# The influence of the perceived realism in the relationship between state anxiety and craving in individuals with alcohol use disorder among virtual reality cue exposure

Master Thesis

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**Abstract**

Introduction: This study aimed to determine the role of perceived realism in the relationship between state anxiety and craving in virtual reality (VR) cue exposure therapy (CET) for individuals diagnosed with alcohol use disorder (AUD). Preliminary research already identified relationships between anxiety, craving and presence in VR-CET, whereas results are inconsistent. Moreover, the working mechanism of realism in the relationship between state anxiety and VR craving has not been examined. The objectives of this study were to (1) determine the role of perceived realism of VR environments and (2) investigate the role of perceived realism of VR beverages in the relationship between state anxiety and VR craving in VR CET. Methods: Twenty-one patients participated in this study. Their state anxiety was measured before a VR exposure and VR craving was measured during the exposure to different VR beverages. Further, the patients had to rate their perceived realism of (1) VR environments and (2) VR beverages. To analyse the role of the perceived realisms two mediation analyses were carried out. Results: Neither the perceived realism of VR environments nor the perceived realism of VR beverages were found to mediate the relationship between state anxiety and craving. Our data indicated a relationship between perceived realism VR beverages and VR craving. Conclusions: Results suggest that particularly VR realism beverages is relevant to generate VR craving. Although our data did not show an effect from state anxiety on the perceived realism, and from state anxiety on VR craving, relationships are still assumed based on a broad existing literature base. Verifying the given results in a controlled study with a larger sample size is warranted.

*Keywords:* virtual reality cue exposure, alcohol use disorder, realism, alcohol craving, anxiety

## Contents

# Introduction

## Alcohol use disorders

Alcohol use disorders (AUDs) are characterised by a problematic pattern of alcohol use, leading to clinical impairments. Several behavioural and physical symptoms determine AUDs, for example limitless consumption (American Psychiatric Association [APA], 2013). The diagnosis of AUD is common in our society, comorbid and disabling, with a lifetime prevalence of 29,1% (Grant et al., 2015). This disorder often remains untreated (Grant et al., 2015; Kohn et al., 2004; Mekonen et al., 2020), and treatment effects are generally low (McLellan et al., 2000). The course of AUD differs individually but contains phases of remission and relapse (APA, 2013). After one year of detoxification, relapse rates for AUD are above 50% (Schellekens et al., 2015).

### *Underlying mechanisms of alcohol use disorders*

Alcohol craving is a typical symptom in AUDs. It defines the strong desire to consume alcohol. Cognitions can strongly be influenced or captured by the urge to consume. Therefore, craving may lead to neglecting other responsibilities, e.g. going to work (APA, 2013). Craving for alcohol occurs more likely in an environment where the alcohol has been consumed before, for instance in a bar (APA, 2013).

Anxiety is well-known as a trigger for craving and has been related to the development, maintenance (McCaul et al., 2017) and withdrawal of AUD (APA, 2013). Anxiety can be defined as an unpleasant feeling of worrying, which varies from slight current distress to a psychopathological state. People often regard alcohol as helpful to dampen their anxieties and stress (Hefner & Curtin, 2012). Preliminary research has further detected a strong association between anxiety disorders and AUDs (Lai et al., 2015).

### *Treatments for alcohol use disorder*

There is an existing variety of treatments for AUD, but relapse rates remain high (McLellan et al., 2000). One reason might be that traditional therapies remove the patients from their typical social surroundings (e.g. Owens et al., 2014) and emphasise avoidance (e.g. Laurens et al., 2020). Alcohol avoidance is almost impossible as the cues for drinking are nearly everywhere, e.g. in restaurants or supermarkets. Moreover, the existing treatments are expensive (Bordnick & Washburn, 2019) and may fail because they do not reinforce self-efficacy (Bandura, 1989), whereas self-efficacy is an essential factor in the therapy of AUD (Loeber et al., 2006). There is a need for new treatment options that allow bringing real-world cues and contexts into the therapy (Bordnick & Washburn, 2019) to promote self-efficacy

(Loeber et al., 2006) and make the patient feel in control to change their relationship to alcohol. Virtual reality offers new possibilities to assess and treat AUDs.

## Virtual reality

A virtual reality (VR) is a simulated environment generated by a computer that mimics real-life contexts. Gaming already utilises VR and users can play a virtual character and go, for example, on an adventure. Technically, virtual reality could also be applied to two-dimensional programs displayed on a traditional computer monitor. In this paper, the term VR refers explicitly to the use of head-mounted displays (HMDs), which display scenes in real-time. All five senses can be engaged, including a 3D immersive environment presented to the user (Bordnick & Washburn, 2019).

### *Virtual reality in psychology*

Also, psychological treatments can benefit from VR via creating standardised or individualised cue environments that can evoke emotionally loaded experiences (Bouchard & Rizzo, 2019). Among those virtual environments, dysfunctional or functional behaviours can be induced and analysed (Ryan et al., 2019). VR may allow scientists and practitioners to raise ecological realism while keeping the experimental control, for instance unpredictable events can be precluded (Serrano et al., 2019). In conclusion, VR has increased the opportunities for practitioners and researchers to improve their clients' mental health (Bouchard & Rizzo, 2019).

### *Sense of presence & immersion*

Regarding VR, the sense of presence is a relevant term. Slater (2009) defined this sense of presence as based on two states (1) the feeling of the illusion of plausibility and (2) the illusion of being in real places. When both illusions are generated in a virtual environment, realistic behaviour of the participant is induced. This definition requires the integration of various contingent and coherent channels that allow sensorimotor actions of the user, e.g. that a user can turn his head and look to the right side as being in the physical world. Those sensorimotor channels provide a sense of agency to the user, which can be defined as the awareness of initiating (Slater, 2009). Heeter (1992) described this presence more facilitatively as the illusion of "being there" (p. 262). The sense of presence might be regarded as an illusion where the user or patient loses the awareness that stimuli are created by technologies and experiences realism, which can be social or perceptual (Lombard & Ditton, 1997; Riva et al., 2014). Social realism refers to realism, which compares VR to our real world, whereas perceptual realism defines the realistic depiction of things or persons that must not match our world (Lombard & Ditton, 1997). The sense of presence is affected by displaying components, internal components such

as personality traits (e.g. Song et al., 2021), social factors, and emotions (Servotte et al., 2020). In mental health care, the sense of presence is particularly determined by integrating significant stimuli and environments (Bouchard & Rizzo, 2019).

The sense of presence can be increased by integrating virtual humans into the virtual environment. These are virtual characters controlled by computer programs and algorithms (Ryan et al., 2019). The sense of presence is possibly the most important factor that separates VR from a conventional multimedia experience, e.g. from a video game played on a computer (Bordnick & Washburn, 2019). Preliminary research also assumed that HMDs create a greater sense of presence than computer displays (Cadet & Chainay, 2020).

In general, the level of presence has been shown to influence a person's emotional state (Riva et al., 2007), specifically powerful emotions such as fear correlate with a high sense of presence (Diemer et al., 2015; Ling et al., 2014; Renaud et al., 2002). Although some studies already investigated the relationship between the sense of presence, the feeling of anxiety, and treatment effects, their relationship is inconclusive (Serrano et al., 2019). A relationship was also found between positive emotions and the sense of presence (Pallavicini et al., 2020). Grassini et al. (2020) found that a higher sense of presence may increase the learning experience among virtual environments and should be explored in-depth regarding skill acquisition. Also, a relationship was found between the sense of presence and craving for cigarettes (Ferrer-García et al., 2010).

