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Virtual Reality Therapy for Alcohol Relapse Prevention

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Rigina Skeva
Department of Computer Science

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Abstract

Alcohol misuse affects a large part of the population worldwide, often transforming to a chronic, relapsing condition, and contributes to economic costs to health and social care and other state services, hampering the achievement of sustainable development goals. An important part of alcohol treatments would typically focus on Relapse Prevention (RP) - helping people to develop relevant coping skills in high-risk situations that challenge abstinence. Exposure to personalised and realistic high-risk situations for practising coping within them can be challenging in clinical contexts. Virtual Reality Therapy (VRT) could offer immersive and controlled exposure to high-risk situations via their simulation as Virtual Environments (VEs). VRT could also increase treatment accessibility, being delivered online or via low-immersion VR set-ups for cost-effectiveness. Preliminary evidence suggests VRT's effectiveness on changing alcohol craving levels and alcohol-related attitudes. How to integrate VRT into current clinical practice for addressing specifically RP or other parts of alcohol treatment has not been explored. An interview study was, thus, conducted with practitioners and researchers delivering or designing substance use treatments, to determine VRT's clinical acceptability as a treatment tool in practitioners and identify the preferred content and functionality of a VRT application for RP and appropriate delivery protocols. Via a survey study with adults drinking at diverse levels, the relative treatment preference for and treatment acceptability of VRT (delivered either via standard VR headset or via mobile - mVRT) were explored compared to current, alcohol treatments in the UK, in order to identify factors of VRT's acceptability that should be considered in the design of its delivery protocols for increasing treatment uptake and engagement. A VRT application ("A-PLAN") was developed, that simulated common, high-risk situations, whose design was guided by practitioners' and researchers' suggestions and prior VEs assessed effective in literature for alcohol treatment, to test the suitability of these contexts for RP. Via an online, interview study with low- and high-risk drinkers, "A-PLAN" was assessed about its realism and its capacity to induce alcohol temptation in a cost-effective, VR setting, in order to refine its content for RP and explore the therapeutic potential of low-immersion, cost-effective VR set-ups. The combined findings of these studies informed the clinical application of VRT for RP, facilitating recommendations about its delivery protocol and the content and the functionality that a VRT application for RP should involve. Discussion and reflection on aspects of the delivery protocol and the application design that should be considered when clinically employing VRT for RP, with a focus on their associations with acceptability, therapeutic effectiveness, cost-effectiveness and accessibility, were also included. The reported findings, discussions and conclusions could inform future research and applications of VRT for RP and for alcohol treatment generally. The mixed research approach followed, involving qualitative and quantitative studies, could inform and quicken

the design process of novel, technological treatments tools and lead to their purposeful integration into relevant clinical practices.

Declaration of originality

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Chapter 1

Introduction

Virtual Reality Therapy (VRT) is increasingly being used in the treatment of psychological conditions (Gregg & Tarrier, 2007; S. Kim & Kim, 2020) due to its ability to offer realistic and controlled exposure to diverse, personalisable situations, relevant to the condition being treated. A formal definition of VRT does not currently exist as it is a new form of treatment. While its exact format and treatment goals will depend on the therapeutic paradigm and the psychological condition treated each time, in essence, VRT could be defined as virtual exposure to therapeutically-relevant situations that patients would be immersed in to practise coping within a clinical context (for example, coping by trying to reduce the fear of spiders felt each time in the sight of a virtual spider in Spider Phobia treatment). This is be particularly useful in clinical practice since, in most cases, it could be impractical to expose the patients to certain situations within a therapeutic setting, or risky, if they are not be adequately prepared to handle them in reality.

Alcohol misuse is one of the conditions that the therapeutic potential of VRT has recently been explored on, paired with diverse therapeutic contexts (Ghita & Gutierrez-Maldonado, 2018; Segawa et al., 2020; Trahan et al., 2019), but maintaining its therapeutic core of virtual exposure for practising coping (for example, coping by reducing alcohol craving or strengthening the intent to remain sober). Preliminary evidence suggest that VRT can help alcohol treatments by reducing alcohol craving to a moderate degree and changing drinking-related attitudes (Ghita & Gutierrez-Maldonado, 2018; Segawa et al., 2020; Trahan et al., 2019). The capability of VRT to affect alcohol craving and alcohol-related attitudes could indicate the suitability of VRT for relapse prevention, which targets at the more realistic treatment goal of identifying and regulating alcohol misuse symptoms (such as craving) rather than eliminating them and addressing all factors that could lead to relapse (not only craving). Considering the high relapse rates of alcohol dependant individuals (Moos & Moos, 2006), relapse prevention rises as a crucial part of alcohol treatments and any tools that could assist in that, require further investigation. VRT could, therefore, be more purposefully applied for assisting in relapse prevention rather than targeting at eliminating alcohol misuse symptoms, since practising how to resist drinking and coping mentally and emotionally would be necessary in most occasions. Contexts where VRT could be useful, for example, involve preparation of alcohol dependant individuals to be exposed to alcohol-related scenarios daily before the end of in-patient treatment or practising coping further, after having already relapsed.

Existing VRT studies, so far, have not investigated how acceptable VRT would be in practitioners and patient populations for assisting in alcohol treatment, and the relapse prevention stage, in particular. The effectiveness of VRT for relapse prevention has only been explored by one study with a small sample size (Yoon et al., 2014). Factors that could determine VRT's acceptability in RP and in other parts of alcohol treatment have not been studied at all and factors of its effectiveness have also not be studied in large sample sizes, or in depth via appropriate study designs (e.g. qualitative, interview studies). Such factors revolve around optimal delivery protocols, VRT's risks, benefits and challenges as an alcohol treatment tool, patient eligibility criteria to be delivered VRT and treatment preferences, useful, alcohol relapse prevention contents for the VRT application and software design implications. Thus, the potential of VRT and how to integrate it into current, clinical practice and transform it into a helpful tool for alcohol relapse prevention remain under-explored. The aim of the programme of work presented in this thesis was to inform the clinical application of VRT for alcohol relapse prevention for individuals who misuse alcohol. The findings presented in this thesis could promote the clinical use of VRT for alcohol relapse prevention, by informing the delivery protocols and software design of VRT applications for alcohol relapse prevention, but they could also be relevant for any VRT applications that target parts of alcohol treatments other than relapse prevention.

1.1 Alcohol Misuse and Relapse

Alcohol misuse is defined as drinking that is harmful to the physical or mental health of oneself, including the cases in which alcohol dependence is manifested (National Institute for Health and Care Excellence, 2020; N.H.S., 2018a). Alcohol dependence, in turn, is clinically referred to as Alcohol Use Disorder (AUD) (American Psychiatric Association, 2013; National Institute for Health and Care Excellence, 2020) and its description as a dependence syndrome in the clinical descriptions and guidelines book, *The ICD-10 Classification of Mental and Behavioural Disorders*, by the World Health Organisation, is as follows:

"A cluster of physiological, behavioural, and cognitive phenomena in which the use of a substance or a class of substances takes on a much higher priority for a given individual than other behaviours that once had greater value. A central descriptive characteristic of the dependence syndrome is the desire (often strong, sometimes overpowering) to take psychoactive drugs (which may or may not have been medically prescribed), alcohol, or tobacco. There may be evidence that return to substance use after a period of abstinence leads to a more rapid reappearance of other features of the syndrome than occurs with non-dependent individuals." (World Health Organization, 1992, p. 69).

Alcohol misuse poses a prominent health risk factor worldwide (World Health Organisation, 2020). Alcohol-related harm is linked to early mortality, diseases such as cancer, cardiovascular disease and liver cirrhosis, and health conditions resulting from road injuries and violent incidents (National Institute on Alcohol Abuse and Alcoholism, 2021; World Health Organisation, 2020). Mental and behavioural disorders (for example, Bipolar Disor-

der, Post-Traumatic Stress Disorder or self-harm and suicidal tendencies) are also strongly interconnected with alcohol misuse, triggering or deteriorating disorder-related symptoms (Di Florio et al., 2014; Head et al., 2016; Ness et al., 2015; World Health Organisation, 2018). In addition to individual harm, alcohol misuse can affect the mental or physical health of others. The harm caused to others may range from developmental diseases at an early age, because of prenatal alcohol exposure, to violence or sexual abuse incidents in domestic and public settings ("Institute of Alcohol Studies", 2014; Mattson et al., 2019; Public Health England, 2019). Alcohol-related harm also results in financial costs through health and social care and other state services such as the welfare and criminal justice systems (Public Health England, 2018), burdening sustainable development and society at large (Manthey et al., 2021).

Legal alcohol trade and the lifestyle of modern societies and economies ("Institute of Alcohol Studies", 2017) have led to broad exposure to alcohol cues daily, increasing the risk of alcohol misuse. Alcohol promotion strategies (such as branding, advertisements or multi-buy offers), being either digital (found on social media) or non-digital, have been linked to increased alcohol consumption and binge drinking, particularly in adolescents (Hurtz et al., 2007; Lobstein et al., 2017; Wagenaar et al., 2009). Recent, statistical evidence in the United States suggested that alcohol misuse pertained to most age groups, with binge drinking and heavy alcohol use to be reported by children and adolescents (12-17 years old), and adults (18 years old or over) (National Institute on Alcohol Abuse and Alcoholism, 2021). In 2019, 14.5 million people, who aged 12 and older, suffered from Alcohol Use Disorder, of whom 414,000 aged from 12 to 17 years old in particular (National Institute on Alcohol Abuse and Alcoholism, 2021). Similarities in the drinking patterns and age spread were observed in England and Scotland for the same year where, according to recent, health data, 24% of adults reported harmful use of alcohol and 27% binge drinking (Public Health England, 2021). In 2018, 602,391 adults suffered from alcohol dependency (Public Health England, 2021) and underage drinking (people 15 or younger) was reported by 44% of the pupils (N.H.S. Digital, 2019). These figures indicate the large extend of alcohol misuse in the population, with similar drinking rates and age reach to be reported in other parts of the world (Nalwadda et al., 2018; Pandey et al., 2015; Zewdu et al., 2019), stressing the need for treatments that would be relevant to each age group and personalised to a great degree.

Current treatments for alcohol dependence typically consist of community or residential-assisted withdrawal, depending on the alcohol dependence's severity of the individual, followed by pharmacological and psychological interventions to promote abstinence and prevent relapse (National Institute for Health and Care Excellence, 2011). Psychological interventions such as cognitive behavioural therapies, behavioural therapies and social network and environment-based therapies (involving forms of social support such as community reinforcement) are also recommended for high-risk drinkers and those with any level of alcohol dependence (National Institute for Health and Care Excellence, 2011). Remission rates from alcohol use in individuals with alcohol dependence that have received treatment appear higher than the ones who have not received any treatment (Moos & Moos,

2006), indicating the benefit of receiving therapy for preventing relapse. In either case of having received treatment or not, the relapse rates remain high, ranging from 40% to 60% respectively (Moos & Moos, 2006). Of those receiving treatment, 75% would relapse during the first year of treatment (Menon & Kandasamy, 2018), highlighting the need for effective relapse prevention strategies to be included in the early stages of alcohol treatment. Co-morbidity of alcohol dependence with other psychiatric disorders hinders further alcohol recovery, affecting around 46% of alcohol dependant individuals (Donadon & Osório, 2014) and leading to earlier relapse episodes and emergency hospitalisations (Durazzo & Meyerhoff, 2017; Klingemann et al., 2019). Relapse prevention strategies that could address both alcohol misuse and mental health issues could, therefore, benefit further alcohol recovery.

Predictors of relapse are found to be craving, negative affect and limited social and personal resources such as decreased self-efficacy, lack of emotional support, decreased motivation to change and less reliance on coping (Witkiewitz & Marlatt, 2004). Craving in particular is considered a major cause of relapse and has been officially recognised as an AUD diagnostic symptom and added in the Diagnostic and Statistical Manual of Mental Disorders in its 5th and latest edition (Murphy et al., 2014). Relevant studies also underscore the higher rates of craving and the lower inhibition response reported by detoxified AUD individuals compared to baseline and healthy controls, when they were exposed to their favourite alcohol beverages (Kreusch et al., 2017) or to images and olfactory cues of alcoholic drinks (Field & Jones, 2017). Another empirical study confirmed the direct correlations between craving and AUD severity, craving and amount of drinking, and craving and harmful effects of drinking in heavy, seeking-treatment drinkers (Murphy et al., 2014). For these reasons, craving reduction was the main focus of VRT studies so far (Ghita & Gutierrez-Maldonado, 2018; Segawa et al., 2020; Trahan et al., 2019).

However, the interconnections of craving and other relapse predictors, for example emotional states and individual coping support, seem to additionally determine the occurrence of relapse episodes. Exposure to alcohol-related stimuli and negative emotional state (negative affect) prevailed as individual factors of craving episodes and subsequent relapse in a pair of studies with AUD participants (Pombo et al., 2016; Snelleman et al., 2018). Another set of studies with treatment-seeking AUD participants, exhibited that effective emotion regulation and, thus, positive affect promoted abstinence and decreased craving and the reverse (Khosravani et al., 2017; Petit et al., 2015). Another study, focusing on the psychosocial aspects of relapse in AUD individuals, reported that absence or poor coping skills in high-risk situations were the major factors of relapse rather than the actual exposure to the high-risk situations (Sureshkumar et al., 2017). High-risk situations are typically considered situations where craving is induced either by exposure to alcohol cues or as a by-product of negative emotional states (e.g. anger/sadness/anxiety after a family argument or other traumatic events).

1.1.1 Relapse Prevention Methods

A core part of alcohol treatment therefore involves interventions for the development of coping skills and the prevention of relapse in high-risk situations, once abstinence has been achieved. One of the techniques for the building of coping skills is through exposure to high-risk situations or cues within a therapeutic context. The type of exposure differs depending on the therapeutic paradigm adopted. Cue Exposure Therapy (CET), for instance, has been considered in alcohol treatment for practising craving management via repeated exposure to alcohol cues in reality, in the controlled setting of the therapy session. CET is based on the premise of learning theory's classical conditioning, where association of formerly neutral (conditioned) stimuli (e.g. a shot glass) with unconditioned stimuli (alcohol) happens, eliciting similar responses to the unconditional stimuli (Mellentin et al., 2017). CET aims to unpair the eliciting of the addictive response (alcohol craving) when alcohol-related cues are encountered through repeated exposure.

Alcohol cues may be proximal, relating to the different forms that alcohol can be present (e.g. a glass of alcohol or an alcohol advertisement), contextual, relating to the contexts or objects in which alcohol is typically paired with (e.g. a birthday party or a shot glass), and complex, combining both proximal and contextual cues (e.g. a pub scenario where alcohol is being served). Exposure to proximal cues happens in CET either via photographs or actual objects, yet experiencing most of the contextual and complex cues raises issues of practicality and the risk of immediate relapse (Mellentin et al., 2017). However, as mentioned earlier, craving is not the only predictor of relapse, with CET focusing primarily on this aspect. Relevant literature suggested CET's limited efficacy in the treatment of Alcohol Use Disorder in particular and of Substance Use Disorders in general (Byrne et al., 2019; Martin et al., 2010; Mellentin et al., 2017). On the contrary, Cognitive Behavioural Therapy (CBT) seemed to offer better therapeutic outcomes, especially in comparison to CET (Carroll & Kiluk, 2017; Martin et al., 2010; Mellentin et al., 2017).

CBT focuses on the identification of unrealistic and unhelpful thoughts that contribute to alcohol dependency and their substitution with more helpful ones (N.H.S., 2018a). Furthermore, it involves methods for managing triggers that could lead to relapse (N.H.S., 2018a). On this premise, a specific approach exists, Relapse Prevention (RP), which targets at the identification of high-risk situations that could challenge the individual's abstinence, and the development of coping techniques to manage craving (Menon & Kandasamy, 2018). These coping techniques will typically involve building refusal skills (ways for saying no to prompts to drink) for resisting drinking in social and peer pressure contexts. Coping techniques will also include practising on both craving and emotion regulation for when any of the identified high-risk situations would be encountered in reality (Witkiewitz & Marlatt, 2004). The identified high-risk situations may be alcohol-related or other interpersonal and emotionally engaging scenarios, such as family arguments or traumatic incidents, that could elicit negative emotions and subsequent craving. The RP model, hence, considers other predictors of relapse such as the impact of emotional states and the need for coping skills that

would address a variety of high-risk situations, be them based solely on exposure to alcohol cues, or to emotional and interpersonal cues, or both.

While RP facilitates preparation for when the identified high-risk situations would be faced in real life, applying successfully the learnt coping techniques on such occasions might prove more challenging. Relevant literature shows that most individuals relapse post-treatment after re-visiting high-risk situations in real life, having received diverse evidence-based treatments, CBT included (Mellentin et al., 2016). This might be attributed to the lack of practising coping on an environment that would simulate the high-risk situation realistically, offering the possibility of interaction and personalisation of its content, making it relevant for each individual. Moreover, such an environment should have been visited at a controlled setting to prevent immediate relapse while also enabling therapeutic feedback by the practitioner for enhancing the coping techniques further.

1.2 VRT in Alcohol Misuse Treatment

Exposure to high-risk situations using Virtual Reality (VR) may offer a flexible solution for practising coping in a controlled setting during alcohol recovery, and especially prior to real-life exposure. A standard VR set-up typically consists of the VR headset, two hand-held controllers and a laptop that runs the VR application. High-risk situations can be rendered in 3-dimensions via the VR headset, allowing exposure to realistic environments. The controllers enable navigation in the virtual environments (VEs) and interactions with virtual characters and objects presented within. Personalisation of interactive, virtual characters and the VEs' content could allow simulation of diverse social, interpersonal and emotional scenarios, as opposed to the exposure during CET which involves mainly proximal cues (Martin et al., 2010). The multi-sensorial nature of virtual exposure to cues therapeutically may also increase engagement and therefore its clinical effectiveness beyond that of exposure based on simply imagining interacting with the cues (Imaginal Exposure), as seen in studies comparing these exposure modes in PTSD, Flying Phobia and Panic disorder and Agoraphobia (Deng et al., 2019; Gregg & Tarrier, 2007; Maples-Keller et al., 2017; Schwartzman et al., 2012; Singh & Nathan-Roberts, 2019).

Virtual exposure to high-risk situations may be combined with diverse therapeutic contexts, resulting in different forms of VRT. The content of the VRT application will depend on the therapeutic context each time. The treatment goals will also depend on the therapeutic context and the aspect of alcohol recovery that will subsequently be addressed during the VRT sessions. In a RP context, VRT could help people to identify triggers, via exposure to various, high-risk situations through interactive VEs, which might be challenging or risky to explore otherwise. VRT could also help practise coping with the triggers prior to real-life exposure via controlled exposure to the virtual, high-risk situations. High-risk situations could involve alcohol-cued VEs that could be personalised and used for practising coping with alcohol-related cues and alcohol craving in situations where alcohol could be found. Including personalised, interactive characters and avatars in these VEs could also facilitate

refusal skills training via the simulation of relevant, social high-risk situations. Apart from practising craving regulation, VRT could help with practising emotion regulation via the simulation of emotionally-oriented high-risk situations, that may or may not include alcohol cues, but focus primarily on interpersonal relations. Again, the use of personalised, interactive characters and avatars will be involved. This could be useful for addressing mental health disorder symptoms that link to emotional states at the same time. Mindfulness-based interventions, mediated by relaxing VEs, could be also incorporated to reduce anxiety originating from the cued exposure and help address mental health disorder symptoms linking to anxiety further. Delivery of VRT in cost-effective or online VR set-ups could increase treatment accessibility, too, when physical attendance to therapy or financial costs burden the delivery of alcohol treatment.

Based on the current literature that supports the capability of VRT to reduce alcohol craving and change alcohol-related attitudes in ways conducive to therapy, (Ghita & Gutierrez-Maldonado, 2018; Segawa et al., 2020; Trahan et al., 2019), the use of VRT for RP may also be a promising avenue for enhancing alcohol treatments, as it involves the assessment and regulation of such parameters (craving and alcohol-related attitudes). In addition, the controlled exposure that VRT offers intrinsically matches with the training context of RP, and, employing VRT clinically could help decrease the high relapse rates currently reported in relevant literature (Menon & Kandasamy, 2018; Moos & Moos, 2006). However, as mentioned earlier, the evidence base about VRT's effectiveness in RP is limited (with only one study exploring VRT in this therapeutic paradigm, involving a small sample size) (Yoon et al., 2014) and how to integrate it clinically in acceptable and effective ways remain unexplored.

Hence, the main research question that drives this PhD project is how VRT could be effectively used in clinical practice for alcohol RP (Research Question - RQ 1). Secondary research questions revolve around (RQ 1a) whether VRT would be considered an acceptable treatment tool in practitioners and (RQ 1b) what the factors would be that could lead to acceptable treatment protocols according to their views, (RQ 2a) whether VRT would be acceptable in relevant patient groups as a treatment option and (RQ 2b) what the factors would be that could lead to acceptable treatment protocols according to their preferences, and (RQ 3a) what VR contents would be suitable for the VRT application to increase its therapeutic effectiveness and what design considerations should be addressed (RQ 3b).

To answer the aforementioned research questions and inform the clinical application of VRT for alcohol RP a series of studies were undertaken. A literature review was conducted to determine its effectiveness for assessing and treating alcohol misuse and identify factors of its effectiveness (such as therapeutic context, sample traits, VRT content and hardware) so as to inform our study designs and, subsequently, the application of VRT for RP (Chapter 2). An interview study with practitioners and researchers delivering or designing substance use treatments was conducted, to determine the clinical acceptability of VRT and its factors that would inform the delivery protocols of VRT, and to identify desired contents (virtual environments) for the VRT application in the context of RP (Chapter 3). A survey

study with adults drinking at different levels was conducted to explore the acceptability of VRT in patient populations and its acceptability factors and treatment preferences that should guide the design of VRT delivery protocols (Chapter 4). A model VRT application was developed for RP (Chapter 5), guided by the literature review findings and the design suggestions of practitioners from the interview study reported in Chapter 3. Our VRT application was assessed in a cost-effective VR set-up by low- and high-risk drinkers via an online, interview study to determine its relevance and its potential for use in RP and in an accessible, therapeutic context, and to identify design considerations for VRT applications in RP and inform VRT's clinical application. (Chapter 6).

The combined findings of the aforementioned sub-projects helped inform the clinical application of VRT for RP and identify and reflect on key aspects about its acceptability, therapeutic effectiveness, accessibility and cost-effectiveness (Chapter 7). These findings could inform the design of similar, VRT applications and of future studies examining the application of VRT in clinical paradigms (Chapter 7). The research route adopted and reflection on the value of using both qualitative and quantitative methods could also inform the design process and facilitate quick and purposeful clinical applications of novel, technological treatment tools (Chapter 7).

Chapter 2

Literature Review

In order to determine how to best employ VRT for RP, a review of the literature was conducted to obtain a detailed overview of the current work on VRT in alcohol misuse and inform our research design. The secondary objectives of this literature review are outlined below.

First, it was necessary to track down the effectiveness of VRT for assessing and treating alcohol misuse, because its success in assessing alcohol misuse states links to its potential for helping with the identification of high-risk situations during RP, and its success in treating alcohol misuse links to its potential for helping with regulation of alcohol misuse symptoms during RP. For example, it might be shown that VRT is effective for assessment but not for treatment, and, subsequently it might be beneficial for the identification part of RP but not for the regulation part. This could shift the focus of our subsequent studies accordingly.

Second, it was necessary to identify aspects that affect VRT's effectiveness (such as the therapeutic paradigms it has been applied to, the hardware used, the virtual environments employed or any beneficial sample traits) so as to inform our study designs and the clinical application for RP. For example, our study designs could focus more on the consideration of elements that have already worked, or explore further elements that we don't know if they work, or involve samples that could offer insights on unexplored elements (such as practitioners' involvement to determine useful software content not explored in literature).

Third, it was necessary to update the literature by including all recent VRT studies in alcohol misuse and ensure an informed approach for determining an effective, clinical application of VRT for RP. Hence, guided by these objectives could help address to a certain degree the main research question of how to effectively use VRT for RP and inform our research design accordingly.

2.1 Method

2.1.1 Selection of articles

The scope of the current review was to collect articles focused on virtual reality applications for assessing or treating aspects of alcohol misuse. The article search was conducted using PubMed, Google Scholar, ScienceDirect, Scopus and Web of Science. Keywords employed for the search were “Virtual Reality Exposure Therapy”, “Virtual Reality Therapy”, “Virtual Reality” and “Virtual Rehabilitation” combined with “alcohol” or “Alcohol Use Disorder” or ”alcohol misuse” or ”alcohol abuse” or ”alcohol dependence”. The search query used is presented on figure 2.1. On the article search in Google Scholar, however, just the keyword combination of ”Virtual Reality” with ”alcohol” in the title was used in order to retrieve all the possible range of articles as more complicated queries are not always facilitated, depending on the version and updates of the search engine each time.

Figure 2.1. Search query

(“Virtual Reality Exposure Therapy” OR “Virtual Reality Therapy” OR “Virtual Reality” OR “Virtual Rehabilitation”) AND (“alcohol” OR “Alcohol Use Disorder” OR "alcohol misuse" OR "alcohol abuse" OR "alcohol dependence")

2.1.2 Eligibility criteria

In total, 382 articles were retrieved. The screening of the articles was based on the following inclusion criteria: written in English, using VR irrespective of the immersion achieved, using at least one combination of an assessment instrument and an experimental procedure and studies being peer-reviewed. Articles examining other SUDs, or with a focus on alcohol other than VR-based assessment and treatment, or with a focus on alcohol misuse assessment and treatment relating to physical and neurological aspects were excluded. No specific date limitations were applied as VR has been introduced as a psychological method relatively recently, with the first study conducted in 1995 in the treatment of fear of heights (Krijn et al., 2004). Twenty-one studies were included in the review.

2.2 Results

Two main categories of studies exist, focusing on either alcohol misuse assessment or alcohol misuse treatment. In the first category, the aim is to evaluate VR as an assessment tool for identifying the alcohol misuse status of individuals via exploration of their elicited craving and their alcohol-related attitudes. In the second category, the aim is to evaluate VR as a treatment tool for addressing alcohol misuse symptoms.

2.2.1 Alcohol Misuse Assessment Studies

Alcohol misuse assessment studies have explored the extent to which virtual exposure to alcohol cues (VRCE-Virtual Reality Cue Exposure) is able to influence craving and drinking-related attitudes in samples with differing levels of alcohol misuse. Ten studies have examined the effectiveness of VR-CE as an assessment tool for alcohol misuse (Bordnick et al., 2008; Cho et al., 2008; Gatti et al., 2008; Ghita et al., 2017; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; D. Kim & Lee, 2015; J. Lee et al., 2008; Ryan et al., 2010; Simon et al., 2020; Spagnoli et al., 2014).

The preliminary study of Gatti et al. (2008) compared VR-CE with traditional assessment methods. Twenty treatment-seeking AUD patients were recruited and divided equally into experimental (VR-CE) and control (SCID - Structured Clinical Interview for DSM-IV Axis I Disorders) groups (Gatti et al., 2008). In the experimental group (VR-CE), patients were exposed to two neutral and two alcohol-cued daily life scenes, and drinking attitudes, emotional management, self-confidence and the impact of the VE were examined (Gatti et al., 2008). Notable motivation for change was reported by the participants undergone VR-CE assessment but not by the control group assessed via SCID (Gatti et al., 2008). These results were confirmed by the subsequent study of Spagnoli et al. (2014) who used the same protocol with larger, gender-balanced groups of 25 participants each. Participants in the experimental group showcased higher levels of perceived self-efficacy compared to the controls, believing that they would be more capable of coping with high-risk situations (Spagnoli et al., 2014).

Bordnick et al. (2008) examined the utility of VR-CE for eliciting craving in 40 AUD patients. The VR scenes were augmented with olfactory stimuli using the Scent Palette (Envirodine Studios, Inc. Canton, GA) (Bordnick et al., 2008). A vibration platform (Virtually Better, Inc. Decatur, GA) attached to the chair in which the participant was seated was also provided to simulate the vibrations of movements within the VE (Bordnick et al., 2008). Craving was measured using the Visual Analogue Scale (VAS) and a modified version of the Attention to Alcohol Scale (AAS) (Bordnick et al., 2008). Both scales were projected within the virtual environment so as not to obstruct immersion (Bordnick et al., 2008). Alcohol-cued VEs were reported to elicit higher craving than neutral ones (Bordnick et al., 2008). Craving rates were similar in all cued VEs, suggesting that even if certain forms of social pressure are applied (e.g. a party scene), craving appears to be dependent primarily on alcohol stimuli presence for AUD individuals (e.g. kitchen scene) (Bordnick et al., 2008). This was consistent with the attention to sight and scent of alcohol cues measurements, which were similar for both cued VEs (Bordnick et al., 2008). Attention to thoughts about drinking was only lower for the argument VEs (Bordnick et al., 2008). Similarity in craving was also documented for both neutral VEs regardless of the presentation order (start/end of exposure session) (Bordnick et al., 2008). A modified version of the Presence Questionnaire of Witmer and Singer (1998) was employed to measure the presence and realism felt within the alcohol-cued VEs, with participants reporting high scores of presence in both of

them. (Bordnick et al., 2008).

Ryan et al. (2010) in a study with 15 binge drinking (clinically known as Alcohol Intoxication) college students and 8 healthy controls, used the same cued VEs and the same scents' emission hardware for olfactory augmentation as Bordnick et al.'s study (2008) on AUD patients. VAS and AAS were used to rate craving (Ryan et al., 2010). Results showed that binge drinking college students experienced higher craving in the kitchen and party VEs when compared with healthy controls (Ryan et al., 2010). Attention to thoughts about drinking increased for binge drinkers but not for controls in the party and bar VEs (Ryan et al., 2010). Attention to sight and scent differed according to VE but not according to type of drinker (Ryan et al., 2010).

Lee et al. (2008) examined how the presence or absence of social pressure influenced craving in either alcohol-cued or neutral VEs (2 x 2 setting). The experimental group consisted of 14 male AUD in-patients who had been abstinent for at least three weeks and the control group consisted of 14 male social drinkers (J. Lee et al., 2008). Craving was shown to increase when social pressure was applied to the neutral VE in both groups (J. Lee et al., 2008). In the alcohol-cued VE, controls' craving was elicited only when social pressure was applied (J. Lee et al., 2008). In contrast, AUD patients' craving was evoked when exposure to alcohol stimuli occurred, and was not affected further by social pressure (J. Lee et al., 2008). Cho et al. (2008), employed the same study design as Lee et al. (2008), but focused on participants scoring low on the AUD assessment questionnaire used. Higher craving rates were reported when social pressure was applied in VEs both with alcohol cues present and without (Cho et al., 2008), showing a similar craving profile to the control group of Lee et al.'s (2008) study. Head gaze measurements showed that participants stared at virtual characters more than the alcohol stimuli, highlighting the impact of social pressure (Cho et al., 2008). Neutral VEs elicited less craving (Cho et al., 2008). In both studies, VAS was used to measure craving (Cho et al., 2008; J. Lee et al., 2008).

Simon et al. (2020) assessed the alcohol craving elicited in 22 regular drinkers and 18 heavy drinkers after virtual exposure to a bar. Higher levels of alcohol craving were evoked in heavy drinkers compared to regular ones, indicating the potential of the bar VE in detecting an alcohol misuse issue (Simon et al., 2020). Craving rates were measured via the VAS (Simon et al., 2020). The perceived ecological validity (realism) of the VE was also measured and was associated with higher rates of evoked craving (Simon et al., 2020). Heavy drinkers perceived the VE to be more realistic compared to regular ones, suggesting that this should be considered in the design of similar applications for alcohol misuse assessment or treatment (Simon et al., 2020).

Ghita et al. (2019) utilised four alcohol-cued VEs, namely a restaurant, a bar, a pub and a home, to assess the alcohol craving and anxiety elicited during the virtual exposure. Aspects of the VEs such as the time of the day, the alcoholic beverages presented and the social interaction via virtual characters were considered in the design of the VRT application, offering exposure to the following high-risk situations: being in a bar or a restaurant dur-

ing daytime, being at a pub or at home during nighttime, being at home with no social interaction and being in a bar, a restaurant or a pub with social interaction included (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). These situations were then rated by participants in order of temptation, with the least tempting situation to be paired with the least preferred alcoholic beverage and the opposite (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). Participants were presented progressively to the situations from the least to the most tempting ones (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). Olfactory augmentation was also included, involving cotton pads with the smell of the alcoholic beverages picked by participants (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). Participants were divided into two groups, with the clinical group consisting of 13 individuals diagnosed with AUD and the control group consisting of 14 individuals being social drinkers (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). Alcohol craving and anxiety were elicited in both groups, with the clinical group to report higher levels on both (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). However, the anxiety evoked during the virtual exposure was found to be a better measure for indicating alcohol dependence than the evoked alcohol craving (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019).

Kim & Lee (2015) in a study comparing 18 male heavy social drinkers (HSD) and 18 male light social drinkers (LSD), used an Approach-Avoidance Task. The participants were instructed to either pull or push using a joystick according to the appearance of a signal in the middle of the scene (D. Kim & Lee, 2015). More specifically, a green dot signalled the pull and a red one the push condition (kim2015a). During pulling the participants brought closer the displayed scene and during pushing they zoomed out (D. Kim & Lee, 2015). The scenes comprised of alcohol- and non-alcohol-related stimuli, and were presented in random order (D. Kim & Lee, 2015). The response duration of a pull or push in relation to the scene displayed was measured (D. Kim & Lee, 2015). In line with the previous AUD-based studies, increased attention bias to alcohol cues was found for HSD compared with LSD after 32 trials, whose reaction times were longer when an alcohol-cued scene was displayed (D. Kim & Lee, 2015). Similar results were reported in the study of Ghita et al. (2017) with 12 HSD in the experimental and 13 LSD in the control group – with 20 out of the total 25 participants being female. Participants were asked to choose either an alcoholic beverage or a non-alcoholic one in each of the following, four VEs: a restaurant, a bar, a chill-out area and a bedroom. HSD college students opted for alcoholic beverages more when compared with LSD college students (Ghita et al., 2017). However, self-reported craving and anxiety, as measured by customized VAS questionnaires, did not differ significantly (Ghita et al., 2017). Authors suggested that alcohol-related behaviour constituted a more representative parameter of alcohol misuse than self-report measures like craving (Ghita et al., 2017).

An overview of the alcohol misuse assessment studies is presented in Tables 2.1, 2.2, 2.3, 2.4.

2.2.2 Alcohol Misuse Treatment Studies

Alcohol misuse treatment studies have examined the potential of VR as a treatment method when combined with traditional psychological techniques. Of eleven studies, four employed VR in conjunction with aversive stimulation (Choi & Lee, 2015; S. Lee et al., 2009; Son et al., 2013; Son et al., 2015), four employed VR in the context of CET (Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2007), one combined VR with CBT for RP (Yoon et al., 2014), one used VR in a gaming context (Metcalf et al., 2018) and one utilised VR in a behavioral, approach-avoidance task training context (D. Kim & Lee, 2019). While all the aforementioned interventions form, in essence, versions of VRT, their original naming has been used (as mentioned by the authors in each paper), instead of VRT, for accuracy purposes.

The studies of Lee et al. (2009), Son et al., (2013) and Son et al. (2015) used a protocol where AUD patients were virtually exposed over the course of 10 sessions to relaxation (5 min), high-risk situation (10 min) and aversive stimulation (10 min) scenes (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). All participants were detoxificated for one week prior to the experiments (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). Kefir, a sour-tasting mild drink, was administered during exposure as the aversive stimulus (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). Olfactory augmentation of the scenes was included in the studies of Lee et al. (2009) and Son et al. (2015). Craving rates were measured using the VAS and neurobiological reactivity in relation to craving changes was measured in three of the studies (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015).

The study of Lee et al. (2009) involved three control groups of male participants: an AUD general treatment group (CBT+education); an AUD no treatment group and a group of the healthy controls. Higher craving decreases were observed in the VR experimental group (VR-CET + aversive stimulation) compared with the AUD general treatment one (S. Lee et al., 2009). The magnitude of evoked craving was also greater for the experimental group in comparison with the healthy controls when transitioning from the relaxation to the high-risk situation scene (S. Lee et al., 2009). Greater magnitude of decreased craving was achieved when transitioning from the high-risk situation scene to the aversive stimulation one again for the experimental group compared with the healthy controls (S. Lee et al., 2009). Electroencephalographic recording (EEG) of the participants in the experimental group also revealed that craving decrease was associated with increased EGG alpha power compared to their baseline EGG alpha power (S. Lee et al., 2009), indicating the effectiveness of the intervention from a neurological perspective.

Son et al. (2013, 2015) employed Positron Emission Tomography-Computerized Tomography (PET-CT) scans. PET-CT scans at baseline showed increased brain metabolism on the right lentiform nucleus and on the right temporal lobe were for AUD participants in comparison with the healthy controls (Son et al., 2013; Son et al., 2015). This difference in neurobiological reactivity between the experimental and the control group indicated the increased sensitivity of AUD participants to alcohol-related stimuli (Son et al., 2013; Son et

al., 2015). After the course of the intervention, the PET-CT scans showed decreased brain metabolism on the right globus pallidus lentiform nucleus and right temporal lobe in AUD patients when compared with healthy controls (Son et al., 2013; Son et al., 2015). The authors suggested that this is related to the regulation occurring in the limbic circuit and the subsequent response to reward (Son et al., 2013; Son et al., 2015). Changes in the temporal lobe in AUD participants were also suggested to relate to emotional stimulation (Son et al., 2013; Son et al., 2015). In addition, a decrease in craving was reported in the second study (Son et al., 2015). However, there were no significant correlations between the craving decrease and the changes in brain metabolism (Son et al., 2015). Finally, it is worth mentioning that three participants in this study did not complete the intervention; two of them because of tragic memories relevant to the aversive stimulation scene and the third one was excluded due to using a mood stabilizer (Son et al., 2015).

Choi & Lee (2015), in their study, followed a different VR-aversive stimulation protocol. Twenty HSD male undergraduate students and 20 LSD male undergraduate students were recruited to form the experimental and control groups, respectively (Choi & Lee, 2015). Both groups were exposed once to an alcohol-cued scene for 10 minutes and afterwards to an aversive stimulation scene for an additional 10 minutes (Choi & Lee, 2015). Explicit and implicit craving were measured for both groups (Choi & Lee, 2015). Implicit craving measurements consisted of an alcohol-IAT test, a Stroop test and eye tracking (Choi & Lee, 2015). A higher decrease in explicit craving was achieved in the HSD group than the LSD group (Choi & Lee, 2015). With respect to implicit craving, attention bias was decreased after the intervention irrespective of the group type (Choi & Lee, 2015).

A decrease in craving was also achieved in the study of Lee et al. (2007) with 10 AUD participants, where VR-CET, rather than aversive stimulation, was employed as the intervention technique. Eight group sessions of 25 minutes exposure to alcohol cues and discussion resulted in progressive craving reduction (J. Lee et al., 2007). However, no statistical significance between the first and the last session was demonstrated due to the differences in the abstinence periods of the participants (5 in early and 5 in sustained remission) (J. Lee et al., 2007). Two participants dropped out of this study, but the reason is not mentioned (J. Lee et al., 2007).

The case study of Ghita et al. (2021) assessed the efficacy of VR-CET for treating alcohol dependence, using the VEs developed in their earlier study about alcohol misuse assessment (Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019). During the initial assessment session, the VEs used (bar, restaurant, pub and at-home) were tailored in terms of the time of the day displayed, the alcoholic beverages presented and whether social interactions via virtual characters would be included, to match the preferences of the participant (Ghita et al., 2021). The participant who was diagnosed with AUD, was then administered six VR-CET sessions, each involving 50 minutes of exposure to the most tempting situations as shaped during the assessment session and 10 to 20 minutes of debrief (Ghita et al., 2021). At end of the course of the treatment, decrease was reported in the alcohol craving, anxiety and attentional bias towards alcohol compared to baseline (Ghita et al., 2021).

The same protocol was additionally used in their other case-series study (Ghita, Hernandez-Serrano, Ruiz, et al., 2019) with 8 participants diagnosed with AUD. Participants were either administered six sessions of VR-CET (experimental group - 3 participants) or six sessions of CBT (control group - 5 participants) (Ghita, Hernandez-Serrano, Ruiz, et al., 2019). At the end of the treatment period, while both groups reported lower alcohol craving and anxiety scores compared to baseline, higher decrease was achieved in the VR-CET group (Ghita, Hernandez-Serrano, Ruiz, et al., 2019). Similarly, in their prospective cohort study utilising the same protocol (Hernandez-Serrano et al., 2020) 15 AUD participants were administered six sessions of VR-CET plus Treatment As Usual (TAU) and 27 AUD participants were administered TAU only. The VR-CET group presented lower scores of alcohol craving at the end of the intervention compared to the TAU group (Hernandez-Serrano et al., 2020). Having used illicit drugs and higher cravings prior to the treatment was seen to result in greater craving decrease (Hernandez-Serrano et al., 2020).

Yoon et al. (2014) evaluated the use of VR for relapse prevention in the context of CBT in 6 alcohol-dependant veterans with traumatic brain injury. After 8 weekly, CBT treatment sessions of 30 minutes, involving virtual exposure to tempting situations when relevant at baseline and on week 4 and 8, alcohol craving was decreased and self-reported days of abstinence were increased compared to baseline (Yoon et al., 2014). These benefits were maintained at the 3-months follow-up (Yoon et al., 2014).

Metcalf et al. (2018) adopted a VR game-based approach, utilising a recovery support game that could be played via Kinect in Xbox One or in Windows. The aim of the game was to hit or kick away alcohol cues, earning points for each successful try (Metcalf et al., 2018). Participants could choose the alcohol cue and the background image displayed via a menu (Metcalf et al., 2018). The sample of the study consisted of 76 individuals (61 included in the analysis) in recovery who were either assigned to the control wait-list group or to the intervention group (Metcalf et al., 2018). Participants reported decrease in alcohol craving and increase in self-efficacy, and in their attitudes and in their intended behaviour relating to receiving support and changing, after being exposed to the game three times (Metcalf et al., 2018).

Finally, Kim & Lee (2019) explored the effectiveness of virtual Alcohol Approach-Avoidance Training Task (VAAT) training for decreasing the approach tendency towards alcohol. Participants were exposed to either alcohol or non-alcohol cued scenes and they were guided to push or pull a joystick to avoid or approach the scenes, respectively, according to the colour signal emitted (D. Kim & Lee, 2019). Participants were heavy social drinkers and were assigned randomly to either the training group (n=14) or to the control group (n=14) (D. Kim & Lee, 2019). After three training sessions, the training group presented decrease in the implicit approach tendency towards alcohol. However, explicit alcohol craving was not decreased (D. Kim & Lee, 2019).

An overview of the alcohol misuse treatment studies is presented in Table 2.5, 2.6, 2.7, 2.8.

2.3 Discussion

Both the alcohol misuse assessment and alcohol misuse treatment studies included in the current review indicate the potential of VR as an assessment and treatment method based on controlled exposure to alcohol cues. Craving was successfully elicited within alcohol-cued VEs in AUD patients of differing abstinence periods (Bordnick et al., 2008; Gatti et al., 2008; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Son et al., 2013; Son et al., 2015; Spagnoli et al., 2014; Yoon et al., 2014), low alcohol misuse participants (Cho et al., 2008), HSD and LSD (Choi & Lee, 2015; Ghita et al., 2017; D. Kim & Lee, 2015, 2019; Metcalf et al., 2018; Simon et al., 2020) and binge drinkers (Ryan et al., 2010). Social pressure was a factor in craving elicitation when alcohol stimuli were not present (Cho et al., 2008; J. Lee et al., 2008). In studies examining Tobacco Use Disorder (TUD) and cocaine, social pressure induced craving to a higher degree than neutral cued scenes, highlighting the importance of context in SUD (Hone-Blanchet et al., 2014). However, in AUD participants, alcohol cues were the most important factor in craving elicitation (Ghita & Gutierrez-Maldonado, 2018; Hone-Blanchet et al., 2014). A similar result has been found for assessment studies about cannabis and meth, in which social pressure when applied to cued scenes led to no further craving increase (Hone-Blanchet et al., 2014). Neutral scenes induced the least craving, a result also seen in TUD, cannabis, meth and cocaine assessment studies (Bordnick et al., 2008; Cho et al., 2008; J. Lee et al., 2008).

2.3.1 Effectiveness of therapeutic contexts

Regarding craving decrease, aversive stimulation enhanced with VR proved to be an effective treatment for AUD participants (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). VR-CET combined with TAU or employed alone seemed to also decrease craving and related anxiety induced by exposure to alcohol cues virtually (Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2007). When VR-CET was compared to the TAU and CBT control interventions, craving (Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2007) and anxiety (Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019) reductions were higher, suggesting the benefits of virtual exposure to alcohol cues in a therapeutic context. Moreover, VR combined with CBT proved an effective treatment option, decreasing alcohol craving and increasing subsequent days of abstinence, with these benefits to be maintained at the 3-months follow-up (Yoon et al., 2014). A gamified VR-based approach also resulted in bettering attitudes towards recovery, such as the intent to consume alcohol and self-efficacy (Metcalf et al., 2018), indicating the potential of VR for behavioral training.

While VRT has been combined in a few studies with evidence-based treatments and com-

pared against their efficacy for treating alcohol misuse, a more consistent evaluation is needed to prove VRT's therapeutic effect as an addition to these treatments, which should involve larger sample sizes, randomised controlled trials and fixed intervention protocols (Trahan et al., 2019). In addition, although VR-CET arises as an effective treatment approach for reducing craving and anxiety, yet other aspects of alcohol misuse are not considered as opposed to the CBT, and particularly to the RP model, where mood states and other relapse factors are addressed during treatment (N.H.S., 2018a; Witkiewitz & Marlatt, 2004). Previous literature has also suggested the limited efficacy of traditional CET for alcohol misuse treatment due to the lack of realistic exposure to alcohol cues because of the impracticality of recreating high-risk situations in real-life (Byrne et al., 2019; Martin et al., 2010; Mellentin et al., 2017; Trahan et al., 2019). What is more, considering the effectiveness reported in studies employing aversive stimulation, during the assessment of this method as a treatment option, ethical concerns should also be addressed as well as the individuals' adherence to such techniques, before suggested for use in clinical practice (Segawa et al., 2020). Thus, for a more holistic and ethical treatment plan, CBT and RP principles combined with VRT might constitute a suitable solution, given the promising results of the study on CBT mixed with VRT that support its effectiveness (Yoon et al., 2014) and the effectiveness of traditional CBT alone that is currently used in clinical practice (Carroll & Kiluk, 2017; Martin et al., 2010; Mellentin et al., 2017; N.H.S., 2018a). CBT being one of the suggested treatments for both substance use and mental health disorders (N.H.S., 2018a) may result in easier integration of the VRT into current treatment protocols.

2.3.2 Validity of measuring instruments

The majority of the VR assessment and treatment studies have used self-reported instruments to measure alcohol craving, such as the VAS and the AAS (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015, 2019; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Son et al., 2013; Son et al., 2015; Spagnoli et al., 2014; Yoon et al., 2014). Although this is common in substance use research, yet potential bias might have been introduced about the efficacy of the interventions (Trahan et al., 2019). In a few studies the treatment effect of VRT in alcohol misuse has been investigated through other physiological and behavioral responses, offering increased validity about the treatment efficacy compared to self-report measures (Trahan et al., 2019). Neurobiological measurements of participants' brain metabolism were conducted by some studies (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). Decreases in craving were seen to associated with neurobiological changes such as brain metabolism decrease in limbic circuit (Son et al., 2013; Son et al., 2015). This indicates that pathological craving entails emotional involvement (Son et al., 2015). Indeed, previous literature in alcohol misuse has linked mood states to craving and relapse occurrences (Witkiewitz & Marlatt, 2004). The need for future studies that address both of

these aspects is, again, highlighted, in an effort to offer a multi-layered treatment approach. Integrating VRT in the treatment model of alcohol RP might therefore facilitate this. However, the only study examining this has measured primarily craving decrease (Yoon et al., 2014), underscoring the necessity for further research to explore the suitability of VRT in addressing other relapse factors, such as for emotion regulation.

Attentional bias has also been measured to indicate attitudes towards alcohol cues during and after the course of VRT (Choi & Lee, 2015; Ghita et al., 2021; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2019). Results suggested that attentional bias towards alcohol seemed to decrease post-treatment (Choi & Lee, 2015; Ghita et al., 2021; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2019), but implicit craving decrease (attention to alcohol cues measured by methods such as eye-tracking or approach-avoidance tasks) was not always associated with explicit craving decrease (craving measured by self-reported scales) (D. Kim & Lee, 2019). This might signal the need for additional measures to confirm craving decrease and the overall therapeutic impact of VRT (Trahan et al., 2019). Biometric measurements could constitute a more accurate measure of VRT's effectiveness (Trahan et al., 2019). Previous TUD studies have shown that Skin Conductance (SC) increased when exposure to smoking- related environments occurred (Bordnick et al., 2005) and Heart Rate (HR) also increased whilst smoking a "virtual cig" in a virtual pub (Garcia-Rodriguez et al., 2013). Thus, in future studies it may be helpful to examine if SC and HR are equally influenced in alcohol misuse patients.

2.3.3 Effect of sample characteristics

In terms of the recruited populations, specific characteristics might have introduced confusion bias while evaluating the efficacy of VRT for treating alcohol misuse. For example, the craving reduction achieved varied according to drinking patterns, with greater craving decrease to be reported in HSD individuals than LSD individuals (Choi & Lee, 2015). This was examined only in one study that followed an aversive stimulation protocol combined with VR (Choi & Lee, 2015). This finding implies that higher alcohol misuse is associated with higher craving reduction. A previous study of TUD similarly reported that higher decreases in craving are correlated with a greater number of cigarettes smoked per day (i.e. smoker of heavy dependence) (Hone-Blanchet et al., 2014). Furthermore, some studies have recruited detoxified AUD individuals and individuals with diverse abstinence periods (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). However, the level of alcohol misuse of participants and their days of abstinence has not been examined rigorously as factors of VRT's effectiveness.

Differences in craving patterns by gender were also not reported in the alcohol misuse assessment and treatment studies, and the gender factor has not been adequately investigated in VRT for alcohol misuse (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al.,

2020; D. Kim & Lee, 2015, 2019; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Son et al., 2013; Son et al., 2015; Spagnoli et al., 2014; Yoon et al., 2014). For instance, the treatment studies focusing on the neurobiological correlates of craving recruited male participants only (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). As confirmed in the study of van der Walder et al., women with AUD are more vulnerable to the physiological consequences of alcohol abuse and tend to suffer more severe cognitive impairment than men (van der Walde et al., 2002), and they may therefore demonstrate a different a neurobiological response. The review of Suh & Prophet on immersive technology use also highlights the susceptibility of women to negative cognitive reactions (e.g. increased cybersickness - symptoms such as nausea, eye tiredness and, in rare cases, vomiting cuased by exposure to VEs) when using an HMD, which may result in different outcomes with respect to craving and the mental and emotional reaction to VEs (Suh & Prophet, 2018).

2.3.4 Quality of experimental protocols

In terms of the experimental protocols adopted in the current alcohol misuse assessment and treatment studies, diverse strengths and limitations exist that speak to the quality of their findings. Respecting the quality of participants' recruitment, some studies applied thorough exclusion criteria (Bordnick et al., 2008; Gatti et al., 2008; Ghita et al., 2017; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2008; S. Lee et al., 2009; Son et al., 2015; Spagnoli et al., 2014), with participants diagnosed with severe mental disorders, addiction disorders other than TUD and significant health problems, and participants taking anti-craving medication to be excluded. While severe mental health disorders (such as schizophrenia) were listed in the exclusion criteria of these studies, yet four studies have recruited participants with mental health disorders of lower severity (such as PTSD) (Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Yoon et al., 2014). This is particularly important in the assessment of alcohol treatments as a large portion of people attending an alcohol misuse service often suffers from a co-occurring mental health issue (Charzynska et al., 2011; Han et al., 2017; Skeva et al., 2021; Torrens et al., 2015; Weaver et al., 2003). Investigating the suitability of VR-based treatment for these populations is necessary. The aforementioned studies suggested the suitability of VR-based treatment for people with co-morbid mental health issues (Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Yoon et al., 2014), but further research is needed to explore potential risks, challenges and benefits of VRT for these individuals, forming safe delivery protocols.

The inclusion criterion in all studies was the existence of alcohol misuse (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015, 2019; J. Lee et al.,

2007; J. Lee et al., 2008; S. Lee et al., 2009; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Son et al., 2013; Son et al., 2015; Spagnoli et al., 2014; Yoon et al., 2014). In eight studies a structured clinical interview using the DSM-IV-TR criteria was administered by a clinician to assess alcohol misuse and other disorders (Bordnick et al., 2008; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2008; S. Lee et al., 2009; Son et al., 2015; Spagnoli et al., 2014). The rest of the studies performed alcohol misuse assessment through questionnaires such as the AUDIT to ensure compliance with the inclusion criterion and allocate participants to the corresponding group (for example, HSD or LSD) (Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; D. Kim & Lee, 2015, 2019; J. Lee et al., 2007; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Son et al., 2013).

