

Design of a Virtual Environment to embed IVR Agents to Screen for Alcohol Use Disorder in Vulnerable Individuals

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ABSTRACT

Individuals with mild to borderline intellectual disability (MBID) are at risk for developing alcohol use disorder (AUD). Immersive virtual reality (IVR) is a promising tool in mental health care. This research focuses on the design of a virtual environment, that is similar to the real world, to screen individuals with MBID for AUD in which an embodied conversational agent (ECA) is embedded. This research presents requirements for such an environment. This paper analyses existing literature and adds to existing literature by presenting results of interviews with field experts and a user study on how end-users experience a prototype of a virtual environment. A sense of presence, involvement and immersion allows users to experience a virtual environment as if it was real. This research showed the importance of a mix between a clinical and professional room, and a comfortable and informal one. Participants from the user study valued a restful environment, a room that allows them to feel calm.

Keywords

Alcohol use disorder, virtual reality, intellectual disability, virtual environment, immersive virtual reality, embodied conversational agent

1. INTRODUCTION

In a study with individuals with AUD, those with an intellectual disability were consuming significantly less alcohol than those without an intellectual disability [6]. So, alcohol consumers with an intellectual disability are more likely to experience drinking problems than consumers without intellectual disabilities [6]. Individuals with MBID are more susceptible for developing AUD compared to individuals without MBID [22].

Virtual reality (VR) has become popularized in recent years due to the rising number of head-mounted displays (HMDs) available to consumers [7]. IVR is when users wear HMDs which are devices that resemble visors or helmets that a person wears to immerse themselves into the virtual environment while also blocking out visual stimuli of actual reality. IVR provides a multi-sensory experience. A suitable virtual environment allows user to experience the environment as if it was real [24]. IVR is a promising tool for mental health. It can be used in the treatment of substance use

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disorders (SUDs), and it is applicable to everyday life [21]. One of VR's main advantages in mental health is its ability to simulate real world experiences [4].

IVR agents could be used to screen for AUD [1]. This study by Auriacombe et al. [1] showed the potential of this idea. The virtual agent had a good acceptability by patients. Using IVR agents to screen for AUD could help healthcare providers by reducing workload. When patients are screened in the real world for AUD, patients may be unwilling to self-report their substance use to their doctor [5]. Thus, a virtual agent could positively influence disclosure behavior.

The study by Auriacombe et al. [1] did use a virtual agent to screen for tobacco and alcohol use disorder. This was the first time a virtual agent was used in screening for addiction. Instead, most research on VR in addiction care has focused on cue-reactivity [13]. In cue-reactivity environments, patients are confronted with substance-related triggers and situations. These can lead to substance craving, for example.

2. PROBLEM STATEMENT

This research will focus on an immersive virtual reality environment that is suitable to conduct a standard clinical screening for AUD using an ECA. Previous IVR research on AUD has focused on cue-reactivity environments [13]. The one study that did use an ECA to screen for addiction, did not focus on individuals with MBID [1]. Instead, participants were selected from a sleep disorder clinic. In contrast to IVR cue-reactivity, this research focuses on designing a suitable surrounding for embedding such an ECA to have a conversation with an individual with MBID to screen for a potential alcohol use disorder. This study aims to design a virtual environment to screen individuals with MBID for AUD. The results should be highly ecologically valid to allow comparison of different approaches and further investigate the capabilities of an ECA. Meaning, that the virtual environment should be similar to an environment used in the real world for clinical screenings.

2.1 Research Question

The problem statement will lead to the following research question:

How to design an ecologically valid environment to embed IVR screening agents, screening for AUD, for individuals with MBID?

This can be answered with the following sub-questions:

1. In which clinical environment are screenings for AUD most commonly performed?
2. Which design elements and characteristics are present in such an environment?
3. How do end-users experience a virtual environment designed for ecological validity?

3. METHODS

To answer the research question, several steps have been taken. A literature review and interview with experts to answer the first two sub-questions and establish requirements for the next step: the design of a virtual environment prototype. Finally, a user study will be done to see how end-users experience the prototype.

3.1 Literature Review

A literature review has been done to explore existing literature. Specifically, to make clear what is known about individuals with MBID and addictive disorders, immersive virtual reality in mental health, the effects of immersive virtual environments on users, and ecological validity. This section aims to present the findings of these past studies, thus establishing the existing level of knowledge and helping the researcher identify literature gaps. In the end, this will help answer the first two sub-questions and define requirements for the virtual environment. A scoping literature search was conducted in Google Scholar and Scopus.