In addition, the term immersion plays a role in virtual environments. Immersion can be described as the extent to which the involved technologies "are extensive, surrounding, inclusive, vivid and matching" (Slater et al., 1996, para. 2.1). Whereas the sense of presence defines how the user experiences virtual reality, the term immersion defines how the applied technologies create a realistic environment (Slater, 1996). In their model, Diemer et al. (2015) suggested that presence is based on two factors (1) immersion and (2) emotional arousal, which can also be manipulated applying VR.

## Virtual cue exposure therapy for alcohol use disorders

Since the first study on VR cue exposure (Kuntze et al., 2001), research on the clinical applications of VR for substance use disorders has developed a lot. VR has been instrumentalised to assess and treat alcohol use disorders (Ghiţă & Gutiérrez-Maldonado, 2018).

### *Cue exposure therapy*

The treatment of alcohol or substance use disorders can similarly to anxiety

treatments be based on exposure techniques. Cue exposure therapy (CET) is declared to rely on the well-known principles of Pavlovian extinction learning (Byrne et al., 2019). It intends to extinguish the paired associations between cues and the reinforcing features of the substance by exposing the addictive person to the drug or alcohol-related cues several times without consumption (Conklin & Tiffany, 2002; Drummond et al., 1990; Marlatt, 1990). A cue is a trigger that elicits a craving to consume a specific drug or alcohol. Cues become conditioned stimuli (CS) during previous substance use, and craving is elicited when seeing the cue as a conditioned response (CR). For instance, a glass of wine elicits craving and has been conditioned with the reinforced response of drinking. In CET, the glass of wine is presented several times but without consumption to weaken the association between the conditioned stimulus (glass of wine) and the conditioned response (drinking). This behaviouristic approach involves identification with the presented cues (Bordnick & Washburn, 2019), and it has been shown that CET for alcohol cues decreases cue reactivity (Carter & Tiffany, 1999; Conklin & Tiffany, 2002). Newer learning models suggested that drug or alcohol cue exposure does not erase the original fear response or cue reactivity (Conklin & Tiffany, 2002). More likely, this new non-fearful or non-consuming learning response is in competition with or inhibits the original representation (Brewin, 2006).

Although some clinicians already apply CET, this technique needs to be improved and the availability needs to be increased so that more practitioners expect positive outcomes (Byrne et al., 2019). Generally, evidence for the effectiveness of CET is inconsistent (Conklin & Tiffany, 2002; Martin et al., 2010; Mellentin et al., 2017), and the new extinction learning may not be translated to any different real-life cue or context (Bouton, 2002; Conklin & Tiffany, 2002).

### *Virtual reality cue exposure therapy*

VR offers new opportunities to implement CET while presenting relevant, interactive cues to the patient in the 3D virtual world to immerse the user and elicit emotions such as anxiety (Serrano et al., 2019). Using HMDs and tracking systems, scenes are presented in real-time, and the user feels aware of initiating (Bordnick & Washburn, 2019). For example, sceneries like pubs, clubs, or restaurants can be displayed, including all details such as alcoholic beverages. Social pressure can be evoked by adding talking avatars to the virtual environment (Cho et al., 2008; Lee et al., 2008).

Among virtual reality cue exposure therapy (VR-CET), a distinction between two different types of cues is made: proximal and contextual. Proximal cues relate to the drug

directly, such as the drug itself or equipment necessary for consumption. In contrast, contextual cues are indirectly connected to the drug, such as the general setting or the social context in which the consumption occurs (Bordnick & Washburn, 2019). When both kinds of cues are combined, these are called complex cues (Traylor et al., 2011). Various cues can be presented simultaneously to trigger craving and evoke specific substance use habits, making VR-CET more efficient than exposure applied in traditional treatments (Bordnick & Washburn, 2019).

***The role of cues for craving in virtual reality cue exposure-based therapy***

Several studies investigated the different cues that induce alcohol craving among VRs. The first study using VR alcohol environments compared cue-reactivity to neutral and alcohol-related cues among heavy drinkers. This investigation showed that VR based alcohol-related proximal and social cues significantly amplify craving compared to neutral cues (Bordnick et al., 2008). Studies with complex cues have been shown to evoke greater cue-reactivity than studies that use contextual or proximal cues alone (Traylor et al., 2011; Bordnick et al., 2008).

Further, participants exhibited more craving for alcoholic beverages through the presence of food (Ghiţă et al., 2019b). Ryan et al. (2010) exposed binge drinkers and non-binge drinkers to different virtual alcohol-related and neutral rooms. Binge drinkers showed a significantly higher craving after the virtual exposure in alcohol-related rooms than non-binge drinking individuals. Simon et al. (2020) demonstrated in their study that heavy drinkers show higher levels of alcohol craving than occasional drinkers after immersion in a virtual environment with alcohol cues. The perceived realism of the virtual environment for each participant has proved to be a moderator in the relationship between the levels of alcohol consumption in real life and post-immersion craving (Simon et al., 2020). Craving among VR-CET is mainly induced by settings such as bars, pubs, parties or being in a house (Lee et al., 2007; Ghiţă et al., 2019b). Patients with AUD feel the urge to consume alcohol more frequently throughout the day, whereas the craving for non-AUD people is higher at night only. People also tend to experience higher alcohol craving levels at the weekend (Ghiţă et al., 2019b). Craving in patients with AUD among VR is also related to negative emotions such as anxiety (Ghiţă et al., 2019a).

Empirical research has also examined the role of social cues among VR-CET. Cho et al. (2008) studied social pressure within a VR environment to induce craving. They showed that social pressure by an avatar increases alcohol craving compared to VR situations without an avatar. In addition to that, Lee et al. (2008) demonstrated that social pressure is only

relevant to the craving of social drinkers. In contrast, patients with AUD showed high levels of craving when being exposed to the alcohol cues, regardless of social pressure in the alcohol cue virtual environment. This conclusion matches the results of studies by Ryan et al. (2010) and Ghiţă et al. (2019b). In a non-alcohol related environment, craving was generated by social pressure in the addictive and control group. Acquired skills in virtual environments can partly be translated and applied in the real world. Researchers discovered the need for a combination of VR exposure techniques and coping skill training to resist social pressure in real-life settings (Lee et al., 2008). Bordnick et al. (2012) showed in their study about coping strategies and relapse prevention that skills build in VR may decrease smoking rates and increase the ability to quit smoking in real life.

Also, anxiety can be treated by using VR. Virtual reality exposure-based therapy (VR-EBT) represents an evidence-based treatment for several anxiety disorders (Opriş et al., 2012). It may provide various stimuli and relevant elements of the anxiety disorder as a way of confrontation (Botella et al., 2004). Clients are exposed to their threat and experience an emotional charge to acquire new mental representations of fear-inducing stimuli (Bouchard et al., 2012).