Most of the results about the suitability and effectiveness of VRT for alcohol misuse assessment and treatment have been produced primarily in pilot and feasibility studies, with small sample sizes and, in some instances, lack of control groups (Amista, 2017; Ghita & Gutierrez-Maldonado, 2018; Hone-Blanchet et al., 2014; Martin et al., 2010; Segawa et al., 2020). However, in a subset of studies that control groups were involved, they were matched with the experimental groups according to age (D. Kim & Lee, 2015, 2019; J. Lee et al., 2008; S. Lee et al., 2009), gender (J. Lee et al., 2008; S. Lee et al., 2009; Spagnoli et al., 2014) and educational status (S. Lee et al., 2009), facilitating high experimental quality. Similarly, in the studies with detoxificated participants abstinence checks were performed, verifying the validity of the studies' results (S. Lee et al., 2009; Son et al., 2013; Son et al., 2015). Checks on whether participants have used at the time of the virtual exposure any type of addictive substance that could affect cognition were also performed by two studies (Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Simon et al., 2020).

The majority of study protocols involved some elements of standardization, increasing the validity and reliability of the results reported. For example, exposure times were fixed (Bordnick et al., 2008; Choi & Lee, 2015; J. Lee et al., 2007; S. Lee et al., 2009; Son et al., 2013; Son et al., 2015) and the presentation order of the VEs pre-defined (Gatti et al., 2008; Ghita et al., 2017; Ryan et al., 2010; Spagnoli et al., 2014). In the other studies, exposure times varied as the completion of tasks was determined by the pace of each participant (Cho et al., 2008; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015, 2019; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Spagnoli et al., 2014) and the VEs' order and content were personalised according to participants' drinking preferences (Bordnick et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; S. Lee et al., 2009; Ryan et al., 2010). Participants were able to choose their favourite alcoholic beverage (Bordnick et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020;

J. Lee et al., 2008; S. Lee et al., 2009; Ryan et al., 2010) non-alcoholic beverage (Ghita et al., 2017), scent (Bordnick et al., 2008; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; S. Lee et al., 2009) and overall environment (S. Lee et al., 2009). While personalisation of exposure parameters might have undermined the level of standardization, it might have increased the therapeutic effect of the VRT interventions, making the VEs more relevant to participants. For example, the influence of culture was visible in some of VEs used as some studies oriented towards Eastern populations and included corresponding alcohol-based cues (e.g. popular Korean beverages like Soju) (Cho et al., 2008; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Son et al., 2015). The relevance enabled by personalisation might prove essential for increasing VRT's effectiveness, but this should be investigated by future studies which could offer personalisation as a part of a standardised protocol.

Although the length of the exposure sessions, being either fixed or dependant to the participants' virtual behaviour, was adequately reported on most occasions, the number of VRT sessions needed to produce an effect was not thoroughly discussed in the current studies (Trahan et al., 2019). Only one study suggested that greater craving decrease was observed after the 10th VRT session (S. Lee et al., 2009) as opposed to the craving decrease reported in the previous 9 sessions. Similarly, debrief after the virtual exposure sessions was included only in some studies. This involved either the participant narrating its virtual experience or exposure to neutral VEs for relaxation (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015; J. Lee et al., 2008; S. Lee et al., 2009; Ryan et al., 2010; Son et al., 2015; Spagnoli et al., 2014). The same relaxation VEs were used at baseline for capturing initial craving rates, acting as control VEs (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015; J. Lee et al., 2008; S. Lee et al., 2009; Ryan et al., 2010; Son et al., 2015; Spagnoli et al., 2014). In all cases, craving rates on neutral VEs remained unaffected irrespective of the order and duration of exposure, the content of neutral stimuli and the type of alcohol misuse of the participants (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015; J. Lee et al., 2008; S. Lee et al., 2009; Ryan et al., 2010; Son et al., 2015; Spagnoli et al., 2014).

The largest proportion of the current studies did not include follow-ups to assess the alcohol misuse symptoms, such as craving, and abstinence of participants in the long term (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015, 2019; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Son et al., 2013; Son et al., 2015; Spagnoli et al.,

2014). Only one study that focused on CBT combined with VRT performed follow-up evaluations of craving decrease and days of abstinence, reporting that benefits were maintained after 3 months and strengthening the effectiveness of this approach in the long-term (Yoon et al., 2014). Considering the variety of approaches adopted, a more manualised treament method to facilitate treatment fidelity and replication of the exposure sessions is needed and should be addressed in relevant research in the future, to allow drawing consistent conclusions about VRT's effectiveness and its specific factors (Amista, 2017; Ghita & Gutierrez-Maldonado, 2018; Hone-Blanchet et al., 2014; S. Kim & Kim, 2020; Martin et al., 2010; Segawa et al., 2020; Trahan et al., 2019).

2.3.5 Effect of VR set-up and associated presence

Twelve studies employed HMDs, offering an immersive experience (Bordnick et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; J. Lee et al., 2008; Ryan et al., 2010; Simon et al., 2020; Spagnoli et al., 2014). The rest of the studies either employed projectors (J. Lee et al., 2007; S. Lee et al., 2009) or did not provide detailed information. Thus, the overall immersion and presence achieved were not adequately documented. In particular, presence in VR involves to which degree the user felt like being in the virtual environment (Witmer & Singer, 1998). Only two studies included presence measurements, attaining positive feedback by the participants (Bordnick et al., 2008; Simon et al., 2020). In the one of these studies, evoked craving was positively associated with the realism of the VEs and, subsequently, the presence felt within them, especially in individuals drinking at heavy levels as compared to occasional drinkers (Simon et al., 2020). In their review of perception and presence in relevant VR research, Diemer et al. propose that if a certain level of presence is achieved, the resulting emotional and mental arousal constitute the major determining factors of VRET's efficacy in Social Anxiety Disorders and Phobias (2015). This requires further exploration in alcohol misuse VR studies since the effect of presence on the virtual treatment of alcohol-related symptoms, such as craving, has not been examined yet.

Cybersickness checks were not reported in any of the studies (Bordnick et al., 2008; Cho et al., 2008; Choi & Lee, 2015; Gatti et al., 2008; Ghita et al., 2017; Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2015, 2019; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Metcalf et al., 2018; Ryan et al., 2010; Simon et al., 2020; Son et al., 2013; Son et al., 2015; Spagnoli et al., 2014; Yoon et al., 2014). Only one study assessed the participants' interaction with the VR gear and recorded problems (Spagnoli et al., 2014). The interconnection of presence and cybersickness require more rigorous investigation in future VRT studies about alcohol misuse treatment, as literature suggested their negative correlation (Segawa et al., 2020). This will also ensure that aspects related to the VR experience which could affect the user experience are taken into consideration, increasing VRT's acceptability in potential patients (Segawa et al., 2020). Moreover, by ex-

amining the level of presence required to ensure VRT's effectiveness, additional parameters such as the financial cost of the VR gear can be addressed in VRT's delivery through cost-effective VR set-ups of lower immersion, without undermining its treatment potential. Hence, studies comparing less immersive and cost-effective VR set-ups are needed in the future to allow relevant conclusions (Segawa et al., 2020).

2.3.6 Impact and relevance of VEs' content

Certain aspects of the VEs' content can impact their ecological validity and, subsequently, the presence felt within the VEs. Some of the aforementioned studies provided multi-sensory VR experiences, augmenting the VEs with olfactory (Bordnick et al., 2008; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; S. Lee et al., 2009; Ryan et al., 2010; Son et al., 2015) and auditory stimuli and offering more immersive and realistic exposure to alcohol cues (Bordnick et al., 2008; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; J. Lee et al., 2007; J. Lee et al., 2008; S. Lee et al., 2009; Ryan et al., 2010; Son et al., 2015). However, it was not clear which stimuli of these were the primary source of the craving increase. Work examining TUD reported that the implementation of olfactory stimuli did not affect the craving induction procedure (Hone-Blanchet et al., 2014). A vibration platform was also employed by one study (Bordnick et al., 2008). Future studies should include augmentation of stimuli checks, focusing not only to the individual stimuli impact on alcohol craving but also to the degree to which each stimuli type can provide a more realistic experience, enhancing the feeling of presence within the corresponding VEs. Moreover, only four studies allowed free navigation within the VR scenes (Choi & Lee, 2015; Gatti et al., 2008; Simon et al., 2020; Spagnoli et al., 2014). Whether free navigation increases realism and, thus, presence, or whether it influences craving was not tested. In the studies where the way of navigation was specified and was controlled by either the psychotherapists (Cho et al., 2008; Ghita et al., 2017; J. Lee et al., 2007; S. Lee et al., 2009; Son et al., 2015) or the software (Bordnick et al., 2008; D. Kim & Lee, 2015; J. Lee et al., 2008; Ryan et al., 2010) there was no comment on whether the type of control influenced the studies' outcomes. Relevant checks should be included in future studies about VRT in alcohol misuse treatment.

2.3.7 Effect of virtual characters and avatars use

Three studies included talking virtual characters, but no dialogue occurred between them and the participants (Bordnick et al., 2008; J. Lee et al., 2008; Ryan et al., 2010). Four studies reported using social interactions with virtual characters in their VEs, but the exact format was not specified (Ghita et al., 2021; Ghita, Hernandez-Serrano, Fernandez-Ruiz, et al., 2019; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020). Another three studies presented virtual characters within the VEs without the speech feature (Gatti et al., 2008; J. Lee et al., 2007; Spagnoli et al., 2014) and again, the impact of the level of virtual characters' interaction on presence felt and craving was not investigated.

Furthermore, whether the induced craving was attributed to social interactions or to other contextual cues was not explored (Segawa et al., 2020). However, this should be addressed by future studies since examining thoroughly the effect of social interactions on craving and emotions during the virtual exposure would be particularly important for determining and increasing the efficacy of VRT during refusal skills training and emotion regulation, especially in social pressure and interpersonal high-risk situations. A consistent body of VRT work about emotional states via virtual characters and avatar use exists in mental health disorders, involving social interactions with virtual characters, embodiment (body swapping virtually and reference frame shifting) and change of perspective via adoption of the selected avatar's viewpoint (Geraets et al., 2021).

In social interaction-based studies, virtual dialogues with personalised avatars and virtual characters have been used for assessment, social skills training and cognitive rehabilitation of individuals suffering from social anxiety, depression, psychosis, schizophrenia and borderline personality disorder (Adery et al., 2018; Dellazizzo et al., 2018; Emmelkamp et al., 2020; Falconer et al., 2017; Freeman et al., 2016; Jin et al., 2019; Klinger et al., 2005; Pot-Kolder et al., 2018; Rijn et al., 2017; Rus-Calafell et al., 2018; Sert et al., 2018; Veling et al., 2014). Results suggested that VRT successfully decreased disorder related symptoms in each case, such as anxiety, depression, refractory auditory verbal hallucinations and paranoic ideations (Adery et al., 2018; Dellazizzo et al., 2018; Emmelkamp et al., 2020; Falconer et al., 2017; Freeman et al., 2016; Jin et al., 2019; Klinger et al., 2005; Pot-Kolder et al., 2018; Rijn et al., 2017; Rus-Calafell et al., 2018; Sert et al., 2018; Veling et al., 2014). This implies that avatars and virtual characters were indeed perceived as real humans or were able to elicit adequate cognitive, emotional and physiological responses (Ku et al., 2006).

Embodiment has been used in the treatment of eating disorders, restructuring perceptions of the real body of individuals and decreasing disorder related symptoms originating from mismatched body perceptions (Riva et al., 2019; Serino et al., 2019). Moreover, the change of perspective has been employed in studies for intimate partner violence, in psychosis and in depression, combined also with embodiment where beneficial (Geraets et al., 2021; Gonzalez-Liencres et al., 2020). In intimate partner violence, non-offenders (individuals without experience of violent incidents) experiencing via 1st and 3rd person perspective the situation helped in decreasing their prejudice against women. Increased behavioural and physiological response was obtained in the first person perspective as compared to the third person perspective (Gonzalez-Liencres et al., 2020). In psychosis, an ongoing clinical trial is using change of perspective in social skills training (Geraets et al., 2021). In depression, change of perspective and body swapping helped individuals increase their self-compassion while decreasing their depressive symptoms after the VRT intervention and in 4-weeks follow-up (Geraets et al., 2021). In AUD, embodiment was examined by one VRT study but information wasn't provided on whether this was conducive to VRT's efficacy as a treatment or not (Choi & Lee, 2015).

The current literature therefore suggests the benefits of virtual characters and avatar use in

social and interpersonal situations for emotion regulation and cognitive rehabilitation. This could be particularly important in RP for practising coping with corresponding high-risk situations, as relapse is attributed to a great degree to lack of efficient emotional management and the subsequent triggering of alcohol craving as its by-product (Witkiewitz & Marlatt, 2004). Utilising virtual characters in social pressure situations identified as high-risk and personalising them could also help in practising emotional management in these situations rather than practising only craving regulation. The change of perspective could assist in coping with high-risk situations whose focus is on the interpersonal relations of the individuals, offering increased insight and empathy via adopting the other's person perspective virtually, while facilitating emotion regulation. This could also provide further insight into the addiction state of the individuals, being able to "see" themselves through a different viewpoint. Furthermore, a large proportion of individuals dependant on alcohol suffer from a co-occurring mental health issue (Charzynska et al., 2011; Han et al., 2017; Torrens et al., 2015; Weaver et al., 2003). This may involve feelings of anxiety, depression or any form of distress, worsening the emotional state of individuals. Thus, this should also be taken into consideration and addressed during the VRT sessions via the use of virtual characters and avatars. However, whether the use of virtual characters and avatars for practising coping in high-risk situations, where emotional involvement is required, would be similarly effective or suitable for alcohol RP remains, thus, to be explored by future studies.

2.4 Limitations

This literature review offers a comprehensive overview of the VR assessment and treatment studies in populations exhibiting alcohol misuse, with some limitations. Firstly, articles in languages other than English were excluded, thus, insightful findings might have been missed. Due to the search sources used, unpublished studies such as dissertations were not considered in this analysis. As VR in alcohol misuse assessment and treatment is a new research field, some studies did not report in detail certain aspects of the experimental trials (e.g. hardware used). Finally, only one researcher run the queries and evaluated the studies reviewed as the extent of the literature available was small.

2.5 Considerations for future, VRT study designs in RP

Via the current literature review certain conclusions were drawn about the suitability of VRT for RP and certain effectiveness factors of VRT were identified that could inform our future study designs for clinically applying VRT in RP of alcohol treatments, as per the literature review objectives mentioned in the introduction.

Firstly, regarding the potential suitability of VRT for RP, the literature suggests that exposure of individuals with alcohol misuse to alcohol-cued VEs (VR-CE) was able to elicit their alcohol craving and make their alcohol-related attitudes and status identifiable. This

could mean that, for the part of RP which involves the identification of high-risk situations of the patients, this could also occur virtually as it relies, in parts, on the elicitation of craving and of alcohol-related attitudes. Elicitation of craving was additionally reported in social interaction VEs. This indicates the potential for identifying social, high-risk situations as part of RP virtually, which, in turn, would be useful for practising how to refuse drinking when socially pressurised (refusal skills training - a major part of RP).

Craving and anxiety reduction, and change in alcohol-related attitudes, were also documented in the literature, when exposure to alcohol-cued and social VEs occurred. This suggests the suitability of VRT for regulating these parameters as part of RP in both alcohol-related and social high-risk situations virtually. Thus, the potential of VRT to facilitate not only craving regulation but also emotion regulation and refusal skills training, which are important aspects of RP, are indicated. In essence, the potential of VRT for both parts of RP (identification of high-risk situations and practising regulating alcohol misuse symptoms for coping in them) are suggested by the literature and confirms the worth of investigating VRT in RP as an alcohol treatment avenue.

Secondly, regarding relevant, effectiveness factors of VRT that emerge from the literature, the suitability of VRT when combined with CBT was identified. In the study where the CBT therapeutic paradigm was adopted, abstinence was maintained in the 3-months follow-up. This means that VRT for RP could be combined effectively with CBT, which is important as CBT is the only paradigm from the ones in the literature that is actively applied in current, clinical practice and suitable for those with alcohol misuse and mental health disorder comorbidity (a large part of individuals as mentioned before). Thus, our study designs will focus on exploring the suitability of combining CBT with VRT for RP.

Regarding the sample traits as an effectiveness factor, the literature suggests that the alcohol misuse symptoms studied were influenced in individuals of differing drinking levels. This suggests that our future, study designs should focus on exploring if drinking patterns influence the effectiveness and acceptability of VRT in RP, requiring to recruit or consider people of differing drinking levels when patient samples and target populations will be relevant. In addition, participants of the reviewed studies were mostly males. This raises the need for higher female representation in other and our future study designs, to ensure the effectiveness and acceptability of VRT for RP will be explored in either gender. Similarly, a few studies included participants with mental health disorders of low severity. In our future studies we should consider whether a mental health diagnosis plays a role in the effectiveness and acceptability of VRT for RP, as a large comorbidity exists in alcohol misuse individuals who attend alcohol treatment services and, thus, it is important to design inclusive clinical applications. Small sample sizes were also reported in the reviewed studies and none involved practitioners to gain a better insight on the acceptability and effectiveness of VRT. Thus, in our future studies, we should ensure recruitment of large sample sizes and the involvement of practitioners to justify in a credible way the acceptability and effectiveness of VRT for RP.

The aforementioned sample traits also speak to the protocols of our future studies. More specifically, we should ensure that we assess the mental health state and background of recruited individuals and their drinking levels (when relevant) and perform comparisons among the sub-groups of these two categories in the reported outcomes (when applicable). The findings of our studies could then elaborate on the findings in current literature and lead to more purposeful applications of the VRT in alcohol treatment.

The acceptability of VRT in practitioners and patients populations for alcohol misuse treatment has not been explored at all in current literature. Thus, in our future study protocols we should ensure that the focus will be shifted, apart from effectiveness, to acceptability, too, and its factors.

Certain delivery aspects of VRT have also not been explored in current literature. In particular, the level of involvement of practitioners during the delivery of VRT and the clinical setting have not been investigated. This should be addressed in our future studies as it may strongly link to the clinical acceptability of and patient preference for VRT as well as its effectiveness. Moreover, the level of personalisation required in the VEs' content and the delivery pace and context for VRT to be acceptable and effective as a treatment have not been investigated. For example, some studies employed fixed exposure times and fixed exposure order to the VEs, yet others have personalised these aspects offering free navigation and tailored exposure pace. Similarly, some studies have included VEs augmented with audio and scents, personalised, in some instances, to the individual preferences. Hence, the effect of these elements and the personalisation associated with them should be addressed in the protocols of our future studies. The type and effect of social interactions with virtual characters within the VEs of the current literature has also been under-reported. Whether verbal communication between the user and the virtual character or communication via body movements play a role on the effectiveness and acceptability of VRT should be, thus, considered in the design of our future studies. Correspondingly, the effect of social interactions with virtual characters on the emotions and presence felt by the users should be explored in our future studies.

Finally, the interconnections of realism, immersion and presence and their influence on the acceptability and effectiveness of VRT require further investigation by our future studies. These aspects remained under-explored in the current literature, with some studies to only report the VR hardware used and, in turn, the immersion level offered and only one study to perform presence and realism checks, but without providing any comments on these interconnections.

2.6 Conclusion

The studies reviewed here revealed that alcohol-cued VEs were able to elicit and alter alcohol craving levels and drinking-related attitudes, indicating the potential of VRT as an assessment and recovery tool in alcohol misuse. The therapeutic contexts employed in these

studies focused mainly on craving reduction when alcohol cues are presented virtually, using the cue exposure paradigm (CET). For a more realistic treatment approach, that targets at regulating all the range of alcohol misuse symptoms, and follows the current, clinical paradigms, VRT could be employed in the context of Relapse Prevention (RP). VR being an immersive tool, able to imitate real life, could operate as an assessment and RP tool when controlled exposure to alcohol-cued, social or interpersonal high-risk situations would be needed. As it does not carry the same risks as a real-life situation, it could offer an accessible exposure solution in diverse clinical settings and be particularly suitable for RP. To promote the clinical application of VRT in RP, effectiveness factors of VRT and aspects that remained under-explored were identified in the reported literature and were considered in our future study designs and discussed in the corresponding thesis' chapters.

More specifically, the next chapter focuses on the acceptability of VRT in practitioners for use in current, treatment paradigms (such as RP), which was explored via an interview study with practitioners and researchers delivering or designing substance use treatments (Chapter 3). The relative acceptability of VRT as a treatment option compared to current, alcohol treatments is discussed in Chapter 4, reporting the results of the survey study with adults drinking at diverse levels about patient treatment acceptability and treatment preferences. Potential content and delivery options are addressed in Chapters 5 and 6 about the the development of a VRT application that could be used in RP and its assessment via an interview study via adult drinkers, respectively, and in Chapter 4 about the treatment preferences of adult drinkers.

Table 2.1. VR-based Assessment Studies in Alcohol Misuse - Part A

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Cho et al. (2008)	Low alcohol misuse	VRCE	-	10 (9/1)	-	1	Dependant	Alcohol- cued: restaurant, pub with/without virtual characters Neutral: office, street with/without virtual characters	N/A	VAS, head gaze	Increased craving when social pressure applied irrespective of alcohol cues present. Neutral scenes without virtual characters elicited less craving than alcohol ones.	Participants looked more the virtual characters than the alcohol stimuli.
Lee et al. (2008)	AUD-abstinent in a controlled environment	VRCST	VRCST – 14 social drinkers	14 (14/0)	-	1	Dependant	Alcohol-cued: pub with/without virtual characters Neutral: street with/without virtual characters	HMD	VAS	Craving elicited in both groups when social pressure applied in neutral environment. In the pub, craving was elicited before social pressure in AUD group and not increased later on. In contrast, in the control group craving was only evoked when social pressure applied.	-
Gatti et al. (2008)	AUD	VRA	SCID – 10 AUD	10(N/A)	-	1	Dependant	Alcohol- cued: apartment, restaurant Neutral: pool, office	HMD	GSE, MAC2-A	Significant improvement in the motivation for change compared with the control group.	-

Table 2.2. VR-based Assessment Studies in Alcohol Misuse - Part B

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Bordnick et al. (2008)	AUD	VRCE	-	40(32/8)	-	1	18 min/ 3 min	Alcohol- cued: bar, kitchen, argument, party Neutral: aquarium	HMD	VAS, modified version of AAS, modified PQ (Witmer & Singer)	Higher craving induced in cued scenes with similar rate across scenes. Similar craving induced in neutral scenes present before and after the cued scenes. Attention to sight and scent were similar to cued scenes. Attention to thoughts about drinking lower to argument scene.	-
Ryan et al. (2010)	Binge Drinking (AI) College Students	VRCE	Non-binge drinking college students – 8	15 (N/A)	-	1	5 min in neutral scene, for rest dependant	Alcohol- cued: bar, kitchen, argument, party Neutral: aquarium	HMD	VAS, AAS	Higher craving for binge drinkers in the kitchen and party scenes with no significant craving differences in other rooms when compared with controls. Higher levels of thinking about drinking for binge drinkers in the bar and party rooms with insignificant differences in other room when compared with controls. Attention to sight and scent of alcohol was influenced by scene but not by group.	-
Spagnoli et al. (2014)	AUD	VRA	25 (15/10) AUD	25(15/10)	-	1	Dependant	Alcohol- cued: apartment, restaurant Neutral: pool, office	HMD	GSE, MAC2-A	Increased self-efficacy of the experimental group when compared with control group. Higher scores at Termination phase scale for experimental group and higher at Contemplation phase scale for control group.	-

Table 2.3. VR-based Assessment Studies in Alcohol Misuse - Part C

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Kim & Lee (2015)	HSD	VAAT	LSD – 18 (18/0)	18 (18/0)	-	1	Dependant	4 Alcohol-cued 4 Neutral	Video-clip projected on a screen	BDI, Approach-Avoidance tendencies associating situation (alcohol/non-alcohol) and instruction (push/pull)	Higher BDI scores for HSD than LSD. Longer pull in HSD when alcohol situations presented when compared with the pull of LSD.	-
Ghita et al. (2017)	HSD	VR-CE	LSD – 13(N/A)	12(N/A)	-	1	Dependant	4 Alcohol-cued: restaurant, bar, bedroom, chill-out area	HMD	VAS-A, VAS-C	No statistical significant difference on craving and anxiety depending on the VR scene or type of drinker. In the bar and restaurant scenes, heavy drinkers selected alcoholic beverages whereas light drinkers non-alcoholic beverages. No differences were reported on the bedroom and chill-out area scenes.	-
Ghita et al. (2019)	AUD	VR-CET	VR-CET- SD 14 (2/12)	13 (8/5)	-	6 (+1 pre- and post-assessment sessions)	10-15 min	4 alcohol-cued: bar, pub, restaurant, at-home Time of day (day or night) to choose from, 22 alcoholic beverages to select from and social interaction via virtual characters to include or not. Neutral VE: a room with white background and a glass of water.	HMD	MACS-VR, VAS-C, VAS-A, STAI	VAS-A scores elicited in both groups with higher ones for the AUD group. VAS-C scores elicited in both groups but statistically significant increase in the AUD group compared to the SD group. Statistically significant differences in the craving and anxiety in the alcohol-cued VEs compared to the neutral VE. No statistically significant differences in the craving and anxiety measures in the neutral VE between the AUD and the SD group.	-

Table 2.4. VR-based Assessment Studies in Alcohol Misuse - Part D

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Simon et al. (2020)	HD	VR-CET	VR-CET - RD 21 (N/A)	18 (N/A)	1 (due to cybersickness)	1	Dependant	1 alcohol-cued VE: bar	HMD	STAI, VAS, ITC-SOPI, UPPS-P Impulsive Behavior Scale	Higher craving reported in HD than RD. Perceived ecological validity was positively correlated with craving more in HD than RD.	-

VRCE = Virtual Reality Cue Exposure, VAS = Visual Analogue Scale, AUD = Alcohol Use Disorder, AI = Alcohol Intoxication, VRCST = Virtual Reality Coping Skills Training, HMD = Head-Mounted Display, VRA = Virtual Reality Assessment, SCID = Structured Clinical Interview for DSM-IV Axis I Disorders, GSE = Generalized Self-Efficacy Questionnaire, MAC2-A = Motivation Assessment of Change Questionnaire- Alcoholism, AAS = Alcohol Attention Scale, PQ = Presence Questionnaire, HSD = Heavy Social Drinkers, VAAT = Virtual Approach- Avoidance Task, LSD = Light Social Drinkers, BDI = Beck Depression Inventory, VAS-A = Visual Analogue Scale-Anxiety, VAS-C = Visual Analogue Scale-Craving, MACS-VR=Multidimensional Alcohol Craving Scale, STAI = State-Trait Anxiety Inventory, SD= social drinkers, HD= heavy drinkers, RD= regular drinkers, ITC-SOPI = ITC-Sense of Presence Inventory, UPPS-P Impulsive Behavior Scale = Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking, Positive Urgency, Impulsive Behavior Scale

Table 2.5. VR-based Treatment Studies in Alcohol Misuse - Part A

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Lee et al. (2007)	AUD in early (5) and sustained (5) remission	VR-CET	-	10 (N/A)	2	8/ 2 per week	30 min/ 25 min	Alcohol- cued: Japanese style pub, western bar	Beam projector with a 2.4m x 1.8m screen	PACS, AUQ, OCDS	Gradual decrease of urge to drink (lower AUQ scores) but no statistically significant difference after 8 sessions.	-
Lee et al. (2009)	AUD- detoxificated for 1 week	VRTP	nVRTP-ADP (6 CBT sessions & 2 education sessions * 2/week) – 18(18/0) AUD, No treatment – 15 (15/0) healthy control	20 (20/0)	-	10/ 2 per week	25 min/25 min (5 min relaxation, 10 high-risk situation, 10 min aversive stimulation)	Alcohol-cued: (beer garden, whiskey house, restaurant, and pub Aversive stimulation: short video of person vomiting Neutral: 5 different landscapes	2 projectors, a silver-coated screen for stereoscopic display, VR goggles for the participant to view the images	VAS, EGG activity, mood, anxiety, aversive stimulation	Greater decrease in craving after the 10th VRTP session when compared with nVRTP-ADP after 10th general treatment session. Higher increases and decreases of VRTP-ADP craving when compared with healthy controls.	EGG alpha power increased after 10th VRTP session for VRTP-ADP compared with their baseline
Son et al. (2013)	AUD- detoxificated for 1 week	VRT-PET-CT	PET-CT– 12(N/A) healthy controls	7(N/A)	-	10	25 min/25 min (5 min relaxation, 10 high-risk situation, 10 min aversive stimulation)	Alcohol- cued: N/A Neutral: N/A	N/A	AUDIT, BDI, BAI , OCDS, Korean-BAS/BIS, HAIS, TCI, VAS, PET images	Neurobiological imbalance on limbic system of AUD patients.	PET-CT : Before VRT: increased brain metabolism on right globus pallidus lentiform nucleus & left temporal lobe fusiform gyrus compared with controls. After VRT: decreased brain metabolism on right globus pallidus lentiform nucleus & right temporal lobe.

Table 2.6. VR-based Treatment Studies in Alcohol Misuse - Part B

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Yoon et al. (2014)	AUD	CBT+VR-RP	-	6 (M)	2	8 CBT sessions + 3 VR-RP at baseline and on week 4 and 8	30 min CBT session, standard VR-RP session (N/A exact time)	N/A	N/A	VAS, self-reported days of abstinence	Decrease in craving and increase in self-reported days of abstinence. Benefits maintained at 3-months follow-up.	-
Son et al. (2015)	AUD- detoxificated for 1 week	VRT- PET-CT	PET-CT – 15 (N/A)	15(N/A)	3	10	25 min/25 min (5 min relaxation, 10 high-risk situation, 10 min aversive stimulation)	Alcohol- cued: N/A Neutral: landscape Aversive stimulation: vomiting scene	three-dimensional television monitor	VAS, PET images, aversive stimulation	No significant correlation between change in brain metabolism within the right lentiform nucleus or right temporal lobe and craving for AUD patients. Craving decreased after 10th session.	PET-CT : Before VRT: increased brain metabolism on right globus pallidus lentiform nucleus & left temporal lobe fusiform gyrus compared with controls. After VRT: decreased brain metabolism on right globus pallidus lentiform nucleus & right temporal lobe.
Choi & Lee (2015)	HSD	VCST	VCST – LSD- 20(20/0)	20 (20/0)	-	1	20 min/20 min (10 min each scene)	Alcohol- cued: Hospital Aversive stimulation: Subway	HMD	AUQ, Alcohol- IAT, stroop test, eye tracking, aversive stimulation	Higher reduction in explicit alcohol craving for HSD than LSD. Similar reduction in implicit craving for both groups.	Alcohol-IAT: weaker positive association with alcohol for HSD than LSD. Eye-tracking: Dwell time bias scores decreased in both groups Stroop test: Reaction times decreased in both groups.

Table 2.7. VR-based Treatment Studies in Alcohol Misuse - Part C

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Metcalf et al. (2018)	Healthy individuals having recently used alcohol	TAKE CONTROL game	Wait-list - Healthy individuals having recently used alcohol (N/A)	(N/A) but 61 included in the analysis and assigned to the intervention or the control group	8	3	15-30 min	Alleyway, bakery, beach, candy aisle, convenience store, dive bar, parking lot, city, liquor store used as background images and alcohol cues that participants kicked away	Kinect motion sensor camera paired with Xbox One and Windows operating systems.	Self-Efficacy, Attitude, Behavior, or Intended Behavior	Increase in Self-Efficacy, Attitude, Behavior, or Intended Behavior	-
Kim & Lee (2019)	HSD	VAAT	HSD 14 (9/5)	14 (8/6)	-	3	Approximately 1 hour	4 alcohol-cued scenes (i.e., scenes of drinking beer with friends in a bar) and 4 non alcohol-cued scenes (i.e., scenes of drinking juice with friends in a cafe)	N/A, joystick to push or pull	STAI-S, STAI-T, AUQ, BIS, BAS	No decrease in the explicit alcohol craving in the training group and increase in the control group.	A-IAT, decrease in the implicit approach towards alcohol in the training group and increase in the control group.
Ghita et al. (2019)	AUD	VR-CET	CBT - 5 (2/3)	3(1/2)	-	6 (+1 pre- and post-assessment sessions)	-	4 alcohol-cued: bar, pub, restaurant, at-home Time of day (day or night) to choose from, 22 alcoholic beverages to select from and social interaction via virtual characters to include or not.	HMD	MACS-VR, VAS-C, VAS-A, STAI	Craving and anxiety reduced after 6 sessions, with higher decrease reported in the VR-CET group compared to the CBT group for both craving and anxiety.	-

Table 2.8. VR-based Treatment Studies in Alcohol Misuse - Part D

Study	Alcohol Misuse Type	Intervention	Control group	N (M/F) – without control group	N of drop-outs	No of sessions	Duration of session	VR Scenes	Hardware	Measures	Results	Physiological Reactivity
Hernadez-Serrano et al. (2020)	AUD	TAU+ VR-CET	TAU - 27 (N/A)	15 (N/A)		6 VR-CET sessions (+1 pre- and post-assessment sessions) + TAU	-	4 alcohol-cued: bar, pub, restaurant, at-home Time of day (day or night) to choose from, 22 alcoholic beverages to select from and social interaction via virtual characters to include or not.	HMD	MACS-VR, VAS, STAI, Alcohol Stroop Test	Chances for improving cravings were reported higher in the TAU+ VR-CET group compared to the TAU group.	-
Ghita et al. (2021)	AUD	VR-CET	-	1 (M)	-	6 (+1 pre- and post-assessment sessions)	1 hour (50 min exposure + 10-20 min of debrief)	4 alcohol-cued: bar, pub, restaurant, at-home Time of day (day or night) to choose from, 22 alcoholic beverages to select from and social interaction via virtual characters to include or not.	HMD	MACS-VR, VAS-C, VAS-A, STAI, Alcohol Stroop Test, VAT	Craving and anxiety reduced after 6 sessions.	VAT: Attentional bias decreased towards alcohol cues.

VR-CET = Virtual Reality- Cue Exposure Therapy, PACS = Penn Alcohol Craving Scale, AUQ = Alcohol Urge Questionnaire, OCDS = Obsessive Compulsive Drinking Scale, VRTP = Virtual Reality Therapy Program, ADP = Alcohol Dependence Patients, EGG = Electroencephalographic, AUDIT = Alcohol Use Disorder Identification Test, BDI = Beck Depression Index, BAI = Beck Anxiety Inventory, OCDS = Obsessive–Compulsive Drinking Scale, Korean-BAS/BIS = Behavior Activation System/Behavior Inhibition System, HAIS = Hanil Alcohol Insight Scale, TCI = Temperament and Character Inventory, VAS = Visual Analogue Scale, PET-CT = Positron Emission Tomography-Computerized Tomography, VCST = Virtual Covert Sensitization Treatment, VAT=Visual Attention Task, STAI = State-Trait Anxiety Inventory, VAS-A = Visual Analogue Scale-Anxiety, VAS-C = Visual Analogue Scale-Craving, MACS=Multidimensional Alcohol Craving Scale, CBT= Cognitive Bahavioral Therapy, VR-RP= Virtual Reality-based relapse prevention, A-IAT= Alcohol Approach-Avoidance Implicit Association Test, AUQ = Alcohol Use Questionnaire, BIS/BAS = behavioral inhibition system/behavioral approach system, STAI-S= State-Trait Anxiety Inventory-State, STAI-T= State-Trait Anxiety Inventory-Trait

Chapter 3

Acceptability of VRT in Practitioners and its Clinical Application

3.1 Introduction

While the review of the literature in the previous chapter (Chapter 2) suggested the effectiveness of VRT for addressing aspects of alcohol treatment and its potential for RP (Ghita & Gutierrez-Maldonado, 2018; Segawa et al., 2020; Trahan et al., 2019; Yoon et al., 2014), it also denoted the lack of practitioner involvement in the experimental protocols and the delivery of the proposed interventions. Thus, the acceptability of VRT for alcohol treatment, in general, and for RP, in particular, in practitioners remained unexplored. Considering, though, the clinical acceptability of VRT is particularly important for effectively applying VRT as a clinical tool for RP as it could justify its suitability for RP by those who would deliver it, based on professional criteria. Moreover, exploring the acceptability of VRT for use in RP in practitioners could help identify factors that could increase its acceptability in clinical practice, such as the formation of acceptable, clinical protocols as shaped by expert views. Increasing the acceptability of VRT for RP in practitioners could, in turn, increase the likelihood of practitioners employing it in their clinical practice, and, thus, make VRT research meaningful, relevant and beneficial for alcohol treatments at a quicker pace than without considering clinicians' views during its development.

While the acceptability of VRT for alcohol treatments has not been explored, the acceptability of VRT in general, clinical practice has been previously investigated by a few studies. Surveys have revealed that practitioners hold positive views about its potential to complement psychological treatments generally, and in particular regarding its ability to provide exposure to hard-to-access situations and easier manipulation of relevant stimuli (Segal et al., 2011). Financial cost relating to the VR hardware and software, technical difficulties and the training required were the most widely identified barriers (Segal et al., 2011). A further survey in 2012 of 262 therapists who had not previously used VR, showed concerns about training, equipment, costs, and a lack of understanding of the benefits and applications of VR (Schwartzman et al., 2012). By 2019, a survey of 185 behavioural therapists reported lower concerns around technical and cost related issues, as VR equipment had been widely commercialised from 2016 (Lindner et al., 2019). Likewise, therapists with knowl-

edge of VR and VRT reported they were more likely to use it in the future (Lindner et al., 2019) and prior VR knowledge has been linked to increased acknowledgement of the potential VRT benefits in treatment (Segal et al., 2011). These highlight the critical impact that practitioner familiarity with VRT attains on its acceptability as a treatment tool, helping to acknowledge potential benefits and outweigh potential challenges of clinically employing VRT (such as financial costs). These also underscore the importance of acceptability studies on identifying benefits and challenges of treatment tools, that could inform their clinical research and application, and why it is critical to consider the clinical acceptability of VRT for RP in our research, at this early development stage.

A few studies have also investigated the acceptability of applied VRT in practitioners over a course of treatment, focusing on its feasibility in the treatment of Childhood Social Anxiety Disorder (Sarver et al., 2014), and over a single therapeutic session with individuals at risk of developing an Eating Disorder (Matsangidou et al., 2020). In both studies, practitioners found VRT as a highly acceptable treatment tool for alleviating the symptoms of each, corresponding psychological condition (Matsangidou et al., 2020; Sarver et al., 2014). These indicate the benefit of exploring acceptability once VRT has been applied, ensuring that it is clinically safe and useful.

To explore the acceptability of VRT for RP in practitioners and identify its acceptability factors, a qualitative, interview study was conducted with practitioners who delivered substance use treatments and researchers who designed substance use treatments. By taking a qualitative approach, a richer understanding of practitioners' and researchers' views on VRT in clinical practice was provided and, as per acceptability factors, suggestions to inform the design of a VRT application for RP and its integration into clinical practice were obtained (please also see Chapter 5). The study focused on the clinical use of VRT in substance use disorders in general, in an effort to investigate whether VRT would be acceptable for any substance use disorder or whether practitioners and researchers would recommend it only for a specific disorder of this field. Similarly, practitioners and researchers were asked about VRT acceptability in alcohol treatment generally rather than RP in particular. This prevented the introduction of bias in their opinions about the applicability of VRT in alcohol treatment and RP specifically while bridged the gap in relevant literature about the acceptability of VRT in substance use treatments, as the clinical acceptability of VRT in substance use treatments has not been explored, either. Practitioners and researchers of this interview study, apart from their views on the acceptability of VRT in substance use treatment, were also asked about their familiarity with VR and VRT since it has emerged as an acceptability factor in relevant research (please see paragraph 2 of the current chapter) that we aimed to explore further.

3.2 Methods

3.2.1 Participants

Psychologists, psychotherapists, counsellors, social workers, NHS nurses and academics with an expertise in SUD treatment were interviewed. The sampling was purposive and the inclusion criterion was at least 2 years' experience delivering or researching and designing substance abuse treatment. University and SUD counselling and recovery organisation websites in the North West of England were searched to identify possible participants. Participants were invited to a face-to-face interview via the email address that appeared on the university or counselling website or the email address provided by the charities or the rehabilitation service they worked for, after initial contact with their administration centre. Private counselling practices, a university, two charities and a rehabilitation and integration service were involved in the study.

3.2.2 Procedure

Informed consent was given by all participants. Each participant was interviewed once at their place of work by the PhD Candidate. The interview started with a brief introduction to VR and VRT. This covered its application to phobias and PTSD, providing examples from literature, but its application to SUD was briefly mentioned as per the exposure it could offer to high-risk situations, to avoid participants having any preconceptions about its possible contexts, delivery methods and content. Images were used to showcase a commercial VR headset with two hand-held controllers, its standard set-up and the view that the wearer will obtain when experiencing VR and when interacting with virtual objects (please see Appendix A).

For the interview, a semi-structured format was used for in-depth exploration of the thoughts of the experts in an open-ended manner (DeJonckheere & Vaughn, 2019; McIntosh & Morse, 2015). The topic guide of the interview involved questions about the acceptability of VRT and more specifically about the risks, challenges, benefits and conditions for using VRT in daily, clinical practice in the field of substance use disorders (please see Appendix A). Aspects such as the target population and eligibility criteria, delivery protocols and contexts, and preferences on the VRT application content were further discussed. Two images of interactive characters applying social pressure from previous VRT studies in alcohol abuse were also given to the participants when asked about the VRT application content, to offer a tangible example of what interactive characters would potentially look like. All interviews were audio-recorded, transcribed verbatim and anonymised, except for one interview where the encrypted digital recorder failed to save the recording. In this case the handwritten notes of the researcher were anonymised and used in the analysis. The content of the notes was checked by the participant for accuracy. Each interview lasted between 45 and 80 minutes. No compensation was provided for participating in the study.

3.2.3 Thematic Analysis

Thematic analysis was chosen as the acceptability of VRT in SUD is a novel research topic and an analytical approach was needed (Braun & Clarke, 2006). The themes were identified using an inductive method, with the data driving their formulation. Furthermore, the identified themes were semantic (Braun & Clarke, 2006) as the explicit meaning of the data was analysed. Consequently, the impact of socio-cultural or any other factors on the participants' opinions was not considered as per the realist approach (Braun & Clarke, 2006).

The analysis followed the steps outlined by Braun and Clarke 2006. The first author read the transcripts repeatedly to promote familiarisation with their content. During the formulation of the primary codes, segments of the transcripts were grouped into relevant concepts-codes. Coding was supervised throughout, and once all transcripts had been coded, the result was shared with the other researchers for validation. To further refine the codes, this process was repeated until each code was efficiently represented by the extracts attached to it. Then, the themes were identified and discussed with the research team. Some codes were not included, as they seemed irrelevant to the themes and could not form individual, meaningful themes. The coding was terminated once the themes were validated by the other researchers. The naming of the themes was crystallised once the thematic analysis report was written.

3.2.4 Ethical Approval

Ethical approval for the study was granted by the University of Manchester Research Ethics Committee (Ref.: 2019-6983-10288).

3.3 Results

3.3.1 Participants

In total, 14 experts were interviewed. Descriptive data for the participants are presented in Table 3.2.

3.3.2 Themes

The identified themes mapped to: the safety of the exposure (1); the realism of the therapy (2); the insight VRT can offer into the condition and the therapeutic experience for the practitioners and the individuals in recovery (3). Each theme is divided into sub-themes which are associated with both positive and negative aspects of VRT and are presented in Table 3.1.

The consensus view was that VRT would be suitable for recovery from any substance and for adults of any age. VRT was viewed as being particularly attractive to young people, due to their regular use of technology. Two participants, focusing on alcohol abuse, suggested that problematic drinkers or people whose abuse stems from psychological dependence could benefit more from VRT than people with severe alcohol dependence whose physical health would be the sole priority. All participants recommended the use of VRT as an assistive tool rather than a stand-alone intervention, as they believed it to be more useful for addressing symptoms than the underlying cause of the disorder. It was additionally underlined that to attend to the diverse needs of each individual, at each recovery stage, combined therapies would be required in any case.

Theme 1: Safety of VRT

This theme addresses the issue of safety in the use of VRT in SUD treatment. The ecological validity of the VE was believed to offer realistic and safe exposure to high-risk situations, without the risk of immediate relapse. This was seen to be useful for individuals with SUDs to explore their addictive behaviour and practise ways to prevent relapse. However, the risks of subsequent relapse, of traumatising and of overconfidence about coping with high-risk situations were raised. Early exposure to high-risk situations and the suitability of VRT for people with co-morbid mental health issues were also discussed. Mitigating measures were proposed to facilitate safety during VRT.

Ecological validity of the VE The key element of VRT's therapeutic value was collectively acknowledged to be the virtual representation of cues, rendering immediate relapse impossible and the exposure safe. "...you're allowing people to experience in a risk-free environment so there's no immediate access to alcohol" (P1). Access to daily, high-risk VEs was seen as valuable for therapy. "...it will be a massive aid. Because it will be recreating a scenario that could be of an everyday, any day occurrence in their life. So we can see how they react to that...look at it differently." (P14). Simulating and tailoring situations that were hard to find in the real world, including embodying a specific individual via an avatar or character, were additionally thought by participants to offer a variety of high-risk situations. "I think the good thing about VR also, apart from bringing it all together is, if they can manipulate aspects of it that might not be possible to manipulate...Having things that are really hard to happen in the real world." (P12).

Addictive behaviour exploration As VRT has the potential to provide safe exposure to diverse situations, participants believed that it could allow individuals to explore their high-risk situations and consequent responses. "...you can gain more information on what they are thinking. It will help them understand what their triggers might be." (P14). VRT could also be used to assess the individual's openness about their substance abuse issue and facilitate a discussion about their high-risk situations. One participant, referencing the Prochaska and DiClemente stages of change model (Prochaska et al., 1992), thought that it could assist

prior to change (Pre-contemplation) or while considering change (Contemplation) by exploring and evaluating the individual's addiction state. "I could see it being used with pre-contemplative people to explore the issues in their life that let them be pre-contemplative of change...I could see it being helpful when they're planning for change." (P10).

Relapse prevention Participants frequently mentioned the potential for VRT to help with relapse prevention. VRT was considered a safer alternative to in vivo ET, as it provided an environment in which people could learn to handle cravings, without exposing them to real-life contact with the addictive substance. "Most people don't ever learn that cravings don't last forever. And learning that...in the virtual world would be really helpful...to practice that in vivo, you know, this is ideal. But... The next thing they know, they're drinking a pint of lager." (P10). The control VRT provided was also seen important by a number of participants for practising coping skills. Firstly, individuals controlling their cravings virtually was thought to help them realise that they could perform this in reality, too, while experiencing in practice a positive feeling linked to coping. "It is about coping skills empowerment, recognising...that they still have a choice…That they are powerful enough to refuse." (P14). Secondly, individuals being able to control navigation and virtual interactions was viewed as positive for increasing their self-confidence while avoiding actual relapse: "...people might gain in confidence and self-esteem about being, you know, in control of their lives...This might be one area that they have got control." (P10). VRT was additionally perceived by a few participants as beneficial for reintegration of people who have finished in-patient therapy and need to adjust to daily trigger exposure. "It can be quite a bubble when you're in therapy...then they go back out into the real world almost...it's quite a big jump. So it would be useful to have it as a tool." (P2). One participant recommended VRT as suitable for acting as a reality check for people who had been abstinent for years, since beliefs that they had been 'cured' and that they could therefore use again were common. Finally, using VRT as homework was suggested by a participant, as it could provide an extra layer of support and involvement. "...this would be like a tool to assist a person, particularly in between therapy sessions." (P7).

Risk of relapse Despite the relative safety of the VEs in terms of exposing individuals to high-risk situations, participants felt strongly that VRT involved its own risks. Whilst there was no risk of relapsing during a VRT session, there may be a risk following a session, as they would have been exposed to immersive, high-risk situations. "If I exposed somebody to an addiction experience...they're regressing to a child ego state which is where their biggest vulnerabilities lie, but also the least reasonable decision making." (P9). However, participants acknowledged that for VRT to be therapeutically beneficial, it had to be sufficiently triggering. "What you want for the system to work, for me, has to be very arousing for them." (P2). It was also acknowledged that the risk of relapse would remain regardless of mitigating measures, but that would be the case for any therapy. "...we're exposing them to potential triggers that they face in the real world, that's kind of part of the process of therapy...I think it's an acceptable risk." (P5). One participant suggested that if VRT were

delivered in residential treatment, this risk would be reduced.

Risk of traumatising Most participants identified the risk of traumatising an individual, by virtually exposing them to cues that they might not be ready or prepared to handle. "...you've got the potential of traumatising someone or re-traumatising them...it's almost a trauma exposure therapy." (P9). One participant noted that this would also be an issue for people with co-occurring mental health issues, as often an existing trauma would underpin their mental health distress and substance abuse. "...maybe post-traumatic stress disorder as...both a cause of that mental health distress, but also a cause of their substance misuse, will be very, very common... Using virtual reality in an area before they were ready could be really detrimental." (P10).

Concern for early exposure to high-risk situations Participants were also concerned about whether people could cope with exposure to high-risk situations before achieving abstinence or stability in use. "Certainly wouldn't be doing it with someone who is dependent at drinking or drinking at increased levels of risk...I think it would be too difficult to manage earlier on." (P2). One participant reflected on whether exposing individuals to high-risk situations at an early stage of recovery would be ethically problematic, but acknowledged that exposure would happen anyway in the everyday environment of individuals. "...whether you are doing this early on in the process raises up an ethical issue…I have to say that in their environments they are surrounded by those cues anyway..." (P11). Readiness for VRT was considered by all participants to depend on their individual capacity. "I wouldn't give it a time, I would give it in terms of the person's progress to treatment and other resources available to them...They need to be ready to be built up." (P12).

Overconfidence risk Some participants identified the risk of people feeling overconfident and falsely assuming that they were cured after managing the virtual, high-risk situation. "It could give people a false sense of security...I've done my virtual reality thing. And I didn't crack up...So now I can be on the real street corner." (P8). A number of participants also felt that individuals might overestimate their progress during therapy. "People have a tendency to think they're doing better than they are." (P8). For that reason, a few participants suggested that it would be useful for individuals to test their coping skills in real, correspondingly high-risk situations after practising them virtually, "They've still got to go in the real world and do it..." (P7).

Eligibility of individuals with co-morbid mental health issues Participants agreed that service users with mental health difficulties should not be excluded from VRT as they represent a major part of the SUD population in recovery. "…over 80 percent of everybody who attends for some kind of substance misuse treatment in this country has an identified mental health problem..." (P10). However, some expressed concerns about its safety for this population. They felt that for individuals with disorders connected to reality, disassociation and

self-awareness, or individuals with hallucinations or psychosis, VRT could potentially be distressing or confusing. "...if they are immersed in this exercise, they may not necessarily be aware of when that reality finishes and when it starts." (P6). Another participant considered whether VRT implied that escaping reality is acceptable to people who try to mentally escape reality or avoid social interactions. "It may be that somebody came to this therapy and what they spend most of their time doing is escaping...then I put a headset on them...do then I collude with their idea, that non-reality is more useful than reality?" (P9).

Participants thought that when individuals had anxiety or depression, their eligibility should be dependent on their capacity due to concerns that VRT might increase anxiety, if it were unfamiliar. "There is the possibility that this experience could heighten someone's anxiety. There's a sense of apprehension with that maybe...I think that'd be for person to person." (P9). The possibility of the VR headset distressing claustrophobic individuals was acknowledged by a few participants. "I think a claustrophobic person probably would not do well with that." (P6). As such, a familiarisation exposure to a neutral, daily scene was believed by all participants to promote a feeling of safety. "Obviously that's useful for people who don't know anything about virtual reality, or computers...to feel safe...that may help in some of those situations where we talk about anxiety… And it might be that people further up this scale may actually be able to have more access to that." (P9).

Mitigating measures Other mitigation measures recommended by participants included proper assessment, preparation and a solid intervention plan. "...if you used it too early or you didn't assess properly you could actually send somebody right back...and there is not enough formulated approach." (P12). Reintegrating the individual after VRT emerged as the most important measure against relapse and as an ethical duty of practitioners. "What you don't want them to do is actually they've watched this, then all of a sudden the cravings are through the roof, and they're just gonna walk out of here and go straight to the pub. And I don't think that's ethical." (P2). A trusting relationship between the individual in recovery and the practitioner was thought necessary for informed clinical decision-making. "I think when you're using anything like this, it's about knowing your client and your client knowing you...I can know when they're becoming overly stimulated..." (P2).