3.2 Expert Interviews

Two field experts have been consulted to gain more knowledge about the environments where screenings for AUD take place. The goal is to explore how the knowledge from the literature review compares to real world experiences from experts. The interviews were also used to discuss the idea and practical implications of embedding an IVR agent in a virtual environment to do screenings for AUD instead of conducting screenings in the real world.

3.2.1 Participants

Expert 1 (E1) is a male psychologist with a master's in psychology and technology. E1 is also a PHD student and does research in the field of virtual reality and addictive disorders.

Expert 2 (E2) is a female psychiatrist at an addiction treatment institute and is also responsible for the addiction and intellectual disability program. As a psychiatrist, E2 does screenings and addiction treatment of individual patients. E2 also works as a researcher in the field of substance use among individuals with MBID.

3.2.2 Measures

Two semi-structured interviews were held, one with each expert. The points of discussion include (1) the environments in which clinical screenings for AUD in individuals with MBID are done, (2) design elements and characteristics of such an environment, and (3) the use of an immersive virtual environment to perform such screenings with an ECA. These three main questions and some sub-questions or topics were used to guide the interview. The interview guide can be found in Appendix A.

3.2.3 Procedure

The interviews were held through online video calls. The experts were informed about the procedure and an informed consent was recorded. The audio from the video calls was recorded.

3.2.4 Data Analysis

The audio recordings were used to make verbatim transcriptions. Emergent coding, where codes are drawn from the text, was used to categorize data. Individuals' thoughts were isolated and assigned to themes. These themes provide understanding of the problem and practical guidelines for the environment.

3.3 Environment Design

A prototype of an ecologically valid, immersive virtual environment has been made to allow user testing. The prototype has been made in Unity 3D. The prototype was made based on requirements set after the literature review and expert interviews.

3.4 User Study

Finally, a prototype evaluation with end-users was done. Four individuals were shown the prototype of the virtual environment and were interviewed. The goal is to find out how these individuals experience the virtual environment prototype.

3.4.1 Participants

In total, $n = 4$ individuals were recruited through convenience sampling by local therapists from an addiction treatment institute for people with mild to borderline intellectual disability. Exclusion criteria included being a minor as well as inability to give informed consent.

Participant	Age	Gender	Disorder
P1	27	F	Borderline Intellectual Functioning
P2	46	M	Cognitive Problems
P3	27	M	Borderline Intellectual Functioning
P4	31	M	Mild Intellectual Disability

Table 1. User Study Participants

3.4.2 Measures

Four semi-structured interviews, one with each participant, were held through online video calls. The three main questions include (1) what did you think of the environment? (2) What would you change? And (3) what did you like? These three main questions and some specific topics were used to guide the interview.

The topics to discuss include (1) distractions, (2) professional or informal setting, (3) interactivity, (4) background view, (5) realism and (6) person or virtual agent.

3.4.3 Procedure

The interviews were held through online video calls. The participants were given an information brochure and informed about the procedure. Participants were informed about the idea of having a conversation with a virtual agent in the room about alcohol use. Following informed consent, the audio recording was started. Since the study was done online, participants were not able to experience the environment through a HMD. Instead, participants were given a link to a YouTube video that showcases the environment. After the participants had watched the video, the interview began.

3.4.4 Data Analysis

The audio recordings were used to make verbatim transcriptions. Emergent coding, where codes are drawn from the text, was used to categorize data. Individuals' thoughts were isolated and assigned to themes. These themes provide understanding of how individuals with MBID experience an environment designed for ecological validity.

3.5 Ethical Considerations

Before doing this research, ethical approval for the research plan was given by both the relevant faculty of the University, and the addiction treatment institute. The research had to be in accordance with the declaration of Helsinki [25], especially

since part of the research involved working with people with MBID. Furthermore, any personal information from the user studies must be stored securely. All relevant documents are stored on the systems of the addiction treatment institute. Because of the Covid-19 measures in the Netherlands, all research, including interviews, were done online. This was foreseen and prepared for.

4. LITERATURE REVIEW

4.1 Individuals with MBID and addictive disorders

Knox et al. [11] note that alcohol consumption is prevalent across the world, with 2016 statistics indicating that 2.4 billion people or 33% of the global population were current drinkers. This prevalent use of alcohol has led to the prevalence of AUD and high-risk drinking, especially among adults.