### *Effectiveness of virtual reality cue-exposure-based therapy for treatment & assessment of alcohol use disorders*

There are promising results generated by the use of VR in the treatment of AUD. Spagnoli et al. (2014) regarded VR among alcohol use disorders as an innovative tool to assess patients. Moreover, VR treatment for patients with alcohol use disorder may also be helpful because it may regulate the brain activity associated with alcohol addiction (Son et al., 2015). Kwon et al. (2006) reported a reduction in cue-elicited craving after VR-CET. They assumed that VR magnifies the efficacy of CET by inducing craving for alcohol while desensitising the conditioned response to alcohol cues. Further, it has been found that virtual CET can decrease cue-elicited craving after eight therapy sessions, and therefore VR may increase the effectiveness of CET treatments (Lee et al., 2007). In another study, virtual reality was applied to treat AUD by combining relaxation with a high-risk situation and the presentation of aversive stimuli. This approach decreased craving for alcohol in patients with AUD and generated promising results compared to classic cognitive therapy (Lee et al., 2009). Additionally, induced changes in craving by applying virtual reality are based on neurobiology detected by changes in EEG activity (Lee et al., 2009). CET may also decrease the fear of a specific cue by reducing the fear of losing control (Byrne et al., 2019).

Ghiţă and Gutiérrez-Maldonado (2018) suggested in their systematic review that treating alcohol use disorders using VR is generally advantageous as it can assess and influence alcohol craving and offers further ecological advantages. Hence, there is still a need for clinical investigations using general guidelines and studies that test specific variables, e.g. immersion and their role regarding long-term effects, e.g. relapse rates (Ghiţă & Gutiérrez-Maldonado, 2018). In general, VR-CET seems particularly beneficial for patients with severe AUD and may also deliver better treatment outcomes than treatment as usual (TAU) (Hernández-Serrano et al., 2020).

Empirical research has presented interesting results for VR-CET, specifically when combined with traditional approaches (Bordnick et al., 2012). However, specific research on the general reduction of alcohol dependency needs to be carried out. Whereas the induction of alcohol craving has already shown to be successful, there is a lack of big sample sizes, and results seem to be ambiguous concerning treatment outcomes (Segawa et al., 2019; Trahan et al., 2019).

**Present study**

Whereas exposure techniques for anxiety are based on broad research evidence, the CET for AUD lacks evidence (Byrne et al., 2019). Therefore, CET treatments need to be refined, and VR has enhanced the possibilities to apply CET. If exposure techniques are successful because they create an emotional charge and induce anxiety, the relationship between anxiety and craving should be further analysed among VR-CET. Ghiţă et al. (2019b) already found a positive correlation between trait anxiety and craving for alcoholic beverages.

Among the existing literature, there is a lack of papers that examine the role of presence, and the relationship between anxiety and the role of presence is inconclusive (Serrano et al., 2019). Although, studies on phobias already did find a relationship between the sense of presence and the experienced fear, e.g. Price et al. (2011). In general, there seems to be a correlation between high levels of emotional charge and the role of presence (Diemer et al., 2015). Similarly, Riva et al. (2007) assumed a circular interaction between presence and emotions. Anxiety might influence presence, but presence might also evoke anxiety. There seems to be a bi-directional relationship between both factors (Bouchard et al., 2008; Robillard et al., 2003). Additionally, preliminary studies showed that an emotional experience in a virtual reality environment induces a greater sense of presence (Cadet & Chainay, 2020). Specifically, Bouchard et al. (2008) presumed that anxiety leads to a greater experienced presence among VR in their study on snake phobia by evaluating one-item measures. They elucidated that the

cognition about being anxious might lead to the conclusion of being in a real environment (Bouchard et al., 2008). Moreover, craving has been related to the experienced ecological validity of VR (Simon et al., 2020).

Preliminary research suggested that there are relationships between anxiety, the sense of presence and craving. If there is a relationship between the experienced anxiety and craving, the role of the sense of presence as a mediator needs to be investigated and may explain how and why anxiety and craving are connected.

Former studies found a relationship between the sense of presence and skill attainment (Grassini et al., 2020). If anxiety is decreased and CET works successfully by increased skills such as self-efficacy (Loeber et al., 2006) and self-control (Byrne et al., 2019), the sense of presence may impact the treatment outcomes regarding craving. So, if presence works as a mediator, further research and practitioners may focus on VR presence and increase this factor to improve treatment outcomes among VR-CET. To date, no one has examined the role of presence in the relationship between state anxiety and craving in VR-CET. In this study, two different types of presence should be examined: (1) the perceived realism of virtual alcoholic beverages and (2) the perceived realism of ALCO-VR environments. Attention must be paid to the fact that these measured realisms cannot represent presence to its whole extent. Those measured realisms should be regarded as parts of presence. State anxiety was chosen because it refers to a person's feeling in a specific moment that matches the idea of presence as "being there" (Heeter, 1992) at a specific moment. This study will explore the following hypotheses, whereas craving refers to the craving for alcoholic beverages. The hypotheses are presented in Figure 1 & 2.

H1: The relationship between state anxiety and craving is mediated by the perceived realism of presented alcoholic beverages.

H2: The relationship between state anxiety and craving is mediated by the perceived realism of ALCO-VR environments.

**Figure 1**
*Hypothesis 1*

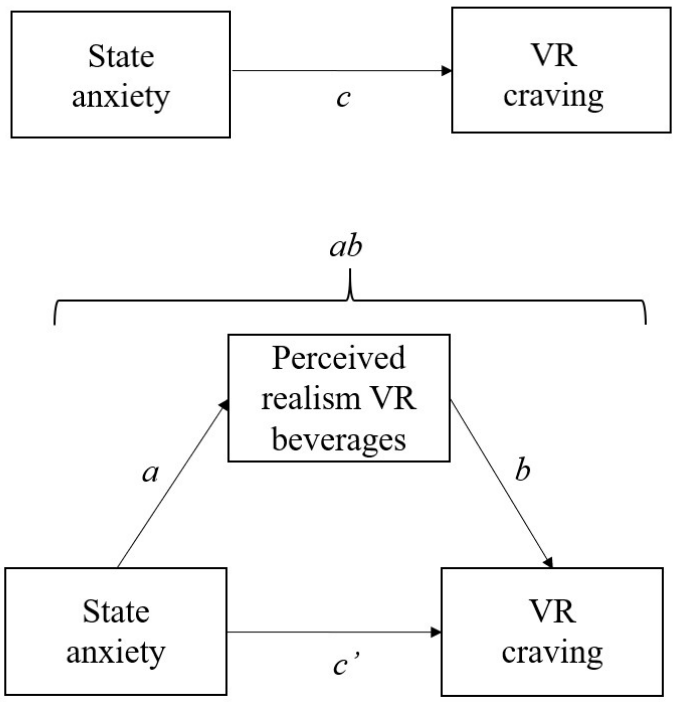
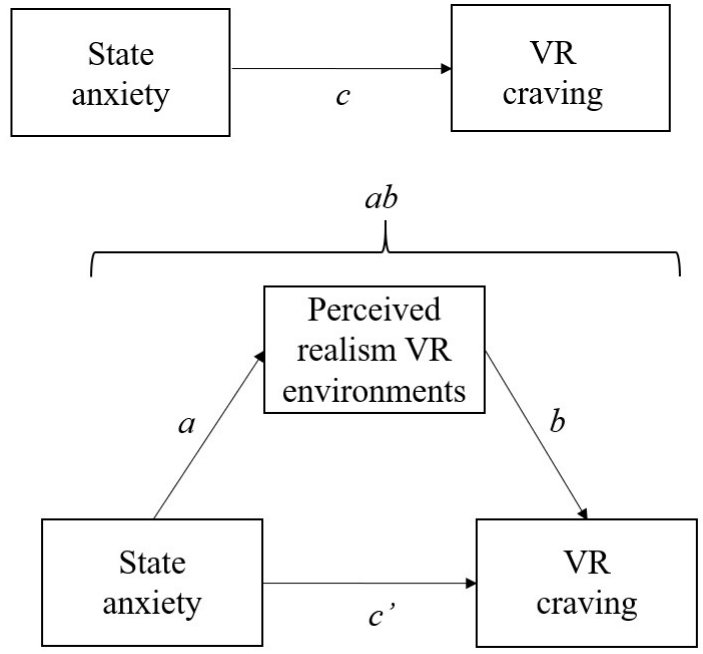