Finally, most participants emphasised that a skilled practitioner should guide the VRT sessions. A clinical psychologist or a Cognitive Behavioural Therapist were considered the most appropriate. For people with co-morbid mental health issues, practitioners who would normally deliver the daily treatments were seen as most appropriate, working in cooperation with the clinical supervisor and the medical professional attending the individual. "I'd talk about it with clinical supervision...And I'd probably run it by the person's responsible medical, mental health professional..." (P10). Participants therefore felt that with careful delivery, the risks accompanying VRT could be reduced. However, one participant compared the risk of VRT to that of PTSD treatment, noting that both would involve exposure to prior trauma that might worsen an individual's state in the short term, but would prove therapeutic in the long term. "So, while someone might struggle with that and feel like they

get a lot of cravings and thoughts about drinking, that's an important and useful process for therapy. That's what therapy is about." (P5).

Theme 2: Realism

This theme addresses the level of realism involved in the use of VRT in SUD treatment. Elements that could influence the realism of the VEs were believed to be the use of avatars and interactive characters, the olfactory augmentation of the VEs, the personalisation of cues and the exposure mode to the cues. Concerns were raised about the engagement of individuals with the exposure material and whether cues would be realistically represented.

Avatar and interactive characters use Another aspect of VRT considered valuable by participants was the level of realism it could offer. Virtually exposing individuals to high-risk situations was thought to be more realistic than imagining or discussing them. "Often in a residential treatment centre, people will talk about certain situations, but it's theoretical until you actually place them back in that situation...being on a street corner and knowing that the dealers will walk past... If we can virtually put them on that street corner, we can retrigger and help them cope with what the physiology is like in those times." (P8). Including interactive characters in the VEs was thought to have the potential to enhance realism. Participants believed that avatars and interactive characters could contribute to a more realistic version of role play. "So, what we would do is practice at role play about how you say no. And we would just kind of act out...VR could do that role. Probably, you know, more realistically." (P5). They thought that interactive characters simulating specific individuals who might apply social pressure in certain environments could contribute to people in recovery better handling cravings caused by these scenarios. This was seen by some participants as more appropriate for alcohol and nicotine abuse, as these are more socially acceptable than other substances and frequently linked to socialising and bonding. The ability to realistically practise the exact words required to refuse using was regarded valuable, especially in early abstinence. "...in the early days...you kind of need to practice what you're going to say to people. So, I think avatars would be really important in that...we don't exist in isolation do we?" (P2).

Participants also suggested that interactive avatars and characters could allow simulation of common, emotional scenarios to be used for craving management, increasing realism. Positive or negative emotional states were considered the real high-risk situations for relapse and the actual cause of the addictive behaviour, as substance abuse is often associated with the inability to regulate emotion. Simulating such scenarios was thought to help in that regard by evoking emotional, cognitive and behavioural reactivity while offering exposure to realistic high-risk situations. "What we know about substance misuse is that most people use it to kind of manage emotions...And being exposed to an argument or an emotional trigger...would be also a part of relapse prevention. So it's just making it more realistic." (P5). There were a range of interpersonal scenarios that were thought to be useful to simulate

during VRT, including family settings and arguments or domestic abuse incidents. "...emotional states and particularly post-argument or post-conflict is a time where people begin to get real urges, to take away the feelings surrounding that conflict..." (P10). Participants believed that family-related scenarios could be used for family work and to educate people on the behavioural aspect, especially in group therapy. "...for more in like group settings, you could use it to really like educate people and particularly more as a set for families." (P13).

Olfactory augmentation It was thought that olfactory augmentation of the VEs with substance-related scents could further promote immersion and realism. Participants were largely positive that smell would assist in initiating craving in nicotine, alcohol or cannabis abuse. "...the smell, that is what drives you mad...It makes the experience much more real." (P1). Some participants thought that olfactory augmentation and live props could overwhelm some individuals, associating immersion with stimulation and the likelihood of relapse. "...it just depends on the individual, but...the scent might be a little bit too much...it's making it very real then." (P13). It was recommended that each stimulus should be introduced progressively. "It is about pacing I think, isn't it?" (P12). One participant mentioned that it would be useful to adjust the scent's intensity. "It would be nice if you could play around with it...have some sort of levels." (P6). It was concluded by all participants that with consent of the individual in recovery, making the exposure as realistic as possible would be more beneficial. "...with consent then anything that makes that experience more real the better." (P9).

Personalisation of cues Personalisation of the cues was perceived as an additional means of ensuring realistic exposure. Participants explained that substance abuse habits would differ from individual to individual and personalising the visual and audio cues would make the scenes more realistic and engaging. "...somebody dependant on smoking heroin, there is no point showing him syringes." (P11). Personalising the avatars and interactive characters and their voices would also promote therapeutic involvement. "...a woman might find another woman to keep asking her to drink more pressurising..." (P12). There was a view that it was important to avoid the interactive character accidentally resembling a person who the individual in recovery may find traumatic, since substance abuse usually entails a prior traumatising experience. "...a male...arriving in a pub... for a female is triggering in a whole different way that you didn't envisage. That's why I was talking about that control element of a VR experience." (P5).

Exposure mode The ability to repeatedly expose individuals to identical VEs and scenarios was another feature discussed by participants. On the one hand, participants found the option to manipulate the scenario visited in a VE (in either random or controlled ways) appealing, as this would be more like real-life. "I think that VR would be great, helpful for mopping up what was unexpected...that's where it has strengths, that it can be unexpected." (P12). It was suggested by some participants that changes could prevent desensitisation to the scene. "I think minor changes would make it more realistic... I think that ele-

ment of surprise in that first exposure... It hits that emotional level more..." (P2). This was thought by most participants to better prepare people for handling change, helping to ensure that their coping techniques would be transferable to other situations. "A lot of people who have addiction problems really struggle with change... So it's almost learning to transfer the skills. So, when they go out into the real world and they hit that trigger, it's all right, because I've practised this and I've done it in 10 different scenarios, and it's all been okay." (P2).

Participants also thought that repeated exposure to the same scenario could be useful for building resilience. "I guess it depends on how well they performed on that scenario in previous attempts... you really need to get that response before moving on to a different scenario." (P11). Some participants thought consistency of the exposure material was important to start with, so that individuals could track their progress. "Consistency would be better initially...So when you first looked at that you had this reaction but now you're having this reaction." (P8). Some participants mentioned that exposure to the same scenario would be helpful for training people to cope with high-risk situations and achieve greater resilience as their reactions would depend on their corresponding emotional state. "I will do it again a few times. Because it depends on how the person is feeling." (P14).

Concern for engagement Despite the potential for realistic exposure to high-risk situations, some participants were unsure whether genuine responses could be elicited. "...if I found that it was very convincing...in the sense that you could see that people were having genuine reactions, as opposed to playing with a toy...then I can see it becoming very useful." (P8). They were concerned that recreating individuals, verbal interactions and high-risk situations, like a friend overdosing, would be challenging. "...it might be encountering a situation that brought you to use, being stressed, things which are quite difficult to mimic I would have thought within the virtual environment." (P11). A few participants doubted whether feelings could be induced artificially by fake cues, but also considered the artificial triggering of emotions unethical. "You can't invoke those feelings artificially. They are happening in some part of the brain that is very fundamental and it is difficult to know how a fake cue can elicit real emotion. And it would be very unethical too." (P11).

Concern for realistic representation Another concern of a small number of participants was whether the software would be sophisticated enough to allow for realistic personalisation of the VEs, avatars and interactive characters. "Because you won't be able to completely personalise it, will you? To the extent that you can completely build your own, you know like in Minecraft?" (P5). One participant thought that personalised character and avatar appearance combined with drug abuse could result in confusion as to whether the individual was interacting with the real person or their avatar or character, and therefore suggested that only avatar and character behaviour (and not appearance) should be personalised. "I think that because of how certain drugs can affect the mind, …if they were personalised to the characters' [appearance] in real life, as opposed to adopting behaviours of characters in

real life, then that person may cross over the boundary of what is reality and what is not." (P1). The ethics of involving real people by virtually simulating them was registered as a concern by another participant. "...to what extent are you including other human beings when they're actually avatars?" (P8). Regardless of whether realistic personalisation was achieved, it was thought by a few participants that virtual exposure to the addiction cues could still prove therapeutically valuable. "...just seeing that cigarette and just seeing that alcohol is a trigger. So, you've got...part of the experience there, at least. And that's still valuable." (P9).

Theme 3: Additional Insight for Practitioners and Individuals in Recovery

This theme addresses the additional insight that the use of VRT in SUD treatment can offer to both practitioners and individuals in recovery. Virtual exposure to high-risk situations was believed to facilitate better understanding of individuals in recovery. Practitioners using a monitor to observe the virtual behaviour of users was thought to increase further the understanding of individuals in recovery but was also linked to misconceptions about the individual's responses and biased behaviour. Adopting a different viewpoint via an avatar was perceived to be useful for individuals in recovery to gain insight into their addiction but the risks of relapse and disengagement were also associated with it.

Better understanding of individuals in recovery Participants believed that VRT could offer insight into how individuals in recovery process high-risk situations, either pre- or post- lapse, and that this could inform their subsequent intervention. "If they relapse… you could kind of use it as a tool... Put this on [the VR headset]. Where did you go? Were any feelings that you are feeling now there last night? Let's explore them. So, it could be a, you know, a really good tool…to get a bit more of a better understanding." (P3). Some participants additionally felt that it could be beneficial to deliver VRT within a group as their awareness about their substance abuse could be increased via sharing their experience. "I think discussing it as a group session would be even better...I think it would be really good that all 'd be kind of discussing how they feel about it, to be able to mirror it to the group." (P3). Olfactory augmentation of the VEs was similarly thought by participants to give greater insight into the root cause of the substance abuse issue. They stated that smell is one of the most powerful senses, able to trigger the surfacing and subsequent processing of memories of prior life events that led to the addiction initially. "Smell can really take you back...it gets into where it needs to be. To the root of the problem quicker." (P2). Participants also appreciated the opportunity for interaction during the session, which might also support a better understanding. "And, so that's kind of, live feedback, which is going to be useful for therapy." (P5).

Monitoring of virtual behaviour Using a monitor to observe the individuals was seen by most participants as an opportunity to improve understanding of the individual and their high-risk situations. "...we can look at what they are seeing, what they are reacting to and then

we can gauge that and why they might have reacted to that and not to that." (P14). A monitor would also facilitate proper supervision, control over the exposure material and flow and help with clinical decision making. "I want to be in it as well, and just see what they see, so as to be sure when I'm talking to them about it or introducing it to them." (P12). Participants suggested that it would increase practitioners' interaction with the individuals, as they could comment on and discuss the individual's virtual behaviour. "...you would be able to have a visual representation of it...And you can maybe ask additional questions based on what they're seeing." (P10). Finally, a participant mentioned that it would demonstrate the practitioner's involvement and attention to the therapeutic process, empowering the therapeutic alliance. "...you'd want them to know that you were concerned and interested in what they were doing." (P8).

Although participants expressed a desire to observe the individuals' actions, they were concerned that this might bias behaviour, due to individuals being aware that they are observed by their therapist. "There's something interesting about, does that person know, that you're watching? ...does that change how addiction works?" (P9). Lastly, some participants considered the possibility of inaccurate interpretation of the individual's actions, as practitioners might focus on observing the monitor rather than other informative sources such as body language or verbal feedback from the individual. "I think I would just prefer to watch...and actually get their feedback on what it is that they're seeing, because we might think that's what's triggering them. But actually it's the old bag in the side of the corner that reminds them of their Grandad." (P2).

Adoption of a different viewpoint Adopting the viewpoint of another person had the potential to offer further insight to individuals in recovery, particularly for family work and psychoeducation. Participants believed that by impersonating another member of their family through an avatar (change of perspective), which their practitioner or themselves would control, the individual may be able to perceive their view more clearly and have a direct experience of the impact of their substance abuse. "...understanding how all these perceive you when you're drinking...if you can then look at how your child sees it. I think that'd be really powerful." (P2), "The reasoning of all that objective perspective...here's what this person's seen." (P7). Adopting the viewpoint of an avatar of the opposite sex was mentioned as having the potential to assist in addictive behaviour exploration from a psychosocial approach. "...a man, white English male... goes to the pub... his friends start drinking 20 pints. What happens if he goes in there as a woman? Does he have the same experience?" (P9).

Regardless of the insight it could offer, a few participants noted that the impact of adopting another viewpoint remains unexplored. "I don't think there's much precedent for knowing what... type of change that would create inside the person." (P9). It was thought that experiencing their projected self virtually, being represented by a separate avatar, through the "eyes" of another person (via the currently adopted, avatar perspective) could increase self-shame, leading to cortisol production and, in turn, the urge to use. "You're dad and you've been arguing with your wife because you've drunk too much and the son is upset. To put

yourself in the son's shoes...We might be setting this person up for shame..." (P9). A participant also stated that the individual could disengage or terminate therapy due to being confronted, if this is not approached carefully. "So why would you have to do it really safely? ...you wouldn't want to leave the person thinking, you know, now I'm being criticised...it might just cause them a reason for resistance and conflict with you..." (P10).

3.4 Discussion

Practitioners and researchers participating in this study had not previously delivered VRT as part of their SUD interventions. Nevertheless, some of their recommendations on the acceptability of VRT in SUD treatment align with conclusions drawn from trials of its use. For example, they felt that VRT should operate as an adjunct to other treatments; recent reviews of VRT SUD studies have similarly suggested that more controlled trials are needed to determine its efficacy as a stand-alone treatment (Segawa et al., 2020; Trahan et al., 2019). Additionally, most studies paired VRT with other interventions when evaluating it, achieving better results than studies which used it as a stand-alone intervention (Segawa et al., 2020; Trahan et al., 2019). VRT has also proved more effective when combined with CBT (Segawa et al., 2020; Trahan et al., 2019). Participants noted that the nature of VRT enables behaviour training and that a CBT practitioner would be suitable for delivering it. Additionally, VRT delivered in a group was thought to potentially increase efficacy. This has been investigated in one study, which showed that group-based CET combined with VR in Alcohol Use Disorder (AUD) resulted in decreased craving (Ghita & Gutierrez-Maldonado, 2018). Other literature also indicates that group treatments are slightly more effective than individual ones in maintaining abstinence (Lo Coco et al., 2019). Previous studies about technology-based treatments (web-based, online and artificial intelligence-based) further suggests that practitioners endorsed their use as an adjunct to substance abuse treatments, but not as stand-alone therapies (Quaglio et al., 2017).

Participants also drew on the effect that the presence of the practitioner would have on the delivery of VRT. On one hand, they suggested that being present during the VRT session and monitoring the individuals' actions within the VEs could bias behaviour. However, participants also mentioned this feedback would be important in informing their intervention and, in turn, in increasing the effectiveness of VRT. In addition to this, participants felt that being present during VRT could moderate the risks associated with the exposure. For instance, they believed that it would help them identify when the individuals would become overwhelmed and adjust the intensity of the VRT session, minimising the risk of relapse. They also added that they could offer personalised debrief after the virtual exposure and address further the risk of subsequent relapse. Correspondingly, the importance of the practitioner's presence has not yet been investigated in the context of Augmented Reality (AR)-based interventions for substance abuse treatments, but, like VRT, the clinical potential of flexible exposure to high-risk situations are considerable (Vinci et al., 2020).

Previous experience of VR in any context did not seem to influence participants' opinions

about VRT in SUD treatment. Participants who had not tried VR before expressed the same concerns and identified the same risks and benefits of VRT as those with prior VR experience. However, participants who were familiar with VR recognised more technical challenges involved in VRT's delivery. Although all participants suggested that personalisation of the VEs would be necessary for a realistic and engaging outcome, those who had used VR previously acknowledged that building a VE from scratch would be challenging, requiring sophisticated software.

The combination of realistic and safe exposure to high-risk situations offered by VRT was the reason that participants considered it as a good alternative to Imaginal Exposure and CET for SUD treatment. The capability to simulate realistic high-risk situations with multisensory feedback was believed to have the potential to enhance therapy when any type of cue interactivity was needed (e.g. with avatars, interactive characters or objects). Simultaneously, the fact that cues are virtual prevents actual exposure to the addictive substance and immediate relapse, ensuring safety in that regard. The option offered by VRT to control and personalise the cues also appealed to participants. Whether VRT can result in better therapeutic outcomes than Imaginal Exposure or CET has not been examined yet within SUD studies (Amista, 2017; Bordnick & Washburn, 2019; Grochowska et al., 2019; Hone-Blanchet et al., 2014; S. Kim & Kim, 2020; Martin et al., 2010; Pericot-Valverde et al., 2019; Segawa et al., 2020; Trahan et al., 2019; Wang et al., 2019; Worley, 2019), but its realism, safety and the flexibility it offered in the presentation of the environmental content were thought to be positive for its potential in diverse recovery stages and contexts. However, there were also concerns that realism could also raise the risk of subsequent relapse by over-stimulating individuals. To avoid this, participants suggested that the individual capacity of each individual should be considered throughout. For this reason controls over the exposure material and flow (such as personalisation or monitor use for observation) emerged as requirements, as well as benefits. Debrief after VRT was perceived as the most important safety measure and a formulated delivery the second most important one.

The use of avatars and interactive characters, controlled by either the practitioner or the individual in recovery, during VRT was perceived to be useful for a more insightful and realistic intervention. The ability to adopt a different viewpoint via an avatar (change of perspective) was considered powerful, but relapse or conflict with the practitioner was the risk if this was not managed carefully. Whilst the impact of changing perspective has not been explored for SUD, controlling a personalised avatar (via embodiment) in eating disorder VRT has been shown to have a positive effect on patients' cognitive perception of their bodies (Carvalho et al., 2017; Irvine et al., 2020; S. Kim & Kim, 2020; Riva et al., 2019). Moreover, simulating emotionally involving situations with avatars and interactive characters as triggers and adopting a different avatar viewpoint, virtually, was seen by participants as beneficial for family or relationship-oriented work, as well as individual therapy. A study exploiting the use of a drug user's avatar viewpoint in a virtual reality setting showcased that increased empathy was felt by participants in this condition, compared to the desktop setting, suggesting the therapeutic potential of adopting an avatar's viewpoint for eliminat-

ing stigma and facilitating empathy (Christofi et al., 2020). However, a study of VRT for treating AUD found that observing a general argument scene to invoke lower craving than situations involving social pressure (Hone-Blanchet et al., 2014). This might mean that for emotional scenes to be triggering a level of personalisation is required, as stated by participants in this study.

Participants believed that the target population most likely to benefit from VRT would be young people due to their frequent use of technology. This has not been examined in previous SUD studies as participants were all middle-aged (Trahan et al., 2019). A study of the acceptability of VR headsets in older adults found there were positive attitudes, especially after the first use (Huygelier et al., 2019), suggesting that age should be not considered a barrier. Similarly, studies about wearable and wireless mobile Health technologies reported that individuals were open to wearing and using such devices to monitor drug and alcohol use and related parameters for relapse prevention purposes (Goldfine et al., 2020). Moreover, a few participants were concerned that people with mental health issues relating to self-awareness might be confused about which reality they were in, or that people with severe mental health issues might become distressed. However, meta-analysis and reviews of VR studies with people with depression and schizophrenia showed positive results in reducing anxiety and depression symptoms and assisting in cognitive re-adjustment (Fodor et al., 2018; Grochowska et al., 2019; Macedo et al., 2015; Rus-Calafell et al., 2018; Zeng et al., 2018).

Participants further suggested that individuals should be delivered VRT when they feel prepared to handle exposure to high-risk situations, after any medical issues caused by SUDs have been attended to and in co-operation with any medical professionals involved in their care, particularly if there is a co-morbid mental health difficulty. Participants did not identify cybersickness – symptoms such as nausea, eye tiredness and, in rare cases, vomiting – as a particular problem for individuals with SUD despite the existence of linked conditions such as Mallory-Weiss syndrome which can lead to bleeding in the gastroesophageal junction after vomiting (Haber & Kortt, 2020). Other populations that might be impacted by the use of VR include individuals with epilepsy, especially if cybersickness is experienced. So far, studies about the use of VR for cognitive assessment and learning of epileptic patients have appeared promising, with no serious adverse effects reported (Canovas et al., 2011; Grewe et al., 2014; Maidenbaum et al., 2019; Rosas et al., 2013). VR has been known to cause cybersickness on occasions when the frame rate is low and there is display latency, when the field of view is wider than 100 degrees and when the user moves quickly within the VE (S. Kim & Kim, 2020; Stanney et al., 2020). Other causes of cybersickness may relate to the postural stability, the eye movement and certain neural responses of an individual to the VEs (S. Kim & Kim, 2020; Stanney et al., 2020). Ultimately, most causes of cybersickness, such as the display rate, can be addressed by the design of the VRT applications and by the use of modern VR headsets (S. Kim & Kim, 2020; Stanney et al., 2020).

3.5 Limitations and Strengths

The participants were aware that they were being interviewed by a researcher focusing on the development of a VRT application to be used in SUD treatment, which may have biased their responses. Moreover, the views of participants about the use of VRT in SUD treatment weren't based on their clinical experience of VRT and, thus, these views might have differed if participants have delivered VRT as part of their SUD interventions. Furthermore, participants did not consider the impact that cybersickness may have on the delivery and efficacy of VRT.

The sample consisted of practitioners from private practices, treatment services including rehabilitation and integration services, charities, the NHS, who delivered SUD treatments, and academics who were involved in the design of SUD treatments, allowing different perspectives to emerge. Some participants specialised both in substance abuse and mental health treatment, offering an insight into the eligibility of dual-diagnosed individuals. Participants employed a wide range of interventions, including CBT, psychodynamic therapy, and systemic therapy. To date, this study is the only qualitative study examining experts' opinions on the acceptability and potential of VRT for use in therapeutic settings.

Future research should involve clinical trials to explore aspects that might affect the efficacy of VRT, such as avatar and interactive character use, olfactory augmentation, personalisation of cues, monitor screen use and the optimal therapeutic contexts to be integrated. In these trials, recruitment of participants should be informed, except by the input of practitioners with an expertise in SUD treatment, by the input also of medical doctors and practitioners with an expertise in mental health treatment, so as to examine the suitability of VRT for different populations, forming safe delivery protocols. Cybersickness checks and any causes of cybersickness should also be part of future clinical trials. Future studies can further explore the acceptability of online VRT, with the individuals using either a standard VR headset or their smartphone attached to a VR headset case to run the VRT application, and the practitioners to deliver the VRT session via a video call. Studies about the treatment preferences of individuals with different levels of substance abuse can also explore the acceptability of VRT as a potential treatment option, compared to the SUD treatments available. Finally, this and similar qualitative work about VRT's delivery should be updated as close co-operation between researchers and practitioners could lead to meaningful clinical trials and precipitate the integration of VRT into SUD recovery.

3.6 Clinical acceptability of VRT for RP

The practitioners and researchers of this study proposed the suitability of VRT for RP. They considered VRT the most acceptable to be used during the RP stage of alcohol treatments compared to any other stage, as it intrinsically matches with the training context that RP entails. More specifically, they acknowledged the therapeutic benefits that VRT can offer for RP, that are based on its capability for controlled exposure to high-risk situations. The fact

that VRT can offer flexible exposure to realistic, personalisable high-risk situations, that may also include olfactory and auditory cues and social interaction scenarios with personalisable virtual characters, was thought valuable for creating realistic coping skills contexts for RP. The exposure being virtual and preventing immediate relapse, making training safe and possible within a clinical context, were found treatment aspects that only VRT can provide. The same was believed for the insight that VRT can offer to practitioners by observing patient reactions during exposure to high-risk situations, informing their subsequent intervention. Useful insight was also thought by practitioners and researchers to be offered to patients, too, by giving them the opportunity to practise coping in environments without the risk of relapse and exploring all potential outcomes while building their self-efficacy and coping skills.

However, certain risks were also identified by practitioners and researchers while exploiting VRT for RP. In particular, they highlighted that immersive and realistic exposure to certain, virtual high-risk situations could be traumatising for some patients, if a previous trauma exists and they relive it virtually. They also underscored that patients may feel confident that they could successfully cope with similar high-risk situations in real life, after coping with them virtually, and end up relapsing. To alleviate these risks, mitigating measures were proposed which shaped the acceptability factors of VRT for RP, for it to be used in daily, clinical practice.

3.6.1 Acceptability factors of VRT for RP

Practitioners and researchers identified certain factors that would deem VRT acceptable as a RP tool. These factors link to the delivery of VRT and the functionality (VEs) of the VRT application.

More specifically, they highlighted that a solid treatment plan should be in place, as in every treatment, to ensure safety and smooth delivery to the patients. This treatment plan should involve prior assessment of the individuals by the practitioners (and the medical doctor for those with severe mental health disorders), to identify their current alcohol misuse and mental health state. This was thought important to determine the patients' capacity to handle exposure to triggering cues during the VRT, establishing capacity as a major acceptability factor along with assessment. Interestingly, whether individuals would still use alcohol in a controlled way or be sober was not considered a defining factor, if they were assessed ready by practitioners to handle cue exposure during RP.

Preparation of patients before virtual exposure to triggering cues for RP emerged as another acceptability factor and part of a solid treatment plan. Practitioners and researchers suggested that preparation should involve, apart from explanation to the patient of what VRT is and of its therapeutic benefits, a familiarisation session. The familiarisation session, in turn, was suggested to involve exposure to neutral VEs for patients to first try in a neutral context what VR is and then, based on their feedback, to make an informed choice of if they

want to be delivered VRT. The consent of the patient, thus, rose as an additional, and critical, acceptability factor of VRT, mediated further by the familiarisation session during the preparation stage.

Similarly, providing aftercare at the end of each VRT session was considered an essential part of the treatment plan and an acceptability factor by practitioners and researchers. This was thought to alleviate the risk of subsequent relapse and necessary for re-integrating the patient to reality and reflecting on the virtual experience, maximising the therapeutic benefits of VRT by traditional psycho-therapeutic approaches (such as CBT). The therapeutic paradigm to be combined with VRT (such as CBT or Counselling) was not considered an acceptability factor as long as some sort of debrief was included after the RP. A trusted relationship between the patient and the practitioner was also thought to be an acceptability factor, especially because the practitioner would need to identify when the patient would be overwhelmed during the VRT exposure to triggering cues in the RP session, to provide timely support, but also to provide purposeful and tailored aftercare. This was additionally considered important during the VRT session for RP, for the practitioner to identify previous traumas of the patient and avoid virtual exposure to relevant cues during the identification and coping skills training of RP sessions.

Practitioners controlling the VRT exposure emerged, thus, as another acceptability factor. Practitioners and researchers thought that it would be necessary for them to have a monitor to observe the reactions of patients during the VRT session and provide timely guidance and support and also to be able to personalise the exposure material (VEs), select the exposure mode (repeated exposure to same cues or randomly presented cues) and the navigation style (fixed or freestyle). The involvement of a practitioner throughout the planning and delivery of VRT was, hence, considered necessary by practitioners and researchers and a major acceptability factor. However, it was underscored, that clinical staff should run the VRT sessions and not professionals that do not qualify to deliver alcohol treatments.

3.6.2 Design implications

The aforementioned acceptability factors of VRT for RP translate into certain design implications, relevant to the delivery protocols and the functionality of VEs, that should be considered for the clinical application of VRT for RP.

Delivery protocol of VRT for RP

At any instance of clinically applying VRT for RP, it should operate as an assistive tool rather than a stand-alone, alcohol treatment, for it to be acceptable clinically. It may be combined with any alcohol treatment, at the stage when RP would become relevant to employ.

According to the views of practitioners and researchers documented in this study, an acceptable delivery protocol of VRT should be formed as follows. Such a delivery protocol

should involve, at its initial stage, an assessment of the patient to be delivered VRT by their practitioner, regarding its alcohol misuse and mental health state. If the patient is attended by a medical doctor or other, relevant professional, they should also be involved in the assessment process. The assessment should aim to identify if the patient would be capable of handling virtual exposure to triggering cues, and, thus, ready to be delivered VRT and move on to the RP stage of their alcohol treatment. When VRT would be introduced to the alcohol treatment of the patient, thus, would be subject to their capacity as assessed by experts.

During the assessment, potential traumas and aspects of the cues that could be overwhelming and pose a risk for the patient should be identified (or highlighted again if previously identified in the course of treatment) and be avoided during VRT. The co-operation of the practitioner with the medical doctor, nurse or other relevant professional that attends the patient would help ensure that during the assessment all relevant risks have been considered and that is safe for the patient to be delivered VRT for RP. Ideally, the expert that has been delivering the first parts of alcohol treatment to the patient, should also deliver VRT, to ensure that a trusted relationship between the patient and the practitioner would exist and that purposeful support would be offered throughout VRT according to the individual needs that the practitioner would be aware of in the first place. Thus, more weight in the assessment should be given to the expert's view (be it a practitioner or a nurse or other relevant professional) that has been previously co-operating closely with the patient. That expert should also be qualified to deliver alcohol treatments to ensure a solid approach. In any case, any adult who would be assessed suitable to delivered VRT is eligible to do so, irrespective of whether a comorbidity of a mental health disorder exists.

Following the assessment, the practitioner should inform the patient of what VRT is and its therapeutic benefits and propose a familiarisation session if the patient is interested to try it. In this session, exposure to neutral VEs would occur and the practitioner should explain VRT's workings, introducing the interpersonal element critical to therapy. The patient could then make an informed choice of whether they wish to be delivered VRT for their RP stage of treatment and give their consent, if so. The practitioner should also clarify to the patient that they would be guiding the session to ensure the patient's safety and that they could flexibly personalise the VEs, the exposure pace and mode and the navigation mode, based on the treatment goal of the session and the needs of the patient each time. Practitioners should also mention that aftercare would be provided, potentially in the form of a debrief, depending on the treatment paradigm that VRT would be combined with, to draw a clear picture of what would happen during the VRT session.

During the VRT session, before the start of the exposure, the practitioner should agree with the patient on the treatment goal of the current VRT session and personalise the VEs, exposure mode and navigation mode accordingly. The practitioner should then guide the exposure by offering directions and support, when needed, observing also the virtual behaviour of patient at all times through the monitor provided. The practitioner might wish to also observe the body language of the patient or ask clarifying questions about the virtual reactions

of the patient and take notes, to inform their subsequent intervention. The pace of the exposure and the duration of the exposure could be decided by the practitioner depending on the capacity of the patient and how they both wish to fulfill the treatment goal (on that day or across different sessions or to the extent the patient wants to be exposed to the VEs within the time-frame of a typical, clinical session). In any case, the practitioner should make sure that enough time would be left for aftercare.

After the virtual exposure to cues (the VRT part for RP - be it for identification of triggers or for coping with them), the practitioner should offer a form of aftercare as per the therapeutic paradigm they have agreed to with the patient. For instance, exposure to neutral VEs could introduce a mindfulness-based approach for relaxation, or debrief could introduce a CBT approach. In any case, during the aftercare part of the session, practitioners should make sure the patient has successfully been re-integrated into the reality. This would mean that the patient would not feel overwhelmed or mentally unstable in any way, or experience uncontrolled alcohol craving and thoughts and feelings about consuming alcohol right after the session. In essence, the practitioner should have formatted and controlled the exposure in such a way that any elicited craving and emotions could be handled by the coping skills already built by the patient and their intervention.

Functionality of Virtual Environments for RP

To facilitate acceptable, clinical VEs for RP, practitioners and researchers identified certain features of them that should be handled with care or be present to benefit the RP stage of alcohol treatment. To form acceptable VEs for RP, personalisation of each feature should be possible, to avoid the patients becoming overwhelmed or traumatised and to increase therapeutic relevance and benefit as per individual patient needs. Personalisation should be, thus, possible not only for the environment itself (such as time of day), its alcohol-related cues (such as preferred alcoholic drink or brand) and virtual characters (appearance and behaviour), but also for its functionality. The functionality of the VEs relates to the scenario presented (dialogues and storyline), the exposure mode (repeated exposure to same VEs and cues or randomly presented cues in each VE), the navigation mode (fixed path by software, controlled by practitioner or free navigation) and the olfactory augmentation (selection of preferred scents and intensity level of scents or complete absence). Each of these features was thought necessary and, when personalisable, to align with the capacity of the patient for cue exposure and the treatment goal each time, making VRT a useful, safe and, in turn, acceptable tool for RP.

The need for the software to allow projection of the patient's virtual actions to a separate monitor screen was also considered a necessary, safety and practicality feature to include. This would inform the intervention of the practitioner and allow them to guide the VRT session in the ways suggested above. Menus projected virtually within the VEs were additionally perceived conducive to therapy by practitioners and researchers, to provide immediate support if the user forgot how to use VR and had issues proceeding during ther-

apy, so as not to obstruct immersion by having to remove the VR headset and ask for help. The menus to be visible when the patient requested them and to automatically appear after a long period of inactivity were proposed.

Regarding the type of VEs, the need for a VRT application to include both neutral and alcohol-related VEs was identified by practitioners and researchers. Neutral VEs could be used during the familiarisation session or in aftercare for relaxation. Alcohol-related VEs could be used for the identification and coping skills training parts of RP sessions. Detailed suggestions on the exact VEs that could be used in RP are presented in Chapter 5, where our model VRT application for RP is presented, as its design was informed by the recommendations of practitioners and researchers.

3.7 Conclusion

Practitioners and researchers recommended VRT's use in SUD treatment as an assistive tool throughout recovery. The insight that VRT could offer during SUD treatment both to individuals in recovery and practitioners was acknowledged. VRT was thought suitable for any adult, including people with a mental health condition or trauma, providing that preparation, familiarisation via exposure to neutral VEs and aftercare are performed. Realism, personalisation, avatar and interactive character use and the feature of changing the avatar viewpoint (allowing when relevant the individual to see themselves as a separate person), olfactory augmentation and an observation monitor for the practitioners were perceived as important factors in VRT's efficacy and acceptability and the therapeutic contexts it could serve. The individual in recovery feeling overconfident about coping and subsequently relapsing or being traumatised were identified as risks. The reported practitioners' and researchers' views are useful for informing future VRT applications in SUD treatment.

The clinical acceptability of VRT for SUD treatment and its factors have not been explored before in literature and this is the first study to do so, bridging this gap. The clinical acceptability of VRT for RP and its factors have not been explored before, either, by previous studies and this is the first study to do so. Design implications to form an acceptable delivery protocol and acceptable features for a VRT application were suggested as informed by VRT's acceptability for RP and its factors. The findings of this study informed the clinical application of VRT for RP and could inform relevant, VRT applications and study experiments for SUD and alcohol treatment.

While the delivery protocol of VRT for RP and the features of the VRT application suggested here emerge from acceptability factors identified by practitioners and researchers, yet it could also link to effectiveness factors of VRT for RP that require experimental exploration by future studies that would test this protocol and these application features, considering important acceptability factors such as the practitioner involvement, the need for VRT to be an assistive tool or its flexibility to be combined with any treatment type. Indeed, some features were previously included in VRT studies for alcohol treatment, yet

Table 3.1. Themes and sub-themes of the thematic analysis

Theme	Sub-theme
Safety of VRT	Ecological Validity of VE
	Addictive Behaviour Exploration
	Relapse Prevention
	Risk of relapse
	Risk of traumatising
	Concern for early exposure to high-risk situations
	Overconfidence risk
	Eligibility of individuals with co-morbid mental health issues
	Mitigating measures
Realism	Avatar and interactive characters use
	Olfactory augmentation
	Personalisation of cues
	Exposure mode
	Concern for engagement
	Concern for realistic representation
Additional insights for practitioners and individuals in recovery	Better understanding of individuals in recovery
	Monitoring of virtual behaviour
	Adoption of a different viewpoint

their effect on VRT's efficiency and acceptability has not been explored (please see Chapter 2). This study explored their acceptability and their effectiveness considering the acceptability factors identified here should be tested by future studies. Other factors not considered here should also be explored by future studies with experts and patient groups such as the cost-effectiveness and acceptability of diverse delivery formats (such as mobile-delivered VRT), the effect of cybersickness in acceptability and effectiveness of VRT, and patient treatment preferences and acceptability factors that would inform delivery protocols and application features of VRT.

To elaborate on the acceptability of VRT for RP (and its factors) as a treatment option and how it could be optimally integrated into current, clinical practice, a survey with adult drinkers of diverse drinking patterns was conducted. This would help inform further aspects of the delivery protocols of VRT for RP and features of the VRT application that were discussed here but require additional exploration from potential patients' perspective (such as target patient groups, patient treatment preferences, acceptable delivery methods of VRT and acceptable alcohol treatments for VRT to be combined with, for ensuring increased uptake and engagement as per the patient acceptability factors). The results of the survey focused on the treatment preferences of potential patients and the relative acceptability of VRT compared to available, alcohol treatments in the UK and its acceptability factors and are presented in Chapter 4.

Table 3.2. Descriptive data for participants

Participant ID	Profession and qualifications	Place of work	Years of SUD expertise	Mental health expertise	Interventions used	VR familiarity	VRT familiarity
1	Counsellor (MBACP accredited)	Outpatient mental health treatment services (including dual diagnosis)	20	Yes, as a mental health Support Counsellor	Counselling & Support, Psychosocial Intervention	No prior VR experience but aware of its workings	No experience with VRT delivery, but aware of its use in clinical practice
2	Psychotherapist, Counsellor (MA, MBACP accredited)	Outpatient substance abuse treatment services & private practice (substance use disorder)	14	No	Medical detoxification, Cognitive Behavioural Therapy (CBT), Motivational Interviewing (MI), Psycho-dynamic approach	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice
3	Clinical Psychologist	Outpatient and inpatient substance abuse treatment services & NHS services, & private practice (dual diagnosis)	19	Yes, as a mental health Think Family Practitioner	CBT, Think Family Approach (TFA), Eclectic Therapy Approach	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice
4	Counsellor (PGCert, MA, MBACP accredited)	Outpatient substance abuse treatment services & private practice (dual diagnosis)	11	Yes, as a mental health Therapist	Counselling, CBT, Mindfulness Based Intervention (MBI)	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice
5	Clinical Psychologist	Outpatient substance abuse treatment services (dual diagnosis)	9	Yes, as a Clinical Psychologist	CBT	Prior VR experience in a non-clinical context	No experience with VRT delivery, but aware of its use in clinical practice
6	Counselling Psychologist (HCPC)	Private practice (dual diagnosis)	4	Yes, as a Psychologist in NHS & mental health treatment services	Person-Centred Therapy (PCT), CBT, Cognitive Analytic Therapy, Dialectical Behaviour Therapy	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice
7	Psychotherapist, Counsellor (MSc, MBACP accredited)	Private practice	6	No	CBT, MI, PCT, Hypnotherapy	Prior VR experience in a non-clinical context	No experience with VRT delivery, but aware of its use in clinical practice
8	Psychotherapist (MA, PGDip)	Private practice (substance use disorder)	20	No	Internal Family Systems, Neuro-Linguistic Psychotherapy	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice
9	Psychotherapist, Counsellor (MBACP accredited, PGDip, MA)	Private practice (dual diagnosis)	4	Yes, as a Psychotherapist	Transactional Analysis	Prior VR experience in a non-clinical context	No experience with VRT delivery, but aware of its use in clinical practice
10	Specialist Senior NHS Nurse, Teaching Fellow	NHS services (dual diagnosis)	30	Yes, as a Specialist Senior NHS Nurse and Teaching Fellow	CBT, MI, Cognitive Behavioural Family Therapy	Prior VR experience in a non-clinical context	No experience with VRT delivery and not aware of its use in clinical practice
11	University Professor	University (research into substance use and addictions)	25	No	Opioid Substitution Therapy	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice
12	Clinical Psychologist	Outpatient substance abuse treatment services (dual diagnosis)	26	Yes, as a Clinical Psychologist	MI, Behavioural, Contingency Management, Trauma	No prior VR experience but aware of its workings	No experience with VRT delivery, but aware of its use in clinical practice
13	Social work team leader (BA)	Outpatient substance abuse treatment services (substance use disorders)	5	No	TFA, Counselling, Medical intervention	Prior VR experience in a non-clinical context	No experience with VRT delivery, but aware of its use in clinical practice
14	Recovery support worker	Outpatient & inpatient substance abuse treatment services	4	Yes	12-Step, CBT, Contingency Management	No prior VR experience and not aware of its workings	No experience with VRT delivery and not aware of its use in clinical practice

Chapter 4

Acceptability of VRT in Adults and Treatment Preferences

4.1 Introduction

Having explored the acceptability of VRT as a treatment tool for practitioners and considering their positive outlook on VRT for use in clinical practice, the treatment preference for and acceptability of VRT in relevant patient populations require also investigation to inform the clinical protocol of VRT for RP and the design of a relevant VRT application.

Patient treatment preference can be defined as the requirements and processes that individuals want to be involved in their treatment (Windle et al., 2020). Treatment acceptability is the extent to which an individual considers a treatment method to be fair, reasonable, appropriate and unintrusive for a specific clinical condition (Kazdin, 2000; O'Brien & Karsh, 1991). Current literature linked increased treatment preference and acceptability to less attrition and drop-out rates, and improved treatment outcomes (Milosevic et al., 2015; Tarrier et al., 2006; Windle et al., 2020). It is, therefore, critical to assess the preference for and acceptability of novel treatments at an early stage of their development, exploring also potential characteristics that could predict treatment uptake across given clinical populations. This will also help inform future VRT interventions regarding the delivery methods and protocols as per patient preferences.

Although the number of studies that investigated the treatment acceptability of VRT is small, they suggested its acceptance as a treatment option for a variety of psychological conditions. Most acceptability studies exist in the clinical field of Post-Traumatic Stress Disorder (PTSD) where patients, who were administered VRT, identified it as an acceptable treatment (Botella et al., 2015). Interestingly, participants of a survey about the treatment acceptability of PTSD ranked VRT lower in terms of treatment preference and acceptability compared to evidence-based, traditional PTSD treatments, with authors suggesting that the lack of direct contact with a practitioner might have attributed to this (Tarrier et al., 2006). The acceptability of VRT as a treatment has been also supported by clinical populations in studies about the treatment of psychosis (Rus-Calafell et al., 2018; Thompson et al., 2020), schizophrenia (Adery et al., 2018), panic disorder with agoraphobia (Quero et al., 2014), and by a clinical sample of younger age in a study about childhood social anxiety (Sarver

et al., 2014). So far, no studies have explored the treatment acceptability of VRT in alcohol misuse.

Other aspects that could influence treatment uptake include drinking onset age and drinking patterns, age, sex, marital status, co-morbidity of other substance use or mental health disorders and prior treatment experience (Blanco et al., 2015; Kaufmann et al., 2014; Rohn et al., 2017). Stigma has been widely acknowledged as a barrier to seeking treatment for an alcohol problem in diverse samples (Andreasson et al., 2013; Finn et al., 2014; Hausken et al., 2016; Jacobs et al., 2012; Kaufmann et al., 2014; May et al., 2019; Schuler et al., 2015; Valdez et al., 2018). Delays to, or lack of seeking treatment were also linked to individual conditions other than internalised stigma. These would involve not being aware how to access treatment or unfamiliarity with the purpose of the treatment (Andreasson et al., 2013; Zewdu et al., 2019), accessibility issues for attending treatment services on a regular basis (D'Amico et al., 2004; Mellinger et al., 2018), and concerns about the associated, financial costs (Kaufmann et al., 2014; May et al., 2019; Mellinger et al., 2018). Availability of innovative treatment options that could offer easy access to treatment are, therefore, needed (Blanco et al., 2015), with a particular focus on cost-effectiveness, for reaching people of different socio-economic backgrounds. Increasing treatment access would be important when professional support would be needed, but physical attendance to treatment would not be possible, such as during the outbreak of Covid-19 (Feijt et al., 2020; Ornell et al., 2020; Samuels et al., 2020). During the pandemic, increased relapse rates in alcohol dependant individuals were reported in relevant literature, linking to the isolation policies and associated negative emotional states, such as depression or anxiety (Yazdi et al., 2020), especially for those not in stable recovery (DeJong et al., 2020). Availability of treatment via online channels only, and lack of appropriate online, treatment tools and organisation, impeded the sustainability of abstinence in alcohol dependant individuals (DeJong et al., 2020).

VRT delivered via a standard, VR headset or via a mobile - mVRT, both of which could be delivered online, could form viable alternatives in such contexts, where online, professional support would be needed. MVRT in particular could be a more cost-effective approach than standard VRT since a mobile phone is a cheaper option to mediate the VR experience, yet in a less immersive way. The acceptability of such an approach has not been considered before in literature although it could increase treatment accessibility. The acceptability of VRT delivered online, in either format, has not been considered, either. The acceptability of VRT for alcohol treatment and its factors have not been explored by previous studies, too, even though they could feed into the design process of acceptable and effective delivery protocols and applications for VRT.

To bridge the gap in the literature and promote the clinical application of VRT for RP, the relative preference for and acceptability of VRT (delivered by VR headset or mobile) were examined via a survey study compared to current, evidence-based treatments offered by the healthcare system in the UK in adults drinking at various levels. Preferences about the delivery methods of alcohol treatments were additionally explored. Potential factors of the treatment acceptability of VRT, such as treatment preferences, stigma, demographic char-

acteristics, drinking patterns and motives, mental health history and familiarity with and experience of the included treatments were considered. The findings of this survey helped to inform aspects of the delivery protocol of VRT for RP regarding delivery methods, target patient populations and treatment paradigms to pair VRT with, and could be relevant for informing VRT applications aimed for parts of alcohol treatment other than RP. Thus, the objectives of this study are to determine the patient (treatment) acceptability of VRT for RP for indicating its potential treatment uptake by alcohol misuse patients, and identify acceptability factors for informing the previous delivery protocol suggested by practitioners and researchers (Chapter 3) to increase its potential treatment engagement and, thus, therapeutic effectiveness.

4.2 Method

4.2.1 Sample and Recruitment

The sampling methods of the study were convenience and purposive. Individuals aged 18 or over and who had consumed alcohol at least once in the past year were eligible to participate. Participants were recruited through e-mail databases to staff and students at the University of Manchester, UK, and social media advertisements (via the Facebook and Instagram study accounts) to the University of Manchester social media accounts. The advertising text asked for voluntary participation in a survey about people's drinking patterns during COVID-19 and their views on available alcohol treatments. A prize draw was offered.

4.2.2 Procedure

Demographic Characteristics

Potential participants viewed the study information sheet online before confirming eligibility and providing consent. Participants were asked for demographic information (e.g. gender, age, ethnicity, education and employment status), details of their alcohol consumption (frequency, amount in units) and their mental health background (present or past mental health diagnosis, treatment received) before completing the study questionnaires.

Participants were then asked to complete three validated questionnaires for assessing degree of hazardous alcohol consumption, reasons for drinking, and mental health (anxiety and depression). For assessing the alcohol consumption of participants, the Alcohol Use Disorders Identification Test (AUDIT) was employed (Saunders et al., 1993), which was developed by the World Health Organisation and is used as an alcohol harm screening tool by the health and social care services in the UK and worldwide. It consists of 10 items which assess the risk level of alcohol use as low risk (scores ranging from 0 to 7), hazardous (scores from 8 to 14) and potential alcohol dependence (scores from 15 or more).

For assessing the reasons for alcohol use, the Reasons for Substance Use Scale (ReSUS) questionnaire was administered (Gregg et al., 2009), which was developed to investigate the association between the reasons for substance use and psychiatric symptoms. The ReSUS consists of 38 items which assess the reasons for alcohol use as "coping with distressing emotions and symptoms", "social enhancement and intoxication" and "individual enhancement".

For assessing current mental health state of participants, the Depression Anxiety Stress Scales (DASS) questionnaire was presented for completion (Lovibond & Lovibond, 1995), which was developed to assess the negative emotional states of depression, anxiety and stress. The DASS consists of 42 items which assess the severity level of depression, anxiety and stress as mormal (scores ranging from 0 to 9 - depression; 0 to 7 – anxiety; 0 to 14 - stress), mild (scores from 10 to 13 - depression; 8 to 9 – anxiety; 15 to 18 - stress), moderate (scores from 14 to 20 - depression; 10 to 14 – anxiety; 19 to 25 - stress), severe (scores from 21 to 27 - depression; 15 to 19 – anxiety; 26 to 33 - stress) and extremely severe (scores from 28 or more - depression; 20 or more – anxiety; 34 or more - stress).

Treatment Acceptability and Preferences

For exploring treatment acceptability and preferences, participants were firstly asked about their alcohol treatment preferences hypothesising that their drinking was problematic ("We would like to ask your thoughts about alcohol treatment. Please note that you do not need to consider your drinking to be problematic to take part – we are in interested in your hypothetical preferences"). Then, they were asked questions about the potential stigma of facing a drinking problem. Questions revolved around whether they would feel stigmatised if admitting having a drinking problem, if they would discuss about their problem with relatives, friends or family. Treatment uptake attitudes were also explored with participants being asked whether they would seek treatment or encourage relatives or friends to seek treatment if they were having a drinking problem.

The methodological approach employed to explore the relative preference for acceptability of VRT and mVRT compared to alcohol treatments offered in the UK followed the paradigm of Tarrier et al., in their study about the treatment acceptability of PTSD Tarrier et al., 2006. Participants were presented with a short description of 10 alcohol treatments (Appendix C - "Alcohol Treatment Preferences" section). In these descriptions, the alcohol treatments reported were the ones that an individual would be offered if sought help in the UK, including the novel treatment of VRT (and mVRT). For the scope of this study, VRT and mVRT were presented as separate treatment options, to explore which context would be more acceptable compared between them. This helped simulate the clinical procedure of presenting alcohol misuse treatment options to a patient, that would be followed if one was asking for help about their alcohol misuse issue, resulting in a realistic research study design that would not introduce any bias towards VRT (and mVRT). The description text for each of the currently offered treatments was taken from the NHS website (N.H.S., 2017, 2018a, 2018b) and the

NICE website (National Institute for Health and Care Excellence, 2020), to eliminate bias across the descriptions and to present the same information a prospective patient would be presented in a clinical setting. The pros and cons of each treatment were mentioned at the end of their description.

The 10 treatments were presented in the following order: (1) Brief Intervention, (2) Self-help Groups (such as Alcoholics Anonymous), (3) 12-Step Facilitation Therapy, (4) Cognitive Behavioural Therapy, (5) Group Cognitive Behavioural Therapy, (6) Virtual Reality Therapy, (7) Mobile Virtual Reality Therapy, (8) Guided Self-help, (9) Family Therapy and (10) Counselling. After reading each description, participants were asked to rate each treatment's acceptability. Acceptability was determined by responses to three questions taken from Tarrier et al., 2006. The three questions assessed the degree to which each of the 10 treatments was: i. 'Appropriate for the problem', ii. 'Suitable for them' and iii. 'Beneficial' for treating alcohol misuse. Participants rated each of the three questions on a scale of 1 (strongly disagree) to 7 (strongly agree) and the three ratings were totalled to provide a final acceptability score (range 3 – 21).

For recording the treatment preferences of participants, they were next asked to rank order the ten treatments according to their personal preferences. The option of 'No treatment' was added to the list. Respondents were instructed to give their most preferred treatment a rank of 1, and their least preferred a rank of 11.

Participants were also asked to state their preferred delivery methods of treatment (in-person, over the telephone, via video call, via email, via text and via a mobile/computer application). In the last section, participants were asked about their familiarity with the presented treatments and, if familiar, whether their experience was positive or negative. Whether participants had previously used Virtual Reality (HMD-based or mobile-based) in any context and whether this experience has been positive or negative were additionally asked.

A focus on familiarity was given due to the results of earlier surveys about VRT acceptability in practitioners for general psychological treatments, that indicated the positive effect of familiarity on the clinical acceptability of VRT. The same was found in our previous study with practitioners and researchers about the acceptability of VRT for SUD treatment (Chapter 3), in which familiarity was identified as an acceptability factor that should be addressed by the delivery protocol of VRT for SUD treatment (and during the RP stage of alcohol treatment in particular, too).

4.2.3 Data Analysis

Data were analysed in SPSS version 25.

Within-subject, one-way repeated-measures ANOVA and pairwise comparisons with Bonferroni corrections were performed to identify the relative acceptability of VRT and mVRT. In the ANOVA test, since sphericity was not met in the Mauchley's test ($p<0.001$), we used

the Greenhouse-Geisser results that have the degrees of freedom corrected to avoid a Type I error.

For the treatment preferences of participants, a mean score was calculated to rank the delivery methods in order of average participant preference (from the most to the least preferred), including the 'No treatment' option.

For assessing if drinking patterns (AUDIT case), gender and ethnicity of participants, prior or current mental health diagnosis and prior mental health treatment administration, and familiarity with treatments affected acceptability ratings of VRT and mVRT, Independent Samples T-tests were employed. The associations of depression, anxiety and stress levels (DASS case), drinking motives, stigma and treatment uptake attitudes with treatment acceptability of VRT and mVRT were explored through bivariate Pearson correlations.

4.2.4 Ethical Approval

Ethical approval for the study was granted by the University of Manchester Research Ethics Committee (Ref.: 2020-10900-17395).

4.3 Results

4.3.1 Demographic Characteristics of Participants

A total of 259 participants completed the survey. As Table 4.1 shows, with the demographic data of participants, the majority of participants were female (80.3%) and represented white backgrounds (87.5%). Most participants were students (72.2%). On average, participants were drinking 13.98 units (sd=14.94) of alcohol per week.