A systematic review by Van Duijvenbode et al. [22] states that individuals with mild to borderline intellectual disability are more susceptible for developing AUD compared to individuals without MBID. Alcohol use is more common among adolescents with MBID compared to adolescents without MBID [22]. Individuals with MBID seem to be at risk for SU(D) [22]. The review found three articles that focused on the screening and assessment of SU(D). Only one of these studies' focus was AUD. Self-report seems the most suitable regarding screening for SU(D) among adults with MBID [22]. The CAGE and AUDIT methods can be used for this. CAGE is a questionnaire that uses a series of four questions that doctors can use to screen for alcoholism [17]. AUDIT is the alcohol use disorder identification test [2].

4.2 Immersive Virtual Reality in mental health

Lavoie et al. [14] highlight that VR is a human-computer interface that provides users with various physical sensations, including visual and auditory, to increase realism in the virtual world. In this technology, the user experiences an authentic experience of being in the virtual world due to visual and auditory displays generated by a computer. This is immersive virtual reality. Because of VR's efficacy and HMDs allowing expansion of VR to other areas, mainly due to their size, accessibility, and portability, VR research in alcohol studies is encouraged [7].

VR is a promising tool in mental health care, by "doing" instead of talking [12]. For example, VR can be used to improve psychiatric treatment [9]. Wang et al. [23] highlight that VR technology has been adopted in the medical world to mitigate substance use disorders. But methods must be developed to translate conventional therapy into VR. Lorenz et al. [16] explain that one of the biggest applications of VR has been in the biomedical context. In this field, VR has been applied to treat different types of mental health disorders including substance disorders, schizophrenia, fear of heights, and fear of spiders.

Segawa et al. [21] have found that VR provides benefits in treatment and assessment of SUDs and to achieve high levels of ecological validity. When patients are screened for a SUD like AUD, patients may be unwilling to self-report their substance use [5]. Substance use screening by a virtual agent is a viable approach for fast identification of primary care patients that may require treatment.

However, further research on clinical assessment, such as screening for AUD, is missing [13]. Langener et al. [13]

found 19 studies reporting a relation between cue-reactivity and clinical parameters in VR, while only two studies could be considered as assessment studies. The overwhelming majority of VR studies on substance use are on cue-reactivity. Appropriate cue-reactivity environments in VR can trigger cravings [8]. Ghiță et al. [10] highlight this usage of VR environments for providing therapy in severe cases of AUD. These VR environments, that use cue-reactivity, have been used in treatment, but conclusions about their effectiveness cannot be made [10]. Basically, these VR environments seek to mimic real-life environments by presenting the same alcohol-related variables that people would find in real-world settings such as people and drinks. Thus, the use of VR technology in screening for AUD and therapy involves the replication of real-world alcohol-related and inducing environments in the virtual world. Clinical assessment studies have focused on cue-reactivity environments, though options for using virtual agents, without cue-reactivity, were also explored. Auriacombe et al. [1] have researched the validity of an ECA to screen for AUD and tobacco use disorder in individuals who did not seek help. This study from 2018 was the first time that an ECA is used in screening for addiction. The research was promising, the virtual agent had a good acceptability by patients and such an ECA could be used to systematically screen patients for AUD [1].

4.3 Presence, Immersion, and Interactivity

VR environments have various effects on users, some negative others positive. One of the positive effects of these environments on users is the aspect of presence. Witmer and Singer [24] define presence as used in VR as the subjective experience of being in one place or environment, when one is physically situated in another. Through VR, users can experience presence in the virtual environment whereby the users experience the computer-generated environment rather than their actual physical location. This presence in the virtual world brings happiness and enjoyment to most users. Mütterlein and Hess [18] have found that most users allude to the fun nature of VR environment especially in the way that they are able to immerse themselves into the environment, becoming the central point of focus. In this virtual environment, people feel reborn and excited, especially as they are aware that what they are experiencing is a virtual creation, yet the feeling is so immense leading to a sense of enjoyment. Beyond enjoyment, VR environments make people more focused. As Witmer and Singer [24] explain, when users are experiencing the VR environment, they become more aroused and focused on the tasks to be performed or the situation to be experienced. Mainly, this effect occurs because VR environment present a focused environment whereby the user is only presented with that which he or she needs to experience. In VR environments, there is no space for distractions, unless those distractions have been positioned there strategically to distract the user. Thus, VR environments have the effect of making people more focused and are more enjoyable.

