Virtual Perspectives in Psychosis: Investigating Embodied Virtual Reality Educational Interventions and Unpacking the Impact of Immersion on Participant Attrition

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Thesis portfolio abstract

In recent years, virtual reality (VR) has emerged as an innovative tool with a wide range of applications across various fields. VR has been increasingly explored as an approach for understanding and treating a range of mental health difficulties. One of the most striking uses of VR of interest to the current thesis is its application to psychosis, both in clinical and educational settings.

Whilst VR offers considerable potential in the treatment of psychosis, concerns remain regarding its acceptability, predominantly in relation to cybersickness and dropout rates. A systematic review and meta-analysis was therefore conducted, to compare dropout rates between two types of VR intervention, immersive and non-immersive, used to treat psychosis. The meta-analysis identified a pooled attrition rate from all VR interventions of 15% (95% CI 11, 20), alongside a dropout rate of 11.9% for immersive VR and 22.46% for non-immersive VR. This challenges the suggestion from previous research that cybersickness leads to higher attrition.

Given the impact that stigma can have on participant attrition, an empirical study was conducted to assess the feasibility of delivering a newly developed VR intervention, aimed to foster empathy and reduce stigma toward psychosis. Undergraduate health students from a UK university were recruited, and most participants experienced absent or mild cybersickness following its use and showed an increase in self-reported empathy and decrease in negative attitudes.

Limitations of the present research are discussed along with recommended future directions. In conclusion, this thesis demonstrates the promising application of VR as a tool for both the therapeutic treatment and reduction of stigma surrounding psychosis, despite the adverse effects of VR.

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Declaration

Material from the ClinPsyD Thesis Proposal assignment has been adapted and used throughout this thesis.

CHAPTER ONE: Introduction to the thesis portfolio

General Introduction

Heralded by previous researchers as a technological revolution (Freeman et al., 2017), virtual reality (VR) has emerged as an innovative tool that is transforming the field of mental health. VR leverages interactive digital environments that enable users to engage with and explore simulated experiences, that closely mimic real world interactions. This technology offers unique opportunities for users that support both therapeutic and educational purposes. Over the last decade, VR has demonstrated application across a range of mental health disorders, however one of the most significant uses of VR lies in its application to psychosis.

Currently, the first line of treatment for people with psychotic disorders is an oral antipsychotic medication in conjunction with cognitive behavioural therapy (CBT) (National Institute for Health and Care Excellence [NICE], 2014). Whilst CBT has been part of UK national guidelines since 2002 for people with psychotic disorders, implementation in the UK is extremely poor (Haddock et al., 2014), with a National Audit carried out by the Royal College of Psychiatrists (2018) highlighting only 26% of psychosis patients being offered CBTp. Alongside this apparent lack of access to psychological therapy, globally, most studies have found CBT for psychosis to be, at best, moderately effective in ameliorating psychotic symptoms and improving well-being (Burns et al., 2014; Hazell et al., 2016; van der Gaag et al., 2014). Moreover, approximately 50% of patients do not respond to CBTp (Leucht et al., 2022; Thomas et al., 2011). Similarly, antipsychotics only seem to improve the symptoms of around 50% of patients, compared to 30% of people whose symptoms improve with a placebo medication (Leucht et al., 2022). In addition to the limited effectiveness of existing treatments for people with psychosis, research indicates that people with psychosis often face specific challenges, such as low motivation and difficulties in trusting others, which can hinder engagement and lead many to drop out of treatment (Lecomte et al., 2008). Taken

together, these issues underscore the complexity of treatment needs for this population, and highlight the importance of developing approaches that are better tailored to support their needs.

In response to this, VR has emerged as a tool that overcomes certain limitations of traditional CBT that would usually discourage people from engaging in therapy. VR is capable of exposing individuals to controlled, safe and personalised environments, reducing the need for immediate trust and giving individuals with psychosis more confidence to engage in therapy (Lindner, 2021). VR's immersive qualities have been shown to help address low motivation for people with psychosis (Makransky & Petersen, 2021), making therapy more engaging and interactive, and reducing the cognitive load on people to imagine or role-play situations, as is often necessary in traditional CBT . Previous reviews have showed VR holds promise in improving the cognitive impairments, social skills, auditory verbal hallucinations, paranoid ideation and persecutory delusions of people with psychosis (Chan et al., 2023). Despite the growing interest in VR based interventions for psychosis, there remains a gap in understanding dropout rates across VR treatment. Given that attrition rates are especially problematic in psychosis, as previously highlighted(Lecomte et al., 2008), it is important to try to understand this whether this is a problem with this modality of therapy.

VR has also been gaining popularity as a psychoeducational tool, allowing medical students and other allied health professionals to 'step into the shoes' of individuals experiencing mental health challenges. Whilst still in its infancy, studies have explored the role of VR in this way, examining its ability to enhance knowledge, empathy and positive attitudes towards a range of mental health difficulties including dementia, anxiety and depression (J. L. Tay et al., 2023). As one of the most stigmatised mental health conditions (Gerlinger et al., 2013), the simulation of psychotic disorders presents an attractive concept to

VR simulation (Wood et al., 2014). However, to date, there have been limited studies that have assessed VR in reducing stigma and increasing empathy toward psychosis.

The current thesis therefore seeks to investigate the potential of VR as a tool for advancing both the treatment and stigmatisation of psychosis. In exploration of this, the thesis contains the following two papers:

- a systematic review and meta-analysis that examines the rate of dropout between studies that have employed two forms of VR, non-immersive and immersive VR, in the treatment of psychosis.
- an empirical study to investigate the feasibility of an immersive VR intervention, portraying the journey of a young adult with psychosis, intended to improve empathy and decrease stigma in health students.

Chapter One aims to provide the reader with an introduction to psychosis and its theoretical background, alongside an introduction to VR, its core concepts and the potential benefits and challenges in its application to the field of mental health. Chapter One concludes with a summary of the thesis aims.

Psychosis

Overview of Psychosis

Prior to its classification, Emil Kraepelin was the first to categorise the experiences of hallucinations and delusions that we now identify as belonging to psychosis, into a diagnosable disorder, which he termed *dementia praecox* (dementia of the young). The term schizophrenia was later introduced in 1911 by Eugen Bleuler who described the disorder as a splitting of the mind, particularly between emotional and intellectual functions of the brain. This notion of splitting separated Bleuler's conceptualisation from previously narrow

interpretations, by highlighting it as a condition influenced by emotional factors (Moskowitz & Heim, 2013).

The term ‘psychosis’ has been used variably to denote a syndrome of hallucinations, delusions, and disordered thinking. Today, contemporary psychiatric classification systems are employed to categorise and diagnose symptoms of psychosis into specific ‘psychotic disorders’. Included in The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2022) are schizophrenia, schizoaffective disorder, brief psychotic disorder and delusion disorder, all of which differ with regards to the number, severity and duration of psychotic symptoms. Psychotic experiences also appear across many other mental health conditions, including depressive, anxiety and substance use disorders, and neurological conditions such as Huntingdon’s disease, Lewy body dementia, Alzheimer’s disease and epilepsy (Arciniegas et al., 2001). Psychosis is also associated with certain physical health conditions, in particular delirium (Webster & Holroyd, 2000), and autoimmune disorders such as lupus (Pego-Reigosa & Isenberg, 2008), multiple sclerosis (Benros et al., 2011) and hypothyroidism (Feldman et al., 2013).

The transdiagnostic nature of psychotic experiences is likely attributable to a complex interplay of several factors (DeVylder et al., 2014). Evidence has shown that whilst they are diagnostically disparate, mental health difficulties such as schizophrenia, bipolar disorder and depression share genetic risk loci (Cross-Disorder Group of the Psychiatric Genomics, 2013). Psychosis and common mental health conditions also share environmental risk factors, particularly childhood trauma (Cloitre et al., 2009; Douglas et al., 2010; Galletly et al., 2011). Shared brain mechanisms may also play a role, including dysfunction in the hippocampus, prefrontal cortex, and dopamine system (DeVylder et al., 2014). These are said to mediate the relationship between genetic and environmental risk factors and symptom presentation.

Despite variations across the core psychotic disorders, there is consensus that psychosis is characterised by both positive and negative symptoms. Positive symptoms are so called because historically, they have been considered not to be found in the 'normal' population and are an 'addition' to functioning. Conversely, negative symptoms, are considered to represent the 'absence' of features found in the 'normal' population. Positive symptoms, are conceived of as either; unusual perceptual experiences, commonly referred to as hallucinations; unusual beliefs termed delusions; or, thought disorder which refers to disruptions in the way a person organises, processes, and expresses their thoughts, usually inferred from an individual's speech (Hart & Lewine, 2017). Hallucinations are considered to be changes to auditory, visual, olfactory, gustatory or tactile information occurring in the absence of corresponding external or somatic stimuli (Arciniegas, 2015). One of the most common auditory verbal hallucinations, involves the experience of hearing a voice when someone else is not present. Delusions are beliefs considered to be 'unusual' in that they are removed from a reality shared with society (Bentall, 1993). The negative symptom domain typically consists of five key constructs: blunted affect, alogia (reduction in quantity of speech), avolition (reduced motivation), asociality, and anhedonia (reduced experience of pleasure) (Correll & Schooler, 2020).

Psychosis appears to typically occur in young adults. Men appear to have a single peak age for onset between 21 and 25 years old, whilst women have two peaks age of onset, one between 25 and 30 years old and another one is after 45 years old (Angermeyer & Kühnz, 1988; Jones, 2013; Kirkbride et al., 2012; Nowrouzi et al., 2015). Prevalence rates for psychosis vary across the world, however a meta-analysis by Moreno-Küstner et al. (2018) estimated an average lifetime prevalence of 7.49 per 1000. It is now widely believed to occur on a continuum, with an estimated 7.2% of the general population experiencing subthreshold psychotic experiences at some point in their lifetime (Linscott & van Os, 2013).

Psychosis brings host of challenges and adverse consequences, significantly reducing the quality of life of those living with it (Watson et al., 2018). These include an impaired social and occupational functioning (Frawley et al., 2023), in particular social exclusion and isolation (Lim et al., 2018). Psychotic symptoms are also associated with an increased risk of mortality (Saha et al., 2007), and serious physical health problems including angina, asthma, arthritis, tuberculosis, vision or hearing problems, and dental problems (Moreno et al., 2013). As a result, psychosis has been associated with significant personal, societal and economic costs, and is estimated to cost the National Health Service (NHS) approximately 2.44 billion pounds a year (Ride et al., 2020). The treatment of psychosis is therefore of national and international importance (World Health Organisation, 2008).

Models and causal factors of psychosis

In an attempt to make sense of the complex nature of psychosis and understand how it may best be treated, various evidence driven models have been proposed to identify its underlying causes and contributing factors. The biomedical model of psychosis conceptualises that psychosis arises from biological causes including brain and biochemical abnormalities. The use of drugs to treat mental health problems presents a strong argument for a biological basis for psychosis, in particular antipsychotic drugs which target particular neurotransmitters in the brain (Wong & Van Tol, 2003). Additionally, the observation that certain substances, like amphetamines, can trigger psychotic symptoms by increasing dopamine activity, further supports the idea that neurotransmitters contributes to the development of psychosis (Wong & Van Tol, 2003). Driven by the hypothesis that psychosis is a degenerative brain disease, certain research has implicated global brain differences in people with psychosis, including lower cerebral and higher ventricular volume (Wright et al., 2000). The long term effect of antipsychotics has also attracted research, which has found an overall decline in global or

grey matter volume over the course of treatment. Research has cautioned against the interpretation of these brain abnormalities, which may in fact be a result of treatment with antipsychotics as opposed to a cause of the mental health difficulty itself (Moncrieff & Leo, 2010). This raises the question of whether antipsychotics should always be the first line treatment for people with psychosis (Morrison et al., 2012).

In comparison, a number of cognitive models of psychosis have been proposed in an attempt to explain the development and maintenance of psychosis. These models centralise the role of psychological processes such as appraisals, attributions and attention in hallucinations and delusions (Bentall et al., 2001; Garety et al., 2001; Morrison, 2001). A commonly accepted model of psychosis though is the vulnerability-stress diathesis model (Zubin & Spring, 1977), integrating both biological and psychological causal factors. The model suggests there may be numerous vulnerabilities - environmental, social and psychological and biological - that predispose a person to experiencing a psychotic episode, and stressful life events that can precipitate the onset of a psychotic episode. This is supported by a substantial body of research which evidences the role of social factors in the development of psychosis. This has included maternal health during pregnancy, separation of parents, witnessing interparental violence, dysfunctional parenting, childhood sexual, physical and emotional abuse, childhood emotional or physical neglect, bullying, sexual assaults as an adult, racist or other forms of discrimination, and heavy cannabis use early in adolescence (Bentall & Fernyhough, 2008; Conus et al., 2009; Janssen et al., 2004; Larkin & Read, 2008; Schreier et al., 2009; Verdoux & Tournier, 2004; Welham et al., 2009). Poverty, which operates in a multitude of ways to increase exposure to stress and to inhibit self-esteem and secure attachments, has been consistently implicated in psychosis (Read et al., 2009). On a similar note, well-controlled epidemiological studies show elevated rates of psychotic disorders in densely populated urban areas (Radua et al., 2018; van Os et al., 2004).

Conceptualising psychosis in this way has implications for treatment approaches. While addressing social determinants could help reduce the prevalence of psychosis in the long term, it is also imperative to offer valuable tools for helping individuals manage distressing symptoms by way of psychological treatments.

Virtual Reality

Overview of Virtual Reality

VR has existed in various forms as far back as the 1960's. The first recorded implementation of a digital VR system appeared in the form of a flight simulator designed for training purposes for the United States air force (Page, 2000). As technology advanced, the term 'virtual reality' emerged to describe devices capable of creating interactive environments characterised by visual realism. Since the first VR head mounted display (HMD), there have been several attempts to define it. Over the last decade, the landscape of VR experiences has shifted, with low-cost and consumer friendly hardware becoming increasingly accessible to the average audience.