Of the 259 participants, more than half (52.9%, n=137) were drinking problematically according to the AUDIT (a score of 8 or more). Classification of participants according to their AUDIT scores is presented in Table 4.2. Hazardous drinkers reported higher average scores in drinking to cope with distressing emotions and mental health symptoms at a statistically significant level compared to low-risk drinkers (mean for low-risk drinkers=0.23, sd=0.3, mean for hazardous drinkers=0.46, sd=0.8, t=-4.953, df=163, p<0.001). The same applied to potentially alcohol dependant drinkers compared to low-risk drinkers (mean for low-risk drinkers=0.23, sd=0.3, mean for potential alcohol dependant drinkers=0.83, sd=0.6, t=-6.355, df=49, p<0.001). Hazardous drinkers seemed to drink more for social enhancement at statistically significant levels compared to low-risk drinkers (mean for low-risk drinkers=0.79 sd=0.4, mean for hazardous drinkers=1.26, sd=0.3, t=-9.247, df=213, p<0.001). Similar scores were reported by potentially alcohol dependant drinkers compared to low-risk drinkers (mean for low-risk drinkers=0.79, sd=0.4, mean for potential alcohol dependant drinkers=1.5, sd=0.4, t=-9.889, df=164, p<0.001). Hazardous drinkers also reported higher scores in drinking for individual enhancement at a statistically significant level compared to low-risk drinkers

Table 4.1. Demographic data of participants

	N (%)
Age	
Mean	22.5 (range=18-66, sd=6.7)
Gender	
Female	208 (80.3%)
Male	48 (18.5%)
Other	3 (1.3%)
Ethnicity	
White-British	165 (63.7%)
White-Irish	7 (2.7%)
Chinese	12 (4.6%)
White and Asian	6 (2.3%)
Black or Black British-African	3 (1.2%)
Mixed-White and Black African	3 (1.2%)
Asian or Asian British-Indian	3 (1.2%)
Asian or Asian British-Pakistani	2 (0.8%)
Mixed-White and Black Caribbean	2 (0.8%)
Black or Black British-Caribbean	1 (0.4%)
Any other white background	43 (16.5%)
Any other mixed background	4 (1.5%)
Other	7 (2.7%)
Employment Status	
Students	187 (72.2%)
Employed	65 (25.1%)
Retired	7 (2.8%)
Alcohol units	
Average (per week)	13.98 (range=0.00-131.00, sd=14.9)
Prior or current mental health diagnosis	74 (28.6%)

Table 4.2. Audit cases of participants

	AUDIT cases (N, %)
Low risk drinkers (AUDIT score<8)	122 (47.1%)
Hazardous drinkers (AUDIT score≥8 & ≤14)	93 (35.9%)
Potential alcohol dependant drinkers (AUDIT score>14)	44 (17%)
Total	259 (100%)

(mean for low-risk drinkers=0.21, sd=0.3, mean for hazardous drinkers=0.45, sd=0.3, t=-6.182, df=213, p<0.001), and the same applied to potentially alcohol dependant drinkers (mean for low-risk drinkers=0.21, sd=0.3, mean for potential alcohol dependant drinkers=0.69, sd=0.5, t=-5.94, df=51, p<0.001).

The classification of participants as per their DASS scores on depression, anxiety and stress are presented in Table 4.3.

Half of the sample (52.1%, n= 135) had not previously used VR, while a third (33.6%, n=87) had used standard VR (HMD-based) and 34 (13.1%) smartphone-based VR only. In total, of the 121 participants who had used either type of VR, 99 (82.5%) had a positive experience and 21 (17.5%) a negative one.

Table 4.3. Depression, anxiety and stress data of participants

	Depression (N, %)	**Anxiety (N, %)**	**Stress (N, %)**
Normal	132 (51%)	166 (64.1%)	165 (63.7%)
Mild	29 (11.2%)	16 (6.2%)	23 (8.9%)
Moderate	43 (16.6%)	39 (15.1%)	39 (15.1%)
Severe	23 (8.9%)	18 (6.9%)	24 (9.3%)
Extremely severe	32 (12.4%)	20 (7.7%)	8 (3.1%)
Total	259 (100%)	259 (100%)	259 (100%)

4.3.2 Treatment Acceptability

Less than half (40.2%, n=104) reported that they would feel highly stigmatized if admitted that they had a drinking problem. More than half of the participants (56.8%, n=147) mentioned that they would discuss their drinking problem with family or relatives and less than half (36.7%, n=95) that they would not. In contrast, the majority of participants (80.7%, n=209) would discuss their drinking problem with friends.

The majority of participants (82.6%, n=214) indicated that they would seek treatment if their drinking was becoming or had become, problematic. Almost all (95.8%, n=248) would encourage a relative or a friend with a drinking problem to seek treatment.

The top three acceptable treatments for treating alcohol misuse as per the participants' ranking of treatments about their acceptability were: (1) 12-Step Facilitation Therapy, (2) Cognitive Behavioural Therapy and (3) Counselling. The least three acceptable treatments were: (8) Family Therapy, (9) Virtual Reality Therapy and (10) mobile Virtual Reality Therapy. A detailed overview of the acceptability ranking of treatments and the mean scores obtained (with the highest score to indicate the highest acceptability) are presented in Table 4.4. Within-subject, one-way repeated-measures ANOVA revealed that there were significant differences on the acceptability of each treatment by participants ($F(10134.8, 27878,5) = 93.79$, $p<0.001$, $\eta p2= 0.267$). The mean comparisons with Bonferroni correction were significant at the 0.05 level and are summarized in Appendix D.

Table 4.4. Ratings of treatments upon acceptability and mean scores per treatment

Treatment	**Mean scores**
12-Step facilitation therapy	17.57
Cognitive Behavioural Therapy	17.39
Counselling	16.73
Group Cognitive Behavioural Therapy	14.64
Self-help Groups	14.61
Guided Self-Help	13.83
Brief Intervention	13.64
Family Therapy	12.80
Virtual Reality Therapy	12.58
Mobile Virtual Reality Therapy	11.57

4.3.3 Treatment Preference

Overall, the majority of participants (86.9%, n=225) expressed a preference for in-person delivery of treatments as opposed to treatment delivery via video call (6.2%, n=16), over

the telephone (3.1%, n=8), via email (1.9%, n=5), via a mobile/computer application (1.2%, n=3) or via text (0.8%, n=2).

According to the ranking of treatments by participants, based on their preferences, the top three ranked treatments were: (1) Cognitive Behavioural Therapy, (2) Counselling and (3) 12-Step Facilitation Therapy. The last three ranked treatments were: (8) Virtual Reality Therapy, (9) mobile Virtual Reality Therapy and (10) No treatment. A detailed account of the ranking and the mean scores obtained per treatment (with the lowest score to indicate the highest preference) are presented in Table 4.5. The ordering of treatments via each method (upon preference and upon acceptability) was highly similar, indicating good consistency in participants' rating of treatments according to their preferences.

4.3.4 Treatment Familiarity

According to the reported treatment familiarity of participants, the top three most known treatments were: (1) Counselling, (2) Self-help groups and (3) Cognitive Behavioural Therapy. The three least known treatments were: (8) 12-Step Facilitation Therapy, (9) Virtual Reality Therapy and (10) mobile Virtual Reality Therapy. Mobile Virtual Reality Therapy obtained the highest score (50% of those who were familiar with it) of negative experience. The top preferred treatments were seen to link to the highest percentages of positive experience with the treatment and to the lowest percentages of negative experience with the treatment.

Prior knowledge or experience with the alcohol treatments presented in this study and whether that experience was positive or negative are displayed in Table 4.6. How participants have acquired the knowledge or experience of these treatments was not requested.

Table 4.5. Participants' ranking of treatments upon preference and mean scores per treatment

Treatment	Mean scores
Cognitive Behavioural Therapy	3.35
Counselling	3.66
12 Step Facilitation Therapy	4.19
Self-help Groups	5.25
Group Cognitive Behavioural Therapy	5.53
Guided Self-help	5.88
Brief intervention	6.39
Family Therapy	6.97
Virtual Reality Therapy	7.21
Mobile Virtual Reality Therapy	7.97
No treatment	9.83

4.3.5 Factors of Acceptability

Certain demographic characteristics and treatment preferences and attitudes of participants seemed to link to the treatment acceptability of VRT and mVRT. For VRT, ethnicity, drinking patterns and motives, depression and anxiety scores, stigma and treatment uptake attitudes, treatment delivery preferences and familiarity with treatments of participants were

Table 4.6. Familiarity of participants with treatments and negative or positive reports

Treatment	Prior knowledge N (% of overall sample)	Positive N (% of those who had experience)	Negative N (% of those who had experience)	Not specified N (%)
Brief intervention	83 (32%)	37 (44.6%)	21 (25.4%)	25 (30%)
Self-help groups	197 (76.1%)	142 (72%)	12 (6%)	43 (22%)
12-Step facilitation therapy	59 (22.8%)	39 (66.1%)	7 (11.9%)	13 (22%)
Cognitive behavioral therapy	193 (74.5%)	146 (75.7)	18 (9.3%)	29 (15%)
Group cognitive behavioral therapy	100 (38.6%)	63 (63%)	18 (18%)	19 (19%)
Virtual reality therapy	15 (5.8%)	6 (40%)	4 (26.7%)	5 (33.3%)
Mobile virtual reality therapy	12 (4.6%)	3 (25%)	6 (50%)	3 (25%)
Guided self-help	107 (41.3%)	50 (46.7%)	34 (31.8%)	23 (21.5%)
Family therapy	144 (55.6%)	73 (50.7%)	37 (25.7%)	34 (23.6%)
Counselling	208 (80.3%)	156 (75%)	20 (9.6%)	32 (15.4%)

all associated with its acceptability at a statistically significant level (Table 4.7). Comparisons between ethnicities revealed that participants of any other white background perceived VRT more acceptable compared to White-British or Irish participants. The same applied to participants of mixed backgrounds compared to White-British or Irish, Chinese and Mixed-White and Black African participants. Low-risk drinkers considered VRT more acceptable compared to hazardous drinkers. Participants who would drink to enhance their social skills and their physical or emotional state, and those experiencing depression and anxiety perceived VRT less acceptable compared to participants scoring lower in these items. Participants who were more open to discuss their drinking problem with family or relatives, and those who would seek treatment or who would encourage others to seek treatment considered VRT a more acceptable treatment compared to participants who were less inclined to do so. Participants who preferred delivery of treatments via video call or via a mobile/computer application considered VRT more acceptable (placing it in the 4th place) compared to those preferring in-person delivery (placing it in the 9th place). Finally, participants with knowledge of VRT perceived it more acceptable compared to those who didn't know about it. Interestingly, participants who were familiar with VRT placed it 4th in the ranking of acceptable treatments as opposed to those without knowledge of VRT who placed it in the 9th place. Similarly, a positive VRT knowledge was linked to significantly increased acceptability of VRT (3rd place) compared to a negative one (10th place).

For mVRT, ethnicity, gender, mental health diagnosis and mental health treatment history, drinking patterns and motives, depression, anxiety and stress levels, stigma and treatment uptake attitudes, and treatment delivery preferences were associated with its acceptability at a statistically significant level (Table 4.8). Comparisons between ethnicities showed that any other white background considered mVRT more acceptable compared to White-Irish or British. The same applied to Chinese participants compared to White-Irish or British, Mixed-White and Black Caribbean and Asian or Asian British-Indian, and to any other mixed background participants compared to Mixed-White and Black African. Male participants perceived mVRT more acceptable as opposed to female ones. Participants without

a mental health diagnosis and those who haven't received mental health treatment considered mVRT more acceptable compared to those with mental health diagnosis and those with mental health treatment history. Low-risk drinkers thought mVRT of more acceptable compared to hazardous drinkers. Participants who would use alcohol to enhance their social skills and their physical or emotional state, and those with depression, anxiety and stress perceived mVRT less acceptable compared to participants with lower scores in these instances. Participants who were more inclined to discuss their drinking problem with family or relatives, and those who would seek treatment considered mVRT more acceptable compared to participants who wouldn't do so. Finally, participants who opted for delivery of treatments via video call perceived mVRT more acceptable (placing it in the 6th place) compared to those preferring in-person delivery (placing it in the 10th place).

4.4 Discussion

This study examined the alcohol treatment preferences of adult drinkers, with an additional focus on discovering the relative acceptability of VRT and mVRT. Acceptability and preference for VRT and mVRT in adult drinkers has not been previously explored for alcohol treatment, nor compared to acceptability and preference for traditional treatments. According to participants' rankings of treatments in order of preference, VRT and mVRT featured in the 9th and 10th position, respectively, being the least preferred treatments, but preferred to not receiving treatment at all. This suggests that VR-based treatments might be a viable option when other treatments would not be available, with the potential for increasing people's preference if combined with current, evidence-based treatments as in the context of this survey they were presented as stand-alone treatments.

Similarly, VRT and mVRT were considered the least acceptable treatment options compared to the rest of the presented treatments. The acceptability of VRT was seen to be highly influenced by participants' familiarity with it, attaining the 4th position in acceptability ratings of those who were familiar with it. In contrast, mVRT was still considered less acceptable, being placed only a position higher (9th) by those being familiar with it. This might be attributed to the overwhelming majority (86.9%) expressing a preference for in-person delivery of treatments, as mVRT was being described as a treatment that could be delivered online, too. In line with that, participants who preferred video call delivery of treatment placed mVRT in the 6th position of acceptable treatments. The lack of direct contact with the practitioner was also seen to attribute to the low acceptability of VRT for PTSD treatment in a survey about PTSD treatment preferences (Tarrier et al., 2006). The need for the practitioner to guide the delivery of VRT for increasing safety and its therapeutic effect has also been identified in a study about the acceptability of VRT with practitioners delivering substance use and mental health treatments (Skeva et al., 2021).

The most preferred and acceptable treatment options for addressing an alcohol problem, according to participants of this survey, were CBT, 12-Step FT and Counselling, obtaining the top three positions both in the participants' rankings of treatments and acceptability rat-

ings per treatment. Participants have additionally reported high familiarity levels with these treatments, indicating the association of familiarity with treatment preference and acceptability. Indeed, VRT and mVRT had the lowest familiarity scores compared to any of the other, presented treatments. Likewise, in a survey about the acceptability of VRT in practitioners for treating psychological conditions, familiarity with it appeared critical for its acceptability and the likelihood of its future use by practitioners clinically (Lindner et al., 2019). Furthermore, previous studies, exploring the acceptability of VRT for mental health treatment after patients were administered VRT and were familiar with it, documented the patients' positive outlook on VRT for treating PTSD, psychosis, schizophrenia, panic disorder with agoraphobia and childhood social anxiety (Adery et al., 2018; Botella et al., 2015; Quero et al., 2014; Rus-Calafell et al., 2018; Sarver et al., 2014; Thompson et al., 2020).

Factors other than treatment familiarity and treatment delivery preferences influencing the acceptability for VRT and mVRT were also considered. More specifically, participants of male gender were more likely to find mVRT acceptable as a treatment. While this applied to VRT as well, the results were not statistically significant as opposed to mVRT. These findings are in line with previous studies which found that VR's acceptability linked to increased familiarity of younger people, and particularly males, with technology, and social media and video gaming contexts (Felnhofer et al., 2012; Hauk et al., 2018; Shafer et al., 2017). Depression and anxiety were also associated with decreased acceptability of VRT for treating an alcohol problem, while for mVRT depression, anxiety and stress were linked to considering it less acceptable treatment option. Having received mental health treatment or been diagnosed with a mental health disorder were additionally associated with reduced acceptability of mVRT, and although the same tendency was observed for VRT, it was not statistically significant in VRT's case. This might suggest that individuals with a co-occurring mental health disorder might be more inclined to be delivered VRT rather than mVRT as part of their alcohol treatments, considering also the patient acceptability of VRT in treating mental health disorders reported in relevant studies (Adery et al., 2018; Botella et al., 2015; Quero et al., 2014; Rus-Calafell et al., 2018; Sarver et al., 2014; Thompson et al., 2020). Alcohol consumption levels did not influence acceptability of VRT and mVRT, although people who were motivated to drink alcohol for social and emotional or physical enhancement purposes rated VRT and mVRT as less acceptable treatments.

Concerning participants preferences on delivery methods, in-person delivery of treatment was preferred by the majority over video call-, telephone-, email-, mobile/computer application- or text-based delivery of treatment. This has been reported by previous studies about delivery preferences of alcohol treatments where face-to-face treatments were preferred over internet- or phone-based ones (Andreasson et al., 2013; Benjet et al., 2020; Hausken et al., 2016). However, clinical trials exist that suggest the acceptability and effectiveness of digitalised and mobile-based treatments as additional treatment tools and adjuncts to traditional, face-to-face treatments for alcohol misuse (Cunningham et al., 2011; Johansson et al., 2021; Tarp et al., 2017; Witkiewitz et al., 2019), yet the most optimal ways to integrate such forms of treatment into current, clinical practice require further exploration (Cunning-

ham et al., 2011).

Upon the hypothesis of encountering an alcohol problem, the predominant response of participants was that they would themselves seek alcohol treatment (n=214) and encourage others to seek treatment as well (n=248). Participants inclined to seek treatment or encourage others to seek treatment if an alcohol issue was faced perceived VRT as more acceptable compared to those being less willing to seek or advise others to seek treatment. Similarly, participants who would seek treatment considered mVRT as more acceptable, too, compared to those who would not seek treatment, suggesting that treatment-seeking attitudes relate to more openness about novel treatment options like VRT or mVRT. Being able to discuss having an alcohol problem with family members or relatives was linked to higher VRT acceptability, but not with higher mVRT acceptability. On the contrary, being able to share facing an alcohol problem with close friends did not influence VRT's or mVRT's acceptability, indicating that stigma relates more to concerns about acknowledgement of an alcohol problem by family members rather than friends and this, in turn, influences openness to novel treatment tools.

A large part of the participants also mentioned that they would feel highly stigmatised about facing an alcohol issue (n=104). Participants who would feel stigmatised about their alcohol problem considered mVRT as less acceptable but this did not affect acceptability ratings of VRT, indicating that the presence of a practitioner during treatment might be necessary for increasing treatment uptake, as mVRT was proposed to also be offered online as opposed to the in-person delivery of VRT. Relevant literature suggests further that alcohol-related stigma impedes treatment-seeking behaviour in individuals from a range of socioeconomic and cultural backgrounds to a great extent (Andreasson et al., 2013; Finn et al., 2014; Gyawali et al., 2018; Jacobs et al., 2012; Kaufmann et al., 2014; Mattoo et al., 2015; May et al., 2019; Nalwadda et al., 2018; Rathod et al., 2015; Schuler et al., 2015; Valdez et al., 2018; Zewdu et al., 2019) and that online interventions could increase treatment accessibility, especially for individuals in low income countries (Riper et al., 2011) or rural areas (Gordon et al., 2011; Witkiewitz et al., 2019). Thus, the acceptability of online treatments for increasing reach in these scenarios requires further investigation to inform relevant interventions, determine the stigma effect and promote familiarity with alternative treatments, such as mVRT, and their potential benefits, considering the effect that familiarity also had in treatment acceptability of VRT and mVRT.

4.5 Limitations and Strengths

This is the first study to examine the relative preference for and acceptability of VRT and mVRT for alcohol treatment and the preference of adult drinkers for being delivered VRT and mVRT in comparison to other available, evidence-based treatments. The sample consisted of a diverse range of drinkers including low-risk (47.1%), hazardous (35.9%) and potentially dependant (17%) drinkers allowing exploration of the VRT's and mVRT's acceptability and their factors across a wide range of drinking populations. Moreover, the

majority of participants were female (80.3%). This might have introduced gender bias in the results and, particularly in relation to the acceptability of VRT and mVRT. Previous literature has associated male gender with increased video gaming experience and, in turn, with higher acceptability of VR (Felnhofer et al., 2012; Shafer et al., 2017). This is also a strength of the study, since previous studies have underscored the need for participation of more females in research about the feasibility of VRT in alcohol treatment (Trahan et al., 2019).

The descriptions of less evidence-based therapies presented to the participants, like VRT and mVRT, might have influenced their acceptability ratings. Indeed, the existence of preliminary data only on the effectiveness of VRT and mVRT for treating an alcohol problem was included in their description (please see Appendix C - "Alcohol Treatment Preferences" section). This, however, was essential to convey accurate evidence about their effectiveness and inform participants' choices in an ethical manner. The description for the rest of the therapies was based on the data present in the official NHS and NICE websites for those who would seek help for an alcohol problem (National Institute for Health and Care Excellence, 2020; N.H.S., 2017, 2018a, 2018b). This ensured that participants would be presented with the same information if they were to seek treatment in real life, preventing from coercion to rate a specific treatment higher than others.

Finally, the survey did not explore the acceptability of VRT and mVRT as assistance to other interventions nor any treatment or delivery method combinations. Future research should therefore, investigate such features and determine additional factors of VRT and mVRT's acceptability, to inform the subsequent clinical assessment and application of VRT and mVRT for alcohol treatment, especially for when online interventions to increase treatment accessibility in less reachable populations would be involved. In addition, future studies should also investigate the interconnections of familiarity with treatment uptake regarding novel alcohol treatments and ways to promote familiarity in treatment-seeking populations of diverse backgrounds. Furthermore, the acceptability of VRT and mVRT in individuals with co-occurring mental health disorders and the additional effects of familiarity and stigma requires further exploration.

4.6 Treatment (patient) acceptability and preference of VRT for RP

Both versions of VRT (standard or mobile delivered) were less acceptable in potential patient populations compared to other alcohol treatments, with mVRT attaining the lowest acceptability scores and VRT the second lowest. The same trend was observed in the ranking of both versions of VRT by potential patients in order of treatment preference, with mVRT attaining the lowest place and VRT the second lowest (the 'No treatment' option was the least preferred but this is not considered a treatment anyway). Thus, in general, VRT delivered via a standard VR headset would be considered more acceptable and more preferred than mVRT (mobile-delivered) for RP in relevant patient populations.

In addition, according to treatment preferences of patients, in-person delivery of treatment was the most acceptable delivery method for alcohol treatments in general compared to online delivery of treatments. This suggests that in-person delivery of VRT (standard or mobile-delivered) might be more acceptable and preferred than if they were to be delivered online.

4.6.1 Acceptability factors of VRT for RP

Certain factors influenced the treatment acceptability of VRT for either of its versions (standard or mobile-delivered) and should be considered when determining VRT's patient acceptability for RP. More specifically, familiarity with VRT (particularly if the knowledge about VRT was positive) increased the treatment acceptability to a great degree, indicating the importance of familiarisation with VRT before delivering it to patients. Willingness to seek treatment or encourage others to seek treatment if facing an alcohol problem was also linked to increased VRT acceptability, suggesting that people who would be open to receiving treatment or those who would not be resistant to treatment (if they would have already been undergoing treatment) would be more likely to consider VRT acceptable than those not wanting or resisting treatment. The same applied to those who would feel open to discuss their alcohol problem with others, indicating that those not feeling stigmatised about facing an alcohol problem would potentially consider VRT an acceptable treatment option. A preference for delivery of treatments via video call or mobile/computer application was also linked to increased VRT acceptability, suggesting that those preferring such treatment formats would find VRT more acceptable compared to those preferring in-person delivery of treatments. Male participants additionally showed an increased acceptability tendency for mVRT specifically, potentially due to typically being more familiar with diverse video gaming platforms (as suggested in literature - Felnhofer et al., 2012; Shafer et al., 2017).

On the contrary, a negative effect on VRT's treatment acceptability was noted when people suffered from higher than normal levels of depression, anxiety and stress (as assessed by DASS), when they had received or have been receiving mental health treatment and when they had or have been diagnosed with a mental health disorder. This suggests that patients with a mental health background would be more likely to consider VRT a less acceptable option compared to those who without. In addition, people who would drink to enhance their social skills, or their physical or emotional state, found VRT less acceptable compared to those scoring low in these categories, indicating that drinking to increase self-efficacy and self-confidence, particularly in social contexts, would be linked to decreased acceptability to be delivered VRT.

4.6.2 Design implications of VRT delivery protocols for RP

The aforementioned treatment acceptability factors translate to specific design implications to be addressed in the delivery protocols of VRT for RP, informing their initial format, as

previously shaped by practitioners' and researchers' views (Chapter 3).

Overall, in-person delivery of VRT (standard or mobile-delivered) would appear to be the most acceptable combination regarding delivery methods. This indicates that the involvement of the practitioner would be acceptable by patients, which aligns with the necessity of the practitioner to guide the VRT session during RP for safety purposes (identified as a requirement by practitioners and researchers previously - Chapter 3). Regarding more accessible online, and potentially cost-effective, delivery methods of VRT, such as video call delivery of treatment, or delivery solely via a mobile (mVRT)/computer (standard VRT) application, which was linked to increased treatment acceptability for a few participants only, the practitioner to guide the VRT session for RP should always be facilitated. This would ensure a safe delivery of VRT for RP as suggested by practitioners and researchers (Chapter 3), if online delivery of treatment would be relevant and practical for a certain context (increasing treatment access during pandemics, or when physical attendance would be hard or costly). VRT delivered by a standard VR headset should also be the primary option compared to mVRT (being considered more acceptable), but if mVRT would be a practical solution then familiarisation sessions could help increase its acceptability. As long as the involvement of practitioner would be ensured, then accessibility and cost-related reasons could be considered to determine the appropriate delivery setting of VRT, promoted always by a familiarisation session (treatment and clinical acceptability factor - Chapter 3).

Moreover, at the assessment stage of the protocol, practitioners wanting to introduce VRT as a treatment tool for RP should consider, or assess if not already known, if their current patient would be (1) open to treatment in general, (2) open to discuss their alcohol problem with others, (3) familiar with VRT, (4) preferring (or receiving currently) video call or mobile/computer application-based treatment and (5) male (in case of mVRT only). If so, the likelihood of considering VRT an acceptable treatment option for their RP stage would be increased and, thus, VRT for RP could become a primary option for these patients.

In contrast, practitioners should also consider, or assess if not already known, if their current patient would be (1) suffering from depression, anxiety or stress currently, (2) having or have had a mental health disorder diagnosis or treatment background and (3) drinking to enhance their social skills or physical and emotional state. If so, a familiarisation session for introducing VRT would deem even more necessary than for cases who these would not be true, to increase the acceptability of VRT as a treatment tool for RP.

These patient characteristics should, therefore, be included in the assessment conducted by practitioners at the assessment stage to inform how VRT would be introduced and how acceptable it would be considered, and why, by these groups of patients. The need for a familiarisation session is highlighted in any case in this study, too, to increase patient acceptability and aligns with the practitioners' and researchers' opinions, that considered it essential to ensuring gradual and safe exposure to cues for RP and to make it inclusive for everyone and particularly for patients with mental health comorbidity (Chapter 3).

Regarding the combination of VRT with other treatments, which would be particularly rel-

evant for the aftercare stage of the VRT protocol for RP (please see Chapter 3) and also in general when incorporating VRT into an alcohol treatment, CBT, Counselling and 12-Step FT could form appropriate matches, as they were the most acceptable and preferred treatments by participants, currently offered by the healthcare system in the UK. Combining VRT with any of them could increase the overall treatment acceptability and the individual acceptability of VRT in patients and, in turn, the therapeutic effectiveness. CBT was also suggested by practitioners and researchers as the most suitable option due to the behavioural training that entails, which is intrinsic to VRT for RP and could be considered the primary treatment setting for integrating VRT.

4.7 Conclusion

This study assessed the alcohol treatment preferences and the relative acceptability of VR treatments for alcohol misuse in adults, being low-risk, hazardous or potentially dependant drinkers. Participants expressed a strong preference for in-person delivery of treatment of 'traditional' alcohol treatments. VR-based interventions ranked lower, which can be largely attributed to decreased familiarity and experience with these approaches. Male gender were linked to higher acceptability of VRT, but not of mVRT. Mental health and drinking motives seemed to further influence VRT's acceptability, but for mVRT it was a more determining acceptability factor. Stigma was associated with decreased acceptability for VR-based interventions. Overall, in-person VRT was considered a more acceptable treatment option compared to online or in-person, mobile-delivered VRT. Integration of VRT interventions into alcohol treatments may be benefited by promoting familiarity with these approaches as a part of the delivery protocols, especially for those with co-morbid mental health disorders or people who are not regular technology or video gaming users, and by involving the practitioner's support. Considering the potential of VR-based interventions to increase treatment accessibility via online delivery and treatment engagement via on demand support, especially in settings where in-person treatment delivery would be challenging, and also their potential to offer a personalised training environment not available by other forms of treatment, it is important that acceptability factors were identified and could be used to form acceptable versions of VRT for RP.

This acceptability study is the first one to explore the treatment (patient) acceptability (and its factors) of and preference for VRT for alcohol treatment and its relative acceptability and preference for VRT compared to current, alcohol treatments offered in the UK by the healthcare system. The findings of this study informed the delivery protocol of VRT for RP, based on VRT's acceptability and its factors, and patient treatment preferences, and could be relevant for other VRT applications aiming at assisting alcohol treatment in general.

To explore the acceptability of VRT in terms of the content of VEs that could be used for RP and test the relevance of online, cost-effective VR set-ups for addressing alcohol misuse (since it could be acceptable delivery formats if accompanied by familiarisation sessions and practitioner involvement), informing further the clinical application of VRT for RP, we

report the design and development of a VRT application for RP and its assessment by adult drinkers in Chapters 5 and 6, respectively. Practitioners' and researchers' suggestions on acceptable and useful contents of VEs to be used for RP are also reported in Chapter 5, along with previously used VEs in literature, that were found effective for reducing some alcohol misuse symptoms. This would help determine acceptable and effective VEs for RP that should be a part of the clinical application of VRT and be combined with the delivery protocols suggested in this PhD thesis.

Table 4.7. Factors of the acceptability of VRT

Variables of VRT	Test	Test Result
Familiarity with treatments Prior VRT knowledge VS no prior VRT knowledge	Independent samples T-test	Acceptability mean with VRT knowledge=15.27, sd=5.1, acceptability mean without VRT knowledge=12.4, sd=4.1, t=2.553, df=254*
Positive VRT knowledge VS negative VRT knowledge	Independent samples T-test	Acceptability mean with positive knowledge=17.17, sd=2.3, acceptability mean with negative knowledge=9, sd=5.7, t=3.203, df=8*
Treatment delivery preference Via video call VS in-person	Independent samples T-test	Acceptability mean for video call delivery=14.69, sd= 3.4, acceptability mean for in-person delivery= 12.44, sd=4.3, t=2.057, df=239*
Via a mobile/computer application VS in-person	Independent samples T-test	Acceptability mean for mobile/ computer application delivery=15, sd=0, acceptability mean for in-person delivery=12.44, sd=4.3, t=8.998, df=224*
Drinking patterns Low-risk drinkers VS hazardous drinkers	Independent samples T-test	Acceptability mean of low-risk drinkers=13.19, sd=4.2, acceptability mean of hazardous drinkers=11.96, sd=4, t=2.147, df=213*
Drinking motives Social enhancement & acceptance	Pearson correlation	r=-0.155*
Emotional & physical state enhancement	Pearson correlation	r=-0.128*
Depression & Anxiety	Pearson correlation	depression: r=-0.134*; anxiety: r=-0.155*
Stigma Ability to discuss an alcohol problem with family or relatives	Pearson correlation	r=0.143*
Treatment uptake attitudes Seeking appropriate treatment	Pearson correlation	r=0.182*
Encouraging others to seek treatment	Pearson correlation	r=0.145*
Ethnicity Any other white background VS White-British or Irish	Independent samples T-test	Acceptability mean for any other white background=14.02, sd=4.8, acceptability mean for White-British or Irish=11.92, sd=4, t=2.930, df=213*
White & Asian VS White-British or Irish	Independent samples T-test	Acceptability mean for White & Asian=15.50, sd=3.5, acceptability mean for White-British or Irish =11.92, sd=4, t=2.142, df=176*
Any other mixed background VS White-British or Irish	Independent samples T-test	Acceptability mean for any other mixed background=18.25, sd=1.9, acceptability mean for White-British or Irish =11.92, sd=4, t=3.122, df=174*
Any other mixed background VS Chinese	Independent samples T-test	Acceptability mean for any other mixed background=18.25, sd=1.9, acceptability mean for Chinese=13.75, sd=3, t=2.793, df=14*
Any other mixed background VS Mixed-White & Black African	Independent samples T-test	Acceptability mean for any other mixed background=18.25, sd=1.9, acceptability mean for Mixed-White & Black African=11.67, sd=3.5, t=3.239, df=5*

*Statistically significant at the 0.05 level.

Table 4.8. Factors of the acceptability of mVRT

Variables of mVRT	Test	Test Result
Treatment delivery preference Via video call VS in-person	Independent samples T-test	Acceptability mean for video call delivery=14.13, sd=3.5, acceptability mean for in-person delivery=11.39, sd=4.2, t=2.544, df=239*
Drinking patterns Low-risk drinkers VS hazardous drinkers	Independent samples T-test	Acceptability mean of low-risk drinkers=12.16, sd=4.3, acceptability mean of hazardous drinkers=10.96, sd=4, t=2.050, df=213*
Drinking motives Social enhancement & acceptance	Pearson correlation	r=-0.167*
Emotional & physical state enhancement	Pearson correlation	r=-0.217*
Depression, Anxiety & Stress	Pearson correlation	depression:r=-0.206*; anxiety:r=-0.186*; stress:r=-0.180*
Stigma Ability to discuss an alcohol problem with family or relatives	Pearson correlation	r=0.143*
Treatment uptake attitudes Seeking appropriate treatment	Pearson correlation	r=0.137*
Ethnicity Any other white background VS White-British or Irish	Independent samples T-test	Acceptability mean for any other white background=12.79, sd=4.8, acceptability mean for White-British or Irish=11.05, sd=4, t=2.448, df=213*
Chinese VS White-British or Irish	Independent samples T-test	Acceptability mean for Chinese =13.75, sd=2.8, acceptability mean for White-British or Irish=11.05, sd=4, t=2.290, df=182*
Chinese VS Mixed-White & Black Caribbean	Independent samples T-test	Acceptability mean for Chinese =13.75, sd=2.8, acceptability mean for Mixed-White & Black Caribbean=8, sd=1.4, t=2.776, df=12*
Chinese VS Asian or Asian British-Indian	Independent samples T-test	Acceptability mean for Chinese =13.75, sd=2.8, acceptability mean for Asian or Asian British-Indian=7.33, sd=4, t=3.287, df=13*
Any other mixed background VS Mixed-White & Black African	Independent samples T-test	Acceptability mean for any other mixed background=18.25, sd=1.9, acceptability mean for Mixed-White & Black African=11.67, sd=3.5, t=3.239, df=5*
Gender Male VS Female	Independent samples T-test	Acceptability mean for male=12.88, sd=3.6, acceptability mean for female=11.28, sd=4.3, t=2.366, df=254*
Mental health treatment history Not having VS Having received treatment	Independent samples T-test	Acceptability mean for people without mental health treatment experience=11.94, sd=4.2, acceptability mean for people with mental health treatment experience=10.64, sd=4, t=2.262, df=257*
Mental health diagnosis Without VS With mental health diagnosis	Independent samples T-test	Acceptability mean for people without a mental health diagnosis=11.95, sd=4.3, acceptability mean for people with a mental health diagnosis=10.64, sd=3.9, t=2.272, df=257*

*Statistically significant at the 0.05 level.

Chapter 5

Development of the VRT application

5.1 Introduction

After having explored the acceptability of VRT for RP regarding delivery protocols and in order to inform further the clinical application of VRT for RP, we focused on the relevance (and, thus, acceptability and potential effectiveness) of the content (VEs) that a VRT application should have. To meet this objective, we explored the clinical acceptability of VEs that could be used for RP via our previous interview study with practitioners and researchers (please see Chapter 3). Practitioners and researchers in that study were asked about potential VEs that they would find useful, acceptable and potentially effective to include in a VRT application for RP (both for the identification and the coping skills training parts). Identified VEs involved places or settings where individuals in recovery would typically consume or be tempted to consume alcohol as per their drinking habits and are presented in this chapter (please see Section 5.2). To elaborate on relevant and effective VEs (linking to patient acceptability) we also considered the VEs used in literature and reported efficient (please see Chapter 2 and Section 5.3 in this chapter), that could be used for RP, even though they have not been tested primarily in that context.

Informed by the suggestions of practitioners and researchers and the literature review in this thesis, we developed a VRT application named “A-PLAN”, as a model, clinical tool that would be the first choice (“A-PLAN”) for identifying triggers and coping with craving once triggered. ”A-PLAN” was assessed by adult drinkers to determine its relevance and potential for use in RP. Factors of relevance that should be considered in the subsequent design of this and other VRT applications for RP were also explored, helping form acceptable and effective VEs for RP and facilitating VRT’s purposeful integration into current, clinical practice.

5.2 Clinically acceptable VRT contents for RP

The clinical acceptability of VEs for use in RP was explored in our previous study with practitioners and researchers, delivering or designing substance use treatments, respectively (please see Chapter 3). Their suggestions on useful and acceptable VEs for RP are presented in this section of this chapter.

Practitioners and researchers taking part in the study suggested that socially-oriented scenarios would be relevant to address the social aspect of alcohol use. Such situations included gatherings, ceremonies and sports events, as well as scenarios of social pressure where one is pressurised by others to drink alcohol. These high-risk situations were considered useful for practising coping with alcohol craving and for refusal skills training - practising how to say 'no' to people's prompts to drink alcohol. A list of the recommended places and occasions consisted of pubs, weddings, stag dos, funerals, churches, football games, Christmas or other festive gatherings, barbecues, office or celebration parties, beer gardens on warm, sunny days and any events that would involve crowded places and gatherings. For the aforementioned situations, they also felt that emotional involvement mediated by virtual characters would be important to recreate the social pressure present in them. For example, they proposed to include scenarios such as pressure to drink in a toast during a wedding or other celebrations, or to drink for supporting friends and family in hard times like break-ups. Relevant literature about alcohol relapse has identified social pressure as a relapse factor (Marlatt, 1996; Shafiei et al., 2014), which can lead to repetitive relapse incidents (Zywiak et al., 2006).

Practitioners and researchers highlighted that a large part of alcohol dependant individuals would also drink at home and in isolation, often hiding their addiction. For these cases, they believed that an alcohol RP VRT application should also include VEs such as the living room of a home, benches in parks and street corners. Although these VEs were recommended not to include virtual characters and social interactions, practitioners and researchers underlined that individuals could practise resisting drinking in them after being emotionally triggered by others for some reason. For example, individuals might have had a fight with their family members or partner and then be in their homes, trying to cope with their alcohol craving caused as a result of their argument earlier. The underlying context which these VEs would be approached with could be personalised to the life events and living conditions of the individuals each time. This could enhance the therapeutic effect of VRT since previous studies have associated the triggering of alcohol craving with emotional states and subsequent relapse episodes (Khosravani et al., 2017; Petit et al., 2015; Pombo et al., 2016; Snelleman et al., 2018; Witkiewitz & Marlatt, 2004). Thus, emotional involvement via the use of virtual characters in social interaction VEs and an emotionally oriented approach of the lone drinking VEs could assist in addressing this factor of relapse.

Practitioners and researchers noted that other, daily-life places, such as supermarkets and convenience stores, would be equally relevant for alcohol RP. They suggested that people have to shop for essentials anyway, and resisting buying alcohol on such occasions might prove challenging, since it would involve exposure to alcohol cues. It was added that if individuals would be in a unstable emotional state, irrespective of being negative or positive, alcohol craving could be triggered further while shopping and threaten their abstinence. Thus, the scenario of resisting purchasing alcohol in such contexts was perceived by practitioners and researchers useful to include in the VRT application for practising the related coping skills. Previous literature has also linked multi-buy offers and lowered prices on

alcoholic beverages to increased alcohol purchasing and intake in adults and adolescents (Hurtz et al., 2007; Wagenaar et al., 2009), aspects which can be addressed through exposure to a supermarket VE for treatment purposes.

Practitioners and researchers of the interview study recommended further that familiarisation sessions prior to the cued exposure to any of the aforementioned VEs would ensure gradual exposure and give the opportunity for individuals to make an informed decision on whether they would like to be delivered VRT. This was also thought to allow individuals with co-morbid mental health disorders or those not familiar with technology to release additional stress and anxiety linking to trying a new, immersive technological gear. These familiarisation sessions were suggested to involve exposure to neutral VEs, being situations that would not include alcohol cues. Such VEs were outlined to be nature scenes like parks, gardens, rivers, beaches, forests, everyday situations like walking a pet, watching television, walking down a street, and generally scenarios where would be less crowded and busy. Having these neutral VEs was additionally thought to help for relaxation purposes after the cued exposure, to re-integrate individuals back to reality after practising coping in virtual, high-risk situations.

5.3 Effective VEs in literature

VEs that have already been assessed about their efficiency in addressing alcohol misuse symptoms by previous studies are presented in this section of this chapter. These VEs have been proven relevant for use in alcohol treatment, although they weren't used in a RP context, but they could provide indications of what acceptable and relevant VEs would be for RP.

Alcohol-cued VEs that were used in literature include a pub, a restaurant, a home, a bar, a kitchen, a bedroom, a chill-out area, a beer garden, a whiskey house, a party and an argument scene (please see Tables 2.1-2.8 of Chapter 2). The single study that focused on RP did not mention what VEs were employed (please see Table 2.6 of Chapter 2). Virtual characters were used in some of the VEs, yet whether the speech feature was provided it was not reported, except from the argument scene, in which the user was the observer and did not participate.

5.4 "A-PLAN" VEs for RP

To adequately address the social, daily, emotional and lone-drinking aspects of alcohol use in the "A-PLAN" application for RP and enhance its therapeutic potential, we developed a home, a supermarket and a pub VEs.

Previous VRT studies about alcohol treatment have employed a pub and a home VE (S. Kim & Kim, 2020; Segawa et al., 2020); our design included advertising cues (branding, TV and leaflet ads with drink offers) to explore their effect on eliciting alcohol craving in

both the home and the pub VEs. This has not been explored before in the literature. In addition, in the pub VE, positive emotional states in the context of social pressure were involved to also examine their impact. Similarly, this has not been explored before in previous studies as virtual characters have not been reported to offer the speech feature. The relevance of a supermarket VE has also not been explored before by previous studies (S. Kim & Kim, 2020; Segawa et al., 2020) and, thus, was included in our design to test its suitability for RP. Thus, by a combination of practitioners and researchers suggestions and the review of the literature, we informed our VRT design such as to address new aspects of potential, useful therapeutic contents, with a particular focus on RP, which has not been explored as a context either, except by one study.

We have also built a neutral VE of a city street for familiarisation and relaxation purposes. Although participants had suggested that nature scenes would be relaxing and fit for this purpose, yet some of the participants noted that a very calming scene prior to the cued exposure might affect the coping skills training. Thus, a mundane scene of a city street, being a daily scenery, felt more appropriate for not affecting negatively the subsequent cued exposure via individuals being overly relaxed.

5.5 Methods

5.5.1 Game Engine and Integrated Development Environment

Our VRT application for alcohol RP, “A-PLAN”, was developed in the Unity game engine (https://unity.com/) which included libraries that enabled VR software building for a variety of commercial HMDs. One of the default Integrated Environments compatible with Unity was Visual Studio (https://visualstudio.microsoft.com/), which was used as the code editor. The application was written in C#.

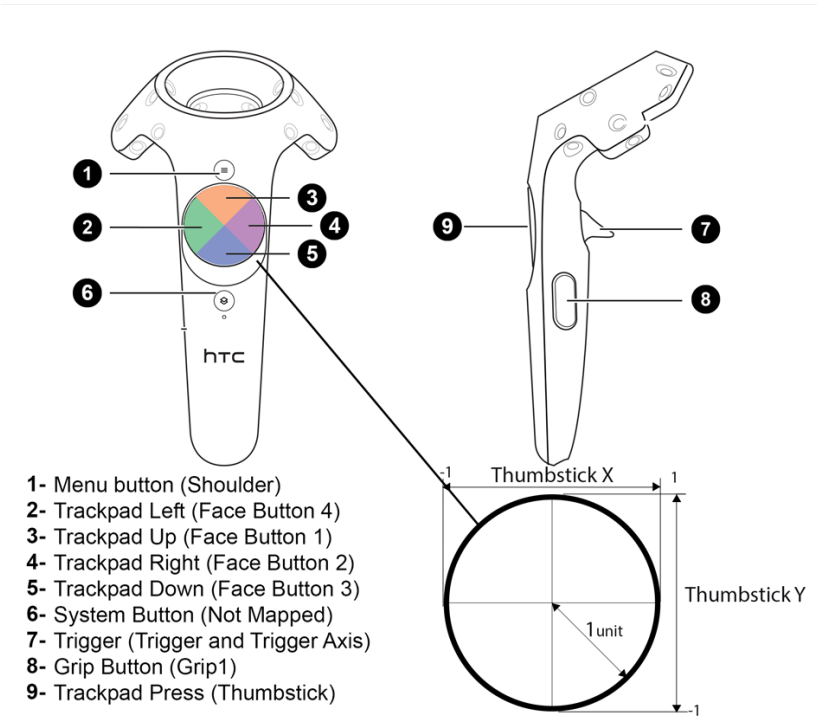
The option for the practitioner, who would typically deliver the VRT session, to observe the actions of the individual being exposed through a monitor screen was included in the application’s design. This was an identified design implication that emerged from the clinical acceptability factors of VRT for RP (please see ”Functionality of Virtual Environments for RP” in Chapter 3). A monitor screen to observe virtual actions was suggested by practitioners and researchers to be useful for informing the course of therapy and their subsequent intervention. To facilitate this, when the application would run in the laptop, all the actions happening within the VEs would be displayed in the laptop screen through the “SteamVR” software (https://store.steampowered.com/steamvr) that would facilitate the experiencing of VR content.

5.5.2 Targeted VR Headset and Avatar User

The VRT application was developed for use with the “HTC VIVE Pro” VR headset (https://www.vive
uct/vive-pro-full-kit/). The VR headset enabled the VR experience, offering immersive exposure to the VEs of the application via head-tracking, which allowed updating of the vision field as per the head movements of the interface user. Apart from visual feedback, audio feedback was also offered by the VR headset.

A-PLAN also facilitated the use of the two,“HTC VIVE Pro” hand-held controllers which enabled navigation into the VEs and interaction with the objects within them. The avatar used to impersonate the user visually within the VEs was the default red leather glove, hand models provided by the SteamVR plugin (https://assetstore.unity.com/packages/tools/integration/steamvr-plugin-32647), the library that is available in Unity for integrating the VR functionality for the “HTC VIVE Pro” headset into Unity projects. The avatar hands were programmed to move according to the fingers’ movements of the user, showcasing at the same time which buttons or presses happened in the controllers, enabling a user-friendly experience for users to easily monitor their actions. Furthermore, the avatar could navigate the VEs by sliding across in all directions, pressing the trackpad of the controller in the desired direction (Figure 5.1: forward - 3, backwards - 5, left - 2 or right - 4). The sliding speed (sensitivity) was set to 3, offering lower sensitivity in the controller input, to reduce the likelihood of cybersickness since previous literature identified fast movements within the VEs as cybersickness factors (S. Kim & Kim, 2020; Stanney et al., 2020). In addition, the avatar could grab the objects of the VEs using the grip button in either controller (Figure 5.1: grip - 8).

Figure 5.1. Mapping of the controller inputs



The height of the avatar was adjusted to offer easy navigation within the VE, proportionate to the height and size of the VEs’ objects, and to allow a realistic viewpoint of the VEs,

similar to the one a person would have if being in these VEs in real life. This was facilitated by calibrating the VR headset and fixing its position on a height of 160 cm from the ground. The VRT application was build to offer a seated VR experience rather than a standing or room-scale experience, to ensure that users would use the controllers to navigate rather than walking, which may introduce cybersickness and unsafety (Zielasko & Riecke, 2021) and has linked to lower presence (Clifton & Palmisano, 2020), hindering the therapeutic potential of such applications. This implementation choice was made for practicality reasons, as it would be difficult to facilitate a safe, standing or room-scale VR experience in a practitioner's office, where the office space would be limited and the focus would be on coping skills training and on talking with the practitioner while being exposed to the virtual world. Setting up the motion tracking sensors for a standing or room-scale VR experience would be more difficult for a practitioner as opposed to simply providing a chair and running the VRT application, with the sensors being put a few meters apart and at a lower height. This set-up would also be easier to employ in a home setting, if VRT was delivered online, or to re-built it to a mobile application for on demand support of the individuals.

5.5.3 VEs Assets and Prefabs

Assets to build the VEs were obtained, either free of cost or upon purchase, from the Unity Asset Store (https://assetstore.unity.com/). Such assets involved already made textures, materials or prefabs that were then edited within the Unity editor to be matched to the needs of the application's VEs. Such assets were the furniture of the VEs, alcohol bottles and glasses, all with the relevant glass, wooden or metal textures and lighting effects. To ensure a realistic result, textures used were of high resolution. Normal maps and shaders were also created for each object of the VEs, to realistically represent how the lighting would interact with the surfaces of the objects according to their shape and material and, subsequently, make them look realistic. A range of light probes, spotlights and the particle effect system were additionally employed to represent light in the VEs, be it the sunlight or lighting indoors. Via the particle effect system, groups of particles were employed to represent fizzy beer in the pub VE. Sounds were also added to the VEs, importing relevant background sounds and music via mp3 audio files into the editor and attaching them to Audio Sources of the GameObjects within the virtual scenes. To ensure 3D representation of sounds, the volume level of the sounds was set to dynamically adjust according to the distance of the avatar to the audio source.

To optimise run times, Single-pass rendering was used, which reduces the Draw Call in the GPU, resulting in less texture swapping during rendering and, in turn, savings in the CPU work and less latency in the frames update. This was also critical for reducing the likelihood of cybersickness as the current body of literature suggested that latency in the frame rate caused more cybersickness incidents (S. Kim & Kim, 2020; Stanney et al., 2020). Baked lightmaps were generated for each VEs, since the only dynamic GameObject was the avatar, to ensure less latency in the frame rates during runtime.

5.5.4 Virtual Characters and Animation

Virtual characters populated the supermarket and pub VEs. Textures, materials and some of the animation clips for the virtual characters were obtained from the Mixamo library (https://www.mixamo.com/#/) of the Adobe, free of cost. The rest were found in the Unity Asset Store. Some of the virtual characters required to be rigged as humanoids to allow accurate animation which was done in Blender (https://www.blender.org/) and then imported into the Unity editor for use with the build-in animation system of Unity, Mecanim. Mecanim facilitated then configuration of the animation clips' order, speed and blending.

While most of the virtual characters were animated to stand, breathe and move in repetitive patterns when relevant, in the pub VE the customer virtual character was interactive, applying social pressure for the avatar user to drink. To achieve this, additional animation was involved, including also the lip movements of the virtual character. To animate the facial expressions and lip movements of the virtual character the Maya animation software (https://www.asidek.es/en/3d-visualization-and-animation/autodesk-maya/) was used and then the animation clips with the 3D character were imported into Unity. The LipSync Pro (https://lipsync.rogodigital.com/) was also purchased in the Unity Asset Store to allow lip synchronisation between the audio clips imported and the animation clips. While lip synchronisation was mostly automated, additional manual tuning was required to match the animation clips per frame accurately to the audio clip frames. Via the LipSync Pro animation of the eyes of the virtual character was also possible, recreating the movement of the eyes blinking and adjusting the blinking rate. Configuring the virtual character to look the avatar user when approaching and talking to them was also included in the application's functionality.

To animate GameObjects other than humanoids, custom scripts were written (for example to animate the movement of a glass with alcohol when grabbed by the hand of a virtual character, following the virtual character's hand movement) or animation clips were recorded directly within the Mecanim system (for example, to animate the opening and closing of a door).

5.5.5 Physics and Gameplay Area

The other aspects of the VEs were implemented to imitate reality and the physic laws during object interactions. To do so, exploiting the built-in physics engine of Unity, colliders were attached to each object, to ensure that collisions will be tracked. For floors, walls and other static objects, static colliders were assigned, but for moving (avatar) and interactable objects (a glass of beer) rigidbodies were also attached to allow their reaction when forces are applied to them by other objects or scripts, fully simulated by the Physics engine. Through colliders and rigidbodies elements such as gravity were simulated in the VEs, resulting, for example, in the glass of beer to fall down to the floor when the avatar user stops grabbing it with the controller, or the avatar to be able to go up and down the

staircase without walking through the staircase object. Similarly, this facilitated the avatar not moving through the walls and restricting organically the Gameplay area, ensuring that the avatar user will be exposed to the therapeutic elements required rather than walking away of the relevant exposure material within the virtual world. This was particularly important as practitioners and researchers suggested that having also free navigation within the VEs, apart from fixed trajectories, would offer a realistic result and would, therefore, be more insightful and purposeful for the therapy (please see ”Functionality of Virtual Environments for RP” in Chapter 3). Thus, restricting naturally the Gameplay area allowed for free navigation to be a viable implementation option.