While VR environments are virtual environments that mimic real-world environments [15], it is essential that these environments are suitable for the specific aspect or environment that they represent. This suitability means that the VR environment should be good enough to convince the user that the user is not in a virtual environment but in a real-world situation. Banos et al. [3] highlight VR environments not only need to have the aspect of presence but also of reality. In terms of presence, the authors indicate that the users need to experience the feeling of being there. They need to be able to observe the environment, interact with objects and

entities in it, and events in the environment. Schuemie et al. [20] explain that it is through such experiences that users can experience presence in a VR environment as these realistic interactions allow users to have meaningful interpretations of their experiences and the environment. However, Schuemie et al. [20] also indicate that a high sense of presence in a virtual environment requires a simultaneous low level of presence in the real world and vice versa. Basically, for users to achieve presence in the VR environment, it is key that there are minimal distractions from the real world [15] to ensure that the user is fully immersed, involved, and present in the virtual environment. As such, a suitable VR environment needs to afford a user with a high degree of presence to allow for greater immersion and involvement in the environment.

It is not enough that users are present in a VR environment; rather, they also need to experience the environment as if it were real. Banos et al. [3] explain that reality is a key aspect in VR environments as it helps to convince users of their presence in the VR environment. By making the VR environment realistic, even though the user is physically absent from the environment, the user does not question the reality of what is happening as he or she experiences and feels it as if he or she was in that spot in that remote location. Having a realistic VR environment enhances the presence experience of the user. Without the environment being realistic, the user would not be able to believe or experience the sense of presence. The two factors that are necessary for users to experience reality and presence are immersion and involvement [3]. Witmer and Singer [24] explain that involvement is a psychological state experienced as a consequence of focusing one's energy and attention on a coherent set of stimuli or meaningfully related activities and events. Involvement is based on the degree of significance or meaning that a person attaches to an activity, stimuli, or event. Therefore, for VR environments to be realistic and for people to experience presence in them, they must have a stimuli or activity that is relevant to the users of that VR environment. Basically, as VR users focus more attention on the VR stimuli, they become more involved in the VR experience which leads to an increased sense of presence and reality. To enhance this involvement, it is essential that users are not preoccupied with activities occurring outside of the VR environment. Therefore, a suitable VR environment is that which minimizes distractions in the VR environment both from within and outside and ensures that the VR environment is realistic to enhance the sense of presence.

Another key aspect to ensuring a suitable VR environment is the aspect of immersion. Witmer and Singer [24] define immersion as the *“psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences”* (p. 227). If a VR environment can provide a greater sense of immersion, then it accords the user a higher sense of presence. In the VR environment, various factors affect immersion. Witmer and Singer [24] highlight these factors as isolation from the physical environment, natural modes of control and interaction, perception of self-movement, and perception of self-inclusion in the VR environment. Basically, a suitable VR environment is one that effectively isolates users from the physical environment. By isolating users from the physical environment, the VR environment deprives them of the sensation and stimuli provided by the physical environment and allows them to focus and be attentive to the VR environment, thus leading to an increased degree of immersion into the VR environment. Mainly, many VR

environments provide this level of isolation through the use of HMD which help the users to fully focus on the VR environment and minimizes distractions from the physical environment. Witmer and Singer [24] highlight the efficiency of HMD in isolating users by noting that when users perceive that they are outside of the simulated environment and looking in, for example through a CRT display, the immersion aspect is lost as although the stimuli is there, the physical environment distracts the user from the VR environment. The perception of movement, control, and interactions are also important in helping increase immersion into a VR environment. Mütterlein and Hess [18] explain that suitable VR environments are those that accord users the perception of control, movement, and interactions. Basically, users should not just be immersed in the environment, but they must perceive to be able to control their activities, move around the environment, and interact with avatars and objects in the VR environment. Thus, to allow for the perception of immersion, suitable VR environments need to provide users with the perception of control, movement, and interactions in the VR environment.