With the rapid advancement of technology, the terminology used within the literature to describe VR has also varied. In medical literature, references to VR have included the use of 2-dimensional (2D) and 3-dimensional (3D) screens, projectors and HMD's (Pottle, 2019), all with varying fidelity. Haptic feedback devices, that enable a user to 'feel' the textures of the simulated environment, eye tracking and motion sensors further complicate the picture (Abbas et al., 2020). A recent systematic review by Abbas et al. (2023), argues that varied terminology and the inclusion of somewhat ambiguous terms such as 'immersion' and 'presence' complicates the process of identifying and defining VR experiences. Martingano et al. (2021) presents an all-encompassing definition of VR as *"any computer technology that virtually simulates one or more senses (auditory, visual, olfactory, gustatory, and/or tactile*

simulations)" (p.4). VR simulations can also be categorised into three types, non-immersive (NIVR), semi-immersive, and fully immersive (IVR), each with their own definitions and features (see Table 1).

Table 1

A table demonstrating the three different types of VR

VR type	Immersion level	Description	Equipment
Non-Immersive VR	Low	Users interact with a digital environment on a screen without being fully immersed.	Computer monitor, keyboard, mouse, joystick
Semi-Immersive VR	Medium	Users experience a partially virtual environment while still being aware of the physical world.	Large screens and projectors
Immersive VR	High	Users are completely immersed in a digital world	Head-mounted display, motion controllers, haptic gloves

Core concepts in virtual reality

When examining VR several foundational concepts warrant consideration. Several contributing factors have been explored by previous literature but five appear particularly pivotal: sense of presence, immersion, engagement and interest, illusion of virtual body ownership, and agency. These elements form the backbone of VR's capacity to facilitate behaviour change and skill development, making them essential for the design of healthcare interventions.

Presence is a construct that has been referred to in the literature as the interpretation of an artificial environment as if it were real (Lee, 2004). To distinguish it from other alternative similar meanings, this psychological sensation of 'being there' in VR has

commonly been referred to as ‘Place Illusion’. This encompasses the idea of having a strong perceptual illusion of being in a place in spite of knowledge that you are not there (Slater, 2009). Within the literature, presence is a concept closely related with immersion. As a result, the terms are often used synonymously and interchangeably (McGloin et al., 2013), creating implications and confusing the exact relationship between these two concepts. However, Slater and Wilbur (1997) argue that whereas presence refers to a state of consciousness and the psychological sense of being in the virtual environment, immersion should be regarded as the technological quality of media delivery (including display resolution, field of view, frame rate, and surround-sound). In essence, immersion describes the extent to which systems are capable of delivering a vivid illusion of reality while shutting out physical reality (Cummings & Bailenson, 2016).

Recently, the conceptualisation of presence in VR literature has been broadened to include the sense of being present in someone else’s body. These feelings of embodiment have been labelled the “illusion of virtual body ownership” (Maselli & Slater, 2013). A correlate of virtual body ownership illusion that has emerged has been termed sense of agency - the illusion of being in control of one's actions or movements (Banakou & Slater, 2014). The distinction between sense of agency and embodiment is captured in the case of involuntary movement such as a knee-jerk. During these instances an individual experiences they are moving and the movement belongs to them, confirming a sense of ownership, whilst lacking a sense of agency for such movement (since it is not them who caused it) (Tsakiris et al., 2007). Agency has also been found to be self-attributed even in the absence of actual user intention or initiation (Tsakiris et al., 2007). This holds implications for VR as it demonstrates that simulated prosocial actions could be perceived as voluntary actions of the subjects themselves (Bertrand et al., 2018).

Application of VR to mental health and psychosis

Advantages of VR

VR offers several advantages for conducting psychiatric research, largely due to its ability to create sensations or situations that are practically impossible to create in real life. By immersing individuals in real-world situations, it provides a unique platform for creating scenarios that more closely emulate daily life (Bell et al., 2020). This capability overcomes the issue of ecological validity, a critical barrier in research and treatment which refers to how closely a study or intervention mirrors real-world conditions. VR excels in this regard over traditional methods, by authentically replicating real-life scenarios whilst maintaining full experimental control. Strong methodological rigor can be achieved in the manipulation of variables within a study or intervention, to establish clear cause-and-effect relationships. The controlled nature of the VR experiences allows for greater reproducibility, in comparison to field studies which often lack control because of a constantly changing environment.

One study that demonstrates this strength comes from Veling et al. (2016), who conducted a study where participants with psychosis, their siblings, and healthy controls were randomly assigned to virtual environments with differing levels of social stress. The study found that as the level of social stress in the virtual environment increased, so did the participants' experiences of paranoia, an observation that was particularly evident in participants with psychosis and those at higher risk (siblings). Their application of VR in this way, lends strong evidence to support the theory that social stress may explain the connection between environmental factors and psychosis.

Beyond its application in research, VR offers considerable clinical advantages in the treatment of psychosis by enabling the creation of realistic yet fully controllable environments. These environments can be used to deliver interventions modelled on CBT, enhancing core elements through immersive, first-hand experiences. One of the defining

features of VR is its ability to enable users to interact directly with virtual environments, something previously only possible with expensive methods using actors or stooges. Moreover, VR experiences can be tailored to match individual needs, abilities, or preferences. For example, Dellazizzo et al. (2020) created an intervention for people with schizophrenia that personalised the face and voice of an avatar to resemble the person or entity believed to be the source of their most distressing voice. Scenarios in VR can also be used to deliver behavioural experiments, a core component of CBT, and can be designed to closely mirror real-life situations. This allows therapists to precisely control variables including the responses of other characters (Levin et al., 2015). For patients with psychosis this is particularly valuable given that research has shown that many are reluctant to face feared real-world situations due to the high levels of anxiety they provoke (Repetto et al., 2013). Imaginal exposure also presents challenges, as it may lack realism or intensity (Gega et al., 2013), and can be especially difficult for those who struggle with vivid mental imagery or who purposefully avoid or struggle to fully engaging with distressing scenarios (Clemmensen et al., 2020). This problem may be particularly pertinent for people with psychosis who may face cognitive impairment (Lecomte et al., 2008). VR helps overcome both sets of barriers by enabling gradual exposure in a safe and controlled environment where patients know they can withdraw at any time. This sense of control can help build trust and motivation, making it particularly advantageous to people living with psychosis, offering patients the opportunity to practise strategies knowing it is not "real," yet still respond as though it were - allowing for the possibility of these skills to generalise into the real world (Slater, 2018).

Disadvantages of VR

Although VR holds promise in many areas of mental health, it currently faces hurdles that prevent its wide spread application as a tool. In particular, the construction of the virtual environments displayed within the VR systems require high time, energy and cost investment. Highly immersive VR systems also have many adverse effects, which are defined in the literature as those perceived as unpleasant or harmful by the user (Lundin et al., 2023). In the context of healthcare, the adverse effects are those perceived by either the patient, clinician, or family and can include symptomatic deterioration, addiction, or delusions manifesting in relation to VR use (Lundin et al., 2023).

One of these adverse effects that has attracted a lot of research includes the occurrence of VR-induced symptoms and effects. These unpleasant and uncomfortable physical symptoms experienced by the user are often referred to as 'cybersickness', and can include nausea, dizziness, eyestrain, disorientation, postural instability, and fatigue. The mechanism underlying adverse effects is also not yet fully understood. One hypothesis suggests that symptoms arise primarily from the mismatch between the visual system which perceives motion, and the vestibular system, which does not detect corresponding physical movement (Bos et al., 2008).

Whilst the available evidence indicates that adverse effects associated with VR are common, there is a lack of robustly recorded data that makes it difficult to estimate the prevalence of these symptoms with any confidence (Lundin et al., 2023). Efforts have been made by previous researchers to identify the impact of multiple factors of motion sickness individually, that might mitigate the effects of cybersickness or increase a user's proneness to it. This has highlighted that high-end VR HMDs alongside ergonomic VR software seems to mitigate the presence of cybersickness substantially (Kourtesis et al., 2019).

Despite the mitigation of side effects through technological advancements, the variability of side effects between subjects suggests that various humanistic factors may

influence its occurrence. Demographic factors of interest have included gender, age, experience with VR and type of virtual environments, alongside certain physiological factors such as heart rate (Holmes & Griffin, 2001), blood pressure, body temperature, and cortisol level (Kim et al., 2022). Despite this research, systematic reviews have revealed contradictory evidence within these factors. As a result there is a lack of consensus among researchers regarding the impact of multiple factors and side effects of motion sickness caused by VR systems.

Despite its challenges, VR is advancing at an extraordinary pace, reshaping both technology and healthcare landscapes. While this rapid progression leads to more sophisticated applications, it also poses challenges for research and healthcare implementation, as cutting-edge systems quickly become outdated and obsolete. This complicates efforts to integrate research into healthcare policy and practices, and requires continuous updates by research to allow it to keep pace with innovation.

Aims of the thesis

Overall, this thesis aimed to investigate two applications of VR in psychosis, in both clinical and educational settings, contributing valuable insights to the growing body of literature on VR-based interventions in mental health.

The thesis begins by synthesising research on immersive and non-immersive VR interventions for the treatment of psychosis with a systematic review and meta-analysis (Chapter Two) to investigate differences in participant dropout. By comparing dropout in this context, the study aims to provide insights into the effect of VR modality on treatment engagement, thereby informing future VR-based treatment approaches for individuals with psychosis. Chapter Three acts as a bridging chapter which links the systematic review and the empirical paper. It aims to explore the issue of participant dropout in the context of

stigmatising attitudes. Following this, Chapter Four is an empirical project which assesses the feasibility of an immersive VR intervention developed to convey the experience of living with psychosis to health students, with the aim to improve empathy and decrease stigmatising attitudes towards this population. The findings from this study will highlight whether a future, larger scale trial to assess the intervention's efficacy. Chapter Four provides a critical discussion of the findings, including strengths and limitations, theoretical and clinical implications, and recommendations for future research.

Chapter Two is a systematic review and meta-analysis which was written up in preparation for submission to Psychiatry Research (see Appendix A for author guidelines and Appendix C for highlights). The following supporting documents for this chapter are provided in the appendix: Mixed Methods Appraisal Tool (MMAT; Appendix B).

Chapter Three is an empirical study, written up in preparation for submission to Psychiatry Research. The following supporting documents for this chapter are provided in the appendix: Background Survey (Appendix E), System Usability Scale (SUS) (Appendix F), CyberSickness in Virtual Reality Questionnaire (CSQ-VR) (Appendix G), Permission to use the Jefferson Scale of Physician Empathy – Student version (JSPE-S) (Appendix H), Attribution Questionnaire – 27 (AQ-27) (Appendix I), Subjective Experience Survey (Appendix J), the Participant Information Sheet (Appendix K), the Participant Screening Questionnaire (Appendix L), the Consent Form (Appendix M), and the Debrief statement (Appendix N), screenshots of scenes from the video (Appendix O) and coding of positive and negative feedback (Appendix P). Finally a statement of ethical approval for the study is provided (Appendix Q).

CHAPTER TWO: Systematic review

A Meta-Analysis of Attrition Rates in Immersive vs. Non-Immersive Virtual Reality Therapy for Psychosis

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Abstract

Background: Virtual reality (VR) has become a promising tool in the assessment and treatment of psychosis, utilising both immersive (IVR) and non-immersive (NIVR) modalities. Given concerns about cybersickness in IVR, understanding treatment acceptability and dropout rates is crucial. This meta-analysis aimed to compare dropout rates between IVR and NIVR interventions.

Method: A systematic search was conducted using PubMed, PsycINFO, CINAHL, Scopus and Embase databases. Studies that used IVR or NIVR therapy with participants diagnosed with a disorder of psychosis to treat psychotic symptoms, cognition, social skills, stress management and daily living skills. . Proportion meta-analyses were conducted to estimate the overall dropout rate, and for IVR and NIVR therapy separately. Post-hoc analysis was used to investigate the moderating effect of other study characteristics, using meta-regression and odds ratios.

Results: Twenty three studies were included in the review - 16 IVR and 7 NIVR. An overall estimate of dropout from all VR interventions was 15%. Dropout rates did not significantly differ between IVR and NIVR therapies, which were found to be 11.9% and 22.46% respectively. IVR dropout was not moderated by the number of sessions, duration of treatment, session length or the presence of active or passive control condition.

Conclusion: Dropout rates for VR-based interventions in psychosis are comparable to or lower than other treatments. This challenges the assumptions that VR specific barriers such as cybersickness lead to higher attrition. Future trials should build on this analysis as VR grows as a treatment modality.

Keywords: Virtual Reality, Psychosis, Attrition, Dropout, Meta-analysis

1. Introduction

Even in its early stages, psychosis has been associated with significant disability. Its far reaching effects have a multitude of adverse consequences on those living with it, including impaired social and occupational functioning (Frawley et al., 2023), social exclusion (Lim et al., 2018), increased risk of homelessness and unemployment (Lin et al., 2022) and increased mortality (Saha et al., 2007). In its broadest terms, psychosis describes a pattern of hallucinations, delusions, and disordered thinking, that appears to result from a combination of genetic risk, early disruption in brain development and exposure to stressors, trauma and substance abuse (Broome et al., 2005). Although psychosis appears as a core symptom in diagnoses such as schizophrenia, it is also associated with many different mental health conditions including borderline personality disorder, and neurodegenerative conditions such as Parkinson's disease (Fénelon & Alves, 2010).

Psychosis as a mental health difficulty is highly resistant to treatment (Suzuki et al., 2012). Cognitive Behavioural Therapy (CBT) and oral antipsychotic medication currently sit as the first line of treatment for people with psychotic disorders (National Institute for Health and Care Excellence [NICE], 2014), however only about half of patients respond to these approaches (Leucht et al., 2022; Thomas et al., 2011). Consequently, researchers and clinicians are increasingly seeking the latest technology to explore new avenues for treatment.

In the last decade, virtual reality (VR) has emerged as a transformative tool in the assessment and treatment of psychosis, due to its ability to create hyper realistic social environments that trigger responses equivalent to the real world (Freeman, 2008). VR simulations can be categorised into three types: non-immersive (NIVR), semi-immersive, and fully immersive (IVR). NIVR involves the presentation of a virtual environment on a standard computer monitor whereby the user interacts via a mouse, keyboard, or joystick

(Fusco & Tieri, 2022). Semi-immersive VR systems provide users with the experience of a partially virtual environment while still being anchored to the physical environment. In contrast, IVR systems operate by immersing a user in a virtual world, using a stereoscopic head mounted display (HMD) (Fusco & Tieri, 2022). HMD's allow users to look around them and move in every direction within the projected virtual environment, interacting with the environment through inputs such as a controller or tactile gloves.