5.5.6 User Interface Elements

To offer a user-friendly experience and easy navigation through the available VEs of the application, User interface elements were created. Practitioners and researchers mentioned that menus would be helpful both for them but also for the individuals in recovery (please see ”Functionality of Virtual Environments for RP” in Chapter 3). They highlighted that they would prefer themselves to explain how the VR exposure would work but then menus to offer on demand support so as not to interrupt the exposure by the individuals having to remove the VR headset to ask technical questions. This was another design implication that emerged from the clinical acceptability factors of VRT for RP (please see ”Functionality of Virtual Environments for RP” in Chapter 3). Therefore, a main menu was provided at the start of the application for the user to choose their preferred VE to navigate, which was placed at the “Startpoint” VE (Figure 5.2). The “Startpoint” VE operated as the base point where the user would return when selecting other VEs to navigate. The user could select any of the interactable areas of the menu (that operated as buttons) by pointing at them with a green laser that the controllers emitted and when the Trigger button was pressed in either controller the selection occurred (Figure 5.1: trigger - 7). When the laser touched an interactable object it turned to red to indicate that this element of the menu is interactable.

A help menu was additionally offered when the user selected and navigated any of the VEs (Figure 5.3). The help menu included instructions about which buttons to press in the controllers in order to interact with objects and navigate the VEs. The help menu was presented when the user pressed the Menu button in either controller (Figure 5.1: menu - 1). The help menu could be toggled on and off on each press of the Menu button. The help menu could be used for the user to exit the application via pointing at and selecting the “Exit’ button and to go back to the main menu and select other VEs via the “Other Scenes’ button (Figure 5.3). If no movement or interaction occurred after 120 seconds, the help menu was automatically presented to the user, to ensure that enough guidance is provided, even if the user forgets how to access the help menu, for not interrupting the immersion of the exposure as recommended by the practitioners and researchers (please see ”Functionality of Virtual Environments for RP” in Chapter 3). An endpoint VE was also included, with instructions that prompted the user to remove their VR headset when the exit button was pressed (Figure 5.4).

Figure 5.2. Startpoint VE - Main menu

Figure 5.3. Home VE - Help menu

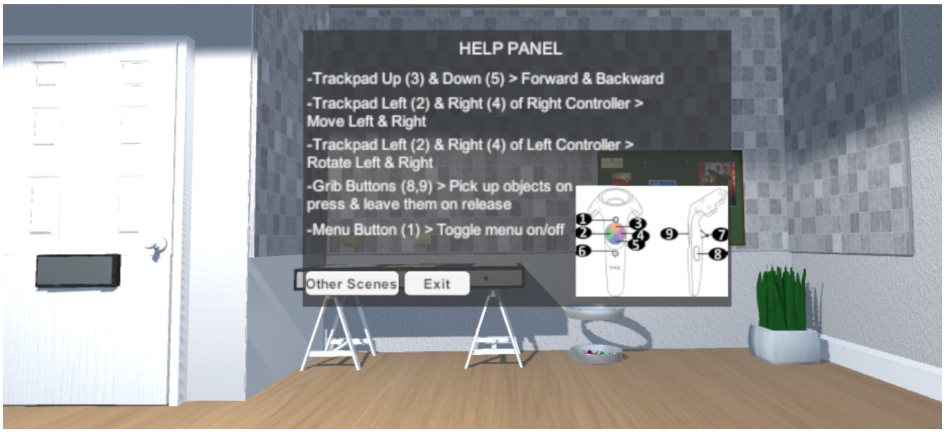


Figure 5.4. Endpoint VE - Remove headset instructions

5.6 Results

Three alcohol-cued VEs were created, a home, a supermarket and a pub VE and a neutral, familiarisation VE of a city street. The final format of these VEs is presented below.

Home VE

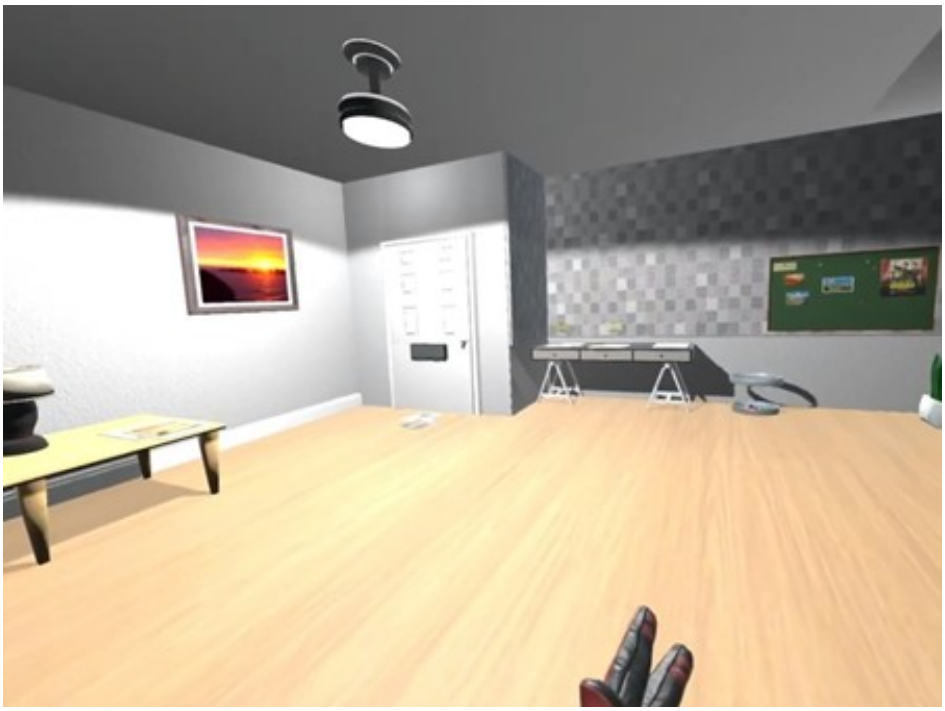
The home VE consisted of a living room, a hallway and an upper floor of a flat. A TV ad of alcohol was playing in the television in the living room (Figure 5.5) and a supermarket leaflet with drinks offers was placed onto the living room table (Figure 5.6). The soundtrack of the TV ad was the audio included in this VE. The avatar user could navigate freely within the VE, grabbing the leaflet and the glasses present on the table (Figure 5.6), walking up and down the staircase (Figure 5.7), pinning and un-pinning the postcards from the notice board (Figure 5.8), opening and closing the house door (Figure 5.8), and checking the mail delivered via the door's mail slot (Figure 5.8).

Figure 5.5. Home VE - Living room & TV advertisement of alcohol

Figure 5.6. Home VE - Supermarket leaflet with drinks offers

Figure 5.7. Home VE – Hallway

Figure 5.8. Home VE - Entrance



Supermarket VE

The supermarket VE consisted of aisles with products typically found in a supermarket. These included aisles with alcoholic beverages, soft drinks, baked goods, frozen, cupboard and can food, vegetables and stationary (Figures 5.9, 5.10, 5.11, 5.12). Drinks multi-buy offers were also included (Figure 5.13). Two virtual characters were shopping in one of the aisles operating as the customers (Figure 5.14). Two other virtual characters were sitting in the check-out points operating as cashiers (Figure 5.12). Background sounds of supermarket announcements, items being scanned and people's voices were included in the VE. The avatar user could navigate freely within the VE, grabbing products from the shelves and opening and closing the freezers' doors (Figure 5.15).

Figure 5.9. Supermarket VE - Beers in the fridge & "in-store selling tobacco" signage

Figure 5.10. Supermarket VE - Wines section

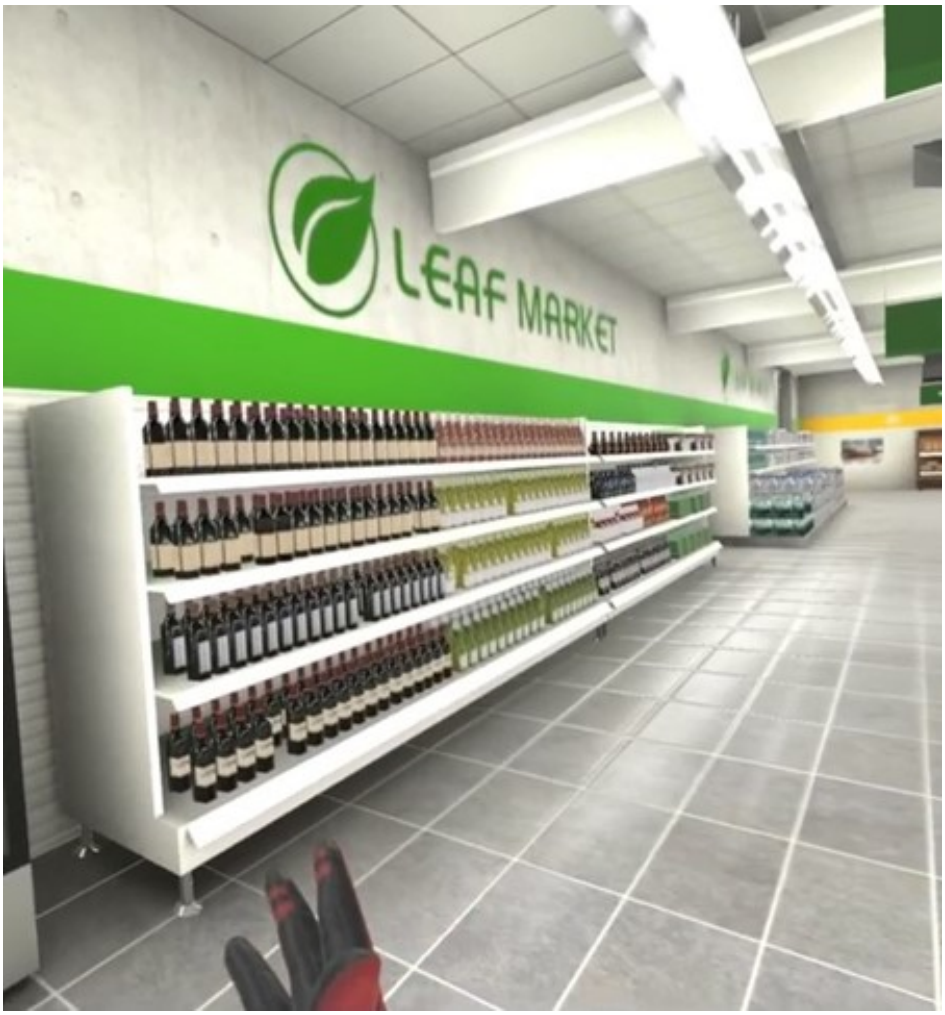


Figure 5.11. Supermarket VE - Spirits section

Figure 5.12. Supermarket VE - Soft drinks section

Figure 5.13. Supermarket VE - Multi-buy drinks offers

Figure 5.14. Supermarket VE - Customer virtual characters

Figure 5.15. Supermarket VE - Grabbing the vodka bottle

Pub VE

The pub VE consisted of an indoors space with wooden tables and chairs, a bar and an outdoors smoking area. The pub was of British style, with wallpapers and a selection of draught beers (Figure 5.16). Drinks offers were listed in the notice board by the bar. virtual characters sitting in the tables operated as the pub's customers (Figure 5.16). A virtual character behind the bar operated as the bartender (Figure 5.17). Glasses of alcohol and bottles of alcohol were included to showcase that customers drink. Background sounds included in the

VE were the noise of people chatting and glasses clinking. The avatar user could navigate freely within the VE, grabbing and drinking a pint of beer or red wine (Figure 5.18), grabbing the pack of cigarettes and the lighter (Figure 5.17), and interacting with the customer virtual character sitting by the bar (Figure 5.19). If approaching close to the bartender, it would ask the avatar user if they are okay for drinks.

Figure 5.16. Pub VE - Pub layout & customer virtual characters

Figure 5.17. Pub VE - Lighter & pack of cigarettes, & the bartender virtual character

Figure 5.18. Pub VE - Action of drinking beer pint

Figure 5.19. Pub VE - Customer virtual character

City Street VE

The city street VE consisted of a quiet city street with a bench, signposting and several buildings (Figure 5.20). One of the signposts prompted the avatar user to throw the can of soda left on the bench into the bin nearby, operating as a simple task to practise interactions within the VE (Figure 5.21). Background sounds included cars and, generally, traffic noises, and dogs barking, in a distance. The avatar user could navigate freely within the VE, grabbing and throwing the soda can (Figure 5.22).

Figure 5.20. City VE - Initial instructions signposting at startpoint

Figure 5.21. City VE - Instructions signposting

Figure 5.22. City VE - Picking the soda can on the bench

5.7 Conclusion

These VEs were built for use in alcohol RP, when identifying triggers and practising coping in the context of a home, supermarket or a pub VE would be relevant. The free navigation offered within any of the VEs allows for a variety of therapeutic approaches to be adopted during the exposure, focusing on the desired aspects of each VE according to the therapeutic goal and the preferences of the individual. The menus included in the application ensure that easy navigation of the application would be possible and that enough support would be provided during the exposure. Finally, the neutral VE of a city street could be used for familiarisation or relaxation purposes, prior or after the cued exposure to the other VEs of the application. These features align with the acceptability factors identified by practitioners and researchers in our previous study (Chapter 3) and the emerging design implications for VRT applications for RP.

Assessment of these VEs from the perspective of potential patients about their capacity to be relevant and realistic to elicit alcohol craving and related emotional responses was conducted via an interview study with adult drinkers and presented in Chapter 6. Factors of relevance were additionally identified and linked to design implications, to inform the development of such applications and facilitate purposeful, clinical use of VRT for this RP application and other, similar applications targeting alcohol treatments.

Chapter 6

Assessment and Clinical Potential of the "A-PLAN" Application

6.1 Introduction

Evaluation of the three alcohol-cued VEs of the "A-PLAN" application, namely the home, the supermarket and the pub, and the neutral VE of a city street was performed via an online, interview study with adult drinkers. The online study design was employed to comply with the social distancing guidelines for controlling Covid-19, enabling safe and accessible participation to the study. Due to the necessity for an online study approach and the unsafety of participants assessing the VEs via the same HMD during the pandemic, a less immersive, cost-effective VR set-up was implemented. The original aim of the study was to investigate the relevance of these VEs for use in RP from potential patients perspective and to identify certain design considerations that could affect their relevance, informing the clinical application of VRT for RP.

Concurrently, evaluating the capacity of cost-effective VR emerged as an additional aim due to the need for accessible treatment options in similar situations where in-person access to treatment is impractical or expensive. As cost-effective VR, we considered the use of the first-person perspective for navigating the VEs, but without real-time interactivity and the immersion provided by the VR headset. Instead, videos of pre-recorded routes and interactions within the VEs, in the first-person perspective and with relevant audio stimuli, were projected on monitor screens and used as a cost-effective, VR approach (imitating an exposure model similar to the one of mobile VRT, but instead of a mobile phone which updates the frame, the VEs are presented in a monitor screen with pre-recorded view updates). Although, this might not be an immersive VR set-up, yet it would still be important to see if VEs would still be relevant and if it could be adopted as a secondary solution when needed. It should be noted that this study was run concurrently with the survey study reported in Chapter 4, which also explored the treatment acceptability of mobile VRT compared to immersive VRT that is mediated by a VR headset. The motivation was to explore the acceptability and relevance of such set-ups compared to original VR set-ups, given the therapeutic restrictions posed by Covid-19.

During Covid-19 access to in-person treatment was limited, with the psychosocial effect

of isolation, such as increased anxiety and depression, to be identified as risk factors of relapse (Ornell et al., 2020; Samuels et al., 2020; Yazdi et al., 2020). A growing increase in alcohol consumption was reported worldwide, both for the general public and people with prior alcohol dependence (Da et al., 2020; Killgore et al., 2021; J. U. Kim, 2020; Pollard et al., 2020). Although forms of online treatment were offered by treatment services, engagement was low due to the lack of structured sessions that would imitate the structure of the in-person sessions and in-person delivery was considered necessary (Seddon et al., 2021). However, online support was found to reduce the relapse likelihood to an extent when offered (J. U. Kim, 2020). Furthermore, treatment reach is an issue faced by many countries, especially in rural and low- and middle-income areas, irrespective of Covid-19, which could be resolved to an extent through online treatment tools (Cunningham et al., 2011; Gordon et al., 2011; Riper et al., 2011; Witkiewitz et al., 2019). Current, evidence-based alcohol treatments may be enhanced via the use of novel technologies, to offer support on demand, and flexibly (Witkiewitz et al., 2019). Behavioural treatments, such as CBT, that involve coping skills training, could be advanced by the availability of methods to practise coping whenever needed, with or without the practitioner's assistance, and prevent relapse.

Thus, exploring the potential of such a cost-effective, accessible VR set-up could benefit future alcohol interventions for RP, providing an alternative for increasing treatment accessibility in the aforementioned situations. Moreover, the game-like nature of VRT could potentially increase engagement with online treatment schemes, offering a more entertaining treatment approach compared to current, web-assisted and video call- or phone call-based treatments.

To determine the relevance of the three VEs for RP in treatment schemes delivered either online or in-person, we assessed them via an interview study with adult drinkers. The cost-effective VR set-up employed was also explored in its potential to operate as a secondary delivery method and indicate the potential of less immersive VR set-ups for RP (such as mobile VRT). The relevance of the VEs for RP was defined as their capacity to be realistic and trigger alcohol temptation in participants, since realism has previously been shown to affect the emotional and mental response of individuals in VR (in our case the temptation to be felt - Loomis, 2016). A qualitative study design with unstructured interviews was employed to facilitate exploration of the factors of realism and alcohol temptation in the three VEs (which would translate to certain design implications). Investigating thoroughly the factors of realism and alcohol temptation (and, in turn, identify relevant design implications) was needed to inform the use of these VEs in clinical, immersive VR set-ups (involving a HMD) for RP and guide the design of similar, VRT applications for alcohol treatment.

6.2 Methods

6.2.1 Virtual Environments and Videos

To facilitate an online, cost-effective VR set-up, VEs were presented to participants via pre-recorded videos. For each VE of the "A-PLAN" application, a YouTube video was recorded with the first author navigating each VE for approximately 2 to 3 minutes. The videos were recorded in a first-person perspective to clearly present the view that participants would have if they were to be immersed in the VEs themselves, via a VR headset. Participants thus experienced the navigation within the environments as if they were the VR users. For testing consistency, personalising the VEs, the virtual characters within them and the avatar user's hands was not included during the presentation of the VEs to the participants but considered in the assessment, since it might increase the therapeutic potential of VRT and was preferred by practitioners if they were to use VRT in clinical practice.

The video of the home VE (YouTube link: https://youtu.be/7nxbnqNoz5c) involved standing in the living room and watching an alcohol TV advertisement, grabbing a supermarket leaflet with drinks offers and navigating within the living room. The video of the supermarket VE (YouTube link: https://youtu.be/fhl21Nd-IhQ) involved navigating the alcohol aisle while observing a variety of drinks and grabbing a vodka bottle. The video of the pub VE (YouTube link: https://youtu.be/j55fSGXHPnU) involved standing at the bar and being offered a pint of beer by an interactive, virtual character whose behaviour was controlled by the pre-defined, application's storyline. The interactive, virtual character was applying social pressure, by mentioning that they have just found a new job and they wanted to celebrate and buy the VR user drinks (Figure 5.12). The VR user grabbed the pint of beer offered and drank it in the first-person perspective (Figure 5.15). Smoking cues (a pack of cigarettes and a lighter – Figure 5.13) were also present at the bar counter and were grabbed by the VR user. The video of the city street VE (YouTube link: https://youtu.be/OMckxit4Zkw) involved the user to walk down a city street and a signpost prompting the user to throw a can of soda in the bin, operating as a simple task to practise interactions within a VE for familiarisation purposes.

6.2.2 Equipment

To create the videos of this study, the 'HTC VIVE Pro' VR headset was used with two handheld controllers. Navigation within the VEs happened via the trackpad of each controller, that on touch, sliding across each direction was possible. By design, sliding occurred in a slow pace and as the VEs represented enclosed spaces, the movement threshold was limited. This approached was informed by the potential of fast-paced movements to cause cybersickness - symptoms such as nausea, eye tiredness and, in rare cases, vomiting (S. Kim & Kim, 2020; Stanney et al., 2020).

To record the videos, the free and open-source 'OBS' (Open Broadcaster Software) recording program was used. Each video was then uploaded to the YouTube channel of the study.

Participants used their personal computers, paired with earphones or headphones when needed, and watched the videos on their 2D computer screens.

6.2.3 Participants and Recruitment

Participants were recruited via purposive and convenience sampling. The inclusion criteria for participating in the online interviews were (1) to be 18 years old or older and (2) to drink alcohol at least once a week. The study was advertised on social media (Facebook, Instagram) accounts of the University of Manchester and in email newsletters to students and staff at the University of Manchester, UK. Individuals who were interested in taking part emailed the first author and were screened to confirm eligibility to participate. Participants were also emailed a link that directed them to the information about the study procedures and consent was taken to record their alcohol use. Informed, verbal consent for audio-recording the interviews was taken by the participants at the start of the interviews.

6.2.4 Procedure

Participants were asked to complete a brief Alcohol Use Questionnaire online detailing their recent alcohol consumption (frequency of drinking, units consumed, please see Appendix B - "Alcohol Consumption Questionnaire" section). After completion, participants were contacted to arrange the interview. Prior to the interview a link to a YouTube video was also sent, where the first author demonstrated how the VR gear worked, through a free, VR game offered by the 'SteamVR' store ("NVIDIA VR Funhouse", n.d.). In the video, it was showcased (1) how the hand-held controllers were used to interact with objects and to navigate within the VE and (2) how the user view and their VR hands virtually corresponded to their physical movements with the hand-held controllers. The online interviews were conducted by the first author. Interviews were audio recorded. The first author explained the study procedures and asked participants if they needed further clarification, ensuring that they had also watched the demonstration video of how VR worked. Participants were also asked if they had used VR before in any context.

The link of each YouTube video was sent to the participants in the Zoom chat. Participants were asked to watch each video in full screen and in high quality (1080p60), to achieve the best immersion possible under this setting. While participants were watching each video, the first author muted themselves and turned their video feed off to minimise distraction. After each video, the first author unmuted themselves and turned their video feed on. Interviews were unstructured, with participants being asked to share their thoughts in a spontaneous manner about the video that they had just watched ("What were you thinking when you watched this video?" - please see Appendix B - "Topic Guide of Assessment" section), irrespective of whether they were relevant to alcohol or to the content of the given VE. The

first author requested clarifications on points that the participants had raised as required. Unstructured interviews allowed exploration of the participants' reactions and thoughts in an open-ended manner. Via unstructured interviews capturing the subjective experience of participants and how they perceived and reacted to this experience was also possible, without the risk of introducing bias through probing (Corbin & Morse, 2003).

The audio recordings produced by the interviews were transcribed verbatim and anonymised. Interview duration ranged from 40–80 minutes. After the interview, compensation was given for taking part in the study and a participant debrief sheet was emailed to the participants with contact details of organisations that could help if they felt any level of distress or if they were concerned about their drinking.

6.2.5 Data Analysis

Template analysis was chosen as the data analysis method as it facilitates detailed, hierarchical coding while analysing the data and, at the same time, allows for adjusting the focus of the under-analysis data to the study's objectives (Brooks et al., 2015). In accordance with the research questions, only data that were relevant to the realism of the VEs and alcohol temptation were coded. In template analysis, the focus can expand on both descriptive and interpretive themes (Brooks et al., 2015). This was necessary in the current study as the degree to which a VE would be realistic or induce temptation might depend on the background of an individual, leading to interpretive codes, as well as descriptive ones.

The template analysis followed the methodology outlined by Brooks et al. 2015. The first author, having conducted the interviews and transcription, was familiar with the content of the transcripts. Initial coding of the data was undertaken, using the 'NVivo' software for qualitative analysis. After coding the first five transcripts, the emerging codes were refined to form a template that clearly showed their interconnections. This template was then used as a guide while coding the next five transcripts. Refinement of the template's codes happened while coding this next cluster of transcripts. This process was used for the remaining clusters of transcripts, such that the template was finalised once all data relevant to the research questions were coded without requiring further additions to the template. The final version of the template was shared with all members of the research team for validation. Quotes belonging to each code of the template were also given as examples, to justify the naming of the codes and themes and facilitate validation across all stages of the analysis.

The feedback of participants about the neutral VE of a city street has not been included in the analysis as it does not link to the alcohol temptation aspect of the research questions. However, elements that could improve neutral scenes in such, alcohol treatment applications, for familiarisation purposes, are discussed.

Table 6.1. Descriptive data of participants

Participant ID	Gender	Age	Alcohol Units/Week	Drinking days/Week
1	Male	42	16	3
2	Male	31	6	1
3	Female	54	16	4
4	Male	22	54	6
5	Male	28	42	5
6	Female	52	20	4
7	Female	26	8	3
8	Female	29	8	3
9	Male	26	24	6
10	Male	21	42	4
11	Female	25	17	3
12	Male	35	9	3
13	Female	28	12	3
14	Male	31	22	2
15	Male	33	42	3
16	Male	29	18	4
17	Male	38	5	2
18	Male	37	4	1
19	Male	65	44	4
20	Female	31	3	1
21	Male	28	15	1
22	Female	24	3	2
23	Male	30	3	1

6.2.6 Ethical Approval

Ethical approval for the study was granted by the University of Manchester Research Ethics Committee (Ref.: 2020-8466-17087).

6.3 Results

6.3.1 Participants

In total, 23 participants were interviewed online. Ten participants (43.5%) were casual drinkers, typically drinking within safe limits (≤14 alcohol units), and thirteen (56.5%) were high-risk drinkers, drinking above safe limits (>14 alcohol units), according to the drinking units limit set by the NHS guidelines (N.H.S., 2018b). Eighteen participants (78.3%) drank alcohol more than once per week typically, with the average alcohol units drunk per week to be 18.76. On average, participants consumed alcohol 3 days a week. Fifteen participants (65%) drank 3 or more times per week. Fourteen participants (60.9%) had used VR before. Fifteen participants were male (65%) and eight were female (35%). Descriptive data of participants are presented in Table 6.1. Data saturation was achieved in the last three interviews (Guest et al., 2006).

Table 6.2. Template of the analysis

1.	**Effect of proximal cues**
1.1	Perceived alcohol presence
1.2	Perceived alcohol realism
2.	**Effect of contextual cues**
2.1	Relevance of layout and furnishing to individual experiences
2.2	Association of virtual agents with human behaviour and social drinking
2.3	Immersiveness of background sounds
2.4	Interconnection of lighting with time of day and ambiance
2.5	Association of smoking-related objects with drinking
3	**Effect of the sense of presence**
3.1	Projection of personal narrative
3.2	Association of self with VR hands

6.3.2 Themes

Three main themes emerged from the template analysis of the interviews. The themes mapped to (1) the effect of contextual cues (stimuli typically associated with alcohol), (2) the effect of proximal cues (alcohol stimuli) and (3) the effect of the sense of presence in the VE on the realism perceived by participants and their temptation to drink. An overview of the themes and subthemes is presented in Table 6.2.

Effect of proximal cues

Perceived alcohol presence The extent to which alcohol was present in the VE seemed to affect the degree to which participants were tempted to drink alcohol and the realism of the situation represented. Animated alcohol cues, entailing motion, like a beer being poured into a glass, the effect of beer foam and bubbles forming on the beer's surface or the glass frosting due to the coolness of the served beer, were considered by participants to be the most tempting. "…what looks attractive to me is when I see…the glass getting cold and getting frosted." (P3; female/54 years old/drinking past safe limits). In the home VE participants suggested that having glasses in front of them containing alcohol instead of empty glasses on the table would trigger their desire to drink more. "… the glasses were not indicating that there was like alcohol drunk, it's just two empty glasses that could be just like full of water." (P20; female/31 years old/drinking within safe limits), "…it's like more tempting when you're actually seeing something served." (P23; male/30 years old/drinking within safe limits). In the pub VE, the pint of beer on the bar was considered tempting, but some participants noted that if it was served at that moment it would look fresher, with more foam, and, in turn, even more attractive. "…the beer looked like it was standing there for a while…it didn't look fresh…if the beer…was like served to me I would have even more desire to drink it." (P10; male/21 years old/drinking past safe limits). The action of grabbing the

pint of beer with the VR hand and drinking it was considered by participants to increase their alcohol temptation in a more dynamic way. "…the action of grabbing the pint…it's completely different. It's more inviting to actually do it." (P23; male/30 years old/drinking within safe limits).

In the home VE, participants found an alcohol advertisement on the television more tempting than the static advertisement of a supermarket leaflet with drinks offers. "…it also has motion to it, like you can see it pouring in the pint. So, to me that's more appealing rather than looking at the poster…" (P17; male/38 years old/drinking within safe limits). At the same time, a few participants noted that an alcohol advertisement on television would not be a common scenario and, thus, less realistic. "…it's been a long time to see an alcohol related advertisement on TV." (P14; male/31 years old/drinking past safe limits). Participants said they would be tempted to drink even more if the VE involved watching somebody else drinking on the television, be it in the context of an advertisement or a film, reality show or a series, as they would empathize with them. "…if like there was an advertisement of someone else drinking a beer. I think that would spark me more than just a beer" (P10; male/21 years old/drinking past safe limits), "I think it's both seeing the beer being poured, but also seeing other people drinking it…I'd empathize with the person drinking." (P3; female/54 years old/drinking past safe limits).

In terms of less interactive advertising and non-animated alcohol cues, some participants were not tempted at all by the supermarket leaflet with drinks offers, mentioning that they would usually throw away such advertising leaflets, as they were exposed to them regularly and largely desensitised. "…we're just surrounded by tons of leaflets about different products. I mean you do not pay attention." (P1; male/42 years old/drinking past safe limits). Several participants added that they associated offers with alcohol of lower quality and binge drinking, decreasing their alcohol temptation. "I don't like offers on drinks…it reminds me of…like binge drinking…drinking for the sake of drinking as opposed to really enjoying it." (P18; male/37 years old/drinking within safe limits). In contrast, some participants explained that they were tempted by the leaflet due to it including offers that they could exploit as they would typically do. "…what I would be tempted to do is instantly like grab my phone and check if the discounts are there. And possibly order some." (P4; male/22 years old/drinking past safe limits). Similarly, in the supermarket VE, most participants referred to the offer presented in the alcohol aisle and to the offers that usually supermarkets would have as a temptation factor, especially if a more expensive alcoholic spirit of their preference would be reduced in price, "…they obviously have an offer of buy two and get three, I think it was. So that probably makes you have a second look at our whatever's on the shelves." (P21; male/28 years old/drinking past safe limits), "If I saw something at a really good price…that would tempt me." (P19; male/65 years old/drinking past safe limits).

Another element that affected participants' temptation to drink was the variety of the alcohol offered in the supermarket and pub VEs. In the supermarket VE, participants mentioned that different options for alcoholic beverages were available, enough for them to start

thinking about trying something new and drinking. "…there was quite a huge selection of alcoholic beverages, so that really caught my eye…" (P7; female/26 years old/drinking within safe limits). A few participants added that a greater variety would increase temptation. "…because I like variety, I wouldn't have all these bottles exactly the same…to have an experience…all of these different drinks you can try." (P13; female/28 years old/drinking within safe limits). In the pub VE, participants found the existence of beer pumps relevant and tempting, again triggering their curiosity. "It's got a selection of lagers which I tend not to drink, but also a selection of cask ales which I do drink." (P19; male/65 years old/drinking past safe limits), "And then I saw the handpumps…I was surprised how much I thought, aw, this looks delicious." (P3; female/54 years old/drinking past safe limits).

Perceived alcohol realism The extent to which the appearance of the alcohol presented matched participants' expectations affected the perceived realism of the VEs and participants' temptation to drink. In the supermarket VE, most participants found the bottles of alcohol in the aisle realistic, with most reminding them of popular alcohol brands. "I notice a few bottles that look similar to the spirits that I drink." (P15; male/33 years old/drinking past safe limits). The fact that the brand names were not identical to the real brand names due to copyright did not bother some of the participants as they explained that they could make the connection with the brand regardless, just by the shape of the bottle. "…at this point it is very intuitive the way that you can distinguish which content is what, because you've been buying those bottles for a long time." (P12; male/35 years old/drinking within safe limits), "…my first thought was that, aw, this is obviously this brand of alcohol, but they're not putting the name, of course, for copyright reasons." (P7; female/26 years old/drinking within safe limits). The resemblance of the alcohol bottles to known brands was thought by participants to increase their alcohol temptation. "I could see some brands, well, different names that refer to famous brands of alcohol…it made it more appealing to drink." (P8; female/29 years old/drinking within safe limits).

In contrast, some participants mentioned that not seeing the exact brand names decreased their alcohol temptation as they would not trust a brand they had never tried before. "I think it will help to kind of know which bottle belongs to which brand, or what type of alcohol…I would like to know and not get something randomly…is a better idea to know what you get." (P5; male/28 years old/drinking past safe limits). However, participants added that for wine, knowing the type is more important than the brand name. "I don't really have a clue about the brand names, but, obviously, the type of wine, Chardonnay, Pinot noir, whatever, seeing those…I tend to look for that first, actually." (P19; male/65 years old/drinking past safe limits). For several participants, involving more colours would denote a greater variety of drinks and a more realistic representation of a supermarket drinks section, triggering their temptation to try an alcoholic beverage more, "…it wasn't really tempting to go get a bottle because they didn't have, like, different colours…like they would have in real life." (P22; female/24 years old/drinking within safe limits).

In the pub VE, some participants similarly added that with draft beer, the brand is not im-

portant as every pub would normally have their own selection. “I will go for the, for the local brewery trying their own brands which I never know.” (P21; male/28 years old/drinking past safe limits). Finally, several participants commented on the appearance of the pint of beer grabbed by the VR hands during the action of drinking it. They noticed that the beer level was not decreasing after each sip or being fizzier, making the beer look unrealistic. “…the level of the beer remained the same and it wasn’t fizzy. And I was like, oh, it’s a plastic beer.” (P14; male/31 years old/drinking past safe limits).

Effect of contextual cues

Relevance of layout and furnishing to individual experiences The extent to which the VEs’ layout and furnishings matched the experiences of participants about those places in real life influenced the realism of the VE and the temptation to drink. For the home VE, participants described it as a standard living room of an apartment. “…it resembles any living room. I would say like a standard one.” (P23; male/30 years old/drinking within safe limits). Some participants found it realistic, having assumed that it was a room of a minimalistic style or a living room in a shared house, or even a hotel. “I know that minimalistic is like quite a trend at the minute or this could just be like you know the living room and you know some people that are just living together.” (P20; female/31 years old/drinking within safe limits). However, most participants felt that it was too empty and too tidy, and, subsequently, less cosy. “It felt quite stark and it was a little bit…sterile. You know, plush furnishings or anything I wish to cuddle up into and snuggle up or anything like that and just back out and have a nice glass of wine.” (P6; female/52 years old/drinking past safe limits). Due to this, participants felt that, although it was graphically realistic, it did not seem like an environment that they would typically inhabit, be it their home or other people’s house. “I wouldn’t be in such a living room, it was quite cold for me.” (P16; male/29 years old/drinking past safe limits), “I think it is realistic, but probably not so in relation to the sort of places or houses where I go.” (P19; male/65 years old/drinking past safe limits). A few participants also mentioned that the living room was too spacious, introducing, again, a less cosy sensation. “…I felt like the room was very big and empty and it had like an unwelcoming feeling for me.” (P8; female/29 years old/drinking within safe limits). The lack of a cosy feeling was seen to affect participants’ desire to drink in that place. “I realized that I didn’t want to drink because the whole environment wasn’t like cosy.” (P21; male/28 years old/drinking past safe limits).

Participants believed that the supermarket VE layout was consistent with a British supermarket. “…this is like a typical British supermarket.” (P9; male/26 years old/drinking past safe limits). Some participants found the layout representative of real-life supermarkets where beers’, spirits’ and soft drinks’ sections would be present and put together, and closer to the tills, too. “So all those sections were quite relevant to me and I would say pretty familiar in terms of the layout.” (P19; male/65 years old/drinking past safe limits), “I thought this was pretty realistic because, like, it was all the alcohol near the counters.” (P13; female/28 years old/drinking within safe limits). In the shelves, some stock missing was also

commented positively by several participants, as it resembled what would typically happen. "I could realise that there were some missing bottles on the shelves, so it's realistic if you think about it." (P23; male/30 years old/drinking within safe limits).

Some participants felt that the aisles were too wide whereas, in reality, supermarket aisles would be narrower. "I think I would probably make the corridor bit narrower…because you know in the supermarket you feel a bit more trapped inside." (P13; female/28 years old/drinking within safe limits). Refinement of the floor texture was suggested by a few participants. "In my mind it would be a bit more realistic if it was just one floor [rather than tiles]." (P17; male/38 years old/drinking within safe limits). Adding labels with prices was a further suggestion. "I didn't see prices or like the description of like, even if it's like a tiny label or something." (P2; male/31 years old/drinking within safe limits). Although several participants mentioned that they were tempted to buy alcohol in there, others suggested that a snack section close to the alcohol one or an advertisement for food to match with specific alcoholic beverages would increase their temptation to drink. "…if it was me there, I would buy a bottle or something, like it." (P13; female/28 years old/drinking within safe limits), "…another thing that I may have added is like, when you go to supermarket, they used to have some small, like chips, close by...usually when you buy alcohol, you will buy some chips or some snacks." (P11; female/25 years old/drinking past safe limits).

Participants felt that the pub VE resembled a typical British pub, with the colour scheme, wallpapers and layout representative of pubs in real life. "…it's an actual, very good simulation of an English pub" (P5; male/28 years old/drinking past safe limits). Some participants added that they imagined smelling the beer or wine scents as they would normally do in a pub. "I could imagine it looked like it might smell of old wine and beer in there as well." (P6; female/52 years old/drinking past safe limits). However, few participants mentioned that they would prefer a carpet instead of tiles. "…all the pubs from my experience or most of the pubs have some sort of carpet…it was more of a traditional pub, so I would like it to have a carpet." (P17; male/38 years old/drinking within safe limits). The furnishings and their wooden textures, and the blackboards with drinks and their prices were also seen as representative and realistic. "I like the place…the wooden columns, the chairs...it's all like cosy…The couple of barrels that were behind that door…the boards on top of the bar. The chairs are also sort of styling." (P21; male/28 years old/drinking past safe limits). The existence of glasses and bottles on the tables where virtual characters were sitting was commented on in a positive way. "I think it was very realistic, like the pub environment, like there were tables. There were glasses on the tables." (P10; male/21 years old/drinking past safe limits).

Association of virtual characters with human behaviour and social drinking The presence of virtual characters influenced the realism of the supermarket and the pub VEs, and the participants' temptation to drink. Some participants mentioned that seeing virtual characters in the VEs helped them feel more immersed. "…there were other like avatars [virtual characters] in the, in the room, which for me, like, added to the immersiveness." (P4; male/22

years old/drinking past safe limits). However, participants suggested that more virtual characters in either VE would increase their realism, as they would look busier as supermarkets and pubs would normally be. “If there were people there who were sort of chatting…like more organic, more representative atmosphere of what a pub looks like or feels like, then probably would have tempted me quite a lot to just like call a friend and then go to a pub, which even at this point I probably would have done.” (P18; male/37 years old/drinking within safe limits).

Since participants humanised the virtual characters involved in the VEs, they also expected them to appear and behave correspondingly. In the supermarket VE, several participants paid attention to whether the two cashier virtual characters and the two customer virtual characters checking out the shelves were actually moving. Although the cashier virtual characters were static, this did not seem to influence the realism felt, “…it had people…the cashier people…I wouldn’t change anything or add anything. It resembles reality to me.” (P23; male/30 years old/drinking within safe limits). In contrast, in the pub VE, most participants believed that the bartender virtual character was too static, decreasing realism and creating the impression that they were bored or not very friendly. “Maybe the avatar [virtual character] of the woman in the bar, she seemed a bit static…but that made her like less realistic.” (P8; female/29 years old/drinking within safe limits). Instead, they suggested that the bartender virtual character be moving, as attending to clients and serving drinks would be the expected behaviour for this job role. “I understand that maybe she had a long day, but she looked bored. And she wasn’t really willing to do anything or come over and ask us, are we OK for drinks? She wasn’t pouring pints.” (P17; male/38 years old/drinking within safe limits).

For the customer virtual character in the pub VE (Figure 5.12), some participants mentioned that improving his facial expressions, such as adding the action of smiling, would make him more realistic and engaging and less unfriendly. “…he was stiff and his face didn’t move.” (P9; male/26 years old/drinking past safe limits). Similarly, few participants added that the blinking and lip movements were not clear enough. “…this guy is just staring at me…not even blinking” (P18; male/37 years old/drinking within safe limits), “Maybe if he made any gestures like…his lips could move like clearly. I don’t know if he did that, but I couldn’t see clearly.” (P22; female/24 years old/drinking within safe limits). Several participants further suggested that the way the customer virtual character held the pint of beer from the handle of the glass was not realistic enough. “…the way he was holding the pint was kind of odd, right? …you don’t hold the pint from the handle.” (P18; male/37 years old/drinking within safe limits). Whilst some participants found that the ability to talk back to the virtual characters would complement realism, others believed that simple gestures on their behalf could bridge this gap. “I would like to speak back…you can express yourself…it will make it more like a complete realistic experience.” (P5; male/28 years old/drinking past safe limits), “I think for me it wouldn’t have mattered so much that I couldn’t say anything back…it could be a little bit of body language to make up for a lot, I think, without saying anything.” (P6; female/52 years old/drinking past safe limits).

Perceiving virtual characters as human led to participants associating them with feelings related to social interaction, even though they could not talk to them. More specifically, participants suggested that the presence of virtual characters in the VEs made them feel less alone while putting them in the mood to buy or drink more alcohol. "…more busy means more, let's say, energy, so it puts me in a better mood to have a good time later, which translates into buying more booze." (P17; male/38 years old/drinking within safe limits), "…in my mind…it's more about the social context than more about drinking because, well, to be fair, the one that makes us drink was the first one [social context]." (P1; male/42 years old/drinking past safe limits). Interacting with the customer virtual character in the pub VE was thought by participants to further increase their alcohol temptation while affecting their emotions positively. "I like the interaction, …and I wouldn't find it tempting to drink on my own or without interacting with someone, so this interaction also makes me want to drink more, like to celebrate." (P5; male/28 years old/drinking past safe limits). The virtual character offering to buy a pint to celebrate their new job was another element that participants endorsed, adding that it prompted them to feel happy and willing to share the virtual character's joy. "I felt that it has, had this feeling when you're going out with a friend and they buy you a pint, especially if something good has happened, like finding a job, it brings like feelings of joy, feelings of sharing with the other person." (P8; female/29 years old/drinking within safe limits).

Immersiveness of background sounds Participants considered background sounds as an important factor of realism in the VEs. They believed that sounds added to the immersiveness of the VEs, facilitating the sense of presence - that they were actually there. "…this is how I perceive the situation because you have the audio cues, yeah OK, I'm in this place now.'' (P9; male/26 years old/drinking past safe limits). The need to integrate sounds for every movement or action that would usually produce a sound in reality was also identified. "…the immersion would be total if you even listen to the sounds of what you're doing." (P23; male/30 years old/drinking within safe limits). A specific example was the sound of footsteps while the avatar of the participants was walking. "I didn't hear any footsteps." (P4; male/22 years old/drinking past safe limits). Similarly, participants commented on the existence of background sounds that would typically be present in corresponding VEs in a positive way, such as people moving in the supermarket aisles, the beep sound in the supermarket check-out or people's chat in the pub. "…you could hear the check-out beeping…I could hear people walking around…that was good." (P15; male/33 years old/drinking past safe limits), "I like the thing that you had always noise, you know, from people that were speaking inside the pub because it's really realistic." (P11; female/25 years old/drinking past safe limits).

However, in the supermarket VE participants believed that more announcements, music and the noise of more people shopping would increase its realism. "Supermarket music, keep things going on, more announcements, more frequently. Bit more of a noisier environment I think generally." (P6; female/52 years old/drinking past safe limits). In the pub VE, some participants suggested that adding more virtual characters would make the back-

ground noise of people chatting more believable as it would be synchronised with the visual representation of it. “I guess a few more people that would be, that would be in sync with the background noise.” (P17; male/38 years old/drinking within safe limits). Moreover, adding music in the pub VE was thought by several participants necessary, whereas for others a typical pub wouldn’t involve any. “I didn’t hear any music because also when you go to a pub it’s little bit rare…I would prefer, you know, the talks rather than music in a pub.” (P11; female/25 years old/drinking past safe limits).

Specific sounds were seen to influence the craving for alcohol by immersing participants further into the situation presented in the VEs. For example, participants perceived the sound of glasses clinking in the pub VEs as well as the noise of people chatting as tempting. “…if you, you know, listen to glasses clinking. You say OK, this is a drinking place, I should drink now…”, “Only with the sound of drinking and talking. You’re like OK. I want a pint.” (P9; male/26 years old/drinking past safe limits)”. In any of the VEs, adding the sound of the beer being poured was perceived as a trigger for inducing alcohol craving. Adding music was also considered by some participants to increase alcohol temptation due to the social association with it in the pub VE, “I am definitely more tempted in a social environment with music.” (P23; male/30 years old/drinking within safe limits), or due to the personalisation it offers in the home VE, “It would make me want to go get a drink even more ’cause I would feel like it’s home. It’s homey, it’s cosy, it’s my music.” (P22; female/24 years old/drinking within safe limits). In contrast, one participant noted that if a song played that they didn’t like it would decrease their temptation to drink. “…if there was like a really bad song or if there was no if there was no music at all then I would be less inspired to drink.” (P10; male/21 years old/drinking past safe limits).

Interconnection of lighting with time of day and ambiance Lighting was another aspect that had an impact on the realism of the VEs, as it created the ambiance of the situation. Participants believed that dimmer lighting would increase cosiness in the home VE, as it would be in line with common, lighting preferences of people relaxing in their living rooms. “…it would seem more realistic…the lights were a bit like a hospital.” (P22; female/24 years old/drinking within safe limits). However, in the supermarket VE, bright lighting was considered appropriate. “…it felt quite realistic, …that you have the intense light. So you can see each product.” (P5; male/28 years old/drinking past safe limits). In the pub VE, dimmer lighting was again preferred as it recreated the relaxed atmosphere of pubs and bars, “…it wouldn’t be that bright because usually you know pubs and bars have low lights.” (P13; female/28 years old/drinking within safe limits).

Dimmer lighting was also associated with increased alcohol temptation in the home and pub VEs. Lower lighting would translate into cosiness and, in turn, into a relaxing atmosphere where alcohol would be consumed. ‘’I would create my own cosy environment for a night…lights very dim...a plan to marry up with that beer.’’ (P21; male/28 years old/drinking past safe limits). Linking lower lighting to night-time and, subsequently, to relaxation and entertainment at the end of the day, when most people drink alcohol, was another way

that lighting impacted alcohol temptation. “I think it felt like this was probably like early in the day and I’m not someone who likes to go to the pub early in the day.” (P20; female/31 years old/drinking within safe limits). In contrast, one participant linked bright lighting in the home VE to a sunny day which triggered his temptation to drink. “…it felt more like bright and colourful. And maybe I would translate it into more sunny. So I kind of make this association to drinking alcohol.” (P5; male/28 years old/drinking past safe limits).

Association of smoking-related objects with drinking Smoking-related paraphernalia seemed to influence not only the temptation to smoke but also to drink. In the supermarket VE, current or ex-smokers noticed the tobacco sales signage: “It makes it, you know, tempting to also buy cigarettes or the other way around. If you buy cigarettes you want to buy something, you know, a pint to drink.” (P11; female/25 years old/drinking past safe limits). Similarly, including a pack of cigarettes in the pub VE and a lighter on the bar counter was seen by participants as important in recreating the pub experience, due to smoking being strongly tied to drinking alcohol. “…the pack of cigarettes too, it added to, I don’t know, the pub feeling.” (P4; male/22 years old/drinking past safe limits). Smoking was also largely connected to the desire to drink alcohol in the pub VE for participants who smoked either on a regular basis or socially, or for participants who have quit smoking. “…if you are a smoker, I mean the thing you connect most with alcohol is smoking...as soon as you drink a beer and you want a cigarette, and then you smoke and then you have a sore throat. And then you want more beer. And it’s a positive feedback loop.” (P9; male/26 years old/drinking past safe limits). However, participants who did not smoke reported no interest in the sight of cigarettes in relation to their temptation to drink. “I don’t smoke so cigarettes wouldn’t work for me.” (P6; female/52 years old/drinking past safe limits).

Effect of the sense of presence

Projection of personal narrative Participants projected their personal narrative to the VEs, creating a sense of inner presence. More specifically, the personal narrative of the participants influenced their interpretation of the VEs and, in turn, their thoughts about drinking alcohol. They projected their own drinking habits on to the situation, building an internal context as to why they were navigating the alcohol aisle in the supermarket VE, and leading them to feel more present in the experience. Some participants associated the visit to the supermarket VE with social events and entertainment like pre-drinking at a friends’ house or parties. “It makes me feel like I’m either visiting a friend, so I’m getting some drinks, or whether it’s pre-drinks or whether we’re spending the night at someone’s place.” (P17; male/38 years old/drinking within safe limits). Others focused more on the act of buying alcohol because they were specifically drawn to one of the available options, but intending to consume it later, at a relevant point. “It was more about tasting like…there was a selection of different things…I was like, OK, what tastes the best or like? What am I in the mood for the most?” (P10; male/21 years old/drinking past safe limits).

Participants were also more tempted to drink in the VE that matched the usual location they

would drink, be it their home or the pub. "…it's like being at home...you know I don't go out and drink anymore. My drinking I do at home." (P15; male/33 years old/drinking past safe limits), "…when I'm alone in the house, it's sad to drink alone. I wouldn't open a beer, but when you're in this social situation, …this is a place to drink [Pub VE]." (P9; male/26 years old/drinking past safe limits). Likewise, when their preferred alcoholic beverage was involved, they were more tempted to drink, particularly in the home and supermarket VEs. "…it's more tempting exactly when you do have the alcohol that you like the most in the in the shelf." (P1; male/42 years old/drinking past safe limits). However, in the pub VE this was not the case, as most participants explained that beer was the most appropriate drink in that setting, even if, for some, it would not ultimately have been their preferred alcoholic beverage. "…so it's really a more social environment, like beer matches that context for me." (P21; male/28 years old/drinking past safe limits). The decision to accept the pint offered by the customer virtual character in the pub VE arose for most participants from a feeling of obligation to abide by the cultural norms of accepting a drink when it is offered, out of politeness. "…it is because of my cultural framework…but whenever someone offers me a drink. I should take it." (P1; male/42 years old/drinking past safe limits).

The time of the day was perceived as an additional factor that affected participants' immersion and their subsequent temptation to drink. This was influenced by when they would usually visit corresponding places in real life. "…one week you might feel that you want to drink and then the week after that you are not. I'm replying as I feel today, right now, right?" (P21; male/28 years old/drinking past safe limits), "…when I think of pubs I think of like going on a Friday afternoon after work with your colleagues. And just like having one or two drinks." (P20; female/31 years old/drinking within safe limits). The COVID-19 pandemic and the associated social restrictions were further determinants of whether the VEs were engaging and tempting. In particular, participants experienced feelings of happiness and nostalgia, and, in turn, the temptation to drink since they had not visited a pub for a long time. "It reminded me of fun times that you can go wild and everything, and I was feeling a bit happy as well." (P14; male/31 years old/drinking past safe limits), "…it reminded me the good old times…You know, just go to a pub and drink a couple of pints and you know just have some fun with your friends." (P11; female/25 years old/drinking past safe limits).

Association of self with VR hands The VR hands that were used to visually represent the movement of controllers, through which navigation and interaction with objects is technically possible in VR, affected the overall realism and spatial presence felt by participants. The "gloves" texture (Figure 5.12) was employed across all three, alcohol cued VEs, as it was the default option for the 'HTC VIVE Pro' VR set-up. While none of the participants found the hands realistic, some were not worried about their appearance, suggesting that they only paid attention to them at first and then focused solely on the experience. "…it was very neutral for me. I mean only at the beginning of the video I would notice the hands, but then I would focus on the environment and I would stop seeing them at all..." (P7; female/26 years old/drinking within safe limits), "I don't think the gloves would necessarily destroy

anything, I just think it looks better without the gloves." (P19; male/65 years old/drinking past safe limits). In contrast, some participants believed that personalisation of the VR hands was necessary, to look like human hands, or, optimally, to match the skin colour and gender of the user. "I think it would just be a thing that would make it easier for me to find it immersive. If they were roughly looking my hands." (P3; female/54 years old/drinking past safe limits). This was considered to fit better with the photorealistic style of the VEs. "I would have preferred human hands…You can wear gloves in games, but it looks a bit, a bit robotic, a bit futuristic." (P15; male/33 years old/drinking past safe limits).