One of the major negative effects of VR environments on users is cybersickness or simulator sickness. According to Schuemie et al. [20], VR causes nausea and dizziness, a phenomenon that is known as “simulator sickness” (p. 188). This sickness occurs because people are being immersed in a new environment that they were not used to and this can overwhelm some users leading to cybersickness. Mütterlein and Hess [18] further highlight this negative effect of VR environments on users by noting that when some users take off their VR glasses, everything gets bright and they feel a little bit dizzy. This translation from the real world into the virtual world and back into the real world causes simulator sickness as people have to adjust to the new features and setting in terms of light and focus among other aspects. Lavoie et al. [7] in their discussion of the harm of VR indicate that cybersickness is the most prevalent and well-documented negative consequence of VR, whereby it can cause users to experience vertigo, dizziness, or nausea. However, the authors explain that these simulator sickness symptoms are in most cases mild and take a short period of time to subside and go away. So, increasing immersion, realism and interactivity could result in cybersickness, causing adverse effects. Lavoie et al. [7] also indicate that VR environments also have other undesired physical and health negative effects. The researchers mention that VR can reduce cognitive performance especially reaction times and cause physical and eye fatigue. These problems occur due to the constant attention and focus that people must pay to VR environments. Finally, Lavoie et al. [7] also indicate that the use of VR can also lead to negative emotional outcomes. Specifically, this transition from the real world to the virtual environment and back can create emotional distress for people who have issues adjusting to new environments or those who become more attached to the virtual environment.

4.4 Ecological Validity

The concept of ecological validity is typically seen as the ability to generalize study findings to the real world [19]. A concern is that the context or stimuli in a study are different on crucial points than the real world. If in this research, the concept of presence was achieved by embedding an ECA in a forest then it would be challenging to compare clinical assessments with medical experts in the real world to a clinical assessment with an ECA. Paying attention to theoretical assumptions of critical components of the context and stimuli help determine the meaning of ecological validity

[19]. A way to achieve this is by limiting confounding variables. Differences between the assessment context and real world can lead to biases [4]. VR may overcome limitations of real world assessments, like the monetary and non-monetary costs [4], because of its ability to generate controlled and realistic experiences by providing users with a sense of presence, involvement, and immersion. More research on the links between presence and cybersickness in IVR should be done [21]. This could be used to improve ecological validity while increasing the acceptance of VR technologies.

4.5 Conclusion

Individuals with MBID are susceptible to develop AUDs. Researchers have widely explored the aspect of VR and how VR can be used to help people struggling with substance abuse. Basically, VR is a human-computer interface that provides users with various physical sensations, including visual and auditory, to increase realism in the virtual world. Through VR technology, humans are immersed in a virtual environment that mimics the real world and where they can move and interact with various objects in the VR environment. While the use of VR in AUD is limited, the limited research in this field indicates that when VR is used for AUD screening, VR environments are created to mimic real world environments with alcohol triggers. This is totally different from embedding an ECA in an environment. VR environments have both positive and negative effects on users. For positive effects, VR environments provide users with a sense of presence, involvement and immersion in the environment which leads to enjoyment. To avoid distractions and lack of focus, VR environments need to be suitable to the user by providing suitable stimuli and reality, which leads to a higher sense of presence, involvement, and immersion. However, these environments also lead to cybersickness which includes feelings of dizziness and nausea, although these symptoms are mild and disappear after a short while. A risk of VR environments is that a great feeling of presence, immersion and involvement could lead to cybersickness, negating the positive effects. To achieve the concept of ecological validity, this study aims to design a theoretically congruent environment. If this was not the case, it would be challenging to compare the effects of the environment on users to those of the real world.

5. RESULTS

5.1 Expert Interviews

Two field experts have been consulted to gain more knowledge about the environments where screenings for AUD take place.

5.1.1 Context

Screenings for AUD mostly happen in a professional room setting, in the room of a therapist like a nurse specialist, psychologist or psychiatrist. It is important to keep in mind that individuals must disclose issues that may be hard to talk about. An individual should not be judged harshly. Individuals with MBID especially, can feel nervous or have tensions. Expert 1 (E1) mentions *“It’s mostly in [therapists’] room, so a professional room setting and it’s a very private situation right. Because you are talking about your habits, your patterns and everything so it’s definitely a privacy situation, so the setting should be somehow closed and quiet.”*

5.1.2 Professional or Informal

Screenings are done in professional rooms but both experts made clear that these rooms should not feel like a hospital.