**Figure 2**
*Hypothesis 2*



# Methods

## Participants

The sample of this study consisted of 21 ($M_{Age}$=52.8, $SD_{Age}$=7.6) individuals who were recruited from the Hospital Clinic of Barcelona. Included were patients with an AUD diagnosis according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders (5th Ed.) (American Psychiatric Association, 2013) and with an outpatient treatment as usual (TAU) for AUD at the Hospital Clinic of Barcelona (Hernández-Serrano et al., 2020).

## Measures

Alcohol consumption, drinking behaviours and alcohol-related problems were assessed using the Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993). The Spanish version of AUDIT (Guillamón et al., 1999) applied in this study uses a 10-item scale assessing alcohol misuse and alcohol-related problems. It consists of three questions on the consumption of alcoholic drinks (amount and frequency), four questions related to dependence, and three questions on the analysis of its consequences. Answers are scored from 0 to 4, and the maximum score is 40. In this study, the AUDIT score was used to measure AUD severity (Hernández-Serrano et al., 2020). The cut-point of the scale is eight for the identification of a potential alcohol-related problem (Reinert & Allen, 2002).

A modified version of the Multidimensional Alcohol Craving Scale (MACS) (Serecigni et al., 2004) (MACS-VR) was applied during the experiment to evaluate alcohol craving directly after VR exposure to alcohol-related contexts and cues. Generally, the MACS-VR consists of the same items, scores, and outcome measures as the MACS. The only difference is the instruction to assess "the intensity of alcohol craving experienced during the VR exposure". The items are scored from 1 ("Strongly disagree") to 5 ("Strongly agree"). The MACS-VR delivers three different outcome scores: "desire to drink," "behavioural disinhibition," and the total score for craving, which were categorised as nonexistent, mild, moderate, or intense.

The State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1971), as a self-reported questionnaire, was used to assess the anxiety of each participant. This questionnaire contains two subscales assessing how an individual feels at the moment (STAI-state, state anxiety). Each of the subscales includes 20 items, which can be scored from 0 ("not at all") to 3 ("very much so"). Higher scores among the subscales might indicate a higher level of trait or state anxiety. Only state anxiety was included in the evaluation.

Perceived realism VR was evaluated by using ad-hoc items including a scale from 0-10 (0 being "not at all real" and 10 being "very much real"). The participants had to rate their

perceived realism of the presented VR beverages and of the virtual environments of the ALCO-VR software. The questions were “How would you rate the VR environments?” and “How would you rate the VR drinks?”.

## Instruments

### *Hardware*

The VR equipment included an Oculus Rift head-mounted display (HMD), 1080 × 1200 resolution per eye, a 90 Hz refresh rate, and 110◦ field of view, sensors, touch controllers, and a computer compatible consisting of the VR technology (INTEL(R) Core(TM) i7-2600 CPU, 16.0 GB RAM, Operating System 64 bits, processor ×64, graphic card NVIDIA GeForce GTX 1080 Ti) (Ghiţă et al., 2021).

### *Software*

The software used in this study is called ALCO-VR, which was developed in an earlier study by Ghiţă et al. (2019b). This software consists of four different VR alcohol-related environments: a pub, a bar, a restaurant, and a house. All these environments represent real-life situations developed with patients. The VR environments were developed considering multiple variables, for example, social interactions (including avatars) and various alcohol-related cues (a menu of 22 alcoholic drinks). Two environments take place in the daytime (bar and restaurant), and two environments take place during the night. Just one scenario contains no social interactions (house), whereas the three other sceneries include social interactions (bar, pub, restaurant). Moreover, the software included a neutral environment (a room with a white background and a glass of water), where the participants could first get used to the virtual environment. The ALCO-VR platform is based on two steps, assessment, and treatment (Ghiţă et al., 2019b).

## Ethical approval

The patients participating in this study were reviewed and approved by the Ethics Committee of the University of Barcelona and the Ethics Committee of the Hospital Clinic of Barcelona. All participants provided their written informed consent to participate in the project (Hernández-Serrano et al., 2020).

## Procedure

The 21 participants of the study were recruited from the Addictive Behaviors Unit, Hospital Clinic of Barcelona. Personal data was collected at the initial assessment, such as AUD history, medication, and abstinence data. After a short explanation about the applied technology, the participants were asked to sign the informed consent document. Before the

experiment, the clients were asked about their clinical state and data, such as dual diagnosis, days of abstinence, medication, alcohol consumption and other substance use (illicit or licit) during the month before the experiment. The collected data was verified by their clinical psychologists. The participants were further asked to complete the AUDIT (Total score = 28), MACS (craving for the last week) and STAI (only the trait part). Afterwards, the participants were introduced to the touch controllers and they received some water to drink to not interfere with alcohol consumption patterns. Subsequently, the patients were exposed to alcoholic beverages and the different VR environments (pub, at home, bar, restaurant). Then, the patients were asked to rate the MACS-VR and the state part of the STAI. Additionally, the participants had to rate their experienced realism of the virtual environments and beverages on a scale from 0-10. The session was held by an experienced clinician-scientist at VR-Psy Lab, University of Barcelona (Hernández-Serrano et al., 2020).

**Statistical analysis**

The statistical analysis was carried out by using SPSS Statistics 27. The alpha level for the analysis has been decided to be 0.05. As a pre-step, the realism VR environments was compared to the realism VR beverages via a *t*-test. Moreover, correlations were computed for relevant variables for the mediation analysis to find potential relationships.

The tool PROCESS 3.5 (Hayes, 2012) has been applied in SPSS to analyse possible mediating effects (1) for the perceived realism of the VR alcoholic beverages and (2) for the perceived realism of VR environments on the relation between state anxiety (STAI state part) and VR craving (MACS-VR). The macro for the mediation analysis is based on ordinary least squares regression, producing unstandardised path coefficients for total, direct, and indirect effects. Bootstrapping with 5000 samples with heteroscedasticity consistent standard errors (Davidson & MacKinnon, 1993) was used to compute the analysis. Effects were shown to be significant when the confidence interval did not include zero.