There exists considerable interest in applying IVR and NIVR technology to patients with psychotic disorders, with both modalities having shown promise in addressing the symptoms of psychosis (Monaghesh et al., 2022; Riches et al., 2021). One common application of NIVR which has been found to be effective for reducing symptoms in a range of mental health difficulties including psychosis is 'serious games' (Lau et al., 2017). These are designed for purposes other than entertainment. However, over the last decade, IVR technologies have progressed in their application to psychosis. Whilst treatment studies generally remain small in size, various studies have demonstrated encouraging results, demonstrating IVR's potential in improving social cognitive functioning through simulated social interaction (Rus-Calafell et al., 2014), alleviating auditory and verbal hallucinations through avatar projection (Craig et al., 2018; Fernández-Caballero et al., 2017) and reducing paranoia via CBT applied principles (Jeppesen et al., 2022).

Treatment effectiveness is not the only factor to consider. High attrition rates are especially problematic in psychosis, where individuals often face cognitive impairments, low motivation, and difficulties with trust and engagement, all of which influence individuals adherence to treatment (Lecomte et al., 2008). Research suggests factors such as childhood physical abuse and difficulties in building a therapeutic alliance can further predict poor service engagement (Lecomte et al., 2008), making it even more critical to understand dropout in this population. Various estimates of attrition for those with psychosis and at

clinical high-risk for psychosis currently exist in the literature. Dropout rates of antipsychotic trials range from 36% to 90% (Gueorguieva et al., 2012; Hofer et al., 2017; Wahlbeck et al., 2001), whilst dropout rates of psychological intervention range from 0% to 63% (Szymczynska et al., 2017). In research, high dropout rates undermine the efficacy of interventions and reduce the validity of clinical findings. Known as attrition bias, the threat to validity occurs when the characteristics of those who drop out differ from those who remain, potentially skewing the study outcomes (Bell et al., 2013). Clinically, attrition can be particularly harmful in psychosis, as incomplete treatment may lead to poorer symptom management, increased distress, and reduced willingness to seek future care (Björk et al., 2009).

Whilst a core strength of IVR lies in its capacity to fully immerse users in a virtual environment, this same feature can also present challenges. The intense immersion of IVR has been associated with a range of adverse symptoms, collectively referred to as 'cybersickness.' These symptoms, frequently highlighted in research, include nausea, dizziness, eyestrain, disorientation, postural instability, and fatigue (Farra et al., 2018; Kim et al., 2014). This issue of potential discomfort, alongside issues of technological complexity, is especially relevant in considering the acceptability of IVR therapy which has been found to influence attrition in studies (Saredakis et al., 2020). In contrast NIVR appears as a more cost-effective and less resource-intensive option than IVR, without the levels of cybersickness associated with IVR.

While the therapeutic benefit of different types of VR based interventions has been previously reviewed, the issue of patient retention remains unexplored, a need highlighted by (Rus-Calafell et al., 2018). Given the ethical principle of “do no harm” it is important to consider not only the potential benefit of VR interventions but also their unintended consequences, particularly for vulnerable populations such as individuals with psychosis

(Kellmeyer, 2018). The present review therefore has two aims. The first was to conduct a systematic review and meta-analysis of studies to assess the overall prevalence of attrition across IVR and NIVR interventions for the treatment of psychosis. The second was to explore reasons for dropout from both IVR and NIVR.

2. Methods

2.1. Study registration

The current study was pre-registered on the International Prospective Register of Systematic Reviews (PROSPERO; CRD42024588797) on 16th September 2024, and followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Page et al., 2021). There was a deviation from the initial protocol to include only studies from 2014, to capture only the most recent advances of VR HMD technology in health practice. The PROSPERO protocol was updated accordingly.

2.2. Search strategy

A systematic search of the literature was conducted by the primary researcher on 27th December 2024 to identify all studies that used IVR and NIVR interventions in the treatment of psychosis. The following databases were searched: PubMed, PsycINFO, CINAHL, Scopus and Embase. Only peer reviewed studies were included. A Boolean search was conducted using combinations of the following search terms across title and abstract only: *Virtual reality OR VR OR augmented reality OR mixed reality OR extended reality OR hybrid reality OR HMD OR "head mounted display" OR oculus OR 360 degree OR 360 video OR "immersive video*" OR 2D OR 3D OR avatar OR video gam* OR computer gam* OR Virtual NEAR/5 (environment* or world* or treatment* or interven* or system* or program* or therap* or simulat* or experienc* or technolog* or computer* or embod* or interact* or immers*) AND Schizo* OR Psychosis OR Psychotic.* These search terms were informed by Abbas et al. (2023) who conducted a systematic review of VR definitions in the medical literature. The authors found a complex network of terminology that included terms such as 'computer', 'environment', 'user', 'interactive' and 'simulation'. Studies published in English between January 2014 and December 2024 were included.

2.3. Study inclusion and exclusion criteria

Original studies using VR with human participants diagnosed with a disorder of psychosis to treat psychotic symptoms, cognition, social skills, stress management and daily living skills were included. Studies were included if they were published in English (or translated to English) and in peer-reviewed journals. In line with previous studies, IVR was defined for the current review as an intervention in which individuals can use their own body for a naturalistic sensory-motor interaction with the virtual environment (Fusco & Tieri, 2022). In accordance with this definition, methods that utilised HMD's or 3D-polarized glasses were included. Non-immersive VR methods were defined as any virtual environment that was displayed on a standard computer monitor and the interaction was limited to the use of a mouse, joystick or remote control (Fusco & Tieri, 2022). Studies that included IVR or NIVR as part of the experimental condition were included.

Studies were excluded for several reasons, including studies with participants under the age of 18, and where no standardised diagnostic tool was used to define psychosis. Case studies, non-experimental design and studies reporting on only a single treatment session were also excluded. In the case of multiple publications from the same study sample, the study with the largest sample size was included. Studies were excluded if there was not enough data to calculate attrition rates or studies did not explicitly state dropout rates. They were also excluded if they did not employ an IVR or NIVR intervention as part of their experimental arm and was not the focus of treatment.

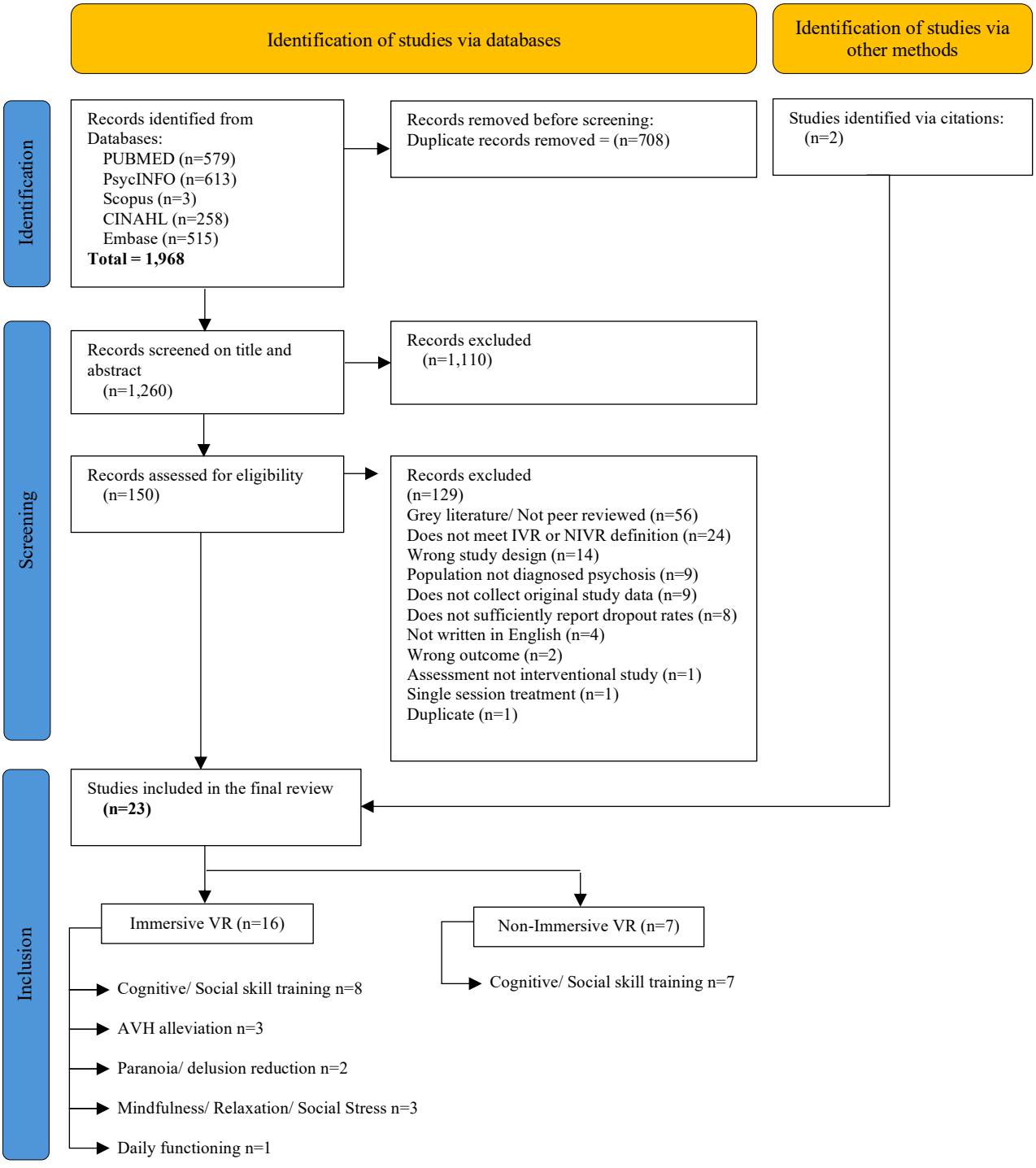
2.4. Study selection

The primary researcher screened 100% of the records to determine eligibility. To ensure consistency and minimise potential bias, a second researcher (AG) independently screened

20% of the records at each stage. Any discrepancies were resolved through discussion. The PRISMA flow chart (Figure 1) shows reasons for exclusions and study inclusion.

Figure 1

PRISMA flow chart for review



Note: VR = Virtual Reality; AVH = Auditory and Visual Hallucinations.

2.5. Data extraction

Attrition was defined as the number of participants who did not complete the intended number of treatment sessions specified by the trial (Benbow & Anderson, 2019). The following data were extracted from each study: (1) study details (author, publication year), (2) type of VR (non-immersive or immersive), (3) information about sample size and drop out (total sample, total VR sample and drop out from the VR condition), (4) intervention details, (5) VR equipment utilised, (6) number of sessions, (7) duration of intervention, (8) duration of VR intervention. Extracted dropout data was taken at the point following the implementation of the intervention. In order to assess potential reasons of attrition from both IVR and NVR studies, reasons for dropout were noted when reported by the study. All data were coded by the primary researcher.

2.6. Assessment of study quality

The Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018) was used to assess the quality of both randomised controlled trials (RCT's) and non-randomised trials included in the analysis. Each criterion is scored as "Yes," "No," or "Unclear," and the overall quality is expressed as a percentage of criteria met (0%, 20%, 40%, 60%, 80% or 100%), with 100% being the highest quality. The MMAT has demonstrated validity and efficiency as a quality assessment tool, which can evaluate multiple study types under one framework (Hong et al., 2019). The MMAT was also selected based on its utilisation by similar reviews (Pallavicini et al., 2022; Shahid et al., 2024). The second reviewer assessed 17.4% of the studies (n=4) to minimise bias.

2.7. Analysis

Proportion meta-analyses were carried out to calculate the estimated dropout rates using the 'metafor' package (version 4.6-0) (Viechtbauer, 2010) with RStudio (version 2024.12.0). A random effects model was used to account for the degree of expected heterogeneity between studies (e.g., differences in symptom severity and number of sessions) (Borenstein et al., 2021). Studies were weighted based on sample size using the inverse variance. Heterogeneity was assessed via the Q statistic and the I2 statistic. An I2 of 25%, 50%, or 75% reflects a low, moderate, or high percentage of between-study variability, respectively (Higgins & Thompson, 2002).

Firstly, a proportion meta-analysis was conducted to assess overall dropout from all included studies. Separate proportion meta-analyses were conducted for IVR and NVR studies. A mixed-effects meta-regression model was then performed to compare dropout rates between IVR and NVR, to assess whether dropout differed significantly between the two types of intervention. Dropout proportions were transformed to log-odds for analysis and back-transformed to proportions for interpretability. In the case of studies which also employed a VR intervention as an active control, data concerning dropout rates from the experimental arm and the active control condition were extracted. These were labelled 'experimental arm' and 'control arm' respectively.

To visually summarise the results, forest plots were generated for the IVR and NVR studies demonstrating proportions. Publication bias was assessed via a funnel plot, which plots the standard error from each study against the study's event rate or odds ratio. Asymmetry in the funnel plot which may indicate publication bias, was further assessed using Egger's regression test (Egger et al., 1997).

3. Results

A total of 23 articles were included in the meta-analysis to assess the prevalence of attrition from IVR and NIVR interventions in the treatment of psychosis. Among these 23 studies, there were 16 papers related to IVR intervention (see Table 3) and 7 papers related to NIVR intervention (see Table 4). Of those studies, the focus of treatment within the IVR intervention could be classified into five areas: cognitive and social functioning (n=8), auditory and visual hallucinations (AVH) (n=3), paranoid ideation and delusion (n=2), mindfulness/relaxation/social stress (n=3) and daily functioning (n=1). All of the interventions within the 7 papers related to NIVR intervention aimed to improve the cognitive and social functioning of participants.

3.1 Study quality

The methodological quality of studies varied. Quality percentages calculated using the MMAT ranged from 20% to 100% (see Table 2). Only one study included in the review was assessed as having high risk of bias across four of the five MMAT domains achieving a score of 20%. The remainder were assessed to have high risk of bias in two domains or less (>60%). Across the included studies, several common limitations emerged. Limitations of RCT's were frequently related to ineffective randomisation processes, the lack of reporting surrounding the completion of outcome data and the processes for dealing with missing data. Limitations of non-randomised studies were related to the lack of consideration given to moderating variables. Across all studies, small sample sizes limited statistical power.