Although it is not a living room, the room should feel comfortable and inviting. Often, there is a desk where you can sit opposite but there are also chairs at a coffee table where you can sit next to each other. Perhaps some patients prefer to sit opposite at a desk while others prefer a more informal setting, sitting next to each other in comfortable chairs. To make the room feel more comfortable, often the therapist will have a picture on the desk. This can be used as an icebreaker. Another way to do this is to add a little game like a Rubik’s cube to play with. To feel more inviting, patients can be offered a drink like coffee. To quote E1: *“For the one person maybe this professional atmosphere is also more comfortable while on the other hand [for] the other person, 2 chairs next to each other would be better. And I can especially think in the case of people with intellectual disability, where you need to maybe give a bit more help during the procedure and a bit more guidance that this more informal approach would be better.”*

5.1.3 Elements

Apart from a desk and a coffee table with chairs, there is often also some type of art in the room. For example, if patients are creative, something they made can be in the room like a self-made chair or a painting. Plants are also used to make the room feel more comfortable and inviting. Practically, there are some other elements that will be present in the room. For example, a shelf, computer, phone, documents, and tissues.

5.1.4 Ambience

In a therapist room, which the experts think is the most suitable environment to conduct a screening for AUD, patients should not feel locked in. If the room is too small, it can feel too full and patients may feel claustrophobic. Yet, the room is not that large. A room that is too big can also feel uncomfortable and in the real world, there are limited resources, so a Dutch therapist room is rather small. To make patients feel comfortable it helps to provide a way out. For example, it can help if the room has windows. The lighting in a therapist room is professional with white light.

5.1.5 VR vs Real World

Even though in VR it is not necessary to have a door or laptop for example, this should still be there. First, patients must feel immersed in the environment. Making it feel real can help. A realistic environment that is ecologically valid can provide users with a sense of presence and immersion. Furthermore, the room should have a door to prevent the feeling of being locked in. A door provides the feeling that it is possible to leave the room. To provide a sense of involvement, the experts advised to have some interactive objects in the room like a coffee mug, pen, or fidget spinner. E1 noted that in the real world there are always noises. To be realistic, there should also be background sound in VR.

Another point that was discussed is the concept of talking to a virtual agent instead of a person. Although this is not directly relevant to this research, future research will have to consider it if virtual agent is going to conduct screenings for AUD. E2 noted *“Sometimes a question can be very much In Your Face. I am very interested that if you have a virtual agent if there is the same effect. Or if people would accept it from an agent if he asks questions bluntly.”*

5.1.6 Requirements

Based on the literature review and the expert interviews, the following requirements for our prototype design were identified:

R1: The room should feel private and secure.

- R2:** The room should feel comfortable and be inviting.
- R3:** The room should be realistic, and interactivity should be possible to allow immersion.
- R4:** A good ambience to enable a pleasant conversation.
- R5:** To help with tensions or nervousness, the room can have interactive objects for the patients to play with.
- R6:** Provide a way out by having windows and doors.
- R7:** Keep the room simple and limit distractions.

Theme	
Context	Specialists, Professional Room Setting, Non-judgmental, Tensions
Professional or Informal	Cleanliness, Hospital, Living Room, Comfortable, Inviting, Desk or Coffee table, Interactive Objects, Picture
Elements	Desk, Coffee table, Chairs, Art, Interactive Objects, Computer, Picture, Documents, Plants
Characteristics	Space, Locked In, Lighting, Sound
VR vs Real World	Realism, Interactive Objects, Immersion, Locked In, Virtual Agent
Design Concepts	Private, Secure, Comfortable, Ambience, Inviting, Realism, Interactivity

Table 2. Interview Analysis: Themes of the interviews

5.2 Environment Design

A prototype of a virtual environment was built. This environment is similar to a therapist room where screenings for AUD are done.



Figure 1. Virtual Environment Prototype



Figure 2. Virtual Environment Prototype

To implement R1, the room is meant to feel inviting, providing a sense of security. The desk, two office chairs and documents provide a professional, private atmosphere. To make the room feel comfortable and inviting (R2) and not like a hospital, multiple features were added. Users have a choice to sit at the desk, or in armchairs at a coffee table. There are also painting and plants for example, providing a more

informal ambience (R4). To be more realistic and make use of interactivity (R3) there is also plenty of space to walk around, and the desk has a laptop, and pen and pencil. A cup of coffee, books and a fidget spinner are also added to the room so patients can pick up some items to play with (R5). Although items are added to make sure the room feels real, the room is kept simple by limiting the number of items (R7). The walls are mostly empty and bright colors and pictures are kept to a minimum. To provide a way out in the room (R6), there is a door and a large window, overlooking buildings. Overall, the room is relatively simple and there is a mix between the professionalism of a doctor's office and the comfort of a living room.

