their AUD patients. They would install four VR spaces, where a randomly selected group of patients will use the gamified VR AAT instead of the 2D AAT.

It was further discussed that even though the AAT game itself is fun and motivating, the gamification elements might distract from the alcohol. First, there should be more visual

cues. These visual cues should be real and actual advertisements that the patients are confronted with in reality. It is sufficient if these cues were static - meaning that they would not need to be customizable to fit the patient's alcohol preference. There should be three different advertisements: one for beer which will appeal to the beer addicts, one for vodka which will appeal to the addicts of strong alcohol, and one for sparkling wine which will also appeal to the wine drinkers. These advertisements should always be clearly visible.

In addition to the visual cues, there should be auditory cues in the game. It is not unusual to hear the current offers of the supermarket through speakers. The auditory cues integrate well into the supermarket environment while (hopefully) also increasing the focus on alcohol. To make it less predictable and more realistic, the offers should not only be about alcohol, but also about other products. This way the patients do not learn that as soon as they hear a voice, there will be an alcoholic cue.

Furthermore, it was discussed that it is important to ask participants about their current craving. This should be done at the very beginning and end and three times in between. This way, the craving development can be understood better. The question should be displayed and answered in VR, so that the patient does not have to take the HMD off and can stay immersed and focused. Typically, the craving inquiry consists of a single visual analog scale with the question: *How strongly would you like to drink alcohol?* Patients can set their current craving using a slider, where at the one end the answer is *Not at all* and on the other *The most I've ever wanted*. This data needs to be logged and saved. Some minor changes were also requested. For instance, the trash bin should look more like a traditional trash bin and more negatively. In addition to the earnings, the number of completes and errors should also be displayed.

In a second step, the VR AAT was tried out by two AUD patients from the University Hospital Hamburg-Eppendorf, who agreed to participate in the focus group. Several therapists were also present to support the patients in case of need. Upon arrival, the patients were first introduced to the topic and the overall objective. They were instructed to immediately abort the experiment if they felt unwell either due to cyber sickness, craving, or any other reason. Then they tried the game for approximately 5 minutes and gave their feedback afterwards.

Initially, the first patient tried the AAT game with beer, which was not his favorite alcohol. This way, he could first try it out more safely. He found the game easy to use and was performing rather well. However, he did not quite feel as if he were in a supermarket. Even though the atmosphere was there when looking around, the interactable shelf was not realistic enough, because it is highly unlikely to have a shelf in a well-organized supermarket that has randomly

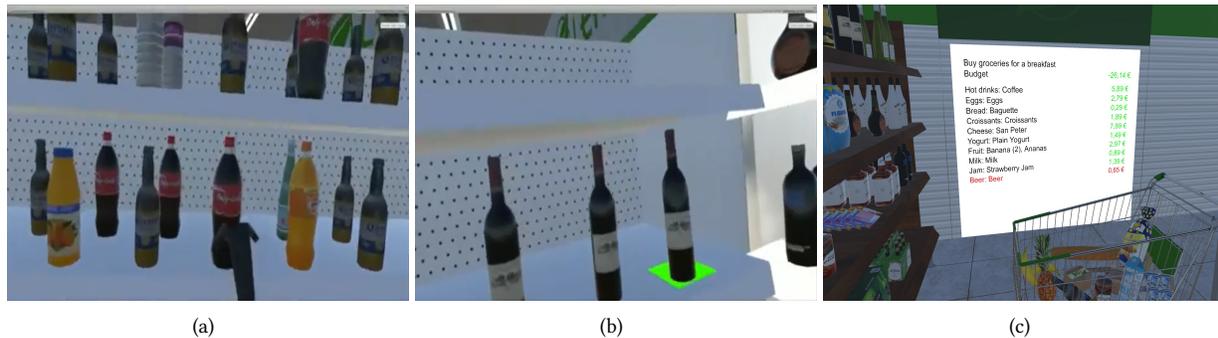


Figure 1: Three mini-games of the VR AUD therapy: (a) AAT: placing the alcoholic beverages into a trash bin and the non-alcoholic beverages in a shopping cart. (b) CET: placing alcoholic beverages from a crate into a shelf. (c) Shopping: buy the items on a shopping list with the earned money.

positioned different kinds of beverages in one shelf. He felt that it might be also more realistic if the supermarket and alcohol section were a little more squished. While placing the alcohol bottles into the trash bin, he noticed it would be more realistic if the trash bin included metal lattice and if there was a rattling sound. When he tried the game with his favorite alcohol (Vodka), he immediately felt his craving for alcohol arousing.

The second patient was physically more fit and was directly playing the game with her favorite alcohol. Her favorite alcohol did not induce craving, but she mentioned that this would have been different in the beginning of her therapy. She really enjoyed the game and being able to throw the alcohol away. She emphasized that this has been a liberating feeling. She, too, found the game easy to use and thought that the supermarket was realistic, but far too clean. She used to buy her alcohol at discounters, where there was more dirt on the floor and different objects standing in the way. Also, she would have preferred cans over bottles, since she had mostly bought her favorite alcohol in cans. She did not notice right from the beginning that she had earned money and did not really pay attention to the time. It was discussed that it could have been more noticeable if the money feedback was not positioned on the bottle, but rather above the container (trash bin or shopping cart).

While meeting the patients, an additional option was requested: the therapist should be able to stop the application in a way that the patient is not alarmed. There should be a prompt in VR stating that the patient should stop playing and take off the HMD. An additional goal of the meeting with AUD patients was to find out whether a session of 10-15 minutes would be appropriate. However, due to the extremely high temperatures we decided to not physically overwhelm the patients and therefore let them play the game for only 5 minutes.

5 CONCLUSION

We presented a PACT analysis for virtual AUD therapy and developed a VR application which aims at treating AUD using two CBT methods namely AAT and CET. The application consists of three mini-games in the context of a virtual supermarket. This application was evaluated during two focus groups with clinical experts and AUD patients. The results can be summarized as the following: the Rehab Clinic will conduct a clinical study with VR AAT and compare it to the 2D AAT (using a joystick and a computer screen). For this purpose, some changes such as including auditory and more visual cues as well as a craving prompt need to be further developed.

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