Table 2

Quality rating by study as assessed by The Mixed Methods Appraisal Tool

Study	Screen		Quantitative Randomised Controlled Trials					Quantitative Non-randomised Controlled Trials					Quality assess-ment
	S1	**S2**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**Y%**
Adery et al. (2018)	Y	Y						Y	Y	CT	N	Y	60
Amado et al. (2016)	Y	Y						Y	Y	CT	N	Y	60
Becker et al. (2024)	Y	Y	CT	Y	Y	CT	T						80
Dellazizzo et al. (2020)	Y	Y						N	Y	Y	N	Y	80
Dellazizzo et al. (2021)	Y	Y	CT	Y	Y	N	Y						60
Freeman et al. (2022)	Y	Y	Y	Y	Y	Y	Y						100
Freeman et al. (2023)	Y	Y	Y	Y	Y	Y	Y						100
Freeman et al. (2024)	Y	Y						Y	Y	Y	N	N	60
Fusco et al. (2018)	Y	Y	CT	CT	Y	CT	CT						20
Komemi et al. (2024)	Y	Y						Y	Y	Y	Y	Y	100
Lee et al. (2023)	Y	Y	Y	Y	CT	Y	Y						80
Li et al. (2022)	Y	Y	CT	Y	CT	Y	Y						60
Liang et al. (2022)	Y	Y	CT	Y	Y	N	Y						60
Nahum et al. (2014)	Y	Y						N	Y	Y	N	Y	60
Nijman et al. (2020)	Y	Y						Y	Y	Y	N	Y	80
Nijman et al. (2023)	Y	Y	Y	Y	Y	Y	Y						100
Manghisi et al. (2022)	Y	Y						N	Y	Y	N	Y	60
Mahncke et al. (2019)	Y	Y	Y	Y	Y	Y	Y						100
Pot-Kolder et al. (2018)	Y	Y	Y	Y	Y	Y	Y						100
Shen et al. (2022)	Y	Y	CT	Y	Y	Y	Y						80
Vass et al. (2022)	Y	Y	Y	Y	CT	Y	Y						80
Wang et al. (2022)	Y	Y	Y	Y	CT	N	Y						60
Wang et al. (2024)	Y	Y	N	Y	CT	Y	Y						80

Note: N = No, Y = Yes, CT = Can't Tell

Table 3

Studies employing an Immersive Virtual Reality intervention

Author	Study design	Total study sample	IVR study sample	IVR drop out	Interventions	VR equipment	Number of Sessions	Treatment duration (weeks)	VR duration (minutes)
Intervention: cognitive/social skill training									
Freeman et al. (2024)	Single-group (pre-post) pilot study	12	12	1 (8.3%)	Phoenix VR intends to build up positive self-beliefs and self-confidence via three main VE's - a community garden, a virtual TV studio, and a forest near a lake.	HMD Meta Quest 2 (Meta Platforms, Inc., Menlo Park, California, USA)	12	6	30
Li et al. (2022)	RCT with parallel design	68	30	5 (16.6%)	The intervention comprised of a virtual supermarket where participants were asked to complete different shopping tasks with different lists.	Helmet and joysticks referred to without further details.	10	10	30
Nijman et al. (2020)	Single-group (pre-post) pilot	22	22	5 (22.7%)	DiSCoVR aims to improve social cognition. It displays VE's of a shopping street, a supermarket, and a bar. It targets facial emotion recognition, social perception and theory of mind practiced using role-play exercises.	Oculus Rift HMD (Oculus VR, LLC, Menlo Park, California, USA); Microsoft Xbox game controller to navigate (no further details given)	16	8	DiSCoVR = 60 minutes VRelax = Not stated
Nijman et al. (2023)	RCT	81	DiSCoVR = 41 VRelax =40	DiSCoVR = 15 (36.6%) VRelax =10 (25%)	DiSCoVR aims to improve social cognition. It displays VE's of a shopping street, a supermarket, and a bar. It targets facial emotion recognition, social perception and theory of mind practiced using role-play exercises.	Oculus Rift HMD (Oculus VR, LLC, Menlo Park, California, USA); Microsoft Xbox game controller to navigate (no further details given)	16	8	DiSCoVR = 60 minutes VRelax = Not stated

Author	Study design	Total study sample	IVR study sample	IVR drop out	Interventions	VR equipment	Number of Sessions	Treatment duration (weeks)	VR duration (minutes)
Shen et al. (2022)	RCT	87	28	2 (7.1%)	VR-SCIT focused on emotion perception, theory of mind deficits and attributional bias, perspective taking, distinguishing social facts from guesses. Participants applied social cognitive skills in a VR role-play game, considering different possible ways to react to a situation.	Pico Goblin2 All-In-One (Pico Interactive, Inc., Beijing, China)	10 sessions	10 weeks	Not stated
Vass et al. (2022)	RCT	43	22	1 (4.5%)	VR-ToMIS consists of virtual roleplay simulating everyday social interactions with an avatar controlled by the therapist.	Samsung's Gear VR (HMD); Samsung S7 smartphone; Samsung Simple Controller (Samsung Electronics Co., Ltd., Suwon, South Korea)	9	9	60
Wang et al. (2022)	RCT	64	31	0 (0%)	The serious game was played from a first-person perspective, with a swinging panda, a scoreboard and a circle of fruit-shooting spouts in the users' field of vision.	HTC Vive HMD (HTC, New Taipei City, Taiwan)	20	1.4	30
Intervention: AVH alleviation									
Dellazizzo et al. (2020)	Single-group (pre-post) pilot study	10	10	0 (0%)	VRCBT for AVH included goal-setting and psychoeducation, mindfulness exercises, use of alternative explanation and relapse prevention.	Samsung GearVR HMD set (Samsung Electronics Co., Ltd., Suwon, South Korea); Morph3D character (Morph 3D, Inc., San Diego, California, USA); Roland AIRA VT-3 (Roland Co.,	9	9	60

Author	Study design	Total study sample	IVR study sample	IVR drop out	Interventions	VR equipment	Number of Sessions	Treatment duration (weeks)	VR duration (minutes)
						Hamamatsu, Shizuoka, Japan)			
Dellazizzo et al. (2021)	RCT with parallel design	74	37	9 (24.3%)	Same as Dellazizzo et al. (2020)		9	9	60
Liang et al. (2022)	RCT	65	32	2 (6.25%)	CATS uses immersive VR to create interactive, personalised 3D avatars representing distressing AVHs. Through progressive sessions, patients confront, dialogue with, and transform their relationship with these avatars, fostering emotional regulation, self-esteem, and resilience.	HTC VIVE HMD (HTC, New Taipei City, Taiwan); Unity 3D game engine (Unity Technologies, San Francisco, California, USA) and Blendshape (V2019.4.0f1, Unity Technologies, San Francisco, USA)	9	9	15
Intervention: paranoia/ delusion reduction									
Freeman et al. (2023)	RCT with parallel design	80	VRCOG+ TAU = 39 VRMR+TAU = 39	VRCOG+ TAU = 6 (15.38%) VRMR+TAU = 6 (15.38%)	The THRIVE trial, based on CBT principles such as behavioural experiments, aims to allow participants to test their fear expectations around other people in order to relearn safety. Set in a virtual shopping centre.	HMD HTC Vive Pro (HTC, New Taipei City, Taiwan)	4	4	VRCOG+ TAU = 30 minutes VRMR+ TAU = 30 minutes
Pot-Kolder et al. (2018)	RCT	116	58	12 (20.7%)	Implemented a VR-CBT intervention to reduce paranoid ideation and social anxiety. Virtual environments consisted of a street, bus, café, and supermarket.	Sony HMZ-T1/T2/T3 HMD (Sony Corporation, Tokyo, Japan); Logitech F310 Gamepad (Logitech International S.A., Lausanne, Switzerland)	16	12	100

Author	Study design	Total study sample	IVR study sample	IVR drop out	Interventions	VR equipment	Number of Sessions	Treatment duration (weeks)	VR duration (minutes)
Intervention: mindfulness/ relaxation/ social stress									
Freeman et al. (2022)	RCT with parallel design	346	174	34 (19.5%)	The gameChange VR therapy aims for participants to relearn safety by testing their fear expectations around other people. One of six VR social scenarios (café, general practice waiting room, pub, bus, home, and small local shop).	HTC Vive Pro headset (HTC Corporation, New Taipei City, Taiwan)	6	6	26 (on average)
Fusco et al. (2018)	RCT	22	11	0 (0%)	Progressive muscle relaxation via IVR compared against traditional progressive muscle relaxation.	HMD and a pair of headphones (no further details given)	8	8	10
Lee et al. (2023)	RCT	64	VRM =35 VR control =29	VRM =2 (5.7%) VR control =1 (3.4%)	VRM is a mindfulness intervention that consists of psychoeducation about mindfulness, breathing training, 'five sense' awareness meditation, and awareness meditation.	Oculus Rift CV1 (Meta Reality Labs, Menlo Park, United States)	8	8	VRM = 30 minute VR control= 30 minutes
Intervention: Daily functioning									
Manghisi et al. (2022)	Single-group (pre-post) pilot study	10	10	1 (10%)	The IVR intervention was designed to aid in the rehabilitation of independent living skills by helping individuals locate items associated with specific daily tasks around the house (e.g., an unmade bed, an open closet, soap for handwashing)	Oculus Go (Meta Reality Labs, Menlo Park, CA, USA)	24	12	Not stated

Note: IVR = Immersive Virtual Reality; NIVR = Non-Immersive Virtual Reality; VE = Virtual Environment; HMD = Head-Mounted Display; VRCOG = Virtual Reality Cognitive Therapy; VRMR = Virtual Reality Mental Relaxation; VR-ToMIS = Virtual Reality-Based Theory of Mind Intervention in Schizophrenia; AVH = Auditory Verbal Hallucinations; CBT = Cognitive Behavioural Therapy; QoL = Quality of Life; TR-SCIT = Traditional Social Cognition Interaction Training; VR-SCIT = Virtual Reality Social Cognition Interaction Training. Where number of sessions varied for each study, the sessions were selected.

Table 4

Studies employing a Non-Immersive Virtual Reality intervention

Author	Study design	Total study sample	NIVR study sample	NIVR drop out	Interventions	VR equipment	No. of Sessions	Treatment duration	VR duration
Intervention: cognitive/social skill training									
Adery et al. (2018)	Single-group (pre-post) pilot study	18	18	2 (11.1%)	MASI-VR - package with social scenarios with virtual avatars.	Desktop computer	10	5.5	Not stated
Amado et al. (2016)	Single-group (pre-post) pilot study	10	10	4 (40%)	Patients had to navigate as pedestrians in a virtual 3D town as a group, memorising their itinerary, planning and problem solving.	Desktop computer and joystick	12	12	60
Becker et al. (2024)	RCT	95	Super Mario 64 =24 Super Mario Bros=23	Super Mario 64 = 4 (16.6%) Super Mario Bros =3 (13%)	Subjects assigned to Super Mario 64 or Super Mario Bros, or E-book reading.	Nintendo Dual Screen XXL console (Nintendo DS, 2008, Kyoto, Japan)	8	8	30
Komemi et al. (2024)	Single-group (pre-post) pilot study	31	31	8 (25.8%)	The Functional Brain Trainer simulates real-life environments and daily tasks (e.g. running a food truck, managing a bus station, and working in a supermarket).	Desktop computer and a motion-based camera	8	4	20
Mahncke et al. (2019)	RCT	141	68	24 (35.3%)	Cognitive training exercises - yielded a reward in virtual currency, which could be used in an in-game shopping experience to decorate virtual apartment.	Desktop computer	130	26	60

Author	Study design	Total study sample	NIVR study sample	NIVR drop out	Interventions	VR equipment	No. of Sessions	Treatment duration	VR duration
Nahum et al. (2014)	Quasi-experimental two-group pre-post study	34	22	5 (22.7%)	SocialVille is an online training programme aims to treat social cognition deficits. It targets the social cognitive domains of affect perception (both visual and vocal), social cue perception, ToM and self-referential processing.	Not stated explicitly	24	8.1	10
Wang et al. (2024)	RCT, pilot study	112	40	0 (0%)	Komori Life is a social/life and farming simulation game. It involves decorating the house, planting, hunting, toiling the land, cooking food and socialising.	Tablet computers	20	4	60

Note: NIVR = Non-Immersive Virtual Reality; VE = Virtual Environment; HMD = Head-Mounted Display; CBT = Cognitive Behavioural Therapy; FBT = Functional Brain Trainer; ToM = Theory of Mind; MASI-VR = Multimodal Adaptive Social Intervention in Virtual Reality; 3D = 3-Dimensional

3.2. Meta-analysis

Dropout varied between 0% and 37% in the IVR therapy studies and between 0% and 40% in the NIVR therapy studies. A proportion meta-analysis yielded an overall pooled estimate of 15% dropout in IVR Therapy (k = 27, 95% CI: 11.0, 20.0), with moderate-to-high heterogeneity between studies (Q(26) = 62.12, p = 0.00, I^2 = 62.69%). A pooled estimate of 11.9% dropout in IVR Therapy was found (k = 19, 95% CI 7.8, 17.4), with moderate-to-high variability heterogeneity between studies (Q(18) = 40.798, p = 0.0016, I^2 = 63.66%). The analysis also yielded a pooled estimate of 22.46% dropout in NIVR Therapy (k = 8, 95% CI 15.1, 32.1), with moderate heterogeneity **(**Q(7) = 14.496, p = 0.043, I^2 = 41.76%**).** A meta-regression was conducted to compare dropout rates between IVR and NIVR therapies, with type of VR therapy coded as a moderator. Results indicated that dropout rates did not significantly differ between type of VR (β = 0.65, p = 0.078). The forest plot (see Figure 2) highlights the difference in dropout rates between the two groups. Egger's test for funnel plot asymmetry in the IVR model (t = -4.8982, p = 0.0001) and NIVR model were significant (t = -3.7073, p = 0.0100), indicating potential publication bias in both the IVR and NIVR meta-analyses. Figures 3 and 4 show the funnel plot for the IVR and NIVR studies.