5.3 User Study

Finally, a prototype evaluation was done to find out how end-users experience the virtual environment prototype.

5.3.1 Comfort

The main theme of the four conversations was how comfortable the room felt or should feel. All participants noted the importance of the room's ambience and the mix between an office and a living room. When asked, all participants said they would sit in the chairs at the coffee table, rather than at the desk. Participant 1 (P1) said: *"Talking there would be easier, I think. Otherwise it feels so forced."*

P4 was the only participant who wanted the room to be much more like a living room, a desk was not necessary. P4 would prefer to have a conversation in a relaxed environment like his own living room. The other three participants however, appreciated this room's mix between professionalism and informality. P2 noted *"It is functional but not cold, not charmless."* This was important to him because *"Everyone is already a number[...] you quickly just become a number. So if you would also feel that a place is impersonal, yeah I like it when a place has ambience and feels friendly."* Another participant made it clear that the room should be a little like an office because you are not there for fun, you are there for your alcohol problem. Yet the room should feel relaxed.

P3 would change the colors of the walls. When asked what the problem was with this room, he responded *"It feels so much like a dental practice. Like everything has to be sterile, and in one color."* He also came up with the idea that patients can choose certain aspects of the virtual environment. The color of the walls, for example.

Overall, the participants were positive about the room. P2 said *"Good, really nice room and great layout, I like the decorations."*

5.3.2 Restful

Another theme of the interviews was the concept of a restful room. P1 talked about the difficulty of meeting with people in the city: *"... then you hear all these people, all these stimuli. Before you have arrived you already feel full."* P2 wanted the room to be calm, soothing. He was quickly distracted and wanted such a room to be restful. He loved the amount of space in the room and found nothing distracting but would prefer an even larger room and another window.

However, P3 thought the room was too full, too busy. If a room is too busy, when there are too many triggers, he does not feel good. Finally, P4 liked the space the room provided but also wanted another window to not feel locked in.

It was clear that the participants valued a relatively large room, that does not feel full. They noted that in the real world they get distracted or overwhelmed quickly. It seems that for individuals with MBID, a virtual environment must be restful.

5.3.3 Ambience

All participants liked that there were paintings in the room. P1 found the number of paintings distracting and wanted one or two large paintings of nature. P2 liked it the way it was. Overall, the paintings as well as the plants were appreciated and only minor changes were suggested. The chairs at the coffee table were liked and participants said the room looked real and suitable for a conversation about alcohol use assessment. P1 & 2 noted that items that are normally present in a therapist room, should also be in this room, but no more. Changes that participants would make include removing the small painting in the corner, removing the sink, adding a lamp in the corner of the room, and adding a rug at the coffee table. Overall, the amount of criticism with regards to design elements was minimal.

In the prototype, tall buildings can be seen through the window. P2 said *"What you can see outside, it's really possible. I mean I can see that this room is in a large flat."* When asked what they wanted to see through the window, it all involved nature and not the city. P1 wanted to be in a forest, P2 in a park and the P3 & P4 liked to have a view over the countryside.

5.3.4 Virtual Agent

All participants thought the room was quite realistic. P1 & P2 thought it was realistic enough. P1 noted *"I think it's good like this. You can see what it is, you know what's happening, people will know what it is"*. P3 & P4 on the other hand, prefer the room to be more realistic.

When talking about the idea of using a virtual agent in such a room to talk about alcohol use, some interesting points came up. P3 said *"A lot of people that are addicted have experienced or done something, they distrust a lot of people. I have seen this in the clinic. They don't easily share their story. So maybe this (virtual agent) is a better step to learn to talk. Maybe they get a hang of it, to actually tell their story to a robot rather than a person in real life."*

P1 did not like the idea of having a conversation with a virtual agent instead of a person. However, the other participants did like this idea. However, P2 did note *"Experiences and examples that people (professionals) mention are also very important. If a robot does not do that, then you may miss that."*