For a partial mediating effect, the following four criteria should be met: (1) the independent variable state anxiety should influence the dependent variable VR craving in a direct relation (2) variations in levels of the independent variable anxiety significantly influence the expected mediator perceived realism VR beverages or perceived realism VR environments, (3) the mediator has a significant relation to the outcome variable VR craving, (4) when Paths a and b are controlled, a previously significant relation between the independent variable state anxiety and dependent variable VR craving is still significant. To test this mediation, the researcher will estimate the four following regression equations: first, the regression of the

independent variable on the dependent variable, second, the regression of the independent variable on the mediator; third, the regression of the mediator on the dependent variable; and fourth, a multiple regression of the mediator and independent variable on the dependent variable (Baron & Kenny, 1986). Newer research suggested that a significant indirect effect is sufficient to identify a mediator (Zhao et al., 2010).

The assumptions for this regression analysis were met, except for the distribution of normality for the variable VR realism environments. The Shapiro-Wilk test was significant, $p < .05$, for this variable. A Histogram was made for this variable and showed a slight left-skewed distribution. As this might be a result of the small sample size, normality is assumed.

## Results

### Descriptive analysis

The socioeconomic data is presented in table 1. 21 participants were included in this study with a mean age of 52.8 years (*SD*=7.6). The majority of patients has a Bachelor's degree (38.1%) or a Post-high school education (33.3%). The socioeconomic status is mainly medium (76.2%), and almost half of the participants live in a relationship (42.9%). Less than half of the sample suffers from a comorbid pathology (42.9%). More than half of the participants smoke currently (57.1%). 42.9% of the sample is taking antidepressants or anxiolytics, and one third is taking Disulfiram (33.3%). The mean value of the AUDIT questionnaire, which was used to measure AUD severity was *M*=17 (*SD*=10.5) and can be classified as high (Miller, 1992).

**Table 1**

*Descriptive Data of the sample*

| Variable | *n* (%) / *M* ± *SD* |
|---|---|
| Age | 52.8 (7.6) |
| Gender | |
| Female | 47.6 |
| Male | 52.4 |
| Education | |
| Secondary School | 9.52 |
| Highschool | 14.3 |
| Post-high School | 33.3 |
| BSc | 38.1 |
| MSc | 4.8 |
| Socioeconomic Status | |
| Low | 14.3 |
| Medium | 76.2 |
| High | 4.8 |

**Table 1 (continued)**

| Variable | *n* (%) / *M* ± *SD* |
|---|---|
| Civil Status | |
| Single | 14.3 |
| In a Relationship | 42.9 |
| Divorced/Separated | 33.3 |
| Widower | 9.5 |
| Comorbid Psychopathology | |
| None | 42.9 |
| Depression | 19.1 |
| Depression & Anxiety | 14.3 |
| Depression & Anxiety & Personality Disorders | 4.8 |
| Personality Disorders | 4.8 |
| Smoking | |
| Not Smoking | 28.6 |
| Currently Smoking | 57.1 |
| Medication | |
| No | 28.6 |
| Antidepressants | 23.8 |
| Anxiolytics | 19.1 |
| Anxiolytics & Antidepressants | 28.6 |
| Disulfiram | |
| No | 66.7 |
| Yes | 33.3 |
| AUDIT | 17 (10.5) |
| Abstinence days | 74.2 (92.6) |

Table 2 shows the relevant variables for the mediation analysis. Mean state anxiety was 20.5 (*SD*=11.4), which can be categorised as no or low anxiety (Kayikcioglu et al., 2017). Further, the realism VR environments and the realism VR beverages assessed by ad-hoc items were compared via a *t*-test. A significant difference $t$=2.71, $df$=20, $p$=.013 was found between realism VR environments (*M*=7.9, *SD*=1.5) and realism VR beverages (*M*=6.8, *SD*=1.9). The mean value of VR craving measured using MACS-VR (*M*=30.7, *SD*=12.3) can be classified as a moderate craving.

**Table 2**
*Mean values of chosen variables*

| Variable | *M* | *SD* |
|---|---|---|
| Realism environments | 7.9 | 1.5 |
| Realism VR beverages | 6.8 | 1.9 |
| State anxiety | 20.5 | 11.4 |
| VR craving | 30.7 | 12.3 |

Table 3 contains the correlation coefficients for relevant variables for the further analysis. There was a significant moderate correlation (Cohen, 1988) between the perceived realism of the VR drinks and the VR craving assessed by MACS-VR ($r$=.47, $p$=.033).

**Table 3**

*Pearson's correlation coefficients for relevant variables*

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. VR craving | 1.00 | | | |
| 2. Realism VR environments | .07 | 1.00 | | |
| 3. Realism VR beverages | .47* | .35 | 1.00 | |
| 4. State anxiety | .42 | -.31 | .10 | 1.00 |

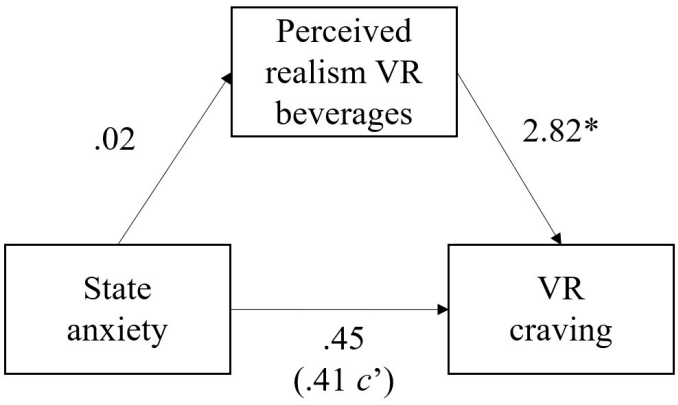
*Note.* *=$p$ < .05 (2-tailed)

**Main analysis**

A mediation analysis was performed to examine whether state anxiety predicts craving in this sample. A non-significant effect of state anxiety on VR craving was observed, $c$=.45, $p$=.0554. However, the $p$-value might indicate a trend. After entering the mediator perceived realism VR beverages into the model, state anxiety predicted the mediator non-significantly, $a$=.02, $p$=.6822, which predicted the VR craving significantly, $b$=2.82, $p$=.0356. The indirect effect was $ab$=.04, 95%-CI[-.22,.42], which is not significant as the bootstrap interval contains zero. In conclusion, the perceived realism of VR beverages could not be detected as a mediator for the relationship between state anxiety and VR craving in this sample.

**Figure 2**

*Results for hypothesis 1*



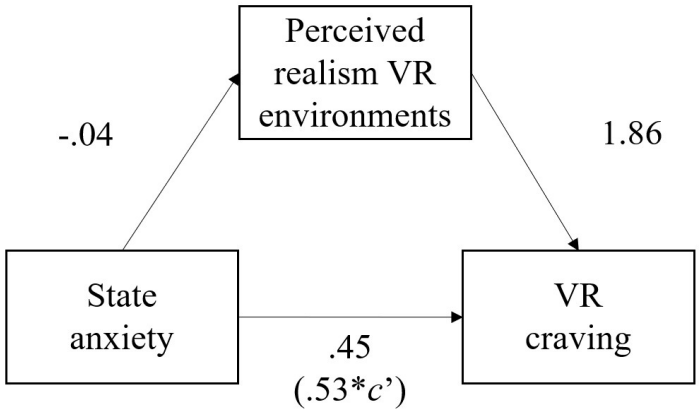

*Note.* *=$p$ < .05

For the second hypothesis, the direct non-significant effect remained the same as shown for the first hypothesis, $c$=.45, $p$=.0554. The mediator perceived realism VR environments was entered into the model. State anxiety predicted the mediator non-significantly $a$=-.04 $p$=.1762, which predicted the VR craving $b$=1.86, $p$=.3179 also non-significantly. The indirect effect for the second hypothesis was $ab$=-.07 95%-CI[-.26,.13], which is also not significant as the

bootstrap interval contains zero. The perceived realism of VR environments could not be identified as a mediator between state anxiety and VR craving in this sample.