In addition, a few participants noted that, in some instances, they felt disembodied. This was attributed to the fact that the hands were wearing gloves, they did not expand visually to form forearms and they would occasionally disappear. "It was the fact that the virtual reality gloves, they kind of disappeared for a bit and also like they didn't have forearms." (P2; male/31 years old/drinking within safe limits). However, they also acknowledged that if they were trying VR in reality and were in control of the hands, this might have decreased the sense of disembodiment perceived through the videos. "I think this may have been completely different if I was actually in control of those hands, that may have made it very different." (P18; male/37 years old/drinking within safe limits). Several participants further explained that grabbing the objects with the VR hands was not realistic enough, as the fingers of the hand did not precisely touch the object grabbed. "…the hands weren't touching the lighter." (P22; female/24 years old/drinking within safe limits). Other participants found the ability to grab objects realistic regardless, as they felt the urge to interact with objects as they would do in real life. "…you can feel like you get to hold kind of something. So it felt more like real. I like it." (P5; male/28 years old/drinking past safe limits), "Also I could pick up stuff…My brain wanted to be able to pick up stuff." (P4; male/22 years old/drinking past safe limits).

6.3.3 Neutral VE and familiarisation

All participants thought that the neutral VE would be useful for familiarising with navigation and interaction with objects within the virtual world, and for setting up certain parameters, such as the VR headset, or software aspects, such as sound volume, "I think it would be useful to...adjust everything. And also familiarize with like walking around, probably using the hands." (P14; male/31 years old/drinking past safe limits), "If this were a testing environment, that would have the option to maybe turn the volume down or up." (P7; female/26 years old/drinking within safe limits). While most participants found the city street VE appropriate for familiarisation purposes, offering the opportunity to practise basic VR interactions like walking and grabbing objects, "...because it prompts you to, to touch something, to throw this kind of thing. That's very helpful. I wouldn't add something else..." (P14; male/31 years old/drinking past safe limits), some of them suggested that they would also prefer more interactions, "...you had that you know picking up the can and then drop it in the bin...Maybe opening doors stuff like that. You know a few more...I don't know

what to call it, intermediate interactions, you know. I mean like a bit more advanced interactions." (P15; male/33 years old/drinking past safe limits).

More specifically, several participants recommended that interactions that mimic natural, real-life behaviour would be more engaging and would intuitively prompt people to interact with the VE, supporting the learning process in a more organic way than reading instructions, "...you need something that made you do an emotional reaction to something or make you go do something." (P6; female/52 years old/drinking past safe limits), "Quick reaction of everyday life or everything would do. Like if there is a pedestrian and you have to change the way you walk, your pace." (P21; male/28 years old/drinking past safe limits), "...maybe cars to start appearing after I do that when I cross the road...if there's a red light I would. I would just wait." (P4; male/22 years old/drinking past safe limits). Delivering the instructions via signposting was, thus, considered by most participants to fit the purpose of realistically integrating guidance into the virtual world while allowing free exploration of the VE which was preferred by most participants over being given strict and traditional instructions on what to do next, "I would rather be free to explore, like just walk around, like find signs that give me a task but not to have like an original instruction." (P23; male/30 years old/drinking within safe limits). In contrast, a few participants suggested that they would prefer to have a narrative to guide them, "Commentary narration...saying...go ahead, down to this, do that. Is not always the instructions that might be what you're going to do now, is some thing just to take you down the road." (P19; male/65 years old/drinking past safe limits), or somebody to explain them beforehand how to use the VR gear and what they can do within the VE, be it a video tutorial or a person, "I would prefer to be maybe told at the beginning...so these are the things that you can do and these are the things that I want you to do. And this is how you do it, right? So like a two minute tutorial." (P18; male/37 years old/drinking within safe limits).

6.4 Discussion

This study assessed three, alcohol cued VEs that represented daily, high-risk settings - a home, a supermarket and a pub - where individuals in recovery might struggle to remain abstinent. The objective was to determine their potential to be realistic and tempting in a less immersive, cost-effective VR set-up, and, subsequently, their relevance for use in online or in-person treatment delivery contexts for RP. Participants were casual (n=10) or high-risk (n=13) drinkers. Key factors of realism and alcohol temptation, as outlined via the template analysis, were the proximal and contextual cues, and the sense of presence within the VEs. Almost all high-risk drinkers experienced temptation to drink alcohol in any VE, while casual drinkers were mostly tempted in the socially interactive pub VE. Animated alcohol cues were considered more tempting than static ones. The action of drinking in the first-person perspective facilitated a strong alcohol temptation. Smoking temptation was elicited via related cues and affected alcohol temptation. Realism and alcohol temptation were further increased by sounds and interactivity, while personalisation in the home

VE was thought to facilitate them. Participants' personal narrative and the user's reaction to the VR hands were determinants of presence.

The cost-effective, low immersion VR set-up of the study involved exposure to the VEs via videos presented on a 2D computer screen, which displayed the navigation within the VEs in a first-person perspective. Similar, less immersive VR set-ups, like stereoscopic monitors or one-screen projection displays, were able to elicit the desired response, be it anxiety, fear or craving, in VRT studies focusing on social anxiety, phobias and substance use disorders treatment, respectively (Ghita & Gutierrez-Maldonado, 2018; Ling et al., 2014). Where comparisons were made to more immersive VR set-ups, like a HMD, lower levels of presence were reported, but in clinical samples the elicited response did not differ significantly (Ghita & Gutierrez-Maldonado, 2018; Ling et al., 2014), indicating the therapeutic potential of such VR set ups. In line with previous research utilising less immersive set-ups (Ghita & Gutierrez-Maldonado, 2018), alcohol temptation and realism were reported by participants. Interestingly, realism was manifested dually; as visual-auditory or physical, in terms of the graphical and auditory fidelity of the VEs to the corresponding, real-life ones, and as psychological, involving the relevance of the VEs to participants as situations that they could experience in reality. This distinction of realism has been discussed in reviews about the clinical effectiveness of VRT, suggesting that psychological realism could be the more critical for patient engagement (Hoorn et al., 2003; Slater et al., 2020).

Due to the current, low immersion VR set-up, assessment of physical realism was limited to the quality of the proximal and contextual cues rather than the immersion and the sense of spatial presence offered. In contrast, psychological realism was widely assessed, with participants reporting a sense of inner presence in the VEs. Exposure to the current VEs via a HMD could have increased the sense of spatial presence and enhance the level of inner presence felt within the VEs, eliciting a stronger physiological and emotional response, while also increasing alcohol temptation. This, however, would be subject to the degree of the visual-auditory realism achieved via the HMD, since previous literature suggested that only high fidelity, audio-visual cues would evoke virtually responses identical to the ones experienced via exposure to corresponding environments in real life (Loomis, 2016).

Previous VRT studies in alcohol misuse have reported that healthy participants were more tempted by social pressure contexts than alcohol stimuli per se, and the opposite was found for alcohol dependent participants (Ghita & Gutierrez-Maldonado, 2018). While quantitative comparisons in the alcohol temptation elicited by distinct cues were not made in this study, casual drinkers similarly found the socially interactive scenario of the pub more tempting than the other, non-socially interactive VEs whilst high-risk drinkers were tempted in all three VEs. Proximal cues in all VEs and social pressure in the pub VE were viewed as the most tempting elements. Animated proximal cues (video of beer being poured, fizzy beer, alcohol being served) were perceived as more tempting than static representations of alcohol (alcohol bottles, leaflet with drinks). The action of drinking was considered highly tempting by participants. Some participants suggested that if the feature of somebody drinking alcohol on TV, or in other entertainment media, was added in the home VE, it could

create the urge to imitate this action, due to empathising. Similarly, the action of drinking a pint of beer in the first-person perspective in the pub VE triggered strong alcohol temptation. A previous VRT study with smokers has also reported that exposure to a virtual pub with enactment of virtual smoking evoked higher craving than without (Hone-Blanchet et al., 2014). In the current study, temptation to smoke was also elicited by relevant cues in social, regular or former smokers, agreeing with previous literature (Hone-Blanchet et al., 2014; Trahan et al., 2019), and was associated with alcohol temptation, suggesting the potential of the "A-PLAN" VEs for regulating alcohol and smoking craving in individuals with co-dependency.

In the supermarket and pub VEs, participants instinctively humanised virtual characters. This affected the realism felt, as they compared the virtual character interactions with those expected of humans. Not having the ability to talk back emerged as a drawback but some participants suggested that body language and non-verbal cues, such as the virtual character having facial expressions or smiling, could have counterbalanced this. Similar research has shown that non-verbal cues had a greater effect on the social presence experienced by participants than a realistic virtual character appearance (Roth, 2016). Having photorealistic virtual characters also increases the chances of the 'uncanny valley' effect, according to which virtual characters that would nearly resemble humans would be perceived as uncanny - causing a feeling of eeriness (Pan & Hamilton, 2018). Interaction with virtual characters was also linked to social drinking and emotions triggered by social interactions, increasing participants' alcohol temptation. Previous studies of diverse contexts have shown that participants behaved and responded emotionally to human avatar and human virtual character interaction similarly to corresponding human interaction (Borst & Gelder, 2015). This suggests the potential of VR applications for use in RP contexts where emotional regulation and avatar or virtual character interaction would be relevant (e.g., an argument scene or a family fight).

Another factor in realism and alcohol temptation was sound. Background sounds relating to the visual content of the VEs were considered to improve physical realism and increase immersion. Previous research about immersion and sound has also indicated that, assuming a VR application featured a sophisticated sound design, sounds would be perceived in the VE in the same way as in real life, facilitating spatial awareness (Loomis, 2016; Poeschl et al., 2013). Similarly, sounds have been shown to enhance physical realism in VEs, by replicating to a greater degree corresponding, real-life situations (McRoberts, 2018; Poeschl et al., 2013). Alcohol-related, auditory cues (glasses clinging, beer pouring) also increased the alcohol temptation of participants here, agreeing with the findings of previous studies with alcohol-dependent participants (Heinze et al., 2007; Qureshi et al., 2018). Some participants associated listening to their preferred music genre or songs with increased alcohol craving and vice versa. Likewise, an increase in the craving of alcohol dependent participants was reported when listening to their chosen song in a previous study (Short & Dingle, 2016), highlighting the importance of relevance for engagement with cues.

Relevance of drinks offers affected participants' responsiveness in the home and supermar-

ket VEs. Some participants were tempted by them, having internalised them as positive by relevant life experiences, while others perceived them as negative, having associated them with binge drinking and alcohol of low quality. However, a few of the participants who viewed offers negatively, reported that they would be tempted by these offers if their favourite drink was involved. Marketing strategies such as multi-buy offers and lowered prices on drinks have been linked to increased alcohol purchasing and consumption in both adults and adolescents (Hurtz et al., 2007; Wagenaar et al., 2009). While previous VRT studies in substance misuse have not considered the effect of alcohol promotions (Ghita & Gutierrez-Maldonado, 2018; Hone-Blanchet et al., 2014), in this study, branding was also investigated. Participants identified alcohol brands by the bottle shape, even with altered names. For some participants, recognising the brand promoted a feeling of trust in the alcohol quality, increasing alcohol temptation. For others, seeing the actual brand name was thought necessary to facilitate authenticity and trigger alcohol craving. However, as depiction of brands would not be possible due to copyright issues, imitating the bottle shape appeared to be a valid alternative for referencing the real-life brand in therapeutic VEs. This would be important for addressing craving induced in vending contexts, as promotion of alcohol brands is becoming digitalised and mediated by the daily use of social media (Carah & Brodmerkel, 2021; Lobstein et al., 2017). Such alcohol promotions have been linked to increased alcohol intake and binge drinking, and often target younger individuals, who are regular users of these platforms, through illicit marketing strategies (Lobstein et al., 2017).

Inner and spatial presence within the VEs was mediated through the projection of participants' personal narratives on the VE and the perceived embodiment via the visual representation of the VR hands, respectively. In the first instance, participants projected their own interpretation of why they were navigating each VE, creating a context that guided their thoughts about drinking and realism of the VEs. This involved approaching the VEs according to their preconceptions of how such environments would look like in reality and the context in which they would typically be in them. Personalisation was important in the home VE, as psychological realism was necessary to believe it was one's own home and induce the temptation to drink in it. This might explain why it was reported to be the least tempting VE. As the supermarket and the pub VEs were public spaces, personalisation was not identified necessary for psychological realism and alcohol temptation, and participants used their personal narrative to bridge the gap of unfamiliarity. This suggests that VRT could assist in RP of those who drink at home if personalisation was applied, whereas for public VEs personalisation would not be needed.

Projecting a personal narrative on the VEs triggered associated emotions in participants, as they approached each VE with a specific mindset. The connection of presence and emotional involvement is supported by studies focusing on virtual presence in clinical settings (Diemer et al., 2015; Gromer et al., 2019). The projection of personal narrative on the VE was also linked to the feeling of presence in social VEs with avatars and virtual characters (Riches et al., 2019). In these social VEs, aspects such as memories, previous experiences, social judgement of oneself and emotions were seen to influence perceived pres-

ence (Riches et al., 2019). Correspondingly, in the current study, during social interactions with virtual characters, participants reacted based on their own systems of beliefs and backgrounds. For example, accepting the offered pint through politeness or always exploiting a free drink were reasons that prompted participants to drink in the pub VE. This indicates the suitability of VRT for developing refusal skills in a more personalised and targeted manner, especially for those who struggle in social settings, due to the fact that social pressure is a common, high-risk situation. Interestingly, the projection of personal narrative was expanded in multiple aspects of the VEs, suggesting that individuals' virtual reactions were similar to their real-life ones. From a neuroscientific perspective, relevant literature also interpreted presence as a transfer of consciousness into the virtual self, where the virtual stimuli are perceived personally and trigger corresponding reactions (Sanchez-Vives & Slater, 2005).

The presence of participants' self spatially was mediated by the visual model of the VR hands. Absence of forearms visually, and inconsistency with the expected behaviour in the movement of the hands and in the grabbing of objects were considered elements that decreased the sense of embodiment, and, in turn, presence. This was also reported in previous studies about virtual embodiment and presence, with the former increased when a complete body was used virtually to represent the physical body of participants, instead of hands alone (Sanchez-Vives & Slater, 2005). Nevertheless, personalisation of the virtual hands' appearance was not considered largely important, with more weight given to the refinement of interactions, like the grabbing of objects or talking back to the virtual characters. These interactions were seen to be critical for enhancing realism and immersion rather than presence alone, underlying their strong interconnection in virtual settings.

6.5 Limitations and Strengths

The VEs were assessed in a low immersion, VR set-up. While the cost-effectiveness of this approach would be beneficial for its clinical application in alcohol treatments, participants' views might have differed had they been exposed to the same VEs in a more immersive VR setting. In addition, not all participants were high-risk drinkers and they were not assessed clinically for alcohol dependency. This might have affected the degree of temptation experienced or caused other differences regarding attention to cues. However, variety in the drinking levels of participants offered a greater insight into and indicated the relevance of these VEs for people with diverse levels of alcohol misuse issues who may seek treatment, even if alcohol dependency does not apply.

The majority of the sample was male (65%). This might have biased the results genderwise, however, inclusion of female participants (35%) was still important. Previous studies of VR in alcohol misuse have mainly recruited males (Trahan et al., 2019), highlighting the need for assessing VRT's effect on females. While some studies suggest that being male was a facilitator of presence and a protective factor for cybersickness (Felnhofer et al., 2012; Melo et al., 2018; Schwind et al., 2017; Shafer et al., 2017), the causality of

this was not clear. The possibility of this being attributed to increased familiarity of males with technology, especially in video gaming contexts, was suggested in these studies, as prior video game and VR experience were positively correlated with presence and negatively with cybersickness (Felnhofer et al., 2012; Shafer et al., 2017). In this study, more than half of the participants (60.8%) had used VR before, which indicates that their views were informed regarding the potential of VR to be realistic and immersive. The qualitative nature of the study allowed diverse and detailed aspects to emerge, as participants were interviewed in an unstructured manner, and provided thorough accounts of their dominant thoughts and associated reactions. This also facilitated the interconnections of realism, alcohol temptation and presence in these VEs to emerge profoundly, leading to the formation of a distinct theme about presence, not otherwise possible.

Specific elements of the VEs of this study have not been explored before by VRT research. In particular, a supermarket VE has not been assessed previously for its potential to elicit alcohol temptation, despite being identified by substance use practitioners and researchers as a high-risk situation (Skeva et al., 2021). Indeed, supermarkets constitute high-risk places that most people would inevitably visit to buy groceries or other essentials, where alcohol would typically be largely available. Other aspects linked to buying alcohol such as branding, advertising and marketing strategies like multi-buy offers have not been investigated previously and are common, tempting factors in vending contexts or on platforms where advertising applies. Likewise, this is the first study to examine representation of brands in therapeutic VEs, avoiding issues with copyright while eliciting the associated alcohol temptation. Similarly, the effect of positive emotional states during social pressure has not been explored either, although emotional states were identified as a relapse factor.

Future research should explore the acceptability and effectiveness of VRT applications in alcohol treatment and should involve more female participants, to investigate potential gender differences in preferences, the sense of presence and cybersickness. Prior experience of VR and video gaming should also be taken into consideration to determine its interconnection with VRT preference, presence, cybersickness and gender. The acceptability of VRT for use in clinical practice and appropriate delivery protocols should also be explored not only in patients but also in practitioners delivering alcohol treatments. The importance of familiarisation with the VR workings via exposure to neutral VEs, prior to the cued exposure, should also be considered in future research and inform the delivery protocol and integration of VRT in clinical practice. Involvement and assessment of VEs that simulate alcohol vending stores and online shopping experiences should also be addressed by future studies for the alcohol RP of people in recovery and, specifically, adolescents who are regular users of social platfoms and targets of embedded alcohol promotions. Assessment of the alcohol cued VEs in VR set-ups of diverse immersiveness would provide further evidence about the potential of less costly VR equipment to induce presence and alcohol craving while achieving realism, determining their therapeutic value in alcohol treatment and, particularly for RP. The level of personalisation required for VRT to be effective should additionally be investigated, in terms of the appearance of avatars, virtual characters and the

user's VR hands, as well as the VE itself, be it private or public.

6.6 Relevance of "A-PLAN" VEs for RP

The VEs of the "A-PLAN" as assessed by low and high-risk drinkers were considered relevant for RP. The VEs were found realistic and tempting by participants in differing levels and factors that associated with these are presented below. Alcohol-cues not explored before in literature (such as brands, alcohol adverts and multi-buy offers), the VE of a supermarket and positive emotional stimuli applied in a social pressure context in the pub VE were perceived relevant by participants for use in RP. These VEs could be useful for patients who want to practise (1) coping with alcohol and/or smoking craving, and (2) emotion regulation, in private (home), social (pub) and vending (supermarket) contexts, and (3) refusal skills in social (pub) contexts. The neutral VE of a city street aimed for familiarisation purposes was also considered relevant for learning and getting used to the concept and workings of VRT.

The cost-effective, low immersion VR set-up employed was seen to affect their degree of relevance (please see section below about the presence factor), but it was still able to elicit realism and alcohol temptation to participants when they were exposed to the VEs in that setting. This indicates its potential use as a secondary delivery method, when a more immersive VR set-up would deem impractical or difficult to use for RP, from a relevance (and potential effectiveness) point of view. This highlights the potential of VR set-ups other than the ones that use VR headsets to be considered for RP, even though mobile VRT was seen less acceptable by patients in our previous study (please see Chapter 4). This also highlights that familiarisation with a specific VR set-up indeed increases its treatment acceptability, as noted in the same study (please see Chapter 4). However, even if this low immersion VR set-up seems relevant for RP, for it to be clinically acceptable, it should align with the delivery requirements suggested by practitioners and researchers in our clinical acceptability study of VRT (please see Chapter 3).

6.6.1 Factors of relevance

Certain factors linked to the level to which the VEs of "A-PLAN" were capable of being realistic and tempting. These factors were the proximal and contextual cues, and the sense of presence within the VEs. Both the proximal and contextual cues linked to realism in two ways - in a physical and psychological sense. The physical realism involved their fidelity with the real life, corresponding cues. The psychological realism involved their relevance to the life of each individual.

The proximal cues linked to the degree to which alcohol was present virtually and how realistic it was perceived. In general, animated alcohol cues, and particularly the action of virtual drinking in the first person perspective, were more tempting that static alcohol cues

(physical realism). Alcohol adverts elicited alcohol temptation in most participants, especially when participants found the advert or brand relevant to their real life preferences and habits (psychological realism). A variety of alcohol bottles and brands was also considered to elicit temptation more compared to fewer options presented virtually, increasing relevance (and psychological realism). Some participants considered important for the brand name to be the original one for the drink to be tempting (physical realism) but others were tempted enough if the appearance pf the alcoholic beverage matched the original packaging (physical realism). Regarding the contextual cues, realism again manifested as physical and psychological and alcohol temptation was linked to certain contexts that individuals found realistic. Whether the VEs were relevant for individuals, thus, was associated with whether the cues presented matched what they would expect to see in corresponding real-life situations (physical realism) and whether they would typically be in such situations (as per their habits and preferences - psychological realism). Such cues involved the layout and furnishings of the VEs, the lighting (which is perceived as time of the day if outdoors and as ambiance if indoors), sounds, smoking cues (such as cigarettes) and virtual characters.

The layout and furnishings of the VEs to imitate the corresponding, real-life places was considered important for participants, although the home VE was the one identified to need personalisation for it to be more relevant (and tempting) to individuals. In the supermarket and pub VEs, individuals projected their personal narrative to justify why they were there (inner presence), which helped finding the VEs tempting as part of their personal storyline (such as shopping alcohol for pre-drinks at a friend's house). The social aspect and interaction with a virtual character were determining for increasing temptation in all participants, even if the interaction was not considered highly realistic (since individuals could not speak back to the character and with the character requiring refinement in its body language, such as the way it holds the beer glass). The individuals seemed to perceive virtual characters as humans and expect them to behave alike, with all relevant social, emotional and mental processes to be involved in their interaction. In contrast, the home and supermarket VEs were found more tempting by high-risk drinkers compared to low-risk drinkers.

Moreover, sounds were linked to alcohol temptation to a great degree in any VE, even if the related visual stimuli was not present (such as glasses of alcohol clinging but without this to be projected in the user). Sounds not matching the visual stimuli was also considered important for physical realism and temptation (such as the sound of a lot of people chatting but not many virtual characters present). Music, as a sub-category of sounds, was also considered highly determining of whether people would feel tempted or not within the VE, according to if music would match their preference. Smoking cues were also highly tempting for those who used to or would still be smoking, even social smokers, because they were presented in a context where socialising and drinking would be a typical match to smoking.

The sense of presence felt within the VEs was another factor of relevance of the VEs. Presence was manifested as inner (mediated by psychological realism - relevance of cues) or spatial (mediated by physical realism - how realistic individuals were interacting with the VEs and the cues). As mentioned earlier, projection of the personal narrative of individu-

als during the exposure to the VEs led to the experience of them through meaningful scenarios, allowing inner presence to manifest, even when the cues were not that relevant and personalised (lack of psychological realism - relevance of cues). Inner presence, in turn, led to increased alcohol temptation felt by participants and its lack was associated with lack of temptation. Thus, it is important to note that inner presence links to the alcohol temptation to be felt, and is mediated both via psychological realism (relevant cues) and the projection of personal narrative, through a dynamic interconnection of these two, where the one can compensate for the other when a public VE is involved. When a private VE is involved (such as a home), which is expected to be highly relevant to the individual to therapeutically work (such as practising coping with alcohol craving when alone in the individual's home), then projection of the personal narrative alone seems to not be effective to elicit alcohol temptation.

Spatial presence was linked to the fact that individuals perceived themselves to be represented in the VEs via the VR hands. Even though a cost-effective VR set-up was used (where individuals did not control the navigation and the interactions of the hands with the VEs), navigation through a first person perspective seemed to mediate presence and individuals to feel embodied in the VEs. This, in turn, allowed for inner presence to emerge and temptation to be felt. Disembodiment happening through the lagging of the hands movements and the hands not being linked to arms was seen to obstruct realism and, in turn, presence and temptation. The hands wearing gloves was also thought by some participants to lower realism and, again, presence and temptation. Others did not find that restrictive, getting used to it very quickly and not paying attention to it during the exposure.

6.6.2 Design implications of VEs for RP

The perceived relevance of the VEs in "A-PLAN" and the factors of relevance identified translate to certain design implications when developing VRT applications for RP, that may also be relevant for when developing VRT applications for alcohol treatment in general.

To increase realism and temptation in the VEs, inclusion of animated alcohol cues would work better compared to static alcohol cues only, making the VEs therapeutically useful for RP. Inclusion of alcohol adverts and brand names could also increase realism and temptation in such VEs. However, due to copyright issues, using the exact brand names might not be possible in VRT applications for RP. If this is counterbalanced by an identical appearance of the product, then using the exact brand name seems as an effective workaround to this. A variety of alcohol beverages to choose from could also lead to realism and temptation increase.

Inclusion of sounds (including music) would increase realism and temptation, and immersion during exposure. Realistic integration of sounds, though, would be a requirement for these, to match with the visual stimuli and imitate the geometry of the space accordingly (coming from the right distance for example). Inclusion of smoking cues would also increase realism and temptation for those who used to or still are smokers (even social smok-

ers). Inclusion of virtual characters would also increase realism and temptation, especially in social VEs. Inlcusion of realistic body movements for the virtual characters would be important and needed more compared to the VRT application to offer ways for the user to talk back. Thus, realistic virtual character animations should be prioritised over user speech functionality. The virtual character to talk realistically would also be important for making the scenario tempting and realistic.

While inclusion of the above features would make a VRT application relevant for RP, yet personalisation emerges as a necessary functionality that the application should offer. Personalisation of the alcohol cues would be beneficial for any VE for RP, especially because inclusion of the preferred alcoholic beverage of the individual seemed to increase realism and temptation to a great degree. This should be facilitated by the functionality of a VRT application for RP. Personalisation of private spaces (such as homes) would also be necessary and should be facilitated by a VRT application for RP, as per the individual preferences and habits, to make such VEs useful. Public VEs would not require personalisation to be effective for RP. Similarly, personalisation of sounds (when relating to personal aspects of oneself like music taste and preferences) would be important for such VEs and should be facilitated by the functionality of a VRT application. Personalisation of virtual characters would be necessary when a social context would not be involved, yet for social pressure scenarios not personalising the characters seemed to be tempting for all participants.

For the familiarisation session and regarding the neutral VE to be used for this purpose, having organic, real-life interactions for assisting learning of the workings of VRT would be more preferred compared to tutorialised instructions. Because of this, VEs that could offer a variety of movements, behaviour protocols (such as the use of signposting to move effectively and safely) and social interactions, such as the city street employed in our application, would be suitable. The VRT application to offer the functionality to set up different features (such as sound volume and brightness) during the exposure to the neutral VE would also be necessary, as part of the familiarisation session.

Regarding the user functionality and interaction, including visual model of arms and not just hands for embodying the user into the VEs would increase realism and, in turn, temptation and should be facilitated by the VRT application. The user not controlling the navigation and the interactions but still experiencing everything from a first person perspective seemed to be realistic and lead to elicitation of temptation. This could potentially mean that the navigation and interactions could be controlled by the software or the practitioner, offering still therapeutic relevance and that VRT applications could offer these as navigation modes. This is important to consider as practitioners and researchers in our previous study (please see Chapter 3) found therapeutic interest in having the navigation controlled by them or the software, depending on the treatment goal of each session. Thus, these navigation modes would be relevant for patients. Personalising the user hands could be ideally offered but if this is too difficult, gloves could be offered as an alternative by the VRT application, as the users seem to eventually get used to being embodied in that way, without severe obstructions to their perceived realism and temptation.

6.7 Conclusion

Twenty-three regular drinkers assessed the alcohol cued VEs of a home, a supermarket, and a pub on their potential to induce realism and alcohol temptation in a cost-effective VR set-up. Factors of the realism and the alcohol temptation were the proximal and contextual cues, and the sense of presence within the VEs. Animated, alcohol cues, including drinking in the first-person perspective, were considered more tempting than static ones. Smoking temptation was elicited via smoking-related cues which linked to alcohol temptation. Realism was manifested as physical, involving the audio-visual fidelity of cues, and as psychological, involving the relevance of cues to the participants' lives. Physical realism was a facilitator of the spatial presence and psychological realism of the inner presence felt by participants. Personalisation of the home VE was thought necessary to increase alcohol temptation and realism. In the public VEs (supermarket, pub), projection of participants' personal narrative counterbalanced the unfamiliarity with them. Participants' personal narrative influenced presence and alcohol temptation generally and particularly relating to alcohol brands, drinks offers and social interactions with virtual characters.

These VEs could be relevant for people who want to practise (1) coping with alcohol and/or smoking craving, and (2) emotion regulation, in private (home), social (pub) and vending (supermarket) contexts, and (3) refusal skills in social (pub) contexts. A neutral VE was additionally considered helpful for familiarising with the use of VR and for adjusting the application parameters before exposure to the alcohol-cued VEs. Realistic representation of a city street and real-life interactions within this neutral VE were mostly preferred for learning purposes compared to strict, tutorialised instructions.

This study reported the relevance of the aforementioned VEs for RP and when delivered in a cost-effective VR set-up (which could be used a secondary delivery method when practical or needed). Relevance factors were identified and linked to certain design implications for VRT applications for RP (including our specific "A-PLAN" model application). This is the first study to explore relevance factors and discuss emerging design implications for VRT in alcohol treatments in general and RP in particular. These findings could also inform the design of other VRT applications for alcohol treatment, from the perspective of ways to increase realism and levels of induced craving in alcohol-cued VEs, and to promote familiarisation in neutral VEs prior to the cued exposure. Recommendations on how to integrate such a VRT application into current, clinical practice are presented in Chapter 7 alongside suggestions for future research that could further inform experimental protocols and facilitate easier integration of VRT in RP.

Chapter 7

Discussion

7.1 VRT Integration into Current, Alcohol Treatments for RP

This PhD project aimed to inform the clinical application of VRT for RP into alcohol treatments (RQ 1). To do so, the clinical acceptability of VRT for RP was explored through a study of practitioners and researchers specialising on substance use treatments, to determine VRT's acceptability as a treatment tool for RP (RQ 1a) and identify acceptability factors (RQ 1b - Chapter 3). These factors were translated into design implications for forming a clinically acceptable delivery protocol of VRT for RP and developing a clinically acceptable VRT application (regarding its functionality - Chapter 3). Suggestions of the researchers and practitioners on therapeutically useful and acceptable VEs for RP (Chapter 5) and VEs evaluated as efficient in literature (Chapter 5) were considered to determine clinically acceptable VEs for RP (RQ 3a) and develop a model, VRT application for RP, to be used as a guide for future research (Chapter 5).

The treatment acceptability of and preference for VRT (delivered either via a standard VR headset or a mobile - mVRT) for RP was explored via a survey with adults drinking at diverse levels, to determine the acceptability of VRT for RP in potential patients as a treatment option (RQ 2a) compared to current, alcohol treatments offered in the UK, and identify acceptability factors (RQ 2b - Chapter 4). These factors were translated into design implications for informing the delivery protocol of VRT for RP that emerged from the earlier acceptability study with practitioners and researchers (Chapter 4). Concurrently, the "A-PLAN" VEs were assessed by low and high-risk drinkers via an interview study about their relevance (capacity to be realistic and tempting) for RP, to identify efficient VEs for RP (RQ 3a) and relevance factors (RQ 3b - Chapter 6). These factors were translated into design implications that informed the content and functionality that a VRT application for RP should have to be relevant from a patient perspective (Chapter 6). A cost-effective, low immersion VR set-up was also evaluated in this study to determine its relevance for RP as an alternative, accessible delivery method when remote delivery of treatments would be needed, informing further the clinical application potential of VRT for RP (Chapter 6).

The clinical application of VRT for RP has only been explored by one study that assessed the potential of VRT for RP as an assistive tool to CBT, in an experimental trial with 6 alcohol dependant veterans (Yoon et al., 2014). However, the programme of work presented

in this thesis focused on the clinical integration of VRT for RP though the formation of an acceptable clinical, delivery protocol and the development of acceptable and relevant VEs both from a clinical and patient perspective. The clinical acceptability of VRT for substance use treatments, and for RP in alcohol treatments in particular, has not been explored before in literature and our study with practitioners and researchers is the first one to do so. The treatment acceptability and preference for VRT for alcohol treatment and the relative acceptability and preference for VRT compared to current, alcohol treatments offered in the UK have not been previously explored either. Our survey study is the first one that addressed this gap in literature. Relevant VEs for RP and relevance factors have not been explored before, as well, and our assessment study facilitated this evaluation. From the aforementioned studies, design implications were identified for the first time in literature, regarding the delivery protocol of VRT and the functionality and content of the VEs for RP, that inform in practice the clinical application of VRT for RP, and could inform similar VRT applications for alcohol treatments. We also followed a novel, participatory research design throughout the programme, which has not been adopted before in relevant literature. Our research approach focused on the involvement of stakeholders (clinicians and patients) in the design of the delivery protocol and of the content of VRT, which could promote the quick integration of such novel, technological tools into clinical practice and create meaningful research endeavours. Our recommendations on the delivery protocol and the content of VRT for RP, that could facilitate its clinical application, are presented below.

7.1.1 Clinical Potential of VRT and Treatment Integration Paradigm

VRT can offer controlled and realistic exposure to a wide range of personalised, alcohol-related, high-risk situations, which can also involve interaction with virtual characters in role-playing scenarios or changing an avatar's viewpoint within the high-risk situations. Observation of the virtual actions and reactions of the patients in high-risk situations by the practitioner is also possible, increasing treatment insight. These properties of VRT can potentially benefit alcohol treatments when identifying triggers, practising coping with alcohol craving, emotion regulation and refusal skills training are required in a safe yet immersive setting, such as for RP. The training environment provided in VRT cannot be currently found in other forms of treatment.

However, employing VRT alone for treating alcohol misuse could prove insufficient. Alcohol misuse expands to different levels of dependence, being a symptom rather than the cause of the addiction problem (Mezquita et al., 2014; Sher et al., 2005). The large co-morbidity of alcohol misuse with mental health disorders may complicate further the identification of the cause of alcohol misuse and its treatment (Charzynska et al., 2011; Han et al., 2017; Skeva et al., 2021; Torrens et al., 2015; Weaver et al., 2003). Alcohol consumption being socially acceptable and the prevalence of alcohol trade and promotion in daily life (Hurtz et al., 2007; "Institute of Alcohol Studies", 2017; Lobstein et al., 2017; Wagenaar et al., 2009) may hinder the realisation of facing an alcohol problem and prevent its treatment (Ssebunnya et al., 2020). VRT was seen to assist with craving regulation and change in alcohol-

related attitudes (Choi & Lee, 2015; Ghita et al., 2021; Ghita, Hernandez-Serrano, Ruiz, et al., 2019; Hernandez-Serrano et al., 2020; D. Kim & Lee, 2019; J. Lee et al., 2007; S. Lee et al., 2009; Metcalf et al., 2018; Son et al., 2013; Son et al., 2015; Yoon et al., 2014), yet alcohol misuse treatment involves attending to other factors of the problem that lead to use and relapse, like identifying its cause and regulating emotions (N.H.S., 2018a; Witkiewitz & Marlatt, 2004). To cater the individual needs of each patient, integrated, diverse interventions may also be necessary (Ostergaard et al., 2018).

Practitioners and researchers in our interview study unanimously suggested that VRT should be employed as an assistive tool rather than a stand-alone treatment based on the aforementioned reasons. They recommended combining VRT with any treatment, in-person or online, for when coping skills should be developed and maintained. This suggested the suitability and clinical acceptability of VRT for RP, as this would be the stage when identifying triggers and practising coping skills would take place. Pairing VRT for RP with CBT was found particularly suitable due to the behavioural training that CBT entails and that VRT could assist in. CBT was also in the top three acceptable and preferred treatments in our treatment preferences and acceptability survey with potential patients, and it is widely being used in clinical practice for alcohol and mental health treatment. Considering the high comorbidity of alcohol misuse and mental health disorders, pairing VRT for RP with CBT would be an easy-to-integrate, inclusive and acceptable treatment solution. Other acceptable solutions could be Counselling and 12-Step FT, both of which are currently used in clinical practice and were considered the most acceptable treatments (along with CBT) compared to others offered in the UK, in our treatment acceptability study.

7.1.2 Delivery protocol of VRT for RP

Regarding the VR set-up, a standard VR headset should be used for an immersive experience with full interactivity. In our treatment acceptability survey, adult drinkers perceived VRT delivered via a standard VR headset more acceptable as a treatment option compared to mobile-delivered VRT (mVRT), indicating that standard VRT could increase treatment engagement more compared to mVRT (please see delivery protocol in Chapter 4). However, when a cost-effective approach or when an online delivery would be necessary, a less immersive video-based VR set-up, as in our assessment study, or mVRT set-up could be adopted. Our assessment study suggested that VEs delivered in low-immersion VR set-ups could be perceived realistic enough to elicit alcohol temptation and inner presence (participants being mentally involved in the virtual situation). This indicates that such VR set-ups could increase the treatment reach in populations of low socioeconomic backgrounds or geographically remote areas (Cunningham et al., 2011; Gordon et al., 2011; Riper et al., 2011; Witkiewitz et al., 2019) and enable treatment delivery when physical attendance would not be possible, such as during the outbreak of pandemics (Feijt et al., 2020; Ornell et al., 2020; Samuels et al., 2020). The need for providing online alcohol treatment was highlighted during the pandemic, with relapse rates to have increased in these patient populations due to the lack of online interventions (DeJong et al., 2020; Yazdi et al., 2020). Irre-

spective of the VR set-up used, in-person delivery of VRT might be more effective compared to online VRT. According to the preferences of adult drinkers in our survey study, technology-assisted delivery methods were less preferred compared to in-person delivery of treatments, and treatment preferences are known to link to treatment uptake and engagement, and, thus, influence treatment effectiveness (Milosevic et al., 2015; Tarrier et al., 2006).

The involvement of the practitioner in the delivery of VRT seems to be necessary in any version of VRT (standard, mobile or via other, low immersion set-ups), to increase its clinical acceptability and safety according to practitioners' researcher's views in our interview study (please see delivery protocol in Chapter 3). They believed a practitioner should guide the VRT's delivery throughout. As such, a clinically acceptable, delivery protocol of VRT for RP, emerging from the practitioners' and researchers' suggestions should primarily involve the practitioners to run assessments about the readiness of individuals in recovery to be delivered VRT. Such assessments should focus on whether the medical needs of the individuals that link to their alcohol problem have been attended to before being delivered VRT, and whether they could handle exposure to high-risk situations, as relapsing after the VRT session has been identified as a risk by practitioners and researchers.

A practitioner to facilitate a proper introduction of the patient to VRT was also considered necessary by practitioners and researchers. It is proposed practitioners to run a familiarization session prior to exposure to alcohol-cued VEs, to ensure the readiness of individuals to be delivered VRT. A familiarization session would involve exposure to neutral, daily situations virtually and trial of the VR equipment, allowing the individual in recovery to give informed consent on whether they would prefer VRT as a treatment and to release the anxiety that could emerge from using the VR equipment for the first time, especially when a co-occurring mental health disorder exists. In addition, through a familiarisation exposure to neutral cues, practitioners could gauge the response of individuals during their contact with the VR equipment and identify any cybersickness symptoms that could negatively impact the physical state of individuals. This will ensure further that during the exposure to high-risk situations, the focus of the therapeutic session will remain on the coping skills training rather than on potential, familiarisation and technical problem-solving issues. Familiarisation prior to the delivery of VRT may also increase its acceptability and preference to be delivered VRT in patient populations, and subsequently enhance its treatment effect. Treatment familiarity and acceptability of VRT were associated in our survey study and treatment acceptability is known to lead to increased effectiveness (Milosevic et al., 2015; Tarrier et al., 2006). Familiarity and experience of being delivered VRT has also been connected to increased treatment acceptability in patient groups suffering from PTSD (Botella et al., 2015), psychosis (Rus-Calafell et al., 2018; Thompson et al., 2020), schizophrenia (Adery et al., 2018), panic disorder with agoraphobia (Quero et al., 2014), and childhood social anxiety (Sarver et al., 2014).

A trusting relationship between the individual in recovery and the practitioner would be additionally needed to signal when the practitioners need to take protective measures to avoid any type of distress to be caused to the individuals prior (during the assessment stage by

identifying traumas, for example), during (while on the exposure session by personalising the exposure content and pace, for example) or after the exposure to virtual, high-risk situations (by providing purposeful debrief to avoid relapse, for example). This was thought particularly important for individuals with prior trauma as overwhelming material could be avoided during the virtual exposure to high-risk situations or be introduced with additional processing to fit the therapeutic scope of the exposure session, as traumatising individuals was another risk perceived by practitioners and researchers. Personalisation of the exposure material by the practitioner is, hence, proposed at any therapeutic stage and should be enabled by the design of the VRT application, offering graded and tailored exposure according to the capacity of the individual. The practitioner and patient to decide on the treatment goal beforehand and tailor the VRT sessions and treatment plan accordingly would also be important. A monitor screen for the practitioners to observe the actions and responses of the individuals virtually will aid further control of the exposure material while offering further insight to the practitioners about the individuals' addiction state.

Aftercare sessions (such as debrief) facilitated by the practitioner after the VRT exposure would also be necessary to ensure that the elicited alcohol craving and related emotions are regulated effectively to prevent subsequent relapse in real life. The aftercare format would depend on the treatment paradigm combined with VRT (such as CBT or Counselling). This could additionally eliminate the feeling of overconfidence of the individual if they successfully coped virtually in the high-risk situation and prevent them to be exposed in similar, real situations, unless advised by their practitioner. By adopting such a delivery protocol, which follows the standards of any treatment, safe exposure to virtual, high-risk situations is facilitated, outweighing risks linked to exposure such as the individual being overwhelmed, distressed or re-traumatised, and relapse when outside of the therapeutic context.

7.1.3 Target population

VRT is suggested for any patient who would be assessed by the practitioner ready to be delivered VRT, whether they would be attracted to it earlier or after having tried it during the familiarization session. Familiarisation with the VR equipment will enable the delivery of VRT to individuals who are not regular technology users but who could find it an appealing treatment option. Practitioners and researchers in our acceptability, interview study further suggested that VRT may be particularly attractive for young people, increasing treatment uptake and engagement in this population. This is particularly important considering the high levels of binge drinking in students (Tavolacci et al., 2016), the fact that are being largely, and often illicitly, targeted via promotional strategies in social media being regular technology users (Lobstein et al., 2017), and the correlation of younger drinking onset age with lower inclination to seek treatment (Mezquita et al., 2014). For the treatment of younger people, thus, alcohol vending contexts, such as the supermarket VE or the home VE of the A-PLAN application, which involve alcohol promotion cues (advertisements, multi-buy offers, drinks offers, imitation of real-life alcohol brands) could be particularly useful for practising ways to resist buying alcohol. Such VEs could also be relevant for

those temped to buy alcohol in these high-risk situations, as in our assessment study, alcohol temptation was evoked in high-risk drinkers after exposure to alcohol brands, animated alcohol advertisements and, in some instances, leaflets with drinks offers.

VRT may offer an integrated treatment solution for dual diagnosis people with alcohol use and mental health disorders, who constitute a large part of the population that attends treatment services in the UK (Donadon & Osório, 2014), and who are reported to relapse quicker, often requiring urgent hospitalisation (Durazzo & Meyerhoff, 2017; Klingemann et al., 2019). Previous VRT studies have suggested the benefits of VRT for treating mental health disorders and its acceptability in this population (Adery et al., 2018; Botella et al., 2015; Fodor et al., 2018; Grochowska et al., 2019; Macedo et al., 2015; Quero et al., 2014; Rus-Calafell et al., 2018; Thompson et al., 2020; Zeng et al., 2018), yet its effectiveness in addressing the co-morbidity of these conditions is subject to exploration by future studies. Practitioners and researchers in our acceptability study suggested that with adequate preparation, as with any population, VRT can be delivered safely to individuals with this co-morbidity, in co-operation with the medical doctor when relevant. In addition, in our assessment study, for those who quit smoking or are current smokers, smoking temptation was elicited. This suggests that VEs, such as the pub VE of the A-PLAN application which includes smoking cues, could be relevant for addressing, apart from an alcohol problem, tobacco addiction, too, when this co-morbidity exists.

Other patient characteristics that should be considered by practitioners during their assessments would be the openness of patients to treatment and to discuss their alcohol problem with others, their familiarity with VRT originally, whether they prefer video call or mobile/computer application-based treatment and being male (for mVRT only). These were linked to increased acceptability of VRT, indicating that VRT for RP would be easy to introduce for these patient populations. On the contrary, for people who suffer from depression, anxiety or stress, for those who are or were diagnosed with a mental health disorder and had received mental health treatment at some point, and for those who drink to enhance their social skills or their physical and emotional state, VRT could seem less acceptable as a treatment option for RP compared to traditional treatments, as these were linked to decreased acceptability of VRT in our treatment acceptability study. However, familiarisation sessions prior to VRT may raise its acceptability in these cases, which would be necessary anyway, especially for those with mental health disorders, as suggested earlier.

7.1.4 Content and functionality of the VRT Application

The home, supermarket and pub VEs of our A-PLAN application were found relevant for use in RP. Aspects important for increasing the usefulness of VRT in RP were considered virtual characters and the ability to interact with the environment via an avatar. In our assessment study, exposure to the social VE of a pub led to alcohol temptation to be elicited in both high-risk and regular drinkers, indicating the defining effect of using virtual characters on the alcohol temptation elicited, even for those who did not misuse alcohol. In our

interview study with practitioners and researchers, the use of interactive, and selectively personalised, virtual characters and modalities such as changing of the avatar perspective (seeing yourself or the situation via another character's "eyes") was thought to facilitate the recreation of role-playing and dialogues involved in the high-risk situations, increasing the realism and variety of the high-risk situations that could be simulated and benefit alcohol treatment in way that cannot currently be achieved by other forms of treatment.

The inclusion of neutral VEs for familiarisation and relaxation purposes were also considered necessary for such an application. This would ensure that familiarisation and debrief would be facilitated easily by the design of the application. Mundane VEs such as a city street were found suitable and acceptable scenarios to have as neutral scenes, both by practitioners and researchers and by adult drinkers in our studies. The ability to adjust the settings (such as volume and brightness) during the neutral exposure was found important for adult drinkers in our assessment study and a feature that the VRT application should offer.

Personalisation of the content was found in our assessment study particularly important for VEs that would represent private spaces such as the home of an individual in order to elicit alcohol temptation and be realistic, whereas for the public places of the supermarket and the pub personalisation was not a factor of alcohol temptation and realism. Personalising the alcoholic drink offered and the virtual characters, though, was considered conducive to increasing alcohol temptation in any VE of the A-PLAN application. Exposure modalities like olfactory augmentation of the VEs or being exposed to the situations via the chosen avatar viewpoint were also believed by practitioners and researchers in our acceptability study that should be subject to personalisation as per the capacity of the individual and the scope of the treatment session. Personalising the hands of the avatar user was seemed important for some participants in our assessment study and, thus, is proposed only if the software can facilitate full personalization of the individual's real hands. Personalising the navigation (controlled by the patient, the practitioner or the software) modes was also considered important by practitioners and researchers. In our assessment study, the first person perspective was maintained, but the navigation was fixed and realism and alcohol temptation were still elicited. This suggests that as long as the first person perspective is maintained, navigation would not impact VRT's effectiveness. The exposure mode (exposure to identical VEs or VEs with newly introduced cues each time) to be personalised was another desirable feature suggested by practitioners and researchers.

Having a separate monitor to project whatever happens in the VEs was also considered an important feature of the application. This was suggested to increase acceptability and efficiency of VRT for RP, as practitioners could gain insight on the status of the patients and inform their intervention at the same time. Menus to provide support during exposure were considered by practitioners and researchers a helpful feature for when the patients need help so as not to remove the VR headset and obstruct immersion during the exposure session. Similarly, adult drinkers in our assessment study suggested that they would prefer to get some type of help when they would need instructions during the exposure, but the VEs to organically facilitate support during the navigation to be the most preferred (imitating what

they would do in real-life, such as having instructions in signposting rather than a menu that pops up in the VE).

7.1.5 Integration Aim and Research Route

The aforementioned key points on how to integrate VRT into current clinical practice for RP speak to the delivery protocols and content of VRT or aspects that should be considered in further research that could inform the application of VRT and determine its effectiveness. However, to facilitate quick integration of VRT, so as to exploit its therapeutic benefits in a time-effective fashion, certain research approaches could be more beneficial than others. The mixed research approach that was used in this PhD project, consisting of both qualitative and quantitative studies, has been particularly useful for enabling such core aspects to arise and for exploring VRT's suitability in alcohol treatment from different perspectives in a cost-effective manner.

The qualitative study undertaken with practitioners and researchers specialising on substance use treatments allowed their involvement in the design of VRT's application, and provided a great insight on the benefits, challenges and risks that could be involved in VRT's clinical use. This also provided the opportunity to explore the acceptability of VRT to a large extent, drawing on what needs to be done for practitioners' to be considering VRT as a safe, treatment tool, which might not have been possible via a primarily experimental or quantitative study. Involving practitioners into the design of VRT increased further their familiarity with this treatment tool, which could also be important for extending its clinical use in the long-term. Firstly, because of familiarity seeming to be important in the acceptability of VRT in practitioners, with relevant research to suggest that the likelihood of practitioners using VRT in their clinical practice and whether they hold a positive outlook on it to be predicted by their familiarity with it (Lindner et al., 2019; Segal et al., 2011). Secondly, because of the potential of maintaining co-operations with practitioners for the experimental testing of VRT, saving further time and effort to identify and initiate collaboration with relevant clinical practices at later development stages.

Regarding potential target patient groups, the survey study with adult drinkers captured their treatment preferences and the acceptability of VRT and its mobile version and highlighted aspects that should be involved in the delivery of VRT to transform it into an acceptable treatment option for RP and alcohol misuse. Wide participation of adult drinkers of differing drinking patterns might not have been possible via a qualitative study and individual characteristics of patients that could predict a preference for VRT might have not been identified. The qualitative study assessing the content of the VRT application developed helped identify further design elements that could affect its capacity on providing realistic and tempting VEs for therapeutic use in RP in adults with different drinking levels (low- and high-risk drinkers). Identifying whether temptation and realism differed based on categorisation of drinking levels or individual patient backgrounds might not have been explored in such detail if an experimental study was conducted instead at this initial devel-

opment stage.

Thus, interchanging between qualitative and quantitative study approaches might prove beneficial for exploring the different perspectives of stakeholders, ensuring the right level of detail and that their views would be incorporated into each stage of the design of technological, treatment tools, leading to their purposeful and acceptable clinical applications. This mixed research approach, enabling the involvement of stakeholders, forms a cost-effective way of integrating such treatment tools into clinical practice, saving resources and time that would be allocated for re-running experimental studies in which multiple iterations of changes would occur in the delivery and content that would deem ineffective. Experimental studies could then test delivery frameworks and the suitable contents identified from such exploratory studies to quicken the integration of technological treatment tools. The research route adopted in this PhD project could inform the steps to be taken for integrating novel, technological treatment tools into clinical contexts in a cost-effective manner, with a focus on the involvement of stakeholders.

7.1.6 Future Research

Future qualitative and experimental studies should further assess the delivery protocol and the functionality and VEs of the application for RP suggested here, to determine their effectiveness in practice (with the involvement of practitioners and medical professionals) and elaborate on aspects under-explored in this PhD project. More specifically, future studies could explore which VR set-ups would be suitable for each delivery context (online or in-person, via immersive VR headset or low-immersion VR set-ups such as mobile- or video-based) and therapeutic purpose (planned coping skills intervention or on-demand support), considering the cost-effectiveness of each approach, and the safety concerns, accessibility restrictions and treatment preferences that link to the involvement of the practitioner and the personalisation of the content in the delivery of VRT for RP. Furthermore, future research should examine the impact of familiarisation on VRT's treatment acceptability and effectiveness in these VR set-ups. Future studies should also explore which acceptable treatment paradigms proposed here (such as CBT or Counselling) would be an effective combination with VRT for RP. The VEs of the "A-PLAN" application could be used to compare the effectiveness of diverse VR set-ups for RP, as suggested above, since through initial assessment they were relevant for practising craving and emotion regulation, and refusal skills, in social, private and alcohol vending contexts. Finally, the factors of alcohol temptation and realism in these VEs could be used as a guide during the design process for facilitating different levels of personalisation and immersiveness and as references during comparisons. Involvement of individuals with co-occurring mental health disorders and individuals who attain the patient characteristics that emerged as acceptability factors of VRT should be considered in these studies, too, to further refine the delivery protocols and VRT applications of VRT for RP.

7.2 Conclusion

This PhD research project explored how to clinically integrate VRT into alcohol treatments for RP, involving the development of a VRT application and assessment and acceptability studies. The clinical acceptability of VRT for alcohol RP in practitioners and researchers delivering or designing substance use treatments was investigated via an interview study to determine if practitioners would use it, if VRT were available, and identify perceived benefits, risks, challenges and optimal ways to integrate VRT into clinical practice (delivery protocols). VRT was considered acceptable as an assistive tool for addressing relapse, or for when practising coping skills would be relevant as it can offer safe, realistic, personalised and interactive exposure to high-risk situations. VRT was thought suitable for treating adults and people with mental health issues or trauma, provided that risks were appropriately managed. Subsequent relapse, trauma and over-confidence in the success of treatment were identified as risks. The opportunity VRT offered to include other actors in therapy (via virtual character use), and observe reactions, were benefits that could not currently be achieved with other forms of therapy. A delivery protocol of VRT for RP and features that a VRT application for RP should offer were identified based on clinical acceptability factors emerged in the study.