5.3.5 Requirements

End-users experienced the prototype positively. Participants generally found the room to be comfortable and liked the mix between professionalism and informality. That said, participants found R2 much more important than R1. As long as the room is realistic (R3) and provides a way out (R6), the room should be as inviting, comfortable and restful as possible (R4). P3 was the only one who did not value the professional aspect of such a room, while the others did want a room similar to a therapist room. Small items like a cup of coffee and a fidget spinner (R5) were not valued highly but the concepts of R7 could be identified in each interview. All participants valued a large, almost soothing environment. Requirements for a new prototype should put a greater emphasis on the balance between an environment that feels like a hospital and one that is like a living room. Furthermore, the target group values a restful room, the environment should not be overwhelming to them.

6. DISCUSSION

This study reviewed literature, gained insights on clinical screening environment by interviewing experts, designed a

prototype environment and evaluated it with end-users. This research presents requirements for a virtual environment to embed IVR agents to screen for AUD in vulnerable individuals. In line with previous research, the environment should feel real. Users were enthusiastic about a realistic virtual environment. This supports the positive effects of presence, involvement and immersion in a virtual environment. This research provides novel insights on requirements for an ecologically valid virtual environment for clinical screenings for individuals with MBID. The environment should be like a therapist room.

The main theme for the environment is the balance between a room that is like a hospital or like a living room. Individual's thoughts on this balance varies, but it is clear that this balance is important. Another theme that came up in the user study was the sense of restfulness. All participants brought this up during the interviews and all of the indicated that this was something they valued themselves. It seems that for vulnerable individuals, extra attention should be paid for the room to convey a feeling of restfulness. The user study participants seemed to support the application of the concept of ecological validity to the design of the virtual environment. Participants 1 and 2 mentioned that items that are in a therapist room, should also be in the virtual environment. The virtual environment should be like a functional therapist room while being simple and limiting distractions.

This seems to be the first exploration on the design of an ecologically valid environment to screen for AUD. The available timeframe limited the study. It was not possible to build multiple iterations of the virtual environment. The interviews in this qualitative research had a small sample size due to recruiting difficulties and time-consuming activities like making verbatim transcripts. Due to Covid-19 measures, it was not possible to show participants in the user study the virtual environment in IVR through HMDs. This may limit the ability to generalize the results of the user study to experiences in IVR.

Perhaps the research on cue-reactivity can be used to support clinical screenings for SUDs like AUD. Rather than using cue-reactivity for the treatment of patients with addiction problems, cue-reactivity environment in VR could be used to screen undiagnosed patients. Does a patient get cravings or is the patient triggered? VR is a promising tool that should be used in addiction care, especially for individuals with MBID.

6.1 Future Work

Future work should continue building on this research by including greater sample size and going through iterative design cycles. To evaluate the applicability of using IVR agents embedded in a virtual environment to screen for AUD, more steps are needed. Research is needed on the design of the agent model, dialogue design, connection between agent and user and other parts to allow screening of individuals with MBID in IVR. Future studies can do similar research for other target groups or SUDs.

7. CONCLUSION

Research was done on how to design an ecologically valid environment to embed IVR screening agents, screening for AUD, for individuals with MBID. The literature review highlighted the concepts of presence, interactivity and immersion for IVR environments. The interview with experts presented valuable information on clinical environments for screenings for AUD. These screenings are most commonly performed in a therapist room. In these rooms, patients can sit at a desk or in comfortable chairs at a small table. The room

should be inviting, private and secure. A user study on how end-users experience a prototype of a virtual therapist room was done. Overall, participants were enthusiastic about the room and the interviews provided valuable insights about the target group. Participants value a mix between professionalism and informality. All participants liked to see some form of nature through the window, rather than a city. To have a conversation in the room, patients need to feel calm, so the room should be restful and not too full.

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APPENDIX

A. INTERVIEW GUIDE EXPERTS

Three main questions and some sub-questions or topics were used to guide the interview:

- In which environments do you or your colleagues perform clinical screenings for AUD in individuals with MBID?
 - What environment is most suitable and why?
- About [Most suitable environment], can you tell me about the design elements and characteristics of this environment?
 - Elements/Attributes
 - Characteristics, e.g., ambience, space, lighting
- In my research I want to build an environment like [Most suitable environment] as a virtual environment to embed IVR agents to screen individuals with MBID. What do you think about this?
 - Realism
 - Immersion
 - Interactivity/Involvement