**Figure 3**

*Results for hypothesis 2*




*Note*.*=$p < .05$

## Discussion

### Main findings

The main objectives of this study were to examine whether (1) the perceived realism of VR beverages and whether (2) the perceived realism of VR environments is mediating the relationship between state anxiety and VR craving. In general, neither a mediating effect of the perceived realism VR beverages nor of the perceived realism VR environments was found.

Apart from state anxiety, VR craving and perceived realism, the sample's AUDIT data was evaluated. The AUDIT revealed a mean value of 17, which determines a high severity of alcohol-related problems in this study population (Miller, 1992).

### The relationship between state anxiety and virtual reality craving

No significant effect was found in the relationship between state anxiety and VR craving. A relationship between state anxiety and VR craving is still assumed based on the preliminary research among VR environments (Ghiţă et al., 2019a) and real-life contexts (McCaul et al., 2017; Miller et al., 2020; Sinha et al., 2011). It can be speculated that this relationship works directly without a mediator (Ghiţă et al., 2019a). The lack of significance in this study is likely a result of the small sample size. However, the non-significant moderate correlation between state anxiety and VR craving and a *p* in the regression analysis, which is slightly above the cut-off point .05, may indicate a trend.

**The relationship between state anxiety and perceived virtual reality realism**

A mediating effect of the perceived realism of VR beverages and VR environments was not found. Specifically, state anxiety and perceived realism VR do not seem to be connected, as the effects in the mediation model are small and non-significant. State anxiety does not seem to influence how a person experiences a VR environment or a VR beverage in our sample. Therefore, anxiety and perception do not seem to be connected. Our results corroborate with previous work by Slater (2003), who regarded presence and emotional states as different from each other and independent concepts. Simultaneously, anxiety as an emotional state may be focused on a person but not on their environment or surroundings.

The given results could also lead to the conclusion that anxiety increases while presence decreases because of a non-significant negative moderate correlation (Cohen, 1988) between state anxiety and VR realism environments. This is consistent to the results of Bouchard et al. (2008) and their evaluation of presence questionnaires. An explanation might be that the cognition of being afraid inhibits the cognition of being real (Brewin, 2006). Possibly, higher state anxiety may decrease the perceived realism because of a greater focus on internal emotions and thoughts. Similarly, empirical research has shown that individuals with social anxiety tend to focus more on themselves. For highly social anxious persons, specifically critical situations – comparable to the VR exposure in this study – can increase their self-focus (Vriends et al., 2017).

While regarding emotions as a continuum, the given results could also be explained by the findings of Pallavicini et al. (2020), who concluded a relationship between positive emotions and presence. Perhaps, those positive emotions have a stronger effect on the feeling of presence as they may foster the perception of the environment and broaden the scope of attention (Fredrickson, 2013). In contrast to that, negative emotions might reduce the feeling of being present and narrow the view.

The findings of this study differ from previous results depicted in the literature. Several researchers suggested relationships between strong emotions such as anxiety and presence (e.g. Bouchard et al. 2008; Diemer et al., 2015; Price et al., 2011; Renaud et al., 2002). It has been argued that this relationship exists because the cognition of being afraid might lead to the assumption to be real (Bouchard et al., 2008). For example, Price et al. (2011) found a relation between in-session peak anxiety and presence rating among their VR exposure therapy. They used the IPQ (Ingroup Presence questionnaire, Schubert et al., 2001) to assess presence, which contains three subscales: spatial presence, involvement and realness. Particularly, the realness

subscale, which is most comparable to the measurement of realism in this study, was significantly related to peak anxiety (Price et al., 2011). In summary, most investigations reported a relationship between presence and emotional arousal, which is in contrast to our results.

One reason that the results of this study are inconsistent to preliminary work might be that the mean state anxiety of the participants could be classified as non-existing or low (Kayikcioglu et al., 2017). This might explain why the participants did not perceive an emotional charge, which could not instill realism.

Another reason why the given results differ from preliminary research is that most prior research focused on participants with anxiety disorders, whereas in this study, individuals with AUD were recruited. The majority of the participants (67%) in this study is not suffering from an anxiety disorder. Whereas, it has been shown that the correlation between anxiety and presence is stronger in patients with anxiety disorders (Ling et al., 2014). Individuals with anxiety disorders are afraid of specific stimuli such as a spider, which can be displayed virtually (Renaud et al., 2002). Possibly their realism increases to keep the feared stimulus focused. Speculating that in this study, people with AUD felt not afraid of the cues themselves but rather afraid to lose control, and therefore they focused on their inner feeling to keep control (Byrne, 2019).

Moreover, there are trait differences between patients with anxiety disorder and AUD. Individuals with anxiety disorders are known to be involved in treatment, whereas patients with AUD are characterised by impulsivity and ambivalence (Byrne, 2019). Potentially, participants in this study felt afraid during the VR exposure but did not intend to feel real and wanted to quit because of their impulsivity (e.g. Verdejo-Garcia et al., 2008). Therefore, they might have thought, “I am afraid.” so “I want to quit the VR, and this is not real.”, whereas patients with anxiety disorders might think, “I am afraid.” so “The VR is real.” (Bouchard, 2008).

In addition, the question concerning realism might have led to the assumption of being not in a real-world via shifting the focus to realism and questioning this.

**The role of the perceived realism virtual reality beverages**

The VR realism beverages did not mediate the relationship between state anxiety and VR craving in our model. Although state anxiety does not seem to influence the perceived realism of the beverages, the mediation analysis revealed that the perceived realism VR beverages influenced the VR craving significantly.

The association of VR realism beverages and VR craving might exist because the VR beverage itself is a proximal cue that is closely related to addictive behaviour. Similar to our results, multiple studies (Cooney et al. 1997; Drummond & Glautier, 1994; Hutchison et al., 2001; Monti et al., 1993; Szegedi et al., 2000) assumed that these real proximal cues increase physical arousal and subjective craving in moderate and heavy drinkers. Since the perceived VR realism of beverages evokes expectations concerning substance availability in the environment, it can induce craving (Field & Cox, 2008). The given results conclude that a higher perceived realism relates to the belief that the VR beverage is truly consumable. Simon et al. (2020) already found a relationship between craving and perceived realism in heavy drinkers. The focus on drug-related cues in heavy drinkers might further foster craving (Simon et al., 2020). Similarly, the average of the sample in this study shows a risky drinking behaviour.

In addition, Andersen et al. (2019) showed that a positively perceived presence sensation in a VR environment leads to the wish to consume a beverage. Patients in this study might have experienced a positive perceived presence when seeing an alcoholic beverage, which created craving. Also, preliminary research on smoking found that presence is a predictor for self-reported craving and a high sense of presence among VR exposure therapy is necessary to assure the effectiveness of CET (Ferrer-García et al., 2012). A higher sense of presence may induce craving and makes it easier to acquire skills in the VR environment (Grassini et al., 2020). In conclusion, the realism VR beverages may generate VR craving, which is crucial for VR-CET (Loeber et al., 2006).