Figure 2

A forest plot of proportions for study dropout at intervention level for IVR and NVR studies

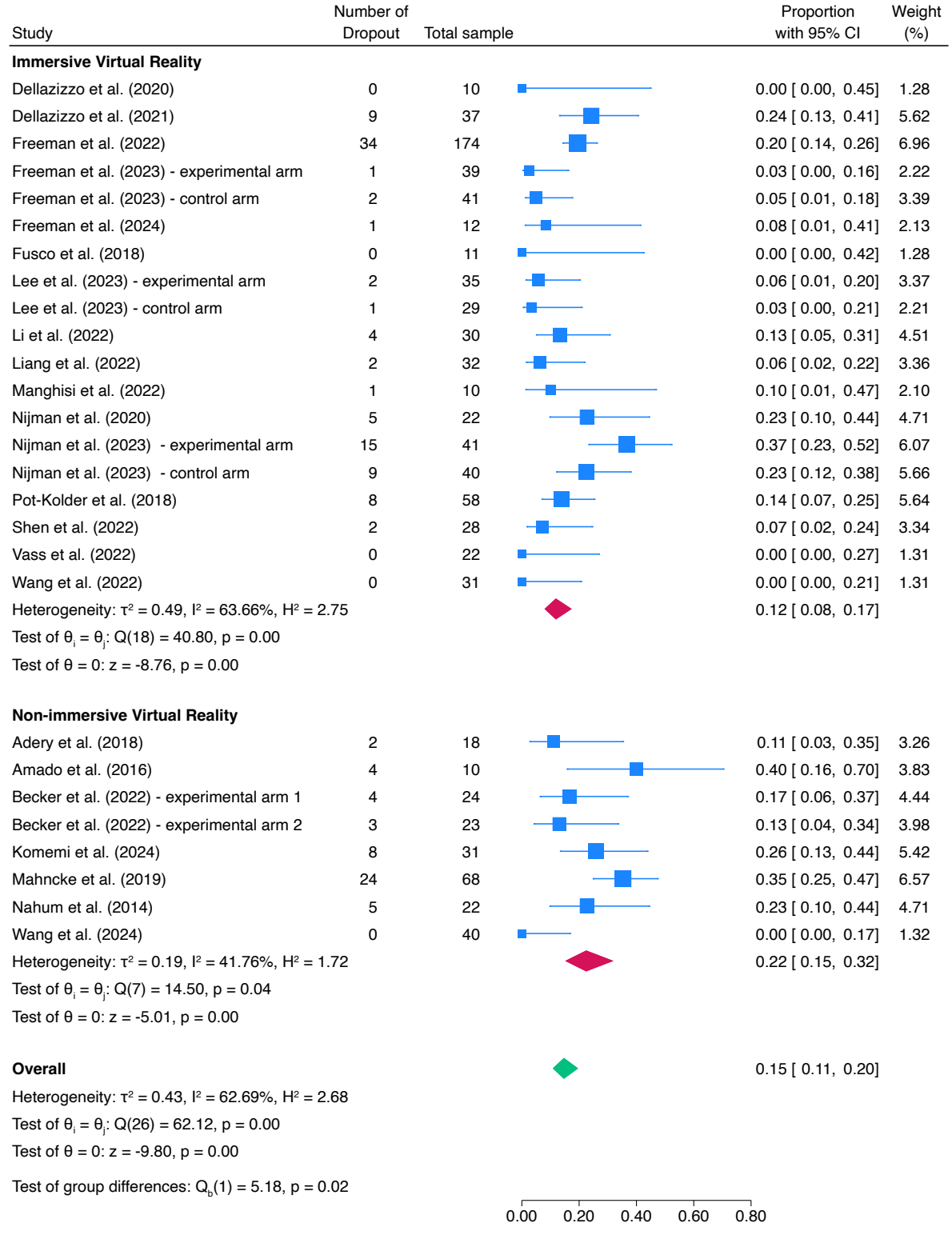


Figure 3

A funnel plot of IVR therapy studies in the current review

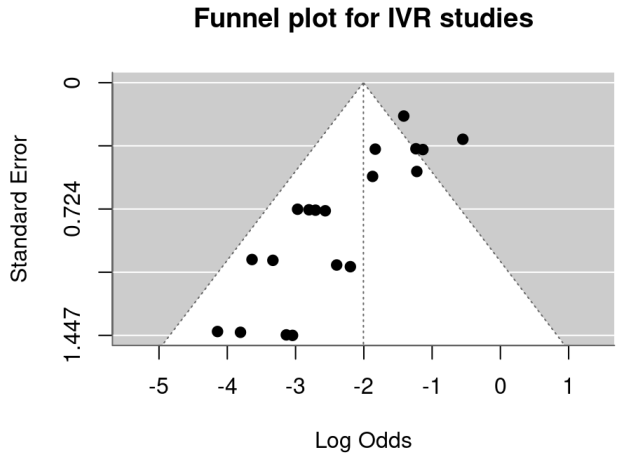
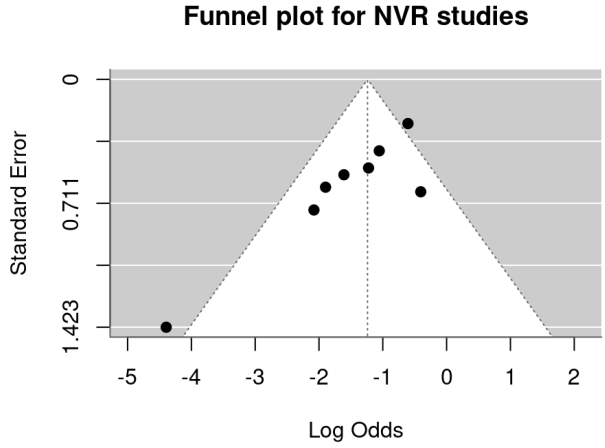


Figure 4

A funnel plot of NIVR therapy studies in the current review



3.3. Post-hoc analysis

Exploratory analysis using meta-regression was also undertaken to understand the moderating effect of other intervention variables including the number of sessions, duration of treatment and duration of VR intervention in the included studies (see Table 5). With research from Cochrane suggesting a minimum of 10 studies per examined covariate in meta-regression (Chandler et al., 2019), this analysis was only conducted using the IVR therapy

studies. The results showed that the number of sessions, duration of treatment and duration of the VR intervention were not significant moderators for IVR dropout.

Table 5

A table of moderators from IVR studies using meta regression

Moderator	Heterogeneity stats (*QE*[df], sign)	I² (%)	Coefficient *(ß)*	95% CI	p-value	Intercept
Number of sessions	*QE*[17] = 38.09, $p < .001$	56.29	0.07	-0.018, 0.158	$p = 0.121$	-2.78
Duration of treatment	*QE*[17] = 40.75, $p = 0.001$	63.17	0.12	-0.0841, 0.3146	$p = 0.258$	-2.96
VR duration	*QE*[15] = 35.71, $p = 0.0019$	60.45	0.02	-0.0009, 0.0361	$p = 0.063$	-2.76

The type of control (active or passive) within IVR therapy studies employing a randomised control design was also investigated. One of the studies (Shen et al., 2022) employed a three condition design involving virtual reality social cognition interactive training (VR-SCIT) and traditional social cognition interactive training (TR-SCIT) and a waiting list. For this study, VR-SCIT was compared twice against control groups (VR-SCIT vs TR-SCIT, VR-SCIT vs waiting list). A mixed-effects meta-regression was conducted with the relative likelihood of dropout assessed using odds ratios (OR). The analysis indicated that the odds of dropout in the passive control group were 1.1019 times higher than in the active control group (95% CI: -0.3490, 2.5528). However, this difference was not statistically significant ($p = 0.14$), and there was no significant heterogeneity between studies ($Q = 17.5044$, $df = 11$, $p = 0.09$).

3.4. Reasons for dropout

Table 6 summarises the reasons for dropout from IVR studies. In total, 112 participants dropped out from IVR therapy in the studies included, with studies attributing reasons for

dropout to 71 (63%) of these participants. Across NIVR interventions, 50 participants dropped out, with studies attributing reasons for dropout to 16 (36%) of these participants. Table 7 summarises the reasons for dropout from NIVR studies. Across the IVR studies, 0.9% of participants were documented as leaving due to cybersickness, and 3.6% participants discontinued because the HMD was uncomfortable. Similarly, in NIVR studies, no cases of cybersickness were reported, and only 2% of participants withdrew due to technical difficulties. The majority of dropouts in both IVR and NIVR studies were attributed to non-VR specific reasons such as COVID-19 restrictions, conflicting commitments, unexpected discharge, or perceived increases in psychiatric symptoms.

Table 6

Reported reasons for dropout from IVR therapy and the total number of participants who provided these reasons for dropout

Reason for dropout in Immersive Virtual Reality	**n =**
COVID-19 restrictions	14 (12.5%)
Unexpected discharge	10 (8.9%)
Perceived increase in psychiatric symptoms	7 (6.3%)
Too intense	6 (5.3%)
Alternative treatment necessary	6 (5.3%)
Conflicting commitments	5 (4.5%)
Unable to complete psychometrics	4 (3.6%)
HMD too uncomfortable	4 (3.6%)
Hospitalisation/ death (unrelated to virtual reality)	4 (3.6%)
Didn’t want to continue	3 (2.7%)
Lost due to clerical error	3 (2.7%)
Connection with therapist	1 (0.9%)
Didn’t attend	1 (0.9%)
No longer eligible	1 (0.9%)
Cybersickness	1 (0.9%)
Unable to attend therapy sober	1 (0.9%)

Note: HMD = Head Mounted Display; COVID-19 = Coronavirus disease, n = Number

Table 7

Reported reasons for dropout from NIVR therapy and the total number of participants who provided these reasons for dropout.

Reason for dropout in Non- Immersive Virtual Reality	**n =**
Conflicting demands	3 (6%)
Perceived increase in psychiatric symptoms	3 (6%)
Unexpected discharge	3 (6%)
Didn't want to continue	3 (6%)
Unable to complete psychometrics	2 (4%)
Hospitalisation	1 (2%)
Technical difficulties	1 (2%)

4. Discussion

This meta-analysis aimed to explore attrition rates in IVR and NIVR therapies for the treatment of psychosis. To the authors knowledge, this is the first meta-analysis attempting to identify dropout of VR therapy in psychosis.

The study demonstrated an overall pooled dropout rate of 15% (95% CI 11.0, 20.0) at the intervention level across all studies employing VR therapy. These results are comparable to that of Benbow and Anderson (2019) who estimated the prevalence rate of attrition from VR for exposure therapy for patients with anxiety disorders at 16.0% (95 CI 12.9, 19.7). Dropout rates for IVR and NIVR therapies were different, but did not meet the threshold for significance, with IVR therapy studies yielding an 11.9% (95% CI 7.8, 17.4), dropout compared with NIVR which yielded a 22.46% (95% CI 15.1, 32.1) dropout at intervention level. This contradicts expectations that the usual barriers associated with IVR therapy, such as cybersickness, technical difficulties, and discomfort (Saredakis et al., 2020), lead to substantial participant dropout in patients with psychosis.

The observation IVR therapy does not lead to substantial participant dropout in patients with psychosis, was also supported by the low number of VR specific reasons for dropout within included studies. Of the documented reasons for dropout, only 4.5% of participants cited cybersickness and HMD discomfort in IVR studies. By contrast, more common reasons included unexpected discharge (8.9%), or a perceived increase in psychiatric symptoms (6.3%). Whilst perceived symptom exacerbation presents a worrying concern, it is important to note that this reason for dropout is not inherently specific to VR as worsening can arise in the context of any psychological intervention or unrelated external factors. This pattern of dropout reasons was also reflected across the studies that utilised NIVR interventions. Together with a low dropout rate, these findings indicate that immersive and non-immersive

VR interventions, are generally well tolerated in individuals with psychosis and adverse VR specific effects are not likely to be of concern.

Exploratory analysis also revealed that IVR dropout was not moderated by the number of sessions, duration of treatment, session length or the presence of active or passive control condition. While the duration of VR intervention was not statistically significant as a moderating variable, it approached significance suggesting that longer sessions may be associated with increased dropout rates in IVR intervention. This finding aligns with prior research indicating that longer exposure to VR can increase discomfort and cybersickness, which could lead to higher attrition (Sharples et al., 2008).

A key observation was that all NIVR interventions were exclusively targeted to improving social functioning, by enhancing social cognition, communication skills, and emotional recognition. This limited scope contrasts with IVR interventions, which addressed a broader range of treatment targets, including cognitive and social functioning, AVH's, paranoid ideation, stress management, and daily functioning. While some of the NIVR interventions demonstrated promising outcomes for social rehabilitation (Komemi et al., 2024; Nahum et al., 2014), their narrower application suggests a more restricted or cautious approach in targeting symptoms of psychosis. This suggests that IVR may offer a more versatile treatment approach in the treatment of psychosis than NIVR, adding to its value as a method for intervention. This may also impact the characteristics of the samples, as certain individuals might be more willing to engage in interventions that target social functioning rather than those that address potentially more distressing symptoms such as AVH's. These factors have implications regarding the investigation of differences in dropout rates between IVR and NIVR, which may not solely reflect the mode of delivery but rather the nature of the intervention.

4.1. Main implications

The main clinical implication of results presented here is that the overall dropout rate for VR therapy in psychosis (15%) is encouraging, particularly when compared to interventions such as CBT, which has dropout rates of around 20% (Fernandez et al., 2015). It is also more favourable than dropout rates for clinically high-risk of psychosis populations (29.6%) (Farris et al., 2020), and for dual diagnosis patients with symptoms of psychosis and substance abuse (27.2%) (Bouchard et al., 2022). This could indicate that certain factors such as engagement and interest, that have been shown to affect learning, may outweigh cybersickness in VR (Makransky & Petersen, 2021). Equally it may also indicate that studies implementing VR interventions have developed strategies to mitigate side effects (So et al., 2001; Wang et al., 2023). Researchers have often been hesitant to adopt VR due to concerns regarding its acceptability however the current review indicates the interventions may not result in high attrition in this population.