Alcohol treatment preferences and VRT's relative treatment (patient) acceptability in comparison to current, alcohol treatments in adults drinking at diverse levels were examined in a survey, to determine if people would prefer to be delivered VRT for addressing an alcohol problem, and to identify aspects that influence VRT's acceptability, for informing VRT's delivery protocols and indicating target populations. VRT was found less acceptable compared to current treatments, especially when delivered via mobile. Low familiarity with VRT was strongly linked to low acceptability ratings of individuals and technology-assisted delivery methods were less preferred compared to in-person delivery, suggesting that familiarisation with VRT and the involvement of the practitioner would raise its acceptability and preference for VRT. The previously formed delivery protocol of VRT for RP and the functionality of the VRT application were refined as per the treatment acceptability factors emerging in this study.

A VRT application for use in alcohol RP ("A-PLAN") was developed according to practitioners' and researchers' suggestions on useful and acceptable VEs by our previous acceptability study and VEs evaluated as effective in literature. It was assessed by low- and high-risk drinkers about its realism and its potential to elicit alcohol temptation via an interview study, identifying also factors of realism and alcohol temptation, for informing the design of this and other VRT applications for alcohol treatment. Proximal (alcohol stimuli) and contextual (stimuli typically associated with alcohol) cues, and a sense of presence within the VEs, were factors to inducing realism and alcohol temptation. High-risk drinkers were tempted to drink in any VE and regular drinkers primarily in a social, pub VE. Temptation to smoke was induced in smokers. The results suggest that the VEs may help people with alcohol or co-morbid tobacco misuse to practice coping with craving, refusal skills (say-

ing ‘no’ to prompts to drink) and emotion regulation in social, private and alcohol vending contexts. Design implications and the relevance of these VEs for use in RP were identified, informing further the functionality and content that a VRT application should offer for RP.

The combined findings of these studies informed suggestions about how VRT could be integrated into current, clinical practice for RP, focusing on delivery protocols and application designs and their interconnections with acceptability, therapeutic effectiveness, cost-effectiveness and accessibility. These aspects have not been explored before in relevant literature. These suggestions could also inform the design of similar VRT applications for alcohol treatments. The mixed research approach employed, including qualitative and quantitative studies and the involvement of stakeholders (practitioners and potential patient groups) that could benefit from the clinical use of VRT, could quicken the integration of VRT into clinical practice in a cost-effective manner and inform the design stages for integrating other novel, technological treatment tools into relevant treatment schemes.

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Appendices

Appendix A

Topic Guide - Practitioner Acceptability Study

Interview Study Questions

Title: Virtual Reality Exposure Therapy in Addiction Recovery
Type: Semi- structured
Audio- recording: Yes
Taking notes: Yes

*Text in *italics* denotes what the interviewer will say to the interviewees to inform them about the context of Virtual Reality Exposure Therapy, technical terms and definitions.
** Any included images will be displayed in printed form to the interviewees as complementary explanation regarding the context of Virtual Reality Exposure Therapy, technical terms and definitions.

Demographic Data

1. What is your job role/qualification?

2. How many years of experience on delivering/researching addiction recovery do you have?

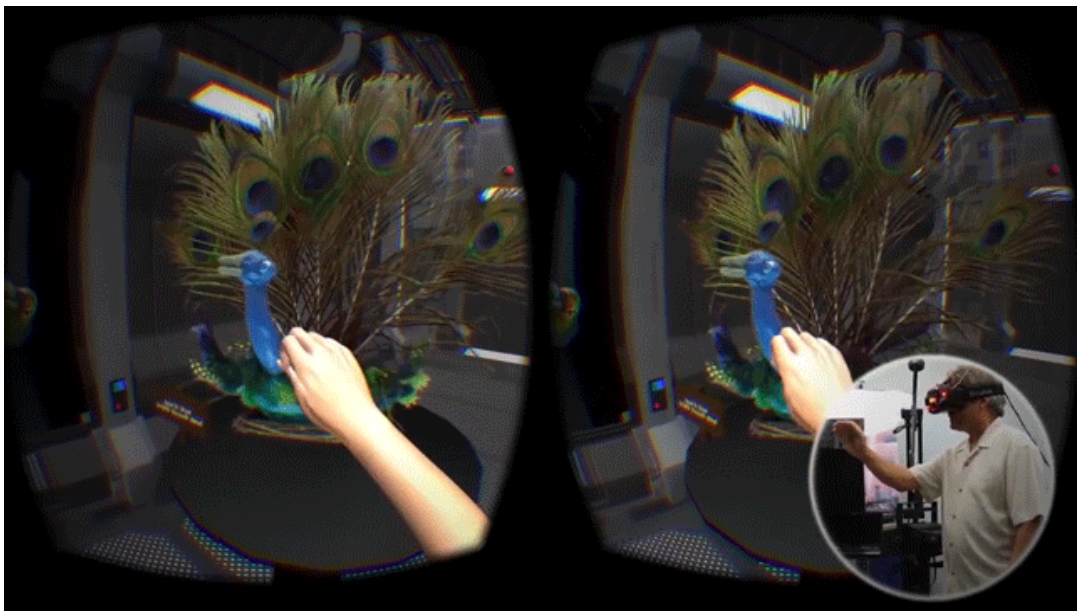
3. What type(s) of treatment/intervention do you deliver/research upon?

4. What type(s) of addiction do you focus on?

Introduction

Virtual Reality Exposure Therapy (VRET) is a form of exposure therapy. As Cue Exposure Therapy, VRET is based on the principles of Pavlov's theory of classical conditioning. The addicted individuals are exposed to the addiction stimuli virtually. Carefully designed virtual environments (e.g. pubs, restaurants, etc.) including cues of the corresponding addiction substance (e.g. bottle of alcohol, a packet of cigarettes, etc.) are employed. Repeated virtual exposure to such environments aims at craving reduction and empowerment of the resistance skills of the individuals.

Figure 1-HTC Vive Head-Mounted Display and Controllers



VRET in Substance Use Disorders (SUD) recovery

1. Having available such an application, would you use it as a stand- alone therapy or as an assistive tool for addiction treatment or not at all?

    - If you wouldn't use it for either purpose, why would that be?
    - If used as a stand-alone therapy, why would that be? Would the patients be detoxificated and for how long before using it?
    - If used as an assistive tool, at which point of rehabilitation would you incorporate it and why? -Would you suggest the existence of private sessions with the psychotherapists after the exposure?

2. If you were to use it what conditions would you set? Are there any age, gender or type of addiction limitations?

Technical details

1. Would you support the idea of an introductory session with exposure to neutral scenes so as to allow familiarization with the VR gear and the navigation within the virtual environment?

2. Would you prefer having predefined trajectories for each virtual environment set by the application's software or the individuals to be able to freely navigate within the virtual environment as in real life or the psychotherapists to control the navigation of the individuals? Why?

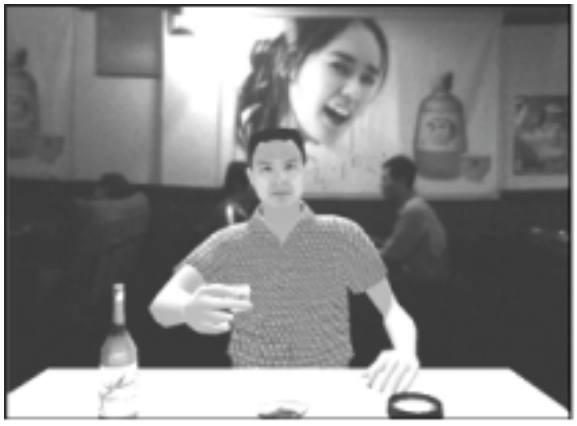
3. Would you prefer having the help menu with instructions about the buttons and how to navigate in written form or have the psychotherapist offering help when required?

4. Would you suggest having a menu to pre-set the addiction stimuli to be added to the virtual environment (e.g. the favourite alcoholic beverage of the individuals, etc.)?

5. Would you suggest having avatars – show a picture of an avatar of previous apps - within the virtual environments applying social pressure? Why? Why not?

Reference: Bordnick, S. P., et al. (2008). Assessing reactivity to virtual reality alcohol based cues. *Addictive Behaviors*, 33, 748

Figure 3-Avatars drinking in a living room setting



Reference: Lee, J. S., et al. (2008). Social pressure- induced craving in patients with Alcohol Dependence: Application of virtual reality to coping skills training. *Psychiatry Investigation*, 5, 241

Figure 4-Avatar offering a drink to the Virtual Reality user

The existence of avatars and direct representation of the addiction stimuli (e.g. a glass of alcohol) within the virtual environment makes the environment a high exposure one. On the contrary, a low exposure one would simply have indirect representation of the addiction stimuli (e.g. an advert of alcoholic beverage).

6. Would you suggest that is useful to have both low and high exposure virtual environments to choose from? Why? Why not?
7. Would repeated exposure to the same virtual environment with minor changes in the storyline (e.g. avatar words differ) be beneficial to the empowerment of resistance skills of the individuals or environments should be used just once per individual? Why? Why not?
8. Would you suggest the psychotherapists to observe the actions of the individuals within the virtual environment via a monitor and see what the individual sees? Why? Why not?

VRET in Alcohol Use Disorder (AUD)

Specifically to alcohol but also add if applies to other SUD

For AUD patients:

1. Do you believe that such an application can help AUD patients in either way during their recovery? Why?
2. Do you believe that such an application can impede the recovery of AUD patients in either way? Why?

For psychotherapists:

1. Do you believe that VRET would assist to the quality of the intervention provided by the psychotherapists? How? Why/ Why not? (e.g. more personalized one, elements/reactions of individuals brought to surface during VRET session, etc.)

If relapse is mentioned:

1. Do you agree that VRET can, therefore, assist to the improvement of the coping skills of the AUD patients and prevent relapse apart from craving reduction alone?

If relapse is not mentioned:

1. Do you believe that VRET can also be beneficial as a relapse prevention tool? Why/ why not?
2. Would you recommend its application to AUD patients at the last stage of rehabilitation, being 9 months abstinent already?

Demo scene

1. What do you think if a forest scene as such (include picture) was employed as a neutral scene?

If suggesting that low and high exposure scenes are both helpful (question 6, Technical Details)l:

Low exposure scene

1. What would you include in a low exposure scene?
2. Provided that a virtual environment exists depicting a hallway of a house, and mail is delivered including supermarket leaflets with alcohol offers, would you employ it as a possible low exposure virtual environment? Why/ why not?
3. Would it be improved and more suitable for alcohol relapse prevention if emotional triggering occurred in a low exposure scene (e.g. recorded voice message playing of a person saying that the individual's benefits are decreased or salary decreased)?
4. Providing that different emotional triggers are available and used (e.g. house, friendship, work-related issues, etc.) with the virtual environment suggested above or the one you suggested, would you add anything else to the scene to enhance it? Would you remove something?

High exposure scene

1. What would you include in a high exposure scene?
2. Provided that a virtual environment exists depicting a beer garden on a sunny day, with avatars drinking and one avatar talking as a friend to the individual, would you employ it as a possible high exposure virtual environment? Why/ why not?
3. Would it be improved and more suitable for alcohol relapse prevention if social pressure occurred (e.g. the avatar saying that they just broke up so they need a drinking buddy and they are going to buy drinks, etc.)?
4. Does the gender of the avatar play a role to its impact depending on the gender of the individual being exposed?
5. Providing that different social pressure versions are available and used (e.g. house, friendship, work-related issues, etc.) with the virtual environment suggested above or the one you suggested, would you add anything else to the scene to enhance it? Would you remove something?

If suggesting that low and high exposure scenes are of no help (question 6, Technical Details):

1. What would you suggest as a cue exposure scene(s)?
2. Why?

3. Would it be improved and more suitable for alcohol relapse prevention if social pressure occurred (e.g. an avatar saying that they just broke up so they need a drinking buddy and they are going to buy drinks, etc.)?

4. If avatars are employed to the scenes, will the gender of the avatar play a role to its impact depending on the gender of the individual being exposed?

5. Providing that different social pressure versions are available and used (e.g. house, friendship, work-related issues, etc.) with the virtual environment(s) suggested above, would you add anything else to the scene to enhance it?

Appendix B

Topic Guide of Assessment Study

B.1 Alcohol Consumption Questionnaire

About your alcohol use

1. Generally, do you drink alcohol more than once a week?
   Yes/No

2. On how many days would you usually drink alcohol?

   1 2 3 4 5 6 7

3. We are interested in finding out how much alcohol you consume in a TYPICAL week. Please refer to the guide below before filling in the number of units for each day:

Guide:

- One pint of ordinary strength lager (e.g. Carling, Fosters), bitter or cider = 2 units

- one pint of strong lager (e.g. Stella Artois, Kronenbourg) = 3 units

- one glass of wine = 1.5 units

- one pub measure of spirits = 1 unit

- 'alcopops' (e.g. Bacardi Breezer, Reef, WKD, Smirnoff Ice) = 1.5 units

	No of units
MONDAY	
TUESDAY	
WEDSNESDAY	
THURSDAY	
FRIDAY	
SATURDAY	
SUNDAY	

B.2 Topic Guide of Assessment

Consent Script_Interview Guide

Links to the videos

Supermarket: https://youtu.be/fhl21Nd-IhQ
Pub: https://youtu.be/j55fSGXHPnU
Home: https://youtu.be/7nxbnqNoz5c
City Street: https://youtu.be/OMckxit4Zkw
VR Demo: https://youtu.be/UDrMZjmD13A

I. **Explain briefly the aim of this study and get verbal consent** ("*The aim of this study is to see if virtual environments can affect the desire to drink alcohol in people who regularly consume alcohol. We have designed 3 VR environments that represent daily tempting situations that could make someone drink. As in-person assessment of the environments is not possible due to COVID, we now want to see via this interview.*

As *part of this interview, I am going to share with you four links that will take you to the four videos to watch. Each video corresponds to a single VR environment. Three of the VR environments represent a common situation in which somebody could possibly be tempted to drink alcohol. After you have watched each video, I will ask you a few questions about its content. Before proceeding with this, though, I would like to make sure that you understand your rights and that you consent to participate by agreeing with the following items. I will read them out loud and please tell me if you agree or disagree with each one of them:*

1) I confirm that I have read the attached information sheet (**Version 0.4, Date 30/10/2020**) for this study and have had the opportunity to consider the information and ask questions and had these answered satisfactorily.
2) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving a reason and without detriment to myself. I understand that it will not be possible to remove my data from the project once it has been anonymised and forms part of the data set. I agree to take part on this basis.
3) I agree to the interviews being audio recorded.
4) I agree that the analysis of the data collected may be published in anonymous form in **academic books, reports or journals.**
5) I agree that any **personal/anonymised** data collected may be shared with the **supervisors of the researcher whose names are mentioned in the PIS.**
6) I agree to take part in this study.

II. **Continue with the main interview if participant agreed to all** (Great. *I have already sent you a video showcasing how VR works in this context. Have you used VR before in any setting? Any questions in regards to this? Is it clear how VR works and what the user sees, how they interact with the VR environment? [Answer questions if any]. Great. Next, I am going to share with you the first link for the first video. While you watch the videos, I will mute myself so as not to interrupt you. I will also turn my video feed off so as to not interfere with your video streaming quality. As such, please let me know once you have finished watching any of the videos so as to un-mute myself and turn back on my video feed. After you have watched each video, I will ask you a few questions about its content. You can always re-watch it if you want to check something again before answering – no need to memorise anything or so. So, shall we start? Any questions? [Answer questions if any]. Good.")*

III. **Share 1st link of Supermarket video of the VR application in the Zoom chat** *("I will now send the first link in this Zoom chat. Please let me know if you have received it. Now click on the link that will direct you to the YouTube video and pause it. Can you see the video? Great. Now please click on the settings icon on your right-hand side to set up the quality at HD/ 720. It might take a few seconds for the video to buffer. Bear in mind that the video displays a first person perspective of the virtual environment, as if you were wearing the VR headset and this is what you would have seen. Click now on the 1st video called "The supermarket" to play the video please. Let me know once you have finished watching it.")*

IV. **Play the supermarket video**

V. **Ask the questions** ("Great. Let me ask you a few questions about this video now. Please feel free to think aloud, this will be really helpful for this assessment. No need to over-think your answers.")

- What were you thinking when you watched this video?
- What is on your mind right now?
- (if not mentioned before) Did this video, this environment make you think of drinking alcohol?
- What worked well?
- What needs improving in order to make it more tempting?

Steps 3-5 will be repeated for the pub/home/city street video. For the city video questions will be changed as presented below.

<u>City street questions:</u>

- Would you find it useful to have this environment to practise the interactions and how VR works? Or set up any preferences in terms of sound, etc? Why? Why not?
- What would you add/remove to make it more helpful to familiarise with VR?
- If you were to set it up on your own, would this be enough? What else would you suggest to have in place for help?

Appendix C

Survey Guide - Treatment Acceptability Survey

Demographic and alcohol use questionnaire

About you

Would you describe yourself as:

- ☐ Male
- ☐ Female
- ☐ Something else
- ☐ Prefer not to say

How old are you?

_____ years

Which of the options below best describes your ethnicity?

- ☐ White – British
- ☐ White – Irish
- ☐ Any other white background
- ☐ Mixed – White and Black Caribbean
- ☐ Mixed – White and Black African
- ☐ White and Asian
- ☐ Any other mixed background
- ☐ Asian or Asian British – Indian
- ☐ Asian or Asian British – Pakistani
- ☐ Asian or Asian British – Bangladeshi
- ☐ Any other Asian/Asian British background
- ☐ Black or Black British – Caribbean
- ☐ Black or Black British – African
- ☐ Any other Black/Black British background
- ☐ Chinese
- ☐ Any other (please describe)

  _____

Who do you live with?

- ☐ Live alone
- ☐ Live with partner/spouse
- ☐ Live with friends in a shared house/university halls of residence
- ☐ Live with parents
- ☐ Live with other family members

What is your marital status?

- ☐ Single
- ☐ Married
- ☐ Widowed
- ☐ Divorced
- ☐ Separated

What is the highest degree or level of school you have completed? (If currently enrolled, highest degree received)

- ☐ No schooling completed
- ☐ Primary school
- ☐ High school, GCSEs
- ☐ High school, AS-level

- ☐ High school, A2-level
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Doctorate degree
- ☐ Trade/technical/vocational training

What is your current employment status?

- ☐ Full-time employment
- ☐ Part-time employment
- ☐ Self-employed
- ☐ Out of work and looking for work
- ☐ Out of work but not currently looking for work
- ☐ Student
- ☐ Retired
- ☐ Unable to work
- ☐ Furloughed

About your alcohol use

We would like to know more about your drinking habits

How often do you currently drink alcohol?

- ☐ Every day
- ☐ More than once a week
- ☐ About once a week
- ☐ About once a fortnight (twice per month)
- ☐ Once a month
- ☐ A few times each year
- ☐ About once a year
- ☐ Never

On weeks where you drink alcohol, how many days per week would you <u>usually</u> drink alcohol on?

☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

We are interested in finding out how much alcohol you consume in a <u>typical</u> week. Please refer to the guide below before filling in the number of units for each day:

- One pint of ordinary strength lager (e.g. Carling, Fosters), bitter or cider = 2 units
- One pint of strong lager (e.g. Stella Artois, Kronenbourg) = 3 units
- One glass of wine = 1.5 units
- One pub measure of spirits = 1 unit
- 'Alcopops' (e.g. Bacardi Breezer, WKD, Smirnoff Ice) = 1.5 units

	No. of units
MONDAY	
TUESDAY	

PTOu

WEDNESDAY	
THURSDAY	
FRIDAY	
SATURDAY	
SUNDAY	

To what extent do you believe your alcohol consumption has changed since March?

1	2	3	4	5
Decreased a lot	Decreased a little	Stayed the same	Increased a little	Increased a lot

Do you consider your alcohol use to be problematic?

- ☐ Yes
- ☐ No

AUDIT QUESTIONNAIRE

These questions refer to your use of alcohol. Please circle the answer that is correct for you.

1. How often do you have a drink containing alcohol?

0	**1**	**2**	**3**	**4**
Never	Monthly or less	2 to 4 times a month	2 to 3 times a week	4 or more times a week

2. How many drinks containing alcohol do you have a on a typical day when you are drinking?

0	**1**	**2**	**3**	**4**
1 or 2	3 or 4	5 or 6	7 to 9	10 or more

3. How often do you have six or more drinks on one occasion?

0	**1**	**2**	**3**	**4**
Never	Less than Monthly	Monthly	Weekly	Daily or almost daily

4. How often during the last year have you found that you were not able to stop drinking once you had started?

0	**1**	**2**	**3**	**4**
Never	Less than Monthly	Monthly	Weekly	Daily or almost daily

5. How often during the last year have you failed to do what was normally expected from you because of drinking?

0	**1**	**2**	**3**	**4**
Never	Less than	Monthly	Weekly	Daily or

PTOu

	Monthly			almost daily

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?

0	1	2	3	4
Never	Less than Monthly	Monthly	Weekly	Daily or almost daily

7. How often during the last year have you had a feeling of guilt or remorse after drinking?

0	1	2	3	4
Never	Less than Monthly	Monthly	Weekly	Daily or almost daily

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?

0	1	2	3	4
Never	Less than Monthly	Monthly	Weekly	Daily or almost daily

9. Have you or someone else been injured as a result of your drinking?

0	2	4
No	Yes, but not in the last year	Yes, during the last year

10. Has a relative or friend or a doctor or other health worker been concerned about your drinking or suggested you cut down?

0	2	4
No	Yes, but not in the last year	Yes, during the last year

Reasons for substance use questionnaire: ReSUS A

We are interested in finding out more about the situations in which people drink alcohol. The list below describes a number of situations in which drinking often takes place.

Please read each item carefully and tell us whether you drink alcohol in each of these situations by circling one of the numbers next to it. There are no 'right' or 'wrong' answers, choose the most accurate answer for you.

I drink alcohol...	Never	Sometimes	Often	Always

PTOu

1 When I want to feel drunk	**0**	**1**	**2**	**3**
2 When I am bored and want something to do to pass the time	**0**	**1**	**2**	**3**
3 When I want to feel more creative	**0**	**1**	**2**	**3**
4 When I am having trouble communicating with others	**0**	**1**	**2**	**3**
5 When I feel anxious or tense	**0**	**1**	**2**	**3**
6 When I want to chill out, relax or feel calm	**0**	**1**	**2**	**3**
7 When I am experiencing medication side effects	**0**	**1**	**2**	**3**
8 When I am feeling depressed	**0**	**1**	**2**	**3**
9 When I am feeling lonely	**0**	**1**	**2**	**3**
10 When I want to fit in with other people	**0**	**1**	**2**	**3**
11 When I want to feel more self aware	**0**	**1**	**2**	**3**
12 When I am feeling suspicious or paranoid	**0**	**1**	**2**	**3**
13 When I think about how good it tastes	**0**	**1**	**2**	**3**
14 When my thoughts are racing	**0**	**1**	**2**	**3**
15 When I want to feel normal	**0**	**1**	**2**	**3**
16 When I am having trouble thinking or concentrating	**0**	**1**	**2**	**3**
17 When I am feeling stressed	**0**	**1**	**2**	**3**

I drink alcohol...	Never	Sometimes	Often	Always
18 When I want to feel good, have a laugh or be happier	0	1	2	3
19 When I want to feel more confident	0	1	2	3
20 When I start to feel guilty about something or feel that I have let myself down	0	1	2	3
21 When I am angry at the way things have turned out	0	1	2	3
22 When I want to feel sexy or increase my sexual enjoyment	0	1	2	3
23 When I am with friends and we want to have a good time	0	1	2	3
24 When I am thinking about bad things that have happened to me in the past	0	1	2	3
25 When I am hearing sounds or voices that other people can't hear	0	1	2	3
26 When I want to stay awake, be more alert, or be more energetic	0	1	2	3
27 When I feel excited about something	0	1	2	3
28 When I feel ashamed or bad about myself	0	1	2	3
29 When I need motivation to do things	0	1	2	3
30 When I have been taking drugs and think about drinking alcohol	0	1	2	3
31 When I want to escape from my problems and worries	0	1	2	3
32 When I have trouble sleeping	0	1	2	3
33 When I feel under pressure from other people to drink alcohol	0	1	2	3
34 When I want to feel more emotions	0	1	2	3
35 When I am experiencing unpleasant thoughts	0	1	2	3
36 When I feel I have been discriminated against	0	1	2	3
37 When I am happy and feeling content with my life	0	1	2	3
38 When I am in pain physically	0	1	2	3

We would now like to ask you some questions about your mental health and experiences of stress.

Mental Health Questions

Have you ever been diagnosed with a mental health disorder?

- ☐ Yes
- ☐ No

If yes, what was the diagnosis?

_____

Have you received treatment for a mental health disorder?

- ☐ Yes
- ☐ No

If yes, what kind of treatment?

- ☐ Psychological therapy
- ☐ Medication
- ☐ Other (please describe)

_____

Have you experienced any of the following stressors since March 2020?

- ☐ Tested positive for COVID-19
- ☐ Felt isolated due to COVID-19
- ☐ Conflict within your household
- ☐ Lost a relative or someone close to you due to COVID-19
- ☐ Had a romantic relationship end due to COVID-19
- ☐ Had a friendship end due to COVID-10
- ☐ Struggled with the transition to online work or study
- ☐ Felt more anxious due to COVID-10
- ☐ Experienced low moods more often due to COVID-19
- ☐ Felt worried about financial obligations
- ☐ Unable to secure an appointment with GP or other medical service
- ☐ Felt your physical health has deteriorated
- ☐ Been unable to get treatment for a mental health concern
- ☐ Been unable to get treatment for a physical health concern
- ☐ Lost a job due to COVID-19
- ☐ Had work hours reduced due to COVID-19
- ☐ Been unable to secure employment

DASS

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

1	I found myself getting upset by quite trivial things	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I just couldn't seem to get going	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I had a feeling of shakiness (eg, legs going to give way)	0	1	2	3
8	I found it difficult to relax	0	1	2	3
9	I found myself in situations that made me so anxious I was most relieved when they ended	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting upset rather easily	0	1	2	3
12	I felt that I was using a lot of nervous energy	0	1	2	3
13	I felt sad and depressed	0	1	2	3
14	I found myself getting impatient when I was delayed in any way (eg, elevators, traffic lights, being kept waiting)	0	1	2	3
15	I had a feeling of faintness	0	1	2	3
16	I felt that I had lost interest in just about everything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I perspired noticeably (eg, hands sweaty) in the absence of high temperatures or physical exertion	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life wasn't worthwhile	0	1	2	3

Please turn the page ☞

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

22	I found it hard to wind down	0	1	2	3
23	I had difficulty in swallowing	0	1	2	3
24	I couldn't seem to get any enjoyment out of the things I did	0	1	2	3
25	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
26	I felt down-hearted and blue	0	1	2	3
27	I found that I was very irritable	0	1	2	3
28	I felt I was close to panic	0	1	2	3
29	I found it hard to calm down after something upset me	0	1	2	3
30	I feared that I would be "thrown" by some trivial but unfamiliar task	0	1	2	3
31	I was unable to become enthusiastic about anything	0	1	2	3
32	I found it difficult to tolerate interruptions to what I was doing	0	1	2	3
33	I was in a state of nervous tension	0	1	2	3
34	I felt I was pretty worthless	0	1	2	3
35	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
36	I felt terrified	0	1	2	3
37	I could see nothing in the future to be hopeful about	0	1	2	3
38	I felt that life was meaningless	0	1	2	3
39	I found myself getting agitated	0	1	2	3
40	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
41	I experienced trembling (eg, in the hands)	0	1	2	3
42	I found it difficult to work up the initiative to do things	0	1	2	3

Alcohol Treatment Preferences

In this last part of the survey we would like to ask your thoughts about alcohol treatment. Please note that you do not need to consider your drinking to be problematic to take part – we are in interested in your ***hypothetical*** *preferences.*

Please indicate the degree to which you agree with the following statements:

If you felt your drinking was becoming or had become problematic:

	Strongly disagree ….strongly agree						
I would seek an appropriate treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would feel stigmatised by admitting a drinking problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would be able to discuss my problem with family/relatives	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would be able to discuss my problem with close friends	**1**	**2**	**3**	**4**	**5**	**6**	**7**

If you felt that a relative or friend had a drinking problem:

	Strongly disagree ….strongly agree						
I would encourage them to seek treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Treatment Choice

We are interested in finding out what treatment(s) you would choose if you ever felt that you would like help to reduce your drinking or stop drinking completely.

Below is a list of treatments that could be offered to you. Please read each description carefully and answer the questions below about each one.

1. Brief intervention

This involves a single counselling session which aims to increase your motivation to reduce your alcohol consumption. It would cover risks associated with your pattern of drinking, advice about reducing the amount you drink, alcohol support networks available to you, and any emotional issues around your drinking. You may be asked to keep a "drinking diary" so you can record how many units of alcohol you drink a week. You may also be given tips about social drinking, such as alternating soft drinks with alcoholic drinks when you're out with friends[1].

Pros: Informative approach that normalizes the need for help to reduce or quit drinking.

Cons: No actual intervention offered, with only one session involved.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

2. Self-help Groups

This would involve meeting regularly with other people who have a drinking problem, such as Alcoholics Anonymous (AA). One of the main beliefs behind AA is that alcoholic dependence is a long-term, progressive illness and total abstinence is the only solution. The treatment is based on a 12-step programme. The steps include admitting you're powerless over alcohol and your life has become unmanageable, admitting you've acted wrongly and where possible, making amends with people you've harmed [1].

Pros: Peer support to quit drinking and make amends. Less intensive than one-to-one treatment. Generally effective as a treatment in maintaining abstinence[4].

Cons: Less personalised and flexible in meeting time/dates than one-to-one sessions. May be intimidating to share personal or traumatic experiences with a group.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

3. 12-Step Facilitation Therapy

   This is based on the programme devised by AA. The difference is you work through stages on a on a one-to-one basis with a counsellor, rather than in a group [1].

   Pros: More personalised treatment option and more flexible in meeting time/dates. Suitable if you feel uneasy or unwilling to discuss your problems in a group setting.

   Cons: No peer support provided and more intensive treatment option than group sessions.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

4. Cognitive Behavioural Therapy (CBT)

   This is a talking therapy that uses a problem-solving approach to alcohol dependence. It involves identifying unhelpful, unrealistic thoughts and beliefs that may be contributing towards your alcohol problem, such as: "I can't relax without alcohol". Once these are identified, you are encouraged to base your behaviour on more realistic and helpful thoughts, such as: "Lots of people have a good time

without alcohol, and I can be one of them". CBT also helps you identify triggers that can cause you to drink such as stress, social anxiety and high-risk environments (e.g. pubs and restaurants) and helps you to avoid those triggers and cope effectively with any that are unavoidable [1].

Pros: Personalised; flexible in meeting time/dates treatment option and more private than group treatment. Generally effective treatment, especially at maintaining abstinence/light days when assessed up to 18-month follow-up [4].

Cons: No peer support provided and more intensive than group treatment.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

5. Group CBT

This is the same as the CBT outlined above but delivered in a group session.

Pros: Peer support provided to moderate/quit drinking. Less intensive than one-to-one treatment.

Cons: Less personalised and flexible in meeting time/dates than one-to-one sessions. May be intimidating to share personal or traumatic experiences with a group.

6. Virtual Reality (VR) Therapy

   With the help of your therapist, you will use a VR headset and handheld controllers to recreate and experience situations that could tempt you to drink (e.g. visiting a pub). The experience is immersive as the environments are in 3-dimensions and your view is updated according to your head movements, like in real life. You may 'meet' talking avatars and personalise the environments – including audio and avatars' voices. Events in the virtual environments can be controlled by the therapist or you, or be pre-designed and can help you identify what/who makes you want to drink and practise how to cope in a more interactive way. After the VR part, you will reflect on your experiences in the VR environment and discuss your emotions and thoughts with the therapist.

   Pros: Personalised, flexible in meeting time/dates and more private than group treatment. Interactive training to cope with personalised triggers in high risk situations is offered, without having to physically enter any high risk environments. Game-like aspect involved.

   Cons: No peer support. a few cases, people have experienced mild nausea. Only a few studies exist about its effectiveness, showing moderate alcohol craving reduction, but larger, standardised clinical trials are needed.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

7. Mobile VR Therapy

   This is based on the treatment above. The difference is that a smartphone is used, instead of a standard VR headset, and it is attached to a VR headset case. The therapist can be present or communicate online with you.

   Pros: Personalised, flexible in meeting time/dates and more private than group treatment. Interactive training to cope with personalised triggers in high risk situations is offered, without having to physically enter any high risk environments. Game-like aspect involved. Online training to cope with triggers. It can be used anywhere (e.g. at home).

   Cons: No peer support. Requires for you to own a smartphone (Android 4.4 or higher, iPhone 5S or newer, with iOS 8 or higher) if delivered online. Anxiety, distress and alcohol craving may be caused by the interactive training. In a few cases, people have experienced mild nausea Less immersive and, depending on the VR application design, may be less interactive due to the lack of the handheld controllers.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

8. Guided Self-help

With guided self-help you work through a CBT-based workbook or computer course with the support of a therapist. The therapist works with you to understand your problems and make positive changes in your life. Guided self-help aims to give you helpful tools and techniques that you can carry on using after the course has finished. During the course your therapist will support you with face-to-face appointments or phone calls[2].

   Pros: Flexible in time/dates. Increased privacy, especially if phone calls are opted. Less intensive than face-to-face treatment.

   Cons: Requires PC/laptop with internet connection when delivered as a computer course. Intervention is limited in nature – usually no more than three to five sessions. A few clinical trials exist about its effectiveness, showing promising results, but larger, standardised clinical trials are needed [4].

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**

I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

9. Family Therapy

Family therapy provides family members with the opportunity to learn about the nature of alcohol dependence and support the member of the family who is trying to abstain from or reduce their drinking. Support is also available for family members in their own right. Living with someone who misuses alcohol can be stressful, so receiving support can often be very helpful [1].

Pros: Personalised treatment plan. Helps others understand what you are going through and support each other. Effective for reducing alcohol use [4].

Cons: Less flexible meeting time/dates as everyone should attend. May be intimidating and upsetting for some people to share their problem/ traumatic experiences with family members.

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

10. Counselling

Counselling is a talking therapy. At your appointment, you'll be encouraged to talk about your feelings and emotions with a trained therapist, who'll listen and support you without judging or criticising. The therapist can help you gain a better understanding of your feelings and thought processes, and find your own solutions to problems. But they won't usually give advice or tell you what to do[3].

Pros: Personalised, flexible in meeting time/dates and more private than group treatment. Offers the ability to talk about your problems and come to the realisation of how to solve them progressively and on your own.

Cons: No peer support. Clinical trials about counselling involved not well-defined or manual-based definitions of it, with a few studies being included in analysis about its effectiveness, showing however promising results [4].

I think this treatment is appropriate for the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would find this treatment suitable for me personally	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I would expect to benefit from this treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Next, please choose which would apply to you:

Overall, if a choice was offered, I would prefer any treatment to be delivered:

- Over the telephone
- Via video call
- Via email
- Via a mobile/computer application
- Via text
- In person

Finally, please rank the treatments in order of your preference – with the first being the most appealing to you and the last the least appealing.

1. Brief intervention
2. Self-help Groups
3. 12-step Facilitation therapy
4. Cognitive Behavioural Therapy (CBT)
5. Group CBT
6. Virtual Reality (VR) Therapy
7. Mobile VR Therapy
8. Guided Self-help
9. Family Therapy
10. Counselling
11. No treatment

Familiarity and Prior Knowledge

Please indicate whether you had any knowledge of, or familiarity with or had heard about these treatments before completing this survey, either through personal experience or through the media or from friends or others. Only indicate yes if you had a reasonable amount of knowledge. If you had prior knowledge of a treatment please indicate overall whether this knowledge was positive or negative.

1. Brief intervention	**yes/no**	**positive/negative**
2. Self-help Groups (e.g. AA)	**yes/no**	**positive/negative**
3. 12-step Facilitation Therapy	**yes/no**	**positive/negative**
4. Cognitive Behavioural Therapy (CBT)	**yes/no**	**positive/negative**
5. Group CBT	**yes/no**	**positive/negative**
6. Virtual Reality (VR) Therapy	**yes/no**	**positive/negative**
7. Mobile VR Therapy	**yes/no**	**positive/negative**
8. Guided Slef-help	**yes/no**	**positive/negative**
9. Family Therapy	**yes/no**	**positive/negative**
10. Counselling	**yes/no**	**positive/negative**

Have you ever used VR in any context?
Yes, standard VR (HTC Vive, Oculus, etc.)
Yes, mobile VR (Smartphone-based)
No

If yes, was the VR experience positive or negative?
Positive/negative

References:

[1] NHS. (2018, August 21). *Treatment*. Retrieved from https://www.nhs.uk/conditions/alcohol-misuse/treatment/
[2] NHS. (2018, August 28). *Types of talking therapies*. Retrieved from https://www.nhs.uk/conditions/stress-anxiety-depression/types-of-therapy/
[3]NHS. (2017, November 9). *Counselling*. Retrieved from https://www.nhs.uk/conditions/counselling/
[4]National Collaborating Centre for Mental Health. (2019). *Alcohol-use disorders: diagnosis, assessment and management of harmful drinking (high-risk drinking) and alcohol dependence*. The British Psychological Society and The Royal College of Psychiatrists

Appendix D

Pairwise Comparisons of Treatment Acceptability

Within-Subjects Factors

Measure: MEASURE_1

Acceptability	Dependent Variable
1	Brief Intervention
2	Self-help Groups
3	12 Step Facilitation Therapy
4	Cognitive Behavioral Therapy
5	Group Cognitive Behavioral Therapy
6	Virtual Reality Therapy
7	Mobile Virtual Reality Therapy
8	Guided Self-help
9	Family Therapy
10	Counselling

Descriptive Statistics

	Mean	Std. Deviation	N
12 Step Facilitation Therapy	17.57	2.972	259
Cognitive Behavioral Therapy	17.39	3.531	259
Counselling	16.73	3.249	259
Group Cognitive Behavioral Therapy	14.64	4.468	259
Self-help Groups	14.61	3.870	259
Guided Self-help	13.83	4.009	259
Brief Intervention	13.64	4.036	259
Family Therapy	12.80	4.598	259
Virtual Reality Therapy	12.58	4.249	259
Mobile Virtual Reality Therapy	11.57	4.229	259

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Acceptability	Pillai's Trace	.704	65.990[b]	9.000	250.000	.000
	Wilks' Lambda	.296	65.990[b]	9.000	250.000	.000
	Hotelling's Trace	2.376	65.990[b]	9.000	250.000	.000
	Roy's Largest Root	2.376	65.990[b]	9.000	250.000	.000

Multivariate Tests[a]

Effect		Partial Eta Squared
Acceptability	Pillai's Trace	.704
	Wilks' Lambda	.704
	Hotelling's Trace	.704
	Roy's Largest Root	.704

a. Design: Intercept
Within Subjects Design: Acceptability

b. Exact statistic

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser
Acceptability	.164	461.410	44	.000	.733

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Epsilon[b] Huynh-Feldt	Lower-bound
Acceptability	.755	.111

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: Acceptability

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F
Acceptability	Sphericity Assumed	10134.799	9	1126.089	93.792
	Greenhouse-Geisser	10134.799	6.599	1535.709	93.792
	Huynh-Feldt	10134.799	6.791	1492.396	93.792
	Lower-bound	10134.799	1.000	10134.799	93.792
Error(Acceptability)	Sphericity Assumed	27878.501	2322	12.006	
	Greenhouse-Geisser	27878.501	1702.652	16.374	
	Huynh-Feldt	27878.501	1752.068	15.912	
	Lower-bound	27878.501	258.000	108.056	

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Sig.	Partial Eta Squared
Acceptability	Sphericity Assumed	.000	.267
	Greenhouse-Geisser	.000	.267
	Huynh-Feldt	.000	.267
	Lower-bound	.000	.267
Error(Acceptability)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Acceptability	Type III Sum of Squares	df	Mean Square	F	Sig.
Acceptability	Linear	419.657	1	419.657	38.794	.000
	Quadratic	189.602	1	189.602	12.679	.000
	Cubic	7284.141	1	7284.141	422.414	.000
	Order 4	16.613	1	16.613	1.456	.229
	Order 5	436.081	1	436.081	32.308	.000
	Order 6	1391.715	1	1391.715	101.686	.000
	Order 7	204.814	1	204.814	13.773	.000
	Order 8	123.330	1	123.330	23.202	.000
	Order 9	68.846	1	68.846	10.998	.001
Error(Acceptability)	Linear	2790.927	258	10.818		
	Quadratic	3858.019	258	14.954		
	Cubic	4448.978	258	17.244		
	Order 4	2944.043	258	11.411		
	Order 5	3482.414	258	13.498		
	Order 6	3531.100	258	13.686		
	Order 7	3836.526	258	14.870		
	Order 8	1371.377	258	5.315		
	Order 9	1615.115	258	6.260		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Acceptability	Partial Eta Squared
Acceptability	Linear	.131
	Quadratic	.047
	Cubic	.621
	Order 4	.006
	Order 5	.111
	Order 6	.283
	Order 7	.051
	Order 8	.083
	Order 9	.041
Error(Acceptability)	Linear	
	Quadratic	
	Cubic	
	Order 4	
	Order 5	
	Order 6	
	Order 7	
	Order 8	
	Order 9	

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	547276.912	1	547276.912	11362.344	.000	.978
Error	12426.788	258	48.166			

Estimated Marginal Means

Acceptability

Estimates

Measure: MEASURE_1

Acceptability	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	13.637	.251	13.143	14.131
2	14.614	.240	14.140	15.087
3	17.571	.185	17.208	17.935
4	17.390	.219	16.958	17.822
5	14.645	.278	14.098	15.191
6	12.579	.264	12.059	13.099
7	11.568	.263	11.050	12.085
8	13.834	.249	13.343	14.324
9	12.799	.286	12.237	13.362
10	16.726	.202	16.328	17.123

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ...[b]
					Lower Bound
1	2	-.977	.320	.111	-2.031
	3	-3.934*	.280	.000	-4.859
	4	-3.753*	.314	.000	-4.787
	5	-1.008	.361	.255	-2.199
	6	1.058	.330	.069	-.032
	7	2.069*	.314	.000	1.035
	8	-.197	.313	1.000	-1.230
	9	.838	.352	.804	-.321
	10	-3.089*	.287	.000	-4.034
2	1	.977	.320	.111	-.077
	3	-2.958*	.250	.000	-3.781

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	95% Confidence Interval for [b]... Upper Bound
1	2	.077
	3	-3.010
	4	-2.718
	5	.184
	6	2.147
	7	3.104
	8	.837
	9	1.997
	10	-2.143
2	1	2.031
	3	-2.134

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence [b]... Lower Bound
	4	-2.776*	.279	.000	-3.696
	5	-.031	.218	1.000	-.750
	6	2.035*	.309	.000	1.014
	7	3.046*	.313	.000	2.015
	8	.780	.313	.603	-.253
	9	1.815*	.312	.000	.785
	10	-2.112*	.283	.000	-3.045
3	1	3.934*	.280	.000	3.010
	2	2.958*	.250	.000	2.134
	4	.181	.226	1.000	-.562
	5	2.927*	.290	.000	1.972
	6	4.992*	.306	.000	3.984
	7	6.004*	.311	.000	4.979
	8	3.737*	.294	.000	2.768
	9	4.772*	.280	.000	3.847
	10	.846*	.220	.007	.119
4	1	3.753*	.314	.000	2.718
	2	2.776*	.279	.000	1.856
	3	-.181	.226	1.000	-.925
	5	2.745*	.245	.000	1.939
	6	4.811*	.330	.000	3.722
	7	5.822*	.335	.000	4.717
	8	3.556*	.295	.000	2.582
	9	4.591*	.306	.000	3.580
	10	.664	.249	.363	-.156
5	1	1.008	.361	.255	-.184
	2	.031	.218	1.000	-.688
	3	-2.927*	.290	.000	-3.881
	4	-2.745*	.245	.000	-3.552
	6	2.066*	.325	.000	.994

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	95% Confidence Interval for [b]... Upper Bound
	4	-1.856
	5	.688
	6	3.055
	7	4.077
	8	1.813
	9	2.844
	10	-1.179
3	1	4.859
	2	3.781
	4	.925
	5	3.881
	6	6.000
	7	7.028
	8	4.707
	9	5.697
	10	1.572
4	1	4.787
	2	3.696
	3	.562
	5	3.552
	6	5.900
	7	6.928
	8	4.530
	9	5.601
	10	1.484
5	1	2.199
	2	.750
	3	-1.972
	4	-1.939
	6	3.137

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ... [b] Lower Bound
	7	3.077*	.327	.000	2.000
	8	.811	.338	.778	-.305
	9	1.846*	.316	.000	.804
	10	-2.081*	.317	.000	-3.126
6	1	-1.058	.330	.069	-2.147
	2	-2.035*	.309	.000	-3.055
	3	-4.992*	.306	.000	-6.000
	4	-4.811*	.330	.000	-5.900
	5	-2.066*	.325	.000	-3.137
	7	1.012*	.181	.000	.414
	8	-1.255*	.355	.022	-2.427
	9	-.220	.341	1.000	-1.346
	10	-4.147*	.329	.000	-5.230
7	1	-2.069*	.314	.000	-3.104
	2	-3.046*	.313	.000	-4.077
	3	-6.004*	.311	.000	-7.028
	4	-5.822*	.335	.000	-6.928
	5	-3.077*	.327	.000	-4.155
	6	-1.012*	.181	.000	-1.609
	8	-2.266*	.335	.000	-3.371
	9	-1.232*	.335	.013	-2.336
	10	-5.158*	.324	.000	-6.228
8	1	.197	.313	1.000	-.837
	2	-.780	.313	.603	-1.813

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	95% Confidence Interval for [b]... Upper Bound
	7	4.155
	8	1.927
	9	2.887
	10	-1.036
6	1	.032
	2	-1.014
	3	-3.984
	4	-3.722
	5	-.994
	7	1.609
	8	-.083
	9	.906
	10	-3.063
7	1	-1.035
	2	-2.015
	3	-4.979
	4	-4.717
	5	-2.000
	6	-.414
	8	-1.162
	9	-.128
	10	-4.088
8	1	1.230
	2	.253

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence ... [b] Lower Bound
	3	-3.737*	.294	.000	-4.707
	4	-3.556*	.295	.000	-4.530
	5	-.811	.338	.778	-1.927
	6	1.255*	.355	.022	.083
	7	2.266*	.335	.000	1.162
	9	1.035	.322	.067	-.028
	10	-2.892*	.297	.000	-3.872
9	1	-.838	.352	.804	-1.997
	2	-1.815*	.312	.000	-2.844
	3	-4.772*	.280	.000	-5.697
	4	-4.591*	.306	.000	-5.601
	5	-1.846*	.316	.000	-2.887
	6	.220	.341	1.000	-.906
	7	1.232*	.335	.013	.128
	8	-1.035	.322	.067	-2.097
	10	-3.927*	.316	.000	-4.967
10	1	3.089*	.287	.000	2.143
	2	2.112*	.283	.000	1.179
	3	-.846*	.220	.007	-1.572
	4	-.664	.249	.363	-1.484
	5	2.081*	.317	.000	1.036
	6	4.147*	.329	.000	3.063
	7	5.158*	.324	.000	4.088
	8	2.892*	.297	.000	1.912
	9	3.927*	.316	.000	2.886

Pairwise Comparisons

Measure: MEASURE_1

(I) Acceptability	(J) Acceptability	95% Confidence Interval for [b]... Upper Bound
	3	-2.768
	4	-2.582
	5	.305
	6	2.427
	7	3.371
	9	2.097
	10	-1.912
9	1	.321
	2	-.785
	3	-3.847
	4	-3.580
	5	-.804
	6	1.346
	7	2.336
	8	.028
	10	-2.886
10	1	4.034
	2	3.045
	3	-.119
	4	.156
	5	3.126
	6	5.230
	7	6.228
	8	3.872
	9	4.967

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

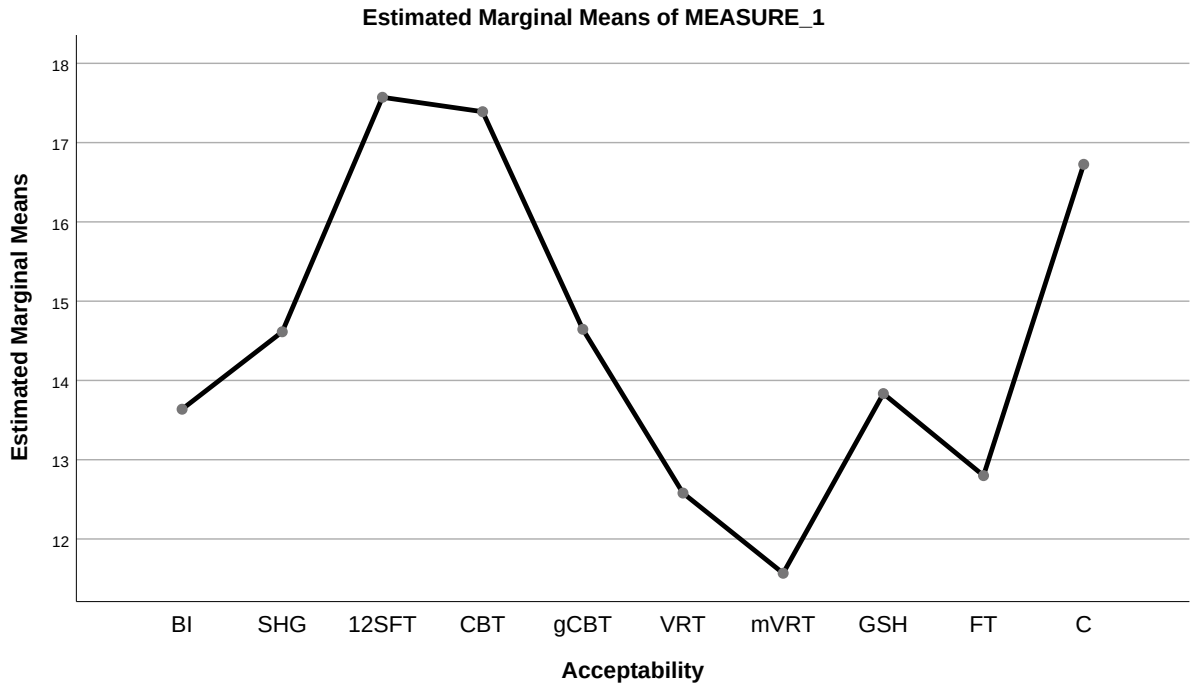
Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.704	65.990[a]	9.000	250.000	.000	.704
Wilks' lambda	.296	65.990[a]	9.000	250.000	.000	.704
Hotelling's trace	2.376	65.990[a]	9.000	250.000	.000	.704
Roy's largest root	2.376	65.990[a]	9.000	250.000	.000	.704

Each F tests the multivariate effect of Acceptability. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

Profile Plots




```
 GET
  FILE='C:\Users\skeva\OneDrive\Documents\Preferences Study\Merged files for R
igina.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
FREQUENCIES VARIABLES=UNITS_total
  /STATISTICS=RANGE MINIMUM MAXIMUM STDDEV MEAN MEDIAN
  /FORMAT=NOTABLE
```

Appendix E

Approved Ethics Application - Cancelled, Pilot Trial

Ethics Application

Research

Please be mindful that each application, submitted via the University's Ethical Review Manager (ERM), costs the University **£750** due to the number of people required to process, review and approve your application.

Please respect this fact and ensure that you carefully follow the guidance provided and help bubble text in order to complete your application appropriately (and choose the correct route of ethical review). Please **DO NOT** use the ERM system for 'test' submissions. Misuse of the ERM system is a waste of numerous resources which could otherwise be dedicated to research, teaching and social responsibility activities.

You are logged into the Ethical Review Manager (ERM), the system provided by Infonetica Ltd that will process the application on behalf of The University of Manchester. Your contact details will be stored by Infonetica Ltd and used by the University for the purpose of managing your application for ethics review. The University will use your details for that purpose only. The information will be retained, archived and deleted in line with the agreed retention policy. Your details will not be passed to any other third party organisations.

The University, in compliance with the Data Protection Act 2018 (DPA) and the General Data Protection Regulation (GDPR), has a **Data Protection Policy** and **Research Privacy Notice** and any information you provide on this form and associated documents will be protected in accordance with these policies. However, it will be assumed that you have not included any sensitive personal information and you should not, therefore, include a *curriculum vitae* or identifiable information about your racial or ethnic origin, political opinions, religious or similar beliefs, trade union membership, physical or mental health, sexual life, commission of offenses and/or criminal proceedings. Should you feel it essential to include such details in your application please contact the Research Governance, Ethics and Integrity team (research.ethics@manchester.ac.uk).