**The role of the perceived realism of virtual reality environments**

The results of this study did not indicate a mediating effect of the perceived realism of VR environments in the relationship between state anxiety and VR craving. This finding is in line with research by van Gisbergen et al. (2018), who concluded that a higher perceived realism does not always evoke a more realistic behaviour.

An explanation that this realism did not mediate the relationship between state anxiety and VR craving might be a ceiling effect (Bouchard et al., 2008). So, that the realism of VR environments was already high enough and could not further be influenced by anxiety nor increase VR craving. Assuming that highly immersive and expensive technologies are not always necessary for VR-CET. If a ceiling effect exists, the question arises: How much realism is needed (Simon et al., 2020)?

**The difference between perceived realism of virtual reality environments and beverages**

Interestingly, the given results show that the perceived realism of environments was higher than the perceived realism VR beverages suggesting that this study could already provide a good level of realism of VR environments by applying immersion. An explanation for this difference might be the higher focus on drug-related cues in people with AUD (Simon et al., 2020), assuming that people with AUD are even more ambivalent and critical about focused cues that they know well from their addictive behaviour.

**Strengths, limitations, and future directions**

This study aimed to enhance the understanding of how state anxiety and craving in a VR context might be connected. The primary strength of this study is that key concepts of VR CET for AUD and possible working mechanisms were related to each other. These different factors combined may amplify the working mechanisms of VR CET for AUD partly. Moreover, two different kinds of perceived realisms and their role in the relationship between state anxiety and VR craving have been analysed, and possible suggestions were made. This study is the first to explore these specific relationships by using the ALCO-VR software (Ghita et al., 2019b). Some limitations need to be considered and addressed in future studies.

First of all, the sample size of this study with 21 participants provided limited power and makes it difficult to generalise the results. Therefore, future studies should focus on increasing the sample size to raise validity. Additionally, the variable VR environments was not normally distributed, although the regression analysis is based on the normality distribution. The results should therefore be interpreted cautiously.

Third, the perceived VR realism of beverages and environments was measured using one item for VR beverages and one for VR environments. This kind of measurement makes the given results hardly comparable to studies, which assessed presence with different questionnaires or interviews. The use of single items may also explain the inconsistency with previous studies. More broadly, research is also needed to target the construct sense of presence in its different parts to receive exact results. The utilisation of the IPQ questionnaire (Schubert, 2001) would be desirable for future work as it contains three subscales to measure the sense of presence: spatial presence, involvement, and experienced realism. Therefore, the measurement of presence of this study is limited and reduced to the factor of perceived realism. Moreover, it is relevant to determine a minimum level of realism to ensure an efficient treatment (Simon et al., 2020). If there is a ceiling effect of realism, practitioners do not need to invest in the most expensive equipment and create highly immersive VR (Bouchard et al., 2008). However, future

studies might focus on increasing the realism of VR beverages as this was lower than the realism of VR environments. Particularly this realism seems to be related to craving. It might also be worthwhile to determine the reasons for the discrepancy between the two measured realisms.

Future studies should also focus on identifying other possible mediators, e.g. self-efficacy (Loeber et al., 2006) or personality traits, in the relationship between state anxiety and VR craving. Moreover, avatars could play a role by inducing social pressure (Cho et al., 2008; Kwon et al., 2009), and their realism might also be a predictor for craving.

The current study has examined state anxiety and VR craving via self-reported questionnaires. This subjectivity could eventually lead to bias such as social desirability (Van de Mortel, 2008). Further experimental investigations should also measure biomarkers to enhance the quality of measured anxiety and craving. Future studies will need to expand their assessment of anxiety and craving by integrating methods like eye-movement tracking, heart rate measurement and galvanic skin response (Zhou et al., 2016) to increase the objectivity of measurement. Particularly, eye movement tracking might be interesting to examine whether the focus on specific stimuli is moderating the relationship between realism and VR craving. Also, EEG measures such as neuropsychological information might be applied to measure and evaluate craving (e.g. Lee et al., 2009) and state anxiety (e.g. Mathersul et al., 2008) in VR CET.

In this study, the mean state anxiety can be categorised as non-existent or low. Future studies might also try to induce an emotional charge and raise anxiety, e.g. by showing a frightening movie or presenting an individualised anxiety trigger to the participant. Afterwards, it should be investigated if anxiety influences realism and VR craving. If VR-EBT for anxiety works successfully because of an emotional charge (Bouchard et al., 2019), this might be a key to raise the efficacy of VR-CET.

Moreover, the sample of this study is heterogeneous concerning abstinence period, comorbid pathology, and medication. Possible influences need to be considered. For example, anxiety disorders might have influenced the correlation between state anxiety and craving. Individuals with anxiety disorders are generally stronger influenced by feared stimulus environments, which can be imitated by VR (Ling et al., 2014). Future studies should consider separating different groups from each other, e.g. with different abstinence periods or people with anxiety disorders and other disorders, to reduce the specific influence of these factors (Ghiţă et al., 2019b). Also, a co-use of illicit drugs was not analysed in this study. Future

research should focus on assessing a co-use as this might also induce higher levels of cravings (Karriker-Jae et al., 2018).

Additionally, more concepts such as self-efficacy (Bandura, 1989), self-control (Byrne, 2019) and their role among virtual reality exposure techniques might be integrated into future studies. Specifically, the concept of self-efficacy has been argued to be essential among CET (Loeber et al., 2006) and may also be increased by applying VR-CET.

## Conclusion

In summary, this work aimed to determine whether the perceived VR realism of VR beverages and the perceived realism of VR environments mediate the relationship between state anxiety and VR craving. Our findings suggest that the perceived realism is not working as a mediator between state anxiety and VR craving. Despite the limitations of this study, the findings indicate that the perceived realism among VR environments is an essential factor in generating craving and ensuring the effectiveness of VR-CET for AUD. Particularly, the perceived realism of VR beverages predicted VR craving in the model and is therefore relevant to achieve among VR-CET for AUDs. Practitioners should not underestimate the influence of a remarkable perceived realism, possibly generated by immersion and good technical standards (Ling et al., 2014). Still, it is necessary to determine a required minimum of realism for VR-CET (Simon et al., 2020). However, future research with larger sample sizes is recommended to verify the given results. An ultimate goal should be to improve VR-CET, reduce relapse rates and increase the attractiveness of VR-CET for practitioners by presenting overall consistent promising and lasting results regarding treatment outcomes. This study has gone towards enhancing the understanding of a potential working mechanism in VR-CET for AUD. Although there are promising results for VR-CET for AUDs, there is a need to continue research and investigate the effectiveness of this approach alone and in combination with traditional approaches (Ghiţă et al., 2021). Finally, this approach might be as same effective and feasible as VR-EBT for anxiety disorders has shown to be (Anderson & Molloy, 2020).

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## Appendix A

## AUDIT questionnaire

# AUDIT

PACIENTE: Debido a que el uso del alcohol puede afectar su salud e interferir con ciertos medicamentos y tratamientos, es importante que le hagamos algunas preguntas sobre su uso del alcohol. Sus respuestas serán confidenciales, así que le agradecemos su honestidad.