4.2. Limitations and future research

Several limitations should be considered when interpreting these findings. Firstly, the review only included publications written in the English language with a specific inclusion criteria around patients diagnosed with psychotic disorders. Studies were also excluded if they did not provide sufficient information about dropout. Due to resource issues, it was not possible to contact the original authors to try and source this information. These factors influenced the inclusion of studies, and the findings may not fully capture dropout patterns across all relevant studies. Our review also included a relatively small number of NIVR studies, and across both types of VR systems, a lot of the studies recruited small numbers of participants. This may limit the reliability of dropout rate estimates and the generalisability of results to broader clinical populations. Furthermore, some RCT and non-RCT studies that were

identified as having a high risk of bias were included; we suggest caution when drawing conclusions from these studies. On a similar note, the authors suggest that the overall dropout rate found may be an underestimation of the actual dropout rate found in real world clinical settings. This may be due to publication bias in favour of studies presenting lower dropout rates, alongside the lack of representativeness of research populations compared to clinical groups. Therefore, it may be relevant to note that dropout rates observed in VR treatment trials are not necessarily predictive of acceptability in the context of clinical care.

Whilst there was significant heterogeneity associated with our results, there are not enough studies at present to limit the variability in other ways such as restricting inclusion criteria to one application of VR such as cognitive or social skill functioning. Therefore at this moment in time, this represents the best indication for dropout across VR intervention for psychosis. It would be beneficial for future research to build on this analysis as future treatment trials are published, including analysis of additional factors, for example therapist experience, reasons for dropout and stage of treatment at which dropout occurred. Future trials should also report the demographic characteristics of participants who dropped out with those who stayed in treatment, as recommended by CONSORT guidelines (Moher et al., 2001). This would allow future researchers to assess whether dropout differences are due to the acceptability of the type of VR, or participant characteristics such as age, gender, and prior VR exposure, which have all been linked with dropout in VR (Ramaseri-Chandra & Reza, 2024).

4.3. Conclusion

This meta-analysis provides the first estimate of dropout rates in VR therapy for psychosis, demonstrating an overall dropout rate of 15%, which is comparable to other VR interventions in mental health. Notably, dropout rates did not significantly differ between IVR and NIVR

therapies, challenging assumptions that IVR specific barriers, such as cybersickness and technical difficulties, lead to higher attrition. The dropout rate for VR overall is comparable to or lower than other psychosis treatments, suggesting strong engagement and effective mitigation of side effects. However, limitations such as small sample sizes and potential publication bias warrant caution. Future research should refine dropout estimates by examining additional factors like therapist experience and participant characteristics.

CRediT authorship contribution statement

Olivia Hannah: Conceptualisation, Data curation, Formal analysis, Methodology, Investigation, Project administration, Writing – review & editing, Writing – original draft, Visualisation. **Jordan Tsigarides:** Conceptualisation, Supervision, Writing – review & editing, **Alisia Green:** Methodology. **Adrian Leddy:** Conceptualisation, Investigation, Methodology, Supervision, Writing – review & editing.

Statements and declarations

Declaration of competing interest

The authors declare no conflicts of interest.

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CHAPTER THREE: Bridging Chapter

One of the key challenges in treating psychosis is ensuring sustained engagement with therapeutic interventions. This is an important area of research, as studies have shown that up to 63% of individuals with psychosis often disengage from psychological treatment (Szymczynska et al., 2017), therefore limiting the associated effectiveness of respective interventions (Haynes et al., 2002). The meta-analysis outlined in the previous chapter examined the therapeutic application of Virtual Reality (VR) in the treatment of psychosis and its associated dropout rates.

One factor that has been shown to contribute to the dropout and treatment adherence of people in treatment for psychosis, is the stigma associated with mental health. Research has shown that individuals who are negatively stigmatised are less likely to seek out treatment and more likely to drop out of treatment (Gaebel et al., 2006; Sirey et al., 2001; Van Dorn et al., 2005). Both external stigma - how individuals feel they are perceived by others - and self-stigma - the internalisation of negative societal attitudes - have been identified as key predictors of treatment adherence (Britt et al., 2015). The consequences of treatment discontinuation are vast, with longer periods of untreated psychosis shown to be associated with poorer long-term outcomes, including a decreased response to treatment and lower chances of recovery (Penttilä et al., 2014).

Psychosis is one of the most stigmatised mental health problems, with more than 40% of people with schizophrenia feeling highly stigmatised (Brohan et al., 2010). People living with psychosis are subject to many harmful misconceptions perpetuated by the media that they are ‘crazy’, dangerous, unemphatic and impulsive (Bowen et al., 2019). Negative attitudes towards individuals with psychosis have a succession of serious and enduring consequences on many aspects of their lives. Those with the most acute psychotic symptoms often experience worse stigma, which can lead to increased social distancing from other

members of society and self-stigmatising beliefs (Lysaker et al., 2007). The effect of this can erode their sense of identity and self-esteem (Major & O'Brien, 2005) as well as exacerbate psychotic symptoms (Lysaker et al., 2007). This worsening of symptoms can then reinforce stigma, further isolating individuals and making it even more difficult for them to seek support, ultimately sustaining the cycle of discrimination and declining mental health. Addressing stigma is therefore important, not only for improving treatment adherence but also for breaking this cycle, with the potential to reduce dropout rates and ultimately enhance long-term outcomes.

Interventions for stigma

Anti-stigma campaigns play a crucial role in challenging misconceptions and fostering more accepting attitudes toward mental health difficulties. Healthcare providers are an important target group for anti-stigma interventions. Whilst healthcare providers are generally caring individuals who devote their work to helping others, they are subject to the same influences of public stigma as any other citizen. As a result, mental health providers often subscribe to the same stereotypes about people with mental health difficulties that are endorsed by the general public (Schulze, 2007). Healthcare professionals may contribute to the stigmatisation of their patients consciously or unconsciously. In line with the idea that stereotyping results from a lack of knowledge (Thornicroft et al., 2007), traditionally, most interventions for improving health provider stigma have been developed from knowledge-attitude-practice frameworks. Studies have shown however that knowledge-based approaches do not always result in expected attitudinal and behavioural changes and some even have negative impacts (Stuart, 2016). Given the direct impact of stigma among healthcare providers on recovery, it is clear that other approaches are needed to reduce stigma to healthcare providers (Kohrt et al., 2020).

The role of empathy in destigmatization

Empathy has shown to be one way to reduce stigma in health professionals; a process which is explained by the empathy-attitude-action model (Batson et al., 2002). Based on social-cognitive theory, the model asserts that ultimately, inducing empathy toward one individual of a stigmatised outgroup can improve attitudes toward that group, and, in turn, promote prosocial behaviour towards that group.

Over the years, social psychology, developmental science, and neuroscience, has attempted to bridge our intuitive folk conception of 'empathy' with a scientific definition. As a result, there are almost as many definitions as there are researchers in this field (Decety & Jackson, 2004). Some recognise it solely as a cognitive process (Clark, 2010; Decety & Michalska, 2010; Hogan, 1969; van der Weele, 2011), in which the subject actively attempts to represent the state of the object by imagining themselves into the situation of another (Buchheimer, 1963). Others only recognise it as an affective process (Decety & Lamm, 2006), defining it by the experience and sharing of emotions. In recent years however, many researchers have rejected the separation of these two notions, arguing that empathy may best be understood as a multidimensional construct that includes both emotional and cognitive components (Lamm et al., 2007; Oliveira-Silva & Gonçalves, 2011).

In medicine, cognitive empathy has been traditionally favoured over an affective understanding of patients' emotions, believing it hinders a physicians ability to remain objective (Halpern, 2007). This has resulted in the taught message and practice of 'detached concern', whereby physicians emotionally distance themselves from their patient. The endorsement of cognitive empathy in the medical community, is echoed within the long-standing teachings of Karl Jaspers, who emphasised that understanding a patients' abnormal mental experiences should be guided by an observation of a battery of clinical indicators

(Jaspers, 1912). These ideas are embedded into current routine practice within psychiatry, with tools such as the mental state examination, aligning with this approach.

Despite a clear link between empathy and quality of medical care, several empirical studies have shown a decline particularly in empathy during undergraduate medical education (Hojat et al., 2004; Triffaux et al., 2019). In one study of particular interest to the current paper, Papageorgiou et al. (2018), measured changes in empathy in two cohorts of undergraduate medical students (n = 333) studying a five year MBBS degree at The Norwich Medical School, University of East Anglia. The five-year longitudinal study found that in accordance with previous research, empathy declined as students' progressed through the course.

'The ultimate empathy machine'

As a three-dimensional (3D) computer-generated experience, VR has vast potential for the manipulation of empathy (Bertrand et al., 2018). As such, VR has become affectionately adopted as the 'ultimate empathy machine' by the academic sphere, providing individuals with the ability to appreciate any situation from any perspective, owing to its unique capabilities (Marques et al., 2022). Overcoming limitations of previous methods, VR eliminates the need for imagination (Rueda & Lara, 2020), establishing itself as an appealing medium for facilitating changes in empathy.

Research has highlighted several key mechanisms that may underpin VR's ability to facilitate empathy, each contributing to the user's immersive experience and perspective-taking. Presence has been discussed extensively in the literature as a mechanism by which VR may be an effective tool for eliciting empathy, a relationship that is supported by the close link between empathy and presence as concepts (Nicovich et al., 2005). A meta-analysis by Ventura et al. (2020) has implicated presence as the main mechanism in the

elicitation of empathy, demonstrating its ability to facilitate feelings of connection with others and accurately understand other perspectives. Alongside presence, research has also pointed to other components of VR including immersion and body illusion, as key mechanisms for the elicitation of empathy. Han et al. (2022) for instance, which examined the effect of immersive VR and perspective-taking on presence and empathy, found that it was the type of perspective-taking (first or third person) that affected participant's empathetic reactions. In this, authors concluded that the combination of direct embodiment in VR and high immersion resulted in stronger empathy compared to low immersion, a finding replicated by previous studies (Banakou et al., 2016). On the other hand, adopting the third person perspective was more effective in evoking empathy when experienced with low immersion. In contrast, Barbot and Kaufman (2020) have shown that illusion of virtual body ownership and sense of agency was among the largest determinants of empathy change.

By leveraging these elements, VR positions itself as an effective medium for facilitating empathy and driving meaningful attitude change, surpassing traditional methods that rely solely on imagination and observation (Rueda & Lara, 2020). The focus of Chapter Four therefore presents the feasibility of a new VR simulation in shaping empathy and attitudes towards psychosis among healthcare students.

CHAPTER FOUR: Empirical study

Evaluating a Virtual Reality Simulation on Empathy and Attitudes towards Psychosis in Health Students: A Feasibility Study

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Abstract

Background: The application of virtual reality (VR) for educational purposes has been gaining traction in the field of mental health. Previous studies have shown that VR in the simulation of psychosis can be used to reduce stigma and increase empathy toward patients, however no study to date has conducted this in a UK population. The present study aimed to assess the feasibility of delivering a newly developed VR intervention, to foster empathy and reduce stigmatising attitudes toward psychosis among health students from a UK university.

Method: The study employed a single-arm, pre-post-test design. The primary aim was to assess the feasibility of delivering the VR intervention. Feasibility was evaluated through participant engagement and acceptability of study materials, including VR usability, side effects, and qualitative feedback on participant experiences. The secondary aim was to examine changes in empathy and stigmatising attitudes following the intervention. To evaluate this, participants completed assessments at baseline and post-intervention.

Results: 30 undergraduate health and medical students from a UK university were recruited. The results demonstrated that participants experienced mild cybersickness following its use and felt the VR systems were easy to use. Participants' empathy scores increased and stigmatising attitudes decreased, with moderate-to-large effect sizes following the intervention. Qualitative feedback highlighted the intervention's potential to promote perspective-taking, though some users noted limitations in content realism and navigation.

Conclusion: Overall, the findings suggest the VR intervention is feasible and acceptable for health and medical students, and holds promise as an educational intervention to enhance empathy and challenge stigma.

Keywords: Virtual Reality, Psychosis, Stigma, Empathy, Health Students

1. Introduction

As one of the most serious neuropsychiatric presentations, psychosis is associated with severe deficits in cognitive, social, and occupational functioning, that compromise the individual's quality of life (American Psychiatric Association, 2022; Cowman et al., 2021; Kahn et al., 2015). People who experience psychosis are one of the most stigmatised groups within western society (Wood et al., 2014). As a result, this population are victim to some of the highest levels of discrimination, which disadvantage them and have a succession of negative consequences on their lives, including increased social isolation, poor housing, homelessness, restricted employment opportunities, and reduced financial autonomy (Corrigan & Shapiro, 2010).

Alarmingly, research has shown that these stigmatising attitudes towards people with psychosis, persist even within healthcare professionals (Schulze, 2007). In a recent systematic review, Chen et al. (2023) revealed out of those professionals who have contact with people with psychosis, general practitioners (GPs) and nurses were found to exhibit the highest levels of stigma and the lowest levels of knowledge about psychosis. GPs in particular often viewed people with psychosis as dangerous, difficult, or unfit for community living, leading to recommendations for supervision or hospitalisation (Magliano et al., 2017). Nurses also reported emotional detachment and pessimism about recovery (Hellzén et al., 2003). In contrast, mental health professionals including psychiatrists and psychologists, tended to demonstrate more nuanced attitudes, however, these professionals still reported low levels of confidence in managing and treating psychosis.

These negative attitudes have tangible consequences on patient care. Anticipated or experienced stigma can lead to avoidance strategies, such as denial or non-disclosure of symptoms, which in turn delay help-seeking (Cotter et al., 2017). This delay contributes to a longer duration of untreated psychosis, a factor that has been strongly linked to poorer

outcomes including more severe positive and negative symptoms, a lower likelihood of remission, reduced social functioning, and worse overall recovery (Penttilä et al., 2014). Stigma also affects treatment engagement more broadly, with services perceived as less stigmatising reporting lower dropout rates (Gray, 2002). Research has also shown how fear and ignorance of serious mental difficulties including psychosis can result in neglection of a patient's physical health needs (Filipcic et al., 2003), contributing to the high mortality associated with psychotic disorders (Oakley et al., 2018).

Empathy has been identified as a powerful tool to combat stigma (Hecht et al., 2021). In healthcare, empathy has been found to engender a trusting clinical relationship, leading to a direct increase in patient adherence to treatment (Hickson et al., 2002; Ngaire et al., 2004). Alongside an increase in overall patient satisfaction (Kim et al., 2004), empathy has also been linked with increased physician well-being and reduced burnout (Hunt et al., 2017; Krasner et al., 2009). As such, empathy has been argued to be one of the most powerful skills in a clinician's toolbox (Hegazi & Wilson, 2013).