Please also note this system will send all correspondence related to your ethics application to your University of Manchester email account.

Please do not proceed unless you are content to comply with this.

A0. Data Protection Statement

☑ I confirm that I have read the above information with regard to data protection and will comply with the requirements as described.

A1. Does your study meet the definition of 'research' using human participants or have you been advised to seek ethical approval for your study (either via the Ethics Decision Tool or other guidance)?

Please visit the help bubble (blue circle with the white letter 'i') to the right of this question for a link to the Ethics Decision tool and supplementary information on the types of projects which may or may not require ethical review.

- (•) Yes

You **must read** the information in the help bubble before answering this question. If you cannot answer yes **do not complete the rest of this form, log out of the ERM system** and if you have any queries contact your Ethics Signatory.

You should only be submitting this form if you can answer yes to this question.

A02 HRA Approval

A2. Does your study include a component which would require approval by the Health Research Authority (HRA)?

Please visit the Help Bubble in the upper right hand corner for details as to what types of research require NHS REC and HRA approval.

Please choose the option which is most relevant for your study. If you have 2 components (i.e. one using healthy volunteers and one using NHS patients), please speak with a member of the FBMH Research Governance team who will advise on the most appropriate avenue for review.

- ( ) Yes: it includes a component that requires review by BOTH the HRA and the University Research Ethics Committee or a Division/School based Committee (e.g. it is being carried out in the NHS but is exempt from NHS REC review)
- (•) No: it only requires review by the University Research Ethics Committee (UREC) or a Division/School based Committee

A03 - 05 Decision Tree

A3. I confirm that this research project is being conducted by a:

- (•) Student
- ( ) Member of Staff
- ( ) Member of Eurolens Research, Optometry Staff

IMPORTANT: Your answer to **Question A4** will lead you to the correct application form for ethical review and it is important that you answer this question carefully**.**

Please ensure you read the guidance notes carefully **BEFORE** answering this question and for student projects, discuss the details with your supervisor.

The guidance notes can be found in the Help Bubble (small blue circle with the white letter 'i') to the right of Question A4.

Answering this question incorrectly will result in **SIGNIFICANT** delays to the review process and will result in you needing to **re-apply** for ethical review.

A4. Please select how you will be applying for ethical review:

Please ensure you read the criteria as described in the help bubble carefully before deciding which route of ethical review to select.

****Division/School review is only available for the 10 Schools/Divisions/Departments listed in the help bubble to the right of this question. If your School/Division/Department is not listed you must apply for Proportionate or full UREC review****

- ○ Division/School Review
- ◉ Proportionate University Research Ethics Committee (UREC) Review
- ○ Full University Research Ethics Committee (UREC) Review

STOP!

Are you doing a **student** project?

If so, are you sure that your project could not be ethically reviewed by a **Division/School** panel instead of the UREC?

Incorrectly applying for UREC review rather than Division/School review can result in you needing to re-apply for ethical review and will result in significant delays. In addition, it wastes a considerable amount of UREC resources.

For details on whether your project qualifies for Division/School review please see the help bubble in Question A4.

A4.1 I am applying for Proportionate UREC Review and confirm the following:

- ☑ My study will be conducted exclusively inside the EU or in one of the 3 non-EU EEA member countries (Please note: if conducting interviews via telephone or Skype all research participants MUST be inside the EEA or the application will need to be submitted for full UREC review).

Please take care when selecting your Division/School/Department/PSS Directorate/Cultural Institution from the drop-down list below.

Mistakes will result in your application being sent to the wrong ethics signatory for review.

Please note, the selection made below should reflect where you are based at the University.

A5 UREC Review (full or Proportionate): Please select which Division/School/Department/Centre/area of PSS/Cultural Institution you are based in:

Department of Computer Science

A5.1 Please confirm which of the following criteria are applicable to your project:

Please ensure you read through the options below and tick **all** that apply to your project. Further guidance is available in the help bubble to the right of this question.

****Denotes mandatory criteria** that must be met in order to qualify for Proportionate UREC review. If your study does not meet these mandatory criteria you will need to apply for full UREC review, where appropriate.

IMPORTANT NOTE: If your study involves the use of human tissue, please **ONLY** tick the final box in relation to human tissue. **DO NOT** tick any of the other criteria.

If your research involves an activity falling within one of the conditional criteria beginning with "If" then it must meet the requirements of that criterion or criteria to be considered for Proportionate UREC Review.

Participants and Consent

- ☑ **Involves only participants who are non-vulnerable adults able to give informed consent or, if children/ young people are involved, they must be a) in an educational setting/accredited organisation, b) have the opportunity to assent (with parental/guardian opt-in consent also provided) and c) NOT be classed/viewed as specifically vulnerable.

Data Collection and Experimental Procedures

Please note: Studies involving EEGs **may be submitted** for Proportionate UREC review as they are **not classed** as physically invasive procedures.

- ☑ **Does not involve physically invasive procedures (any test in which the skin of the participant is broken, an injection is admistered or an implement is inserted into any opening of the human body (e.g. eyes, ears, nose, mouth, lungs, stomach, rectum, vagina and urethra) or involves the taking of body samples such as blood, saliva, hair, urine, faeces, sputum, skin, nails, or taking biopsies of any form for any purpose, or any form of scanning such as Ultrasound scans, MRI or fMRI scanning) with the only exceptions being standard audiology techniques performed on healthy adult volunteers as outlined in the Help Bubble to the right of this question.
- ☑ **Does not involve activities that pose a significant risk of causing physical harm or more than mild discomfort.
- ☑ **Does not involve activities that pose a significant risk of causing psychological stress or anxiety.
- ☑ **Does not require participants to take part in activities that pose a significant risk of having an adverse effect on their personal well-being (e.g. physical and psychological health), social well-being (e.g. social standing, social connectedness) or economic well-being (e.g. employment, employability, professional standing).

Sensitivity of Topic or Data

- ☑ **Does not involve collecting or revealing data that enables individuals, groups or organisations to be identified in such a way that they could experience negative effects on their personal, social or economic well-being.
- ☑ **Does not require research participants to provide personal and sensitive information likely to lead to significant levels of distress (ie research must only involve topics that are either not contentious or sensitive at all, or where a reasonable person would agree the topic is of legitimate interest and may result in distress only in rare instances).
- ☑ If topics being researched are of a sensitive nature, they are not personal to the participants.
- ☐ If using video recording or other images captured by the researcher and/or research study participants, the researcher is able to guarantee controlled access to authorised viewing.
- ☐ If researching professional practice, participants are in professional roles and the research is conducted in their work setting (It would also be acceptable to conduct these interviews via telephone or Skype as long as the content of the interviews is focused on professional practice and non-sensitive topics. Please note that in this instance, participants will be responsible for ensuring appropriate privacy arrangements).
- ☑ If conducting observations, they will be on ordinary, non-sensitive behaviours.

Location of Data Collection

- ☑ **Will be conducted exclusively inside the EU or in one of the 3 non-EU EEA member countries. Please note: if conducting interviews via telephone or Skype all research participants MUST be inside the EEA or the application will need to be submitted for full UREC review. (Human tissue samples may be imported in from non-EU or EU EEA countries under the guidelines).
- ☑ If applicable, will be carried out within normal working hours or at a time convenient to participants.
- ☐ If research will involve going into the homes of participants and this is a student project, participants will be limited to family and friends..
- ☐ If research will involve going the homes of participants and this is a staff project, participants may include members of the

general public providing a completed and signed risk assessment has been attached in support of this application

- ☐ If conducting observations they will be located in a public space or the clearly public areas of a building (e.g. the high street, the University campus, the entrance hall of a town hall).
- ☐ If research is limited to the secondary use of previously collected identifiable data from outside the EEA, 1) a material transfer agreement is in place between the data controller and the University of Manchester and a copy is appended to this application 2) the researcher is able to attach proof that the analysis which will be performed falls within the consent of the data subjects (e.g. that the data can be used for future research).

Human Tissue Specific Criteria

Please note: if you are performing research using human tissue you MUST confirm the following condition.

- ☐ This study involves the use of human tissue and I will complete the additional questions in Section C5.

B02 Students

B2. Contact information for the individual completing this form:

Title	First Name	Surname
Miss	Rigina	Skeva

Email: rigina.skeva@manchester.ac.uk

B2.1 Please confirm one of the following:

- ◉ I am the student investigator of this project.
- ○ I am the supervisor of this project.

B2.2 Please provide the full contact details of your primary supervisor:

This **MUST** be a University of Manchester member of staff with a UoM email address. Please note, the primary supervisor is also the data custodian for your research project. If you have more than one supervisor, please use the '**Add Another**' button below to add the contact details of your additional supervisor(s).

If when using the Search function you cannot locate your supervisor, please ensure they have logged into the ERM at least once. Once they have done this, their details will be stored for future use.

Title	First Name	Surname
Prof	Stephen	Pettifer

Email: steve.pettifer@manchester.ac.uk

B2.2 Please provide the full contact details of your primary supervisor:

This **MUST** be a University of Manchester member of staff with a UoM email address. Please note, the primary supervisor is also the data custodian for your research project. If you have more than one supervisor, please use the '**Add Another**' button below to add the contact details of your additional supervisor(s).

If when using the Search function you cannot locate your supervisor, please ensure they have logged into the ERM at least once. Once they have done this, their details will be stored for future use.

Title	First Name	Surname
Dr	Lynsey	Gregg

Email: lynsey.gregg@manchester.ac.uk

B2.2 Please provide the full contact details of your primary supervisor:

This **MUST** be a University of Manchester member of staff with a UoM email address. Please note, the primary supervisor is also the data custodian for your research project. If you have more than one supervisor, please use the '**Add Another**' button below to add the contact details of your additional supervisor(s).

If when using the Search function you cannot locate your supervisor, please ensure they have logged into the ERM at least once. Once they have done this, their details will be stored for future use.

Title	First Name	Surname
Dr	Caroline	Jay

Email: Caroline.Jay@manchester.ac.uk

B2.3 Are there any additional collaborators on this project?

Please note: Collaborators are defined as individuals who will assist in either the data collection or data analysis of the project and can be members of staff or students.
Please include any external collaborators from other institutions or organisations. They will **NOT** be involved in any of the electronic correspondence for this project.

- ○ Yes
- ◉ No

B2.12 Please confirm the degree being studied for by the student investigator:

- ◉ Postgraduate Research (PGR) (e.g. PhD degree)
- ○ Postgraduate Taught (PGT) (e.g. masters degree)
- ○ Undergraduate (UG)
- ○ Postgraduate Taught + Undergraduate (the study will be conducted by BOTH an UG and PGT student; note: this is rare)

B2.13 IMPORTANT: BEFORE CONTINUING:

Look on the left hand side of the screen for the '**share**' button. Push this button, enter the appropriate email address and be sure to tick all the relevant boxes in the pop up window.

- ☑ I confirm that I have pushed the share button on the left hand side of the screen and 'shared' this form with my supervisor.

C01: Compliance & Monitoring

Please note: Everyone is required to complete the compliance & monitoring questions below, whether you are completing a Proportionate University Research Ethics Committee (UREC), full UREC or Division/School template application.

IMPORTANT NOTE: If you will be travelling abroad for your research, and in particular to what is considered to be a risky or dangerous area of the world, you must ensure that you have completed the appropriate Division/School based **risk assessment**, had this **approved** by appropriate individuals within your Division/School and **checked** with the University's Insurance office **regarding travel insurance**. The ERM system **WILL NOT** inform the University's Insurance office of your travel plans automatically (unless you are performing clinical activity) and it is therefore the responsibility of all members of staff and supervisors to contact the Insurance office **prior** to obtaining ethical approval. Please note that specific areas of the world will require additional approvals and this should be taken into consideration when planning a timeline for seeking ethical approval.

C1. Will your research involve any of the following:

Before answering this question please ensure you click on the help bubble to read the guidance information which includes definitions of each of the terms below. Tick all that apply.

- ☐ the use of invasive techniques on participants
- ☐ the use or collection of human tissue
- ☑ the physical testing of participants
- ☐ the use of psychological intervention (please DO NOT tick this option if you are only administering standard psychological tests/questionnaires)
- ☐ the ingestion or inhalation of any substance by participants
- ☐ the use of a medical device or a potential medical device
- ☐ None of the above

C1.1 Will this research be conducted outside of the UK?

- ○ Yes
- ◉ No

C1.2 Will this research involve participants under the age of 5?

- ○ Yes
- ◉ No

C02 Medical Intervention

This study may be reviewed by the UoM Clinical Trial team. If further information is required, the protocol for your study will be requested. Any advice given by the Clinical Trial team is supplementary to the review by your Ethics Signatory (who takes responsibility for your study on behalf of your Division/School) and the ethical issues raised by the UREC.

C2.1 When conducting the proposed methodology, will you be using any piece of equipment that will have direct contact with your potential participants or their samples?

Please open the guidance in the **help bubble** for additional information on this question.

- (•) Yes
- ( ) No

C2.2 Please confirm if an internal risk assessment has been performed for the piece(s) of equipment that you will be using, which has been reviewed by a School Safety Advisor within your faculty and signed off by your line manager:

- (•) Yes
- ( ) No

C2.3 Please confirm that all standard operating procedures (SOPs) are up to date and have been read by all members of your research team for the pieces of equipment that you will be using:

- (•) Yes
- ( ) No

C2.4 Please confirm that all required training has been documented and completed by all members of your research team for the pieces of equipment that you will be using:

- (•) Yes
- ( ) No

C2.5 Will you be administering a drug or other substance to participants?

- ( ) Yes
- (•) No

C2.8 Please describe the procedures to be undertaken

Please include details of any invasive procedures, and any samples or measurements to be taken and/or any psychological tests etc. What is the experience of those administering the procedures?

The following Galvanic Skin Response sensor kit will be used to measure Heart Rate and Skin Conductance of the participants during the testing of the virtual enviroments:

https://www.shimmersensing.com/products/shimmer3-wireless-gsr-sensor#applications-tab

The researcher will assist the participants to wear the kit following the guidelines of usage. The electrodes are attached to two fingers of one hand (and the optical pulse probe attached to the third finger of the participant) and are all connected to the hardware unit which is fastened with an adjustable strap to the wrist of the participant (see figure in the attached Participant Information Sheet).

The researcher has undertaken the Good Clinical Practice course and has been informed by literature and relevant tutorials (available by the company selling the sensor kit). The researcher was also advised by researchers (eg Dr Paul Warren, SBS) whose research focuses on behavioural responses during real life exposure to stimuli and virtual exposure to stimuli to verify its correct usage. The researcher has also practised its administration on themselves to allow for further familiarization with how to wear and record the GSR and the HR.

C2.9 Will any procedures which are normally undertaken be withheld?

- ○ Yes
- ◉ No

C2.11 Will the research participants' General Practitioner be informed that they are taking part in the study?

- ○ Yes
- ◉ No

C2.12 Please explain why not.

The measuring of Heart Rate and Skin Conductance using the specified kit raise no risk to the participants and in no case can affect the participants in a negative way.

C2.14 What are the criteria that would cause the researcher to electively stop the research project prematurely?

The criteria will not be related to the HR and SC sensor kit. The only criterion that the researcher can stop the study is the participant feeling discomfort wearing the VR headset and wanting to remove it and not proceed.

C03 Medical Devices/Testing

C3.1 Which of the following describes the medical device or potential medical device that you will be using?

- ◉ CE marked
- ○ Non CE marked

C3.2 Are you using the device for its intended purpose?

- ◉ Yes
- ○ No

C3.5 Please declare the following:

- ☑ I confirm that I have attached a completed and signed risk assessment or management plan for this study.

C3.6 Have all members of the research team (including supervisors if applicable) undergone GCP training?

- ◉ Yes
- ○ No

D01 - 02 General Project Information: Resubmission and titles

D1. Is this a re-submission of a project that has previously received an unfavourable ethical opinion?

Please note: this **does not** include applications where revisions have been requested.

- ○ Yes
- ◉ No

D2. Short title of your research project (200 character max)

Using Virtual Reality environments to explore the desire to drink alcohol

D2.1 Formal title of your research project (if different to short title)

D03 Dates of Data Collection/DMP/Data Collection

D3. Will you be collecting data during the course of the research project?

Please note, data refers to any information being gathered about a person or organisation. This information can include specifics such as thoughts, beliefs or characteristics and can be in different formats such as written notes, questionnaires, observations, audio recordings, films, photographs, social media postings or bodily samples.

- ◉ Yes
- ○ No

D3.1 Proposed start date of data collection

Please ensure this date is **far enough in the future to allow for the ethical review process to take place**. The Committee will be **unable to grant approval** to applications which feature a start date **that is in the past**.

10/03/2020

D3.2 Proposed end date of data collection

31/01/2021

D3.3 Please attach a copy of your Data Management Plan:

You **must** use the University's DMP Online system for the creation of your plan and more information can be found in the help bubble.

Please note: if you are not collecting any data for this project, please read the guidance information in the help bubble for additional instructions.

Type	Document Name	File Name	Version Date	Version	Size
Data Management Plan	Data Management Outline - VRET combined with Cognitive Behavioral Therapy for Alcohol Use Disorder Relapse Prevention (DMP No_ 44666)	Data Management Outline - VRET combined with Cognitive Behavioral Therapy for Alcohol Use Disorder Relapse Prevention (DMP No_ 44666).pdf	12/11/2019	0.1	189.0 KB
Data Management Plan	RS_3_2020_DMP_Using Virtual Reality environments to explore the desire to drink alcohol	RS_3_2020_DMP_Using Virtual Reality environments to explore the desire to drink alcohol.pdf	28/02/2020	0.3	237.6 KB

D04 Data Protection Training

All staff and students at the University of Manchester are responsible for ensuring they are familiar with the data protection policies and processes and follow these when conducting their research projects. Under the new General Data Protection Regulations (GDPR) the University is required to provide assurances and safeguards to all research participants that their data will be treated confidentially and will be protected as set out to the relevant data protection legislation. To support this, please complete the relevant question below to confirm that you have undertaken the required Data Protection Training or discussed the University's requirements and expectations with your supervisor.

D4. Please tick **each statement** below to indicate that you **understand** and **will adhere to** data protection regulations and The University of Manchester's data protection policies.

For more information, please see the **University's Records Retention Schedule** and **SOP for Recording of Research Participants**.

- ☑ I will ensure that paper data (e.g. consent forms) are stored in a locked cabinet that only the research team has access to.
- ☑ I confirm that all electronic data will be stored on University servers such as my P drive or on the research drive of my supervisor or University approved cloud services e.g. Dropbox for Business.
- ☑ I will NOT use external hard drives, USB sticks or any other portable device to store personal identifiable data as they are subject to loss or theft.
- ☑ I will NOT use personal devices for the recording of audio, video or photographs. (Please refer to the SOP for Recording of Research Participants for more information).
- ☑ I understand that if I need to use a portable device to record and transfer data, this device should be University of Manchester owned and encrypted, the data transferred to a secure server as soon as possible and must be deleted from the portable device following the transfer. (If an encrypted device is not available you will need to make specific arrangements with respect to securing data as soon as possible and this must be detailed in your ethics application).
- ☑ I will NOT store data on cloud based services other than Dropbox for Business approved by the University.
- ☑ I will ensure that all data are anonymised/pseudonymised as soon as possible to protect the confidentiality of my participants.
- ☑ I will only collect the personal information that is required to answer my research question and as approved by the ethics committee.
- ☑ I understand that personal information should be deleted as soon as it is no longer required. If keeping the contact details of participants to contact them about future research or to share findings of my project, I will store these in a separate password protected file or database held on University servers or approved cloud services.
- ☑ I understand that all data should be stored in accordance with the University's Records Retention schedule and must be kept for the period as specified in my data management plan or approved ethics application.
- ☑ I understand that my supervisor MUST be listed as the data custodian for my project and I must ensure that I transfer custody of all paper and electronic data to them before I leave the University.
- ☑ I understand that I SHOULD use encrypted devices when analysing my study data if not accessing the data directly from my P drive or other secure University server.
- ☑ I understand that I MUST ensure that when I am transcribing or analysing data that it is done in a way in which other people are NOT able to see any personal data on my devices.
- ☑ I understand that if I wish to share study data with other researchers or retain the data for use in future studies that I MUST ensure this is explicitly mentioned in the participant information sheet and consent form.
- ☑ I understand that ONLY University of Manchester or study specific email addresses/phone numbers can be used by researchers for their research projects.

Project Specification: L1-L3

WARNING: You are now completing the ethical review form for the **Proportionate UREC Review**. If you are not applying for Proportionate UREC review, then please return to **Question A4** and **update your answer.**

It should **only be used** for **low risk** research projects **which adhere to the criteria in Question A5.1**. If you are conducting a **high risk** research project, you must submit go for **Full University Research Ethics Committee (UREC) review**.

Please press the '**Next**' button in the upper left hand corner of the screen to continue with the form and please note that the question numbers may not be sequential.

Ethical Considerations: L4

L4. Are participants from any of the following groups?

Tick all that apply

- ☐ Children under 16 years who are being researched outside of an educational setting or accredited organisation.
- ☐ Adults with learning difficulties who are being researched outside of a supportive environment
- ☐ Adults with dementia
- ☐ Adults or children in emergency situations
- ☐ Prisoners or criminals
- ☐ Young offenders
- ☐ Users of illegal drugs or illegal substances
- ☑ None of the above

Research Project Details: L14

L14. What is the principal research question, in lay terms?

Limit response to 750 characters. This **MUST** be in lay language and should not be a cut/paste of your theoretical or intellectual rationale.

Can virtual environments induce alcohol craving in people who regularly consume alcohol?

Further aims of the study:
We plan to investigate whether participants find the virtual environments we have developed (pub, mini market store) comfortable, realistic and immersive.

L15

L15. How have the quality and suitability of the research design and methods been assessed?

Tick all that apply

- ☐ Independent internal review (e.g. review by academic supervisor/advisor, research centre/research group at the University of Manchester)
- ☐ External review (e.g. review by the funder of the research, methodological/technical expert, research centre/research group or commercial organisation not at the University of Manchester)
- ☑ In the case of a student research project reviewed by supervisor(s)
- ☐ Other

L16

L16. Please confirm the following:

- ☑ I confirm the design and methods of the study are appropriate for the question(s) being asked and the researcher(s) has addressed potential threats to validity, accuracy and/or integrity.

You **MUST** tick the box above in order to submit this form.

L17

L17. What is the maximum number of participants you plan to recruit (including, if relevant, the potential for dropout)?

30

L17.3 If you will be using more than one group of participants, please explain why and how your total number will be broken down into specific groups:

This includes if you have experimental and control groups.

Two pairs of virtual environments are built.

Pair A:
- mini market like store without alcohol-selling aisle
- the same mini market like store with alcohol-selling aisle

Pair B:
- pub without social pressure to drink applied from an avatar
- pub with social pressure to drink applied from an avatar twice and with

Therefore, two groups will be formed where each participant is assigned one pair only:

- 1 group of 15 participants testing the mini market like store (pair A)
- 1 group of 15 participants testing the pub virtual environment (pair B)

Participants will be assigned to each pair of environments according to their participation order:

Odd number participants (1st, 3rd...) will be assigned to pair A of virtual environments and even number participants (2nd, 4th...) will be assigned to pair B to counter-balance the recruitment.

As participants will be reimbursed for their time with vouchers of £10, the total number of participants that funding is available for is limited to 30 (including drop-outs as once the participant shows up for the testing, they will be reimbursed anyway, even if due to the case of discomfort caused by the equipment they decide to not proceed and, thus, they will be considered as drop-outs as they will not have tried the alcohol cued environments).

L18

L18. How was the number of participants decided upon?

Please select at least one option

- ☐ Statistical sampling. The sample size is large enough to provide adequate power for appropriate statistical tests concerning statistical significance, effect size and confidence intervals.
- ☐ Theoretical sampling. The number of participants is estimated to provide sufficient data such that further increases would likely yield no significant additional insights concerning the topic under investigation.
- ☑ Purposive sampling. The number of participants is based on access to the subject group most appropriate for answering the research question(s) under investigation (e.g. critical case sampling, key informant sampling or snowball sampling).
- ☑ Convenience sampling. The number of participants is based on selection of the most accessible subject group, to control costs in terms of time, effort or other resources.

L18.1 Please confirm the following:

- [x] Convenience sampling is appropriate because the research is exploratory in nature and/or the conclusions to be drawn from the data will not be threatened by issues concerning selection bias, generalisability, sampling error, and/or statistical power.

Research Methods: L20

L20. Does the research involve any of the following data collection methods?

Tick all that apply

- [ ] Method validation
- [x] Interviews
- [ ] Focus Groups
- [x] Paper based surveys/questionnaires
- [x] Electronic or online surveys/questionnaires
- [x] Standard, copyrighted psychology questionnaires/tests
- [x] Field observation (including participant observation)
- [ ] Child/infant behaviour observation
- [ ] Ethnography
- [ ] Visual methods (such as those used in Anthropology)
- [ ] Case study
- [ ] Social Network Analysis
- [ ] Diary methods
- [ ] Assessment (such as those used in Education research)
- [ ] Intervention
- [x] Recordings (audio, video, photographs, etc)
- [ ] Use of pre-existing media (photographs, video, etc)
- [ ] Creative practice as research (such as drama or music pieces)
- [ ] Cognitive psychology/psychophysics (e.g. perception, attention, memory, language, emotion)
- [ ] Cognitive neuroscience (e.g. EEG, eye-tracking, pupillomery, or related measures)
- [ ] Clinical, social or personality psychology (e.g. hypothetical scenarios, role playing, group interactions, personality/state/trait scales)
- [ ] Other qualitative methods (e.g. discourse analysis, interaction analysis, conversation analysis)
- [ ] Other on-line or electronic methods (e.g. netography, on-line research, textual analysis of digital sources)
- [ ] Any other method not listed above

L20.1 Please attach either a copy of the data collection tools you plan to use (e.g., questionnaires) or a very brief protocol describing the procedure (stimuli, responses, conditions manipulated, etc.)

If performing a study with more than one data collection tool please ensure you include documents for each (i.e. interview topics guides, focus group schedules, questionnaires/surveys, etc)

IMPORTANT: If you are administering standard, **copyrighted** psychology questionnaires/tests to participants you **MUST** provide a description of the questionnaire/test to the Committee using the approved description form. Please ensure you use a separate form for each test and label each document with the name of the corresponding test before attaching to this question in the application form.

Type	Document Name	File Name	Version Date	Version	Size
Additional docs	Penn Alcohol Craving Scale	Penn Alcohol Craving Scale.pdf	12/11/2019	0.1	32.7 KB
Additional docs	Virtual Reality Symptom Questionnaire_Cybersickness Questionnaire	Virtual Reality Symptom Questionnaire_Cybersickness Questionnaire.pdf	12/11/2019	0.1	283.4 KB
Additional docs	Virtual Scales Displayed within the Virtual Environments	Virtual Scales Displayed within the Virtual Environments.pdf	12/11/2019	0.1	506.4 KB
Additional docs	Presence Questionnaire - Store - Pair A	Presence Questionnaire - Store - Pair A.pdf	12/11/2019	0.1	619.4 KB
Additional docs	Presence Questionnaire - Pub - Pair B	Presence Questionnaire - Pub - Pair B.pdf	12/11/2019	0.1	532.6 KB
Additional docs	Feedback Int_Topic Guide - Store - Pair A	Feedback Int_Topic Guide - Store - Pair A.pdf	12/11/2019	0.1	207.7 KB
Additional docs	Alcohol Craving Questionnaire - Short Version Revised	Alcohol Craving Questionnaire - Short Version Revised.pdf	12/11/2019	0.1	180.4 KB
Additional docs	Drop out Justification Int_Topic Guide	Drop out Justification Int_Topic Guide.pdf	12/11/2019	0.1	188.4 KB
Additional docs	Alcohol Consumption Questionnaire_LG	Alcohol Consumption Questionnaire_LG.pdf	11/12/2019	0.1	322.7 KB
Additional docs	Procedural Checklist	Procedural Checklist.pdf	12/11/2019	0.1	644.8 KB
Additional docs	Feedback Int_Topic Guide - Pub - Pair B	Feedback Int_Topic Guide - Pub - Pair B.pdf	24/02/2020	0.2	388.8 KB

L20.2 Please briefly describe your methodology:

Please ensure your description is written according to the guidelines below:

- **Provide responses in bullet point format and limit responses to no more than 2 sentences per bullet point.**
- **One or more bullet points must explain the background of the project.**
- **One or more bullet points must explain how participants will be identified, approached and recruited.**
- **Describe exactly what will happen to participants, how many times and in what order.**
- **Provide responses which are as clear and concise as possible**

• The background of the study is to see if a pub and a market-like store can elicit craving when recreated using virtual reality so as to potentially be used for coping with craving for people with Alcohol Use Disorder under recovery.

• The study will be advertised through:
1. posters that will be put up within the University of Manchester premises
2. social media postings
3. the University of Manchester Volunteering Hub

• Individuals who wish to participate will have to email the researcher at the university email provided in the study advertisements
• The researcher will reply back asking them to confirm the 2 criteria mentioned in the advertisements:

1. If they are 18 years old or older
2. If they are drinking alochol at least once a week
and send them the Consent Form and the Participant Information Sheet (PIS) to read and decide if they are willing to participate

• The researcher will send a reminder to the individual for their possible participation in the study after 48 hours of sending them the Consent Form and PIS –if they haven't replied sooner with their confirmation of fulfilling the criteria

• If the individual wishes not to proceed then the communication is terminated and all relevant emails will be deleted

• If the individual wishes to participate then the researcher will suggest a possible date/time for the testing according to the availability of the participant, but on any occasion within normal working days and hours (and on a Friday no later than 13:00 as a start time of the testing for safety reasons) and having at least one supervisor available to be involved if required

• Once the date/time is decided and one of the seminar rooms available booked for the testing, the participant will receive a confirmation email with the details of the testing and will also be given two options for the day of the testing: the researcher to collect them from the main entrance of the Kilburn building or to wait for them directly to the seminar room booked for the testing

• A day prior to the testing a reminder email will be send by the researcher to the participant summarizing the date/time and location of the testing

• On the day of the testing, two workstations will be created:
1. One with an empty desk space and two chairs (for the participant and the researcher) with a digital recorder present– for the completion of the longer questionnaires required and the final short interview or the drop-out interview
2. One with the VR gear and the laptop running the application set up on a desk with some free desk space and a chair in front of them – for the participant to sit and the researcher to stand by their side watching their actions through the monitor of the laptop ensuring the application runs as expected and providing assistance if required

• Each participant will be assigned to one of the 2 pairs of alcohol cued environments to be assessed (market-like store pair, pub pair)

• The participant upon arrival will be asked to take a sit to the 1st workstation and read again and sign the Consent Form

• The participant, if agrees again, will complete 2 questionnaires: one for their alcohol consumption patterns and one for their average craving during the past week

• Then the participant will be asked to move to the 2nd workstation and will be given an introduction of what will happen during the testing showcasing the equipment to be used (VR gear, GSR sensor kit, digital recorder)

• The researcher will help the participant to wear and adjust the VR headset and familiarise with the VR controllers and their buttons and connected actions (e.g. how to move forward, backwards)

• The researcher will then help the participant to wear the GSR sensor kit in their fingers and wrist as it comes as a wearable kit

• Once the equipment is set up and the participant feels comfortable to proceed the researcher will inform them that they can remove the VR headset at any time if they don't want to continue for any reason without that being a problem

• Then the researcher will ask them if they are happy to begin by trying the introductory "City Street" scene, mentioning what they will do in the scene and the 2 alcohol craving scales they will need to rate

• Every time the participant tries any of the 3 virtual environments (city street, market-like store and pub), they will be observed by the researcher through the laptop's monitor to properly supervise them and ensure smooth operation of the VR application but also to track certain actions as related to the attention the participant paid to the alcohol cues within the virtual environments (see Procedural checklist document, section "Behavioural Response Tracking")

• The participant will try the introductory scene for 3 minutes (completing the 2 alcohol craving rating scales)

• The break scene will be displayed saying to the participant to remove the VR headset

• The researcher will ask the participant if they are willing to proceed to the alcohol cued exposure
1. If not, the drop-out justification interview will occur instead of the final short interview to know the reason for the participant not proceeding and the testing will terminate
2. If the participant wishes to proceed then a short questionnaire to rate their current craving will be given for completion pre exposure on the current workstation (2nd)

• Each participant will be assigned to one of the 2 pairs of alcohol cued environments to be assessed (market-like store pair, pub pair)

• Then the participant will wear again the VR headset and will be exposed to the 1st scene of the assigned pair of virtual environments for 6 min

• On any of the scenes of either pair the VAS craving scale will be displayed at the start and then every 2 min for completion, asking the participant to rate their current alcohol craving

• On any of the scenes of either pair the AAS craving scale will be displayed at the end for completion, asking the participant to rate their attention to alcohol during the exposure to each environment

• After 6 min of exposure and completion of the 2 alcohol craving scales, the break scene will be displayed saying to the participant to remove the VR headset

• The participant will take a break for 2 min

• The participant will again then complete the current rating craving questionnaire for a 2nd time, post exposure on the current workstation (2nd)

• Then the participant will wear again the VR headset and will be exposed to the 2nd scene of the assigned pair of virtual environments for 6 min
1. If the participant is exposed to the pub pair of scenes, they will also be told to imagine that the avatar which is offering them a drink is a friend in general to make the words of the avatar more relevant.
2. The words of the avatar will be:
a. "Hey, good news! I got a job today! Let me buy you a pint!!"
b. "Come on, let's celebrate, drink up!"

• After 6 min of exposure and completion of the alcohol craving scales, , the break scene will be displayed saying to the participant to remove the VR headset

• The participant will again then complete the current rating craving questionnaire for a 3rd time, post exposure on the current workstation (2nd)

• Afterwards, the participant will be asked to move to the 1st workstation to complete the Cybersickness and Presence questionnaires

• On the same workstation, then the final, short interview will occur

• Then the Participant Debrief Sheet and the voucher will be given to the participant to thank them for their time and the testing will be over

L20.3 Please provide additional information below regarding recordings:

Please describe the content of the recordings and how they will be recorded/stored.

The final, short interview to capture the feedback of the participant regarding the virtual environments they tried or in case of a drop-out the drop-out interview instead will be audio recorded. For the exact topic guide please see the attached documents entitled "Feedback Int_Topic Guide - Store - Pair A" and "Feedback Int_Topic Guide - Pub - Pair B" for either pair of the virtual environments as well as the "Drop out Justification Int_Topic Guide".

Audio recordings will be made using a digital, encrypted voice recorder provided by the University of Manchester. Once each testing is over - immediately after the session- , the audio recordings, originally in mp4 format, will be transfered as such to the Research Data Storage system under a 4-digit ID for pseudonymization purposes. The transfer of the audio recordings will occur through a USB cable to avoid safety issues subject to internet based transfers. Only the researcher and the supervisory team will have access to the Research Data Storage system.

Once transcription of the audio recordings is over, then the audio recordings will be deleted permantely from the storage system and the digital recorder. For the detailed handling of the audio recordings please see the attached Data Management Plan.

L20.4 Please confirm the following:

☑ I confirm that I have read, understood and agree to adhere to the guidelines and processes as outlined in the Recording of Participants in Research Projects standard operating procedures.

L20.6 Please provide additional details of the method you wish to use:

If using electronic or online data collection please clarify the platform/site/method to be used as well as where the data will be stored and how they will be transferred.

The virtual alcohol scales (Virtual Alcohol Scale - modified version, Attention to Alcohol Scale - modified version) will be displayed for completion within the virtual environment at start and then every 2 minutes per virtual environment (so 4 times in 6 minutes of exposure per scene). In the neutral exposure, the "City Street" scene, the scales will be displayed only once. In any virtual environment, the participant will be able to slide across each scale a knob rating their alcohol craving.

The current rating of the craving will be saved each time in a text file produced by the application automatically. The name of the text file will be corresponding to the name of the scale and the virtual environment's name at that time (e.g. "VAS Slider 1 Values_Pub.txt"). Once the testing is over the text files will be transfered to the Research Data Storage system (thus no longer present to the application memory) and will be renamed and stored under the participant's allocated 4-digit ID. The transfer of the text files will occur through a USB cable to avoid safety issues subject to internet based transfers.

L21

L21. What do you consider to be the main ethical issues raised by the methodology and how will you address them?

Please provide details in the box below and structure your answers into a bulleted list.

- Consent (both written and verbal) should be given by the participant to ensure that they wish to participate ---> 1. A Participant Information Sheet to fully inform potential participants about the study and what the procedures are will be given, 2. A period of minimum 48 hours will be given for the potential participants to decide whether they want to participate or not and only after 48 hours the researcher will send a reminder email for their participation

- Consent should be given verbally by the participant to ensure that they wish to go on with the testing at each stage ---> 1. At any point the participant can remove the VR headset and stop the testing of the virtual environments due to feeling discomfort caused by the equipment (on rare cases: eye tiredness, slight dizziness or even the feeling that the VR headset is not comfortable to wear), 2. On the extreme occasion of the participant feeling distress due to the content of the virtual environments (which is extreme due to the environments being real life, daily environments that most people go anyway) or for being asked to rate their alcohol craving at any point, they can again remove the VR headset and not proceeding with the testing (and not mentioning the reason for dropping-out in the drop out interview if they don't want to share that)

- Confidentiality should be guaranteed throughout the study ---> 1. All data collected will be psudonymised and once the analysis is about to start it will be anonymised to ensure that the participants' identifiable information aren't disclosed, 2. Access to the data will only be given to the researcher, the supervisory team, the trusted transcription service which has a contractual agreement with the University of Manchester and individuals from The University of Manchester or regulatory authorities who may need to look at the data collected for this study to make sure the project is being carried out as planned

- Participation should be voluntary ---> Potential participants will hear about the study only via advertising posters, social media postings and via the University of Manchester volunteering hub using an approved advertising script

- Coercion should not be performed while participants complete any of the questionnaires ---> The researcher will remain seated at their chair while the participant complete any of the questionnaires ensuring that no pressure to "do well" or report "high craving rates" occurs to the participant

- Coercion will not be performed at any point of the study.

- Protecting people with severe mental health issues as the impact of the application is unknown to these groups and no adequate support can be provided on time ---> In the Participant Information Sheet it will be explicitly mentioned that people with severe mental health issues are advised not to participate as it might cause them high distress

Consent: L22

L22. Will the researcher(s) obtain direct informed consent/assent to take part in the research from all participating individuals?

- (•) Yes
- ( ) Not required as this project will access social media data available to the general public or other routinely available online content for which informed consent is not required.

L23

L23. How will the consent be obtained or verified?

Please note, this section refers to the information being given to adults (or parents only).

*Tick **all** that apply*

- [x] Written consent (please use the University template)
- [ ] Verbally (please explain recording method in the box below)
- [ ] Implied (with the return/submission of a completed questionnaire/survey)

L23.2 Please declare the following:

- The researcher(s) will provide an information sheet to all persons invited to take part that explains in concise and clearly understandable terms:
  1. who is conducting the research
  2. why it is being conducted (including the true purpose of the research)
  3. why they have been asked to take part
  4. what it requires of them (including the amount of time they will be required to commit and what they will have to do)
  5. what will happen to the data they provide
  6. whether and how their anonymity and confidentiality will be maintained
  7. that their participation is voluntary and they are free to withdraw at any time without detriment (where possible)
- The researcher(s) will ensure that participants sign/mark a consent form to indicate that they have received sufficient information about the research and are happy to take part.
- All information sheet(s) and consent form(s) to be used are attached below.

- [x] I confirm all of the above declarations.

The declaration above **MUST** be ticked in order to submit this form.

L23.3 Please attach a copy of your GDPR compliant consent form(s):

WARNING: Your application will be returned to you and incur substantial delays unless you use the new GDPR compliant templates. Please see the help bubble attached to this question for additional guidance.

For secondary data analysis studies only, please provide proof that the analysis you wish to perform falls within the original consent of data subjects.

This **must** be attached in order to submit your form.

Type	Document Name	File Name	Version Date	Version	Size
Consent Form	RS_2020_2_Sample Consent form_GDPR Medical V1.7 FINAL	RS_2020_2_Sample Consent form_GDPR Medical V1.7 FINAL.pdf	26/02/2020	0.2	639.1 KB

L23.4 Please attach a copy of your GDPR compliant participant information sheet(s):

WARNING: Your application will be returned to you and incur substantial delays unless you use the new GDPR compliant templates. Please see the help bubble attached to this question for additional guidance.

For secondary data analysis studies only, please upload a copy of the permission letter from the data controller or external organisation in support of the project.

This **must** be attached in order to submit your form.

Type	Document Name	File Name	Version Date	Version	Size
Participant Information Sheet	RS_2020_2_Sample PIS_GDPR UoM Ethics Medical Studies V7.3 FINAL	RS_2020_2_Sample PIS_GDPR UoM Ethics Medical Studies V7.3 FINAL.pdf	26/02/2020	0.2	638.2 KB

L24-L25

L24. Will you be including participants who are under the age of 16?

- ○ Yes
- ◉ No

L26-L27

L27. Will the researchers give participants at least 24 hours to decide whether or not to take part in the research?

- ◉ Yes
- ○ No

L29

L29. Could participants be considered to have a particularly dependent relationship with the researcher(s) (e.g. students taught or examined by the researcher(s), clients of the researcher(s)).

- ○ Yes
- ◉ No

L30-L31

L30. What are the inclusion criteria for participants?

- ☑ Participants will be included only if they have experiences and/or characteristics relevant to the research question(s) being investigated.

You **MUST** tick the box above in order to submit this form.

L31. What are the exclusion criteria for participants?

- ☑ Participants will be excluded only when they do not have experiences or characteristics relevant to the research question(s) being investigated.

You **MUST** tick the box above in order to submit this form.

L32

L32. How will participants be approached and recruited?

Tick the method below which you will be using for your study. If using more than one method, please tick the appropriate box(es).

- ☐ The researcher(s) will approach participants directly and will:
    1. provide sufficient information to enable informed consent
    2. not pursue non-responders beyond two reminders, and
    3. maintain the anonymity and confidentiality of responders and non-responders

- ☐ The researcher(s) will approach participants indirectly via a third party and the third party will ensure any and all information:
    1. is not coercive,
    2. is limited to information that prospective participants need to determine their eligibility and interest,
    3. does not state or imply a favourable outcome or other benefit beyond what is outlined in the participant information sheet and does not emphasise payments/inducements, using means such as large or bold type, and
    4. contains information that is accurate, honest and socially responsible regarding who is conducting the research, its purpose, risks/benefits, requirements of taking part, contact details for further information

- ☑ Participants will be recruited using an advertisement or equivalent communication (e.g. posters, flyers, bulk email/distribution list, social media invitations/announcements/pages) and the researcher(s) will ensure that any and all information:
    1. provide sufficient information to enable informed consent,
    2. not pursue non-responders beyond two reminders, and
    3. maintain the anonymity and confidentiality of responders and non-responders

- ☐ Not applicable as this is a secondary data analysis of existing data/samples

L32.2 What types of advertisements will be used?

Important note: DO NOT include monetary amounts on any advertisement*.

*See help bubble for more information

- [x] UoM volunteering website
- [ ] Other website
- [ ] SONA system
- [x] Poster on campus
- [ ] Poster off campus
- [ ] Newspapers
- [x] Social media (i.e. Twitter, Facebook, Instagram, etc)
- [ ] Other

L32.3 Please attach a copy of all advertisements to be used:

Type	Document Name	File Name	Version Date	Version	Size
Advertisement	RS_2020_Recruiting poster	RS_2020_Recruiting poster.pdf	18/02/2020	0.3	579.5 KB

L33

L33. Will participants receive payment or other incentives for taking part in the research?

- ( ) No
- (•) Yes, but the payments and/or incentives provided will not be sufficiently coercive to over-ride freely given consent, taking into account the financial status of the participants targeted. Specifically, the sums involved will only cover reasonable out of pocket expenses (e.g. travel expenses), reasonable recompense for time given to take part in the study, Psychology credits at standard rate for this type of research and/or will be in the form of a prize draw.

Risks to Researchers: L34

L34. Where will the data collection take place?

Please choose the location of where the researcher will be when collecting the data.

***Tick all* that apply.**

- ☐ This study involves online surveys/questionnaires that are distributed either globally or to a specific location
- ☑ In a University building on campus.
- ☐ In the researcher's residence/accommodation
- ☐ Off-campus in a public space (e.g. a high street or cafe) in the UK that poses no significant risk to the safety and well-being of participants and researchers
- ☐ Off-campus in a public space (e.g. a high street or cafe) in a safe international setting which poses no significant risk to the safety and well-being of participants and researchers.
- ☐ Off campus at a private building or institutional setting (e.g. the premises of a work organisation, participant's place of work or private residence) in the UK that poses no significant risk to the safety and well-being of participants and researchers.
- ☐ Off-campus at a private building or institutional setting (e.g. the premises of a work organisation, participant's place of work or private residence) in a safe international setting which poses no significant risk to the safety and well-being of participants and researchers.
- ☐ SALC Linguistics/English Language Students ONLY: My project will be primary or practice research conducted in a public space or building within normal working hours, or in a domestic environment familiar to the researcher, within normal working hours or at a time convenient to participants.

L34.1 You MUST agree to the following condition:

- ☑ The researcher(s) has reviewed the Division/School's risk assessment for office environments.

L34.4 Please specify the location:

Example: Kro Bar, Oxford Road, Manchester

Seminar room in Kilburn building, Oxford Road, University of Manchester, Manchester, M13 9PL

L35

L35. Will any of the researchers be required to collect data alone in an off-campus setting?

Please note this does not include gathering survey results or social media data from a computer in your own residence/accommodation.

- ○ Yes
- ◉ No

L39

L39. How will the results of research be made available to research participants and communities from which they are drawn?

Tick all that apply

- [x] Written feedback to research participants
- [ ] Presentation to participants or relevant community groups
- [ ] Other (e.g. video/website)
- [ ] Results will not be made available

Research Sponsorship: L40

L40. Are you in receipt of any funding for your study (either internal or external)?

- (•) Yes
- ( ) No

L40.1 Please provide additional details including:

- Organisation
- UK Contact
- Amount (£)
- Duration

- Ph.D. Scholarship of the University of Manchester
- Tel.: 0161 306 9280
- Tuition fee yearly paid (subject to yearly change), monthly stipend and budget allocated for other expenses (handled by the supervisor)
- 3 years (currently entering 3rd year)

Supporting Documents: L42

Please use this section to attach any additional documentation that you have not attached previously in this form. If you do not need to attach any additional supporting documentation, please tick the box at the bottom of the page.

The supporting documents that you may have already been required to attach are:

- Interview guide
- Focus group topic guide
- Questionnaire(s)
- Statistical review
- Advertisements/e-mails/recruitment text
- Social media recruitment text
- Consent/assent form(s)
- Participant information sheet(s)
- Letters from gatekeepers/letters of permission

Examples of documentation that you may wish to attach include, but are not limited to:

- Translated documents
- Verification of translated documents
- Distress protocol/debrief sheet
- Lone worker policy/procedure
- Confidentiality agreements
- Ethical approval from partnering institutions
- Local insurance arrangements
- Completed risk assessment forms

L42. Additional supporting documentation

Type	Document Name	File Name	Version Date	Version	Size
Additional docs	City street 1	City street 1.PNG	18/11/2019	0.1	1.8 MB
Additional docs	City street 2	City street 2.PNG	18/11/2019	0.1	2.3 MB
Additional docs	Market-like store 1	Market-like store 1.PNG	18/11/2019	0.1	3.6 MB
Additional docs	Market-like store 2	Market-like store 2.PNG	18/11/2019	0.1	3.7 MB
Additional docs	Market-like store 3	Market-like store 3.PNG	18/11/2019	0.1	3.3 MB
Additional docs	Pub 1	Pub 1.PNG	18/11/2019	0.1	8.2 MB
Additional docs	Pub 2	Pub 2.PNG	18/11/2019	0.1	8.9 MB
Additional docs	Pub 3	Pub 3.PNG	18/11/2019	0.1	3.3 MB
Additional docs	Risk_Assessment_Form+guidance Mar 2015 (1)	Risk_Assessment_Form+guidance Mar 2015 (1).pdf	12/11/2019	0.1	204.4 KB
Additional docs	gcp-certificate	gcp-certificate.pdf	09/12/2019	0.1	99.1 KB
Additional docs	General Distress Protocol RS	General Distress Protocol RS.pdf	11/12/2019	0.1	611.6 KB
Additional docs	Participant debrief sheet RS	Participant debrief sheet RS.pdf	11/12/2019	0.1	772.4 KB
Additional docs	Letter 3 Q Answered	Letter 3 Q Answered.pdf	28/02/2020	0.1	462.9 KB

☑ I confirm that all required supporting documentation for this project has been appended.

Final Declaration: L43

L43. In order for your application to proceed to review, please confirm the following:

- To the best of my knowledge the information that I have provided here is accurate and I understand that any deliberate attempts to withhold necessary information or mislead the Proportionate UREC will result in my project being given an unfavourable decision.
- I understand that while I have completed this form, the Proportionate UREC may escalate my application for Full University Research Ethics Committee (UREC) review if my research is deemed to be high risk.

☑ I confirm both of the above declarations.

You **MUST** tick the box above in order to submit this form.

Required Signatures

Final Declarations

1. The information in this form is accurate to the best of my knowledge and belief and I take full responsibility for it.
2. I agree to abide by the ethical principles underlying the Policy on the Ethical Involvement of Human Participants in Research and the University's Code of Good Research Conduct.
3. If the research is approved I agree to adhere to the terms of the full application as approved and any conditions set out by the review body in giving approval.
4. I agree to notify the review body of any amendments to the terms of the approved application (both minor and major), and to seek a favourable opinion from that review body via the formal process before implementing the amendment.
5. I agree to submit annual progress reports setting out the progress of the research as well as end of study reports, as required by the review body for all UREC proposals.
6. I understand that research records/data may be subject to inspection by the review body for audit purposes. In addition, I understand that research records/data for those studies that use human tissue, medical devices or pharmaceutical products may be subject to inspection by regulatory authorities for audit purposes.
7. I understand that the information contained in this application, any supporting documentation and all correspondence with the review body or its operational managers relating to the application
   - Will be held by the University until at least 5 years after the end of the study or at least 10 years for those studies involving medical data.
   - May be disclosed to the operational managers of the review body in order to check that the application has been processed correctly or to investigate any complaint
   - May be seen by auditors appointed to undertake accreditation of the University (where applicable)
   - Will be subject to the provisions of the Freedom of Information Act and may be disclosed in response to request made under the Act except where statutory exemptions apply
   - May be sent by email to members of the review body
8. I understand that information relating to this research, including the contact details on this application, will be held by Infonetica Ltd, and that this will be managed according to the principles established in the Data Protection Act 2018.
9. I confirm that I have not included any sensitive personal information including a curriculum vitae or identifiable information about my racial or ethnic origin, political opinions, religious or similar beliefs, trade union membership, physical or mental health, sexual life, commission of offenses and/or criminal proceedings.

IMPORTANT: Please ensure you request the signatures of the PI or supervisor (if required).

The system now features an automatic submission function which will automatically submit your application (usually within 60 seconds) after all required signatures are obtained as described below.

If you are signing an application, please ensure you remain signed into the ERM system until the screen refreshes and you receive email confirmation that a) your signature has been accepted and b) your application has been successfully submitted.

If you do not receive an email confirmation within 1 hour of signing the form, please perform the following:

1. Open the application and double check the form status as it should be listed as submitted, resubmitted or sent to. If the status is one of these, please email your Ethics Signatory or School Administrator to double check that they have received your application.

2. If the form status is listed as 'changes requested', 'not submitted' or 'returned' then please double check:

   a. That an appropriate signature has been obtained in Section S (it should say for example: Mr Smith has signed on 5/7/2019 at 13.15pm)

   b. That no additional blank signature boxes are listed in Section S

   c. That the application is not pending a mandatory update (listed in a red bar at the top of the screen)

   d. If you have performed all of these checks and the application has still not automatically submitted, please email research.ethics@manchester.ac.uk and provide your project reference number, title and a screenshot confirming these criteria and a member of the team will be able to assist you.

WARNING: Once you have signed the form, it will be **locked** and if you wish to make further changes you must **'unlock'** the form, which will break any signatures already obtained.

For staff projects, if you are NOT the PI, you must obtain their signature (using the request button below).

For student projects, if you are NOT the supervisor, you must obtain their signature (using the request button below).

For student projects, if you ARE the supervisor please ensure you sign the form.

Signature of the Primary Supervisor

To sign this form please look on the left hand side of your screen for an action button called Sign that has a picture of a pencil on it. Please push this button and this button only to sign the form.

Please note that if you are the student requesting your supervisor's signature that by pressing this request button you are confirming that the application is complete, accurate to the best of your knowledge and ready to be signed off by your supervisor for further processing by relevant Division/School/UREC colleagues.

Signed: This form was signed by Prof Stephen Pettifer (steve.pettifer@manchester.ac.uk) on 29/02/2020 07:29