Para cada pregunta en la tabla siguiente, marque una X en el cuadro que mejor describa su respuesta.

NOTA: En los Estados Unidos *una bebida* se refiere a cualquier bebida que contiene aproximadamente 14 gramos de etanol o alcohol puro. Las bebidas que siguen a continuación son de diferentes tamaños sin embargo su contenido de alcohol es el mismo. Es por eso que todas son consideradas *una bebida*:


| Preguntas | 0 | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|---|
| 1. ¿Con qué frecuencia consume alguna bebida alcohólica? | Nunca | Una o menos veces al mes | De 2 a 4 veces al mes | De 2 a 3 más veces a la semana | 4 o más veces a la semana | |
| 2. ¿Cuantas consumiciones de bebidas alcohólicas suele realizar en un día de consumo normal? | 1 o 2 | 3 o 4 | 5 o 6 | De 7 a 9 | 10 o más | |
| 3. ¿Con qué frecuencia toma 5 o más bebidas alcohólicas en un solo día? | Nunca | Menos de una vez al mes | Mensualmente | Semanalmente | A diario o casi a diario | |
| 4. ¿Con qué frecuencia en el curso del último año ha sido incapaz de parar de beber una vez había empezado? | Nunca | Menos de una vez al mes | Mensualmente | Semanalmente | A diario o casi a diario | |
| 5. ¿Con qué frecuencia en el curso del último año no pudo hacer lo que se esperaba de usted porque había bebido? | Nunca | Menos de una vez al mes | Mensualmente | Semanalmente | A diario o casi a diario | |
| 6. ¿Con qué frecuencia en el curso del último año ha necesitado beber en ayunas para recuperarse después de haber bebido mucho el día anterior? | Nunca | Menos de una vez al mes | Mensualmente | Semanalmente | A diario o casi a diario | |
| 7. ¿Con qué frecuencia en el curso del último año ha tenido remordimientos o sentimientos de culpa después de haber bebido? | Nunca | Menos de una vez al mes | Mensualmente | Semanalmente | A diario o casi a diario | |
| 8. ¿Con qué frecuencia en el curso del último año no ha podido recordar lo que sucedió la noche anterior porque había estado bebiendo? | Nunca | Menos de una vez al mes | Mensualmente | Semanalmente | A diario o casi a diario | |
| 9. ¿Usted o alguna otra persona ha resultado herido porque usted había bebido? | No | | Sí, pero no en el curso del último año | | Sí, el último año | |
| 10. ¿Algún familiar, amigo, médico o profesional sanitario ha mostrado preocupación por un consumo de bebidas alcohólicas o le ha sugerido que deje de beber? | No | | Sí, pero no en el curso del último año | | Sí, el último año | |
| | | | | | **Total** | |

***Nota:*** Este cuestionario (el AUDIT) se reimprime con permiso de la Organización Mundial de la Salud y la Generalitat Valenciana Conselleria de Benestar Social. Para reflejar las medidas de consumo en los Estados Unidos (14 gramos de alcohol puro), la cantidad de tragos en la pregunta 3 fue cambiada de 6 a 5. En el sitio ***www.who.org*** está disponible en forma gratuita un manual AUDIT con guías para su uso en la atención primaria.

Excerpted from NIH Publication No. 07-3769 **National Institute on Alcohol and Alcoholism** *www.niaaa.nih.gov/guide*

**Appendix B**

**MACS-VR questionnaire**

## Escala Multidimensional de Craving de Alcohol (EMCA)

| ***En los entornos de realidad virtual.*** | Muy de acuerdo | Bastante de acuerdo | Ni de acuerdo ni en desacuerdo | Bastante en desacuerdo | Muy en desacuerdo |
|---|---|---|---|---|---|
| 1. He tenido ansia de beber | 5 | 4 | 3 | 2 | 1 |
| 2. Habría hecho casi cualquier cosa por beber | 5 | 4 | 3 | 2 | 1 |
| 3. He deseado beber | 5 | 4 | 3 | 2 | 1 |
| 4. He podido controlar completamente mi deseo de beber | 5 | 4 | 3 | 2 | 1 |
| 5. Tomar una copa habría sido ideal | 5 | 4 | 3 | 2 | 1 |
| 6. He estado pensando la manera de ir a por una bebida | 5 | 4 | 3 | 2 | 1 |
| 7. Beber hubiera sido maravilloso | 5 | 4 | 3 | 2 | 1 |
| 8. He tenido muy a menudo la mente ocupada con imágenes relacionadas con la bebida | 5 | 4 | 3 | 2 | 1 |
| 9. Las ganas de beber han sido muy intensas | 5 | 4 | 3 | 2 | 1 |
| 10. Me hubiera sentido mejor si hubiera podido beber | 5 | 4 | 3 | 2 | 1 |
| 11. He experimentado una vez o más un intenso deseo de beber | 5 | 4 | 3 | 2 | 1 |
| 12. Aunque hubiese tenido la oportunidad no hubiera bebido | 5 | 4 | 3 | 2 | 1 |

# Appendix C

## STAI-state questionnaire

### INVENTARIO DE ANSIEDAD ESTADO

### (STATE-TRAIT ANXIETY INVENTORY-STAI)

*Instrucciones:* A continuación encontrará unas frases que se utilizan corrientemente para describirse uno a sí mismo. Lea cada frase y señale la puntuación de 0 a 3 que indique mejor como se siente ***usted ahora mismo***, en este momento. No hay respuestas buenas ni malas. No emplee demasiado tiempo en cada frase y conteste señalando la respuesta que mejor describa su situación presente.

| | Nada | Algo | Bastante | Mucho |
|---|---|---|---|---|
| 1. Me siento calmado | 0 | 1 | 2 | 3 |
| 2. Me siento seguro | 0 | 1 | 2 | 3 |
| 3. Estoy tenso | 0 | 1 | 2 | 3 |
| 4. Estoy contrariado | 0 | 1 | 2 | 3 |
| 5. Me siento cómodo (estoy a gusto) | 0 | 1 | 2 | 3 |
| 6. Me siento alterado | 0 | 1 | 2 | 3 |
| 7. Estoy preocupado ahora pos posibles desgracias futuras | 0 | 1 | 2 | 3 |
| 8. Me siento descansado | 0 | 1 | 2 | 3 |
| 9. Me siento angustiado | 0 | 1 | 2 | 3 |
| 10. Me siento confortable | 0 | 1 | 2 | 3 |
| 11. Tengo confianza en mí mismo | 0 | 1 | 2 | 3 |
| 12. Me siento nervioso | 0 | 1 | 2 | 3 |
| 13. Estoy desasosegado | 0 | 1 | 2 | 3 |
| 14. Me siento muy "atado" (como oprimido) | 0 | 1 | 2 | 3 |
| 15. Estoy relajado | 0 | 1 | 2 | 3 |
| 16. Me siento satisfecho | 0 | 1 | 2 | 3 |
| 17. Estoy preocupado | 0 | 1 | 2 | 3 |
| 18. Me siento aturdido y sobreexcitado | 0 | 1 | 2 | 3 |
| 19. Me siento alegre | 0 | 1 | 2 | 3 |
| 20. En este momento me siento bien | 0 | 1 | 2 | 3 |