Despite a link between empathy and quality of medical care, a body of compelling evidence has demonstrated a global decline of empathy in healthcare (Hojat et al., 2004; Triffaux et al., 2019). For medical students, this phenomenon has been attributed, in part to the unrefuted stress and long work-hours associated with medical training (Michalec, 2010), producing a cynicism and a loss of idealism (Kachel et al., 2020). Whilst some form of empathy-focused training exists on most UK undergraduate healthcare curriculums, most educators recognise a need to offer more (Winter et al., 2023), reinforced by requirements by professional bodies. This includes the General Medical Council (General Medical Council, 2018) and the Nursing and Midwifery Council (Nursing and Midwifery Council, 2015). To meet this priority, there is a clear need for evidence-based, specific, and reproducible training interventions (Riess et al., 2012).

Research indicates perspective-taking as one of the best strategies to cultivate learning to reduce stigma and increase empathy (Marques et al., 2022). Conventionally, this has been induced through role play (Rueda & Lara, 2020), but in recent years, virtual reality (VR) has changed the face of traditional methods of perspective-taking. As a three-dimensional (3D) computer-generated experience, VR allows for first person active learning, eliminating the need for imagination and enable users to engage directly with realistic, simulated scenarios (Rueda & Lara, 2020). The high degree of immersion in VR has been shown to be a key mechanism for fostering empathy (Herrera et al., 2018) and evidence suggests that VR based interventions can improve knowledge and attitudes towards individuals with mental health difficulties (Jones et al., 2021; Jing Ling Tay et al., 2023). VR has also been shown to increase motivation, engagement, and the time spent for learning in students (Huang et al., 2021). Implementing a VR perspective-taking intervention for health students therefore offers a novel, scalable, and experiential approach to tackling stigma at its roots.

VR techniques have become increasingly used in healthcare as an educational tool particularly in the field of psychiatry (Freeman et al., 2017). The simulation of psychotic disorders presents an attractive concept to VR simulation, transforming elusive experiences such as hallucinations into opportunities for self-reflectiveness (Wan & Lam, 2019). To date there have been limited studies assessing the outcomes of VR in reducing stigma toward psychosis. Formosa et al. (2018) investigated the simulation of positive psychosis symptoms through VR in the general public and psychology undergraduates. The results of their pre-post study suggested that just one session could increase students' knowledge, attitudes, and empathy toward patients with psychosis. However, they acknowledged that where VR stands in comparison with the current methods of education is still under question. In a more recent Portuguese study by Marques et al. (2022), researchers compared the impact of a VR simulation of psychotic symptoms whilst performing a cognitive task with a two-dimensional

video. Although both interventions achieved higher levels of empathy and improved attitudes towards people diagnosed with schizophrenia, VR appeared to be most effective at inducing an affective reaction. These results mirror the findings of an Iranian study, Zare-Bidaki et al. (2022), who found VR significantly increased knowledge and empathy of psychosis, compared with the traditional method of visiting patients under supervision.

Whilst there is emerging evidence demonstrating a potential for VR in this context, there are currently no studies, to the authors' knowledge conducted with health students in the United Kingdom (UK). Considering the cultural differences inherent in the UK's healthcare system, investigating VR in this setting could offer valuable insights into how cultural factors influence its implementation.

Given that previous research has identified health and medical students as an altogether hard to reach population, facing barriers including lack of time (Elmannan et al., 2022), a feasibility project is well placed to establish the practicalities of recruiting into a future larger trial. As health students enter the workforce, they will have the opportunity to influence institutional cultures and policies within healthcare systems, confirming their status as a population of interest. This study had two aims:

Aim 1: To assess the feasibility of delivering a VR intervention with a health student population at a university in the UK.

Aim 2: To investigate changes in empathy and stigmatising attitudes following the VR intervention, to provide the likely magnitude of effect which will inform sample size calculations for larger, future research.

2. Methods

2.1. Study aims

2.1.1. Primary aim

The primary aim of this study was to assess the feasibility of delivering a VR intervention with a health student population at a university in the UK.

2.1.2. Secondary aim

The secondary aim of this study was to investigate changes in empathy and stigmatising attitudes following the VR intervention, to provide the likely magnitude of effect which will inform sample size calculations for larger, future research.

2.2. Participants and screening

The study aimed to recruit 30 participants. Recruitment took place between September 2024 and November 2024. Participants were recruited via; poster advertisement; an online learning platform; social media; advertisement via tutors within the university; and word of mouth.

Inclusion criteria:

- Adults ≥ 18 years of age
- Capacity to give informed consent
- Ability to understand and speak conversational English
- A student actively enrolled on the MBBS Medicine programme or any undergraduate healthcare course at the University

Exclusion criteria:

- A personal history of receiving treatment within secondary care for a mental health condition
- Current chronic headaches, vertigo, seizures or medical conditions significantly affected by flashing lights and/or viewing of screens

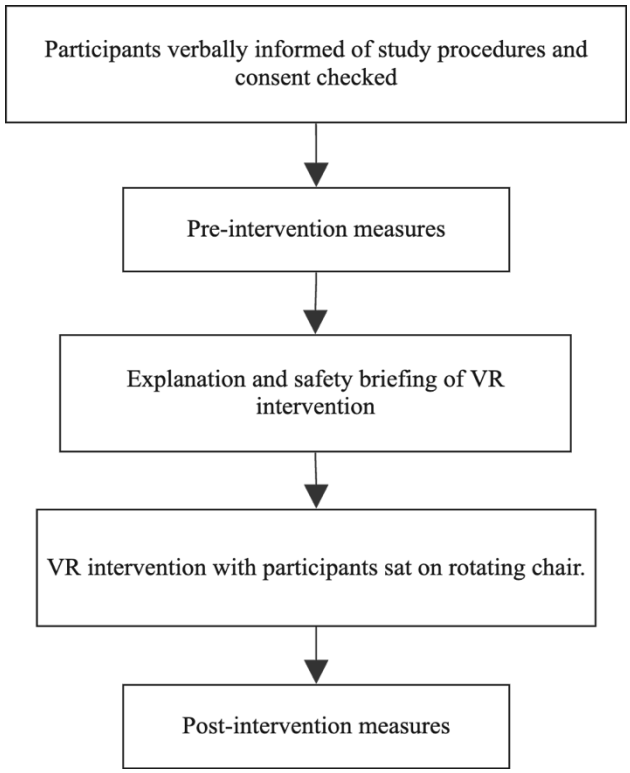
- Current significant hearing or visual impairment that may affect use of a VR system
- Current facial injury that may make use of a VR system uncomfortable or impractical

2.3. Procedure

Interested participants were directed to the study website which included the participant information sheet and screening questionnaire. Those deemed eligible following completion of the screening questionnaire were then directed to complete an electronic consent form and provide their email address. Following completion of the consent form, each participant was assigned a unique identification number by the principal researcher. Participants were then emailed a link to a poll to select a date and time to attend the study. Data collection sessions were conducted in a quiet room at the university according to the following procedure:

Figure 5

Flowchart of study procedure



2.3.1. The VR application development and content

The VR application was co-developed alongside individuals with lived experience. Their feedback informed the emotional tone of the video, with particular attention given to conveying feelings such as embarrassment, fear, shame, and panic. Scenes were filmed using the Insta360 Pro 2 360-degree camera (Shenzhen Arashi Vision Co., Ltd) and audio captured using Rode Go microphones (RØDE Microphones). Volunteer students played the roles of each character. The video itself featured a fictional student living away from home at university and his journey of seeking help for his emerging symptoms of psychosis. Filming was conducted from the perspective of the individual living with psychosis, allowing the viewer to embody this individual during the simulation and experience the world from their perspective. The immersive experience simulated symptoms of psychosis such as auditory/visual hallucinations, paranoia and delusions of reference. The total time for the simulation was 13 minutes. Details of the content of the video are displayed in Table 8.

The VR environment provided a passive, monoscopic 360-degree video (8K resolution) displayed on a VR headset, Meta Quest 3 (Meta Platforms, Inc), mounted on the user's head. Alongside the head mounted display (HMD), over-ear headphones were used to optimise audio quality and promote immersion, with participants always remaining seated during VR use.

Table 8

A table depicting the content of each scene's details and the corresponding time in the simulation

Scene	Details
Opening credits 0 seconds – 40 seconds	• University logo • Short narrative introduces the viewer to protagonist, the fictional student at the centre of the video.

Scene 1 40 seconds – 2 minutes	• Protagonist is in a university seminar • He is stressed about the ongoing workload • He is invited to a party later
Scene 2 2 minutes – 3 minutes	• Protagonist is at a party, feels stressed and paranoid • He begins to hear a voice calling his name
Scene 3 3 minutes – 5 minutes	• Protagonist visits the GP, shares that he hasn't been sleeping, he is lonely, and he is hearing voices • GP is dismissive of his concerns
Scene 4 5 minutes – 7 minutes	• Protagonist is getting the bus home from the GP • His head spirals and he shouts out loud to the voices he hears • Members of the public avoid him
Scene 5 7 minutes – 10 minutes	• Protagonist is in his bedroom • The reporter on the television reports protagonists whereabouts that day (delusions of reference) • He hallucinates the reporter speaks directly to him encouraging him to hurt other people • He calls his mum in distress
Scene 6 10 minutes – 13 minutes	• Protagonist's mum supports him to visit another GP • The GP recognises the symptoms reported as potential first episode of psychosis symptoms
Scene 6 13 minutes – 13 ½ minutes	• Closing credits and acknowledgements

2.4. Primary outcome measures

All questionnaires were delivered in English and completed online via Microsoft Forms, during the lab-based data collection sessions (see Table 9).

Table 9

Measures collected across the different time points of the study

Pre-intervention measures	Post-intervention measures
Demographic Questionnaire	System Usability Scale
Jefferson Scale of Physician Empathy	Cybersickness in Virtual Reality Questionnaire
Attribution Questionnaire - 27	Subjective Experience Survey
	Jefferson Scale of Physician Empathy
	Attribution Questionnaire - 27

Acceptability (including adverse effects) and study engagement were the main outcomes investigated in this study. Acceptability pertained to the degree in which participants found VR interventions likeable, usable, comfortable and satisfactory regarding adverse effects. Adverse effects were defined as any unfavourable or harmful physiological events that occurred during or immediately after the VR intervention that was reasonably associated with its use. Acceptability was assessed both quantitatively via the System Usability Scale and Cybersickness in Virtual Reality Questionnaire, and qualitatively via a bespoke Subjective Experience Survey. Study engagement related to participants' willingness to participate, including rates of study recruitment and retention, and outcome completion rates. Feasibility encapsulates all of the above, and provides an overall indicator of the practicality and potential for successful implementation of the VR intervention in larger-scale studies (Bowen et al., 2009).

2.4.1. System Usability Scale (SUS; Brooke, 1996)

The SUS was developed to assess for the perceived usability of a wide variety of products and services. The questionnaire is composed of 10-items, within which each item is scored on a five-point Likert scale (strongly agree = 5, strongly disagree = 1). Higher scores indicate a more usable system. Higher scores indicate a more usable system with scores above 51.7 considered 'Okay', above 71.1 considered 'Good', above 80.8 considered 'Excellent' and above 84.1 considered 'Best Imaginable'.

2.4.2. Cybersickness in Virtual Reality Questionnaire (CSQ-VR; Kourtesis et al., 2023)

The CSQ-VR is a tool developed to measure nausea, disorientation, and oculomotor symptoms following VR use. There are two items for each symptom, presented on a seven-

point Likert scale (absent feeling = 1, extreme feeling = 7), with space for qualitative responses under each item. Higher scores indicate more severe cybersickness.

2.4.3. Subjective Experience Survey (SES)

To provide a richer understanding of how users experienced the VR intervention, participants were asked four open-ended questions; *Was there anything you liked about the programme?; Was there anything you disliked about the programme?; Do you have any suggestions for future application that would have improved your experience of the virtual reality simulation today?; Is there anything else you would like to share about your experience with the virtual reality intervention?*

2.5. Secondary outcome measures

2.5.1. Jefferson Scale of Physician Empathy – Student version© (JSPE-S; Hojat, Gonnella, et al., 2003)

The JSPE-S is a modified version of the JSPE designed specifically to measure self-reported empathy in medical students. The JSPE-S is a 20-item instrument, scored on a seven-point Likert scale (strongly agree = 7, strongly disagree = 1). The total score is the sum of all item scores, with higher scores indicating a more empathic orientation.

2.5.2. Attributions Questionnaire (AQ-27; Corrigan et al., 2003)

The AQ-27 is a measure of stigmatising attitudes and beliefs towards people with mental illness. The measure consists of a vignette describing an individual with schizophrenia and 27 items with nine-point Likert scales, that invite respondents to endorse their attitudes and beliefs towards this individual. Higher scores typically indicate greater stigmatising attitudes or negative perceptions toward individuals with mental illness.

2.6. Ethical approval

Ethical approval was obtained from the University of East Anglia Faculty of Medicine and Health Sciences Research Ethics Subcommittee (24/01/2024: ETH2223-2761). Prior to participation, informed and explicit consent from each participant was provided via an online electronic consent form. On the day of participation, each participant reaffirmed their consent before beginning the study and was made aware of their right to withdraw their consent at any point. To minimise any adverse effects from the intervention, participants were told to inform a member of the research team if they experienced any discomfort while using the VR equipment and to remove the headset. Participants were fully informed of the potential side effects prior to participation. A verbal and written debrief was built in to ensure the physical and psychological safety of participants had not been compromised. All data collected was held anonymously and handled in accordance with the General Data Protection Regulation Act (2018).

2.7. Data analysis

This was a feasibility study employing a pre-post-test design. It was developed in line with guidance by Lancaster and Thabane (2019), and the National Institute of Health Research (NIHR, 2021). As this study was not intended to be powered to identify a clinically meaningful difference, a formal power calculation was not required. A target of 30 participants, was selected based on guidance from Browne (1995) for conducting feasibility research. This allowed for the detection of obvious flaws in the study design, whilst remaining resource efficient.

Statistical analyses were conducted in IBM SPSS Statistics (Version 29.0.1.0). Descriptive statistics were used to summarise demographic data, with categorical variables

described by use of percentages. Normality of continuous data was assessed using the Shapiro-Wilk test. The distribution of ages was positively skewed (Skewness = 2.602), with a significant deviation from normality as assessed by the Shapiro-Wilk test ($p < 0.001$). This data was represented by the median. All other continuous data was represented by means as Shapiro-Wilk testing revealed it was not skewed.

Scores from the CSQ-VR and SUS, were described by the use of means and standard deviations. The CSQ-VR was supplemented by the box plot to show the range and distribution of the data. Content analysis was used to analyse qualitative data from the SES. A deductive process of extracting meaning from the free-text responses was employed and analysed using a process outlined by Vears and Gillam (2022). Frequencies of codes that emerged were also counted. Estimates of treatment effect were established by analysing participant scores on the JSPE-S and AQ-27 across the pre-post timepoints, using paired samples t-tests and a calculation of effect size using Cohens d.

3. Results

3.1. Sample characteristics

30 participants completed the data collection phase. The majority of participants recruited were female, white British, were completing a medical degree and all were aged between 18 and 47 years old, with a median age of 22 years. Just over half reported no previous exposure to VR prior to participation (n=16), and most had no experience of working with psychosis previously (n=19). Demographic characteristics can be found in Table 10.

Table 10

Participant demographic characteristics

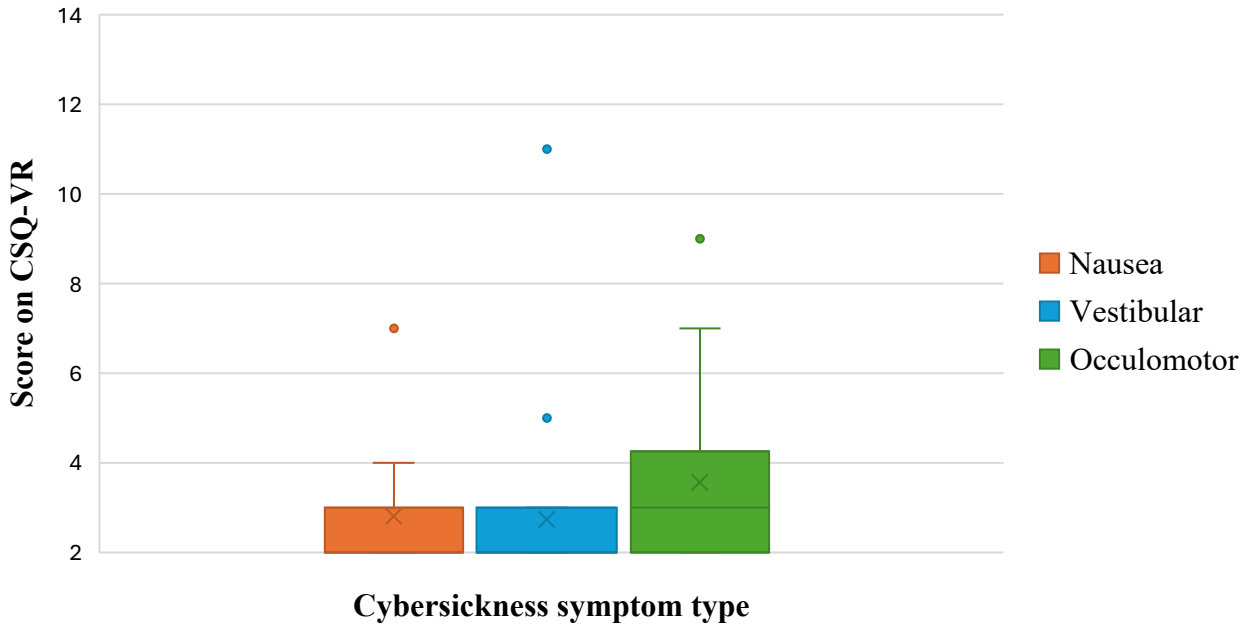
Categorical variables		**N (%)**
Gender	Male	12 (40%)
	Female	16 (53.3.%)
	Genderqueer/ Non-binary	1 (3.3%)
	Other	1 (3.3%)
Ethnicity	White / Caucasian	17 (56.7%)
	Asian / Asian British	7 (23.3.%)
	Black / Black British / Caribbean / African	4 (13.3.%)
	Mixed or multiple ethnic groups	1 (3.3%)
	Other ethnic groups	1 (3.3%)
Degree	MBBS Medicine	18 (60%)
	BSc Adult Nursing	3 (10%)
	BSc Mental Health Nursing	5 (16.7%)
	BSc Children and Young People's Nursing	2 (6.7%)
	BSc Paramedic Science	2 (6.7%)
How participants heard about the study?	Word of mouth	2 (6.7%)
	Email advert	14 (46.7%)
	Social media	6 (20%)
	In person advertisement	4 (13.3%)
	Poster	4 (13.3%)

Experience with VR	No	16 (53.3%)
	Yes	14 (46.7)
Experience working with psychosis	No	19 (63.3%)
	Yes	11 (36.7%)

Note: N = Number of participants, MBBS = Bachelor of Medicine, Bachelor of Surgery, BSc = Bachelor of Science.

Figure 6

Cybersickness symptoms as captured by the CSQ-VR



Note: Nausea, vestibular, oculomotor symptoms by each subscale with a minimum possible score of 2 and a maximum possible score of 14. The boxes represent the interquartile range (IQR), with the horizontal line inside each box indicating the median. The whiskers extend to 1.5 times the IQR. The "X" represents the mean, and the filled circles (●) represent outliers, defined as values beyond 1.5 times the IQR from the nearest quartile.

3.3.3. Content analysis

Responses from the SES were collated together based on positive, or negative and improvement based feedback, because of the overlap between codes across questions (see Tables 11 and 12). Overall, 26 participants provided responses to the questions however this varied according to each question.

Table 11

A table of positive participant experiences as assessed by qualitative feedback

Categories	Codes	Frequency	Example quote
Acceptability and usability	Study was set up well	5	*"I liked how everything was explained to me beforehand, and therefore I knew what to do if there were ever a problem. I was given privacy to think about the questions given"*
	Enjoyable and engaging	12	*"I liked the video, it was interesting and engaging"*
Increased understanding towards psychosis	Insightful into the experience of psychosis	12	*"I liked the opportunity to experience the feelings of psychosis and to view this through my own eyes. I think this is a very unique experience to do through the use of VR headsets"*
	VR medium allowed for empathy and change in perspective	10	*"Before the video, my understanding of psychosis was very limited. Now I will be able to empathise with patients who tell me they have symptoms like the boy in the video had"*
	VR as a good teaching tool	5	*"This is truly valuable to healthcare professionals such as myself and would highly recommend this type of training for all healthcare professionals"*
Immersive technology and realism	Good portrayal of psychosis	8	*"Actors helped make this seem realistic as well, along with experience throughout the healthcare system"*
	VR was immersive / felt real	8	*"VR was really immersive and great choice for the experience"*
	Video well produced	11	*"The quality of video and the screen was very good, meaning I was able to clearly see what was presented to me"*
	Relatable	4	*"I liked that it was [filmed] at [the university] which makes it more relatable"*
Future application	Desire for simulation of other mental health difficulties	4	*"I think if something like this was more widely available for people to be able to quite literally put themselves into someone else's shoes for a while,*

			especially when mental health is such a hard thing to explain and relate to, it could improve people's understanding and empathy towards the struggles that people go through"

Note: Virtual Reality (VR)

Table 12

A table of negative participant experiences and constructive suggestions as assessed by qualitative feedback

Categories	Codes	Frequency	Example quote
Acceptability and usability	Audio problems	3	*"Not really dislike but the volume of the audio was not big enough for me"*
	Side effects	1	*"I feel a bit light-headed after using the headset"*
	Difficulty with visual navigation/ details	4	*"Since it's a 360 VR, I felt a bit lost sometimes. A little cue of what to do or where to look at might help in some situations"*
VR video authenticity	Subtle portrayal of psychosis	5	*"Should have gone more in depth into psychosis, felt very surface level, felt a bit dumbed down to not cause aggravation and be more accessible to everyone"*
	Unrealistic acting	3	*"Maybe found that the actual conversations felt unrealistic"*
VR video content	Need for longer content	4	*"I think a longer video would be nice, as it is quite a short time frame to pick up on what it is like to live that experience"*

Note: Virtual Reality (VR)

3.4. Empathy and attitudes

A dependent samples t-test revealed that mean empathy scores, as measured by the JSPE-S, increased from pre-intervention (M = 109.4, SD = 7.2) to post-intervention (M = 113.93, SD = 8.8), $t(29) = -3.07$, $p < .002$). The effect size, as measured by Cohen's d, indicated a

moderate effect (d = 0.56). A separate dependent samples t-test also revealed a significant decrease in participants' stigmatising attitudes, as measured by the AQ-27. Mean attitude scores decreased from pre-intervention (M = 85.2, SD = 15.8) to post-intervention (M = 78.1, SD = 18.2), $t(29) = 3.87$, $p < .001$), with a moderate effect size (d = 0.71).

4. Discussion

The aim of this study was to assess the feasibility, both in terms of study engagement and acceptability of a VR simulation of psychosis amongst health students studying at a UK University. Overall, the findings suggest that the intervention was well-received, with high participant engagement and usability, while also showing potential to enhance empathy and reduce stigma towards individuals with psychosis.

4.1. Empathy and attitudes

Although the current study did not intend to demonstrate efficacy, results showed higher empathy scores post-intervention, alongside lower stigmatising attitudes as assessed by the AQ-27. The results also revealed a moderate, and moderate-to-large treatment effect for the measurement of empathy and stigma respectively - a secondary aim of the study. These results partially align with findings from previous research by Zare-Bidaki et al. (2022), which found a similar effect size of empathy (0.49) but a much smaller effect size of stigma (0.27). Whilst further investigation is needed, the findings of the current study support the face validity of the intervention, and suggest that the VR in simulation of psychosis has potential to increase empathy and decrease stigma among health students.

4.2. Feasibility

4.2.1. Study engagement

Recruitment to the study was successful, with 30 participants enrolled within a two-month recruitment window, surpassing the expected recruitment time. The most effective recruitment strategy proved to be mass email/ announcements via a learning platform with social media recruiting secondary to this. Retention rates were adequate, with 71.42% of respondents who signed up to the study taking part in the study itself, with the possibility of

recruiting five more participants (11.9%). The use of email reminders alongside flexible and easy scheduling of study appointments proved crucial to retention rates, as eight (26.6%) participants attended the study only after receiving a follow-up email. It will be important for a future, follow up study to employ these strategies to maintain engagement and increase retention. No one withdrew from the study, and all participants completed all quantitative outcome measures (except one participant who did not complete one question). Overall, the findings suggest that there is sizeable interest and willingness among both medical and health students to participate in VR interventions that facilitate the simulation of psychosis.

4.2.2. Acceptability

With regards to the acceptability of the VR intervention and study procedures, the VR platform was well-received in terms of usability, as indicated by the score from the SUS. This demonstrated 'Good', almost 'Excellent' levels of usability, indicating that individuals found the VR system easy to use. This high usability may partly reflect the characteristics of the study sample, as young students are generally more likely to be familiar and comfortable with modern technology.

Adverse effects of the intervention were also assessed. Whilst a small proportion of participants indicated inflated presence of nausea symptoms and vestibular symptoms (e.g. disorientation and postural imbalance), most participants experienced mostly absent or mild symptoms as reflected by the low averages and low variability. Oculomotor symptoms (such as fatigue and eye strain) showed a slightly higher average of severity but was still generally low. These were markedly lower than rates documented in the VR literature (Caserman et al., 2021), and support the scalability of the intervention and further, wider application.

Overall, participants found the VR experience engaging and enjoyable. A number appreciated the clear setup and containing instructions which enhanced their experience with

the study. Participants reported that the intervention helped them to understand the experience of psychosis first-hand, attributing this to the unique medium of VR at times. Students also felt that the experience contributed to their ability to empathise with those living with psychosis, believing it would help their interactions with their patients experiencing similar symptoms.

The quality of the video was also commended, however mixed feedback was received about the content of the video. Whilst some participants enjoyed the portrayal of psychosis and the relatable university settings in which it was filmed, a number reported the conversational acting to be unrealistic and the portrayal of symptoms too subtle. This feedback captures a dilemma that the current researchers faced in the characterisation and portrayal of psychosis, balancing authenticity and impact. On one hand, a subtle, authentic portrayal that parallels a slower onset of psychotic symptoms may lack emotional resonance, whereas an overdramatization of symptoms may enhance interest but lack realism. This conflict is underpinned by research that suggests that the portrayal of psychosis in overly dramatic settings may cause distress to participants and inadvertently harm their attitudes toward people with psychosis (Kalyanaraman et al., 2010). The feedback also revealed a disconnect between participant expectations and the intervention's main focus; many anticipated vivid hallucinations or overt paranoia, whereas the video aimed to emphasise the interpersonal and emotional consequences of these experiences. Whilst feedback regarding the subtlety of symptoms cannot be ignored, careful consideration should be given to revising the video based on this feedback, potentially by enhancing certain elements already integrated into the video.

4.3. Limitations of the study

Despite the promising results of this feasibility study, the results lack statistical power and methodological rigor, by way of a control group, meaning change in stigma and empathy cannot be attributed to the intervention. Future research should facilitate a randomised control trial to establish the effectiveness of the intervention against another intervention in education such as role play. Although the aims of the study were not broadcast with regard to empathy and stigma, participants might have felt compelled to provide responses that aligned with the perceived goals of the intervention, inflating their scores of empathy and reducing their stigma scores. Only one measure of empathy and one measure of stigmatising attitudes was selected. This was chosen to prevent questionnaire fatigue in the current study, however a future trial should incorporate other measures of empathy and stigma. A combination of validated self-report data, alongside behavioural measures of empathy and stigma may reduce the issue of socially influenced data (McNulty & Politis, 2023). Lastly, the current research only involved the recruitment of a small sample from one university, from the desired population of UK health students. The intervention may therefore not be feasible for health students across other universities. The intervention may also be limited in its feasibility outside of a student or technologically competent population.

Whilst the aim of the study was to assess feasibility and tolerability rather than compare outcomes across course types, the inclusion of different training backgrounds presents an interesting avenue for future research. Due to the small sample size, it was not possible to conduct a robust analysis to determine whether participants from different courses responded differently to the intervention. Given that each training programme is nuanced in its approach to mental health education, future studies could explore whether the effectiveness of the VR intervention varies by course type.

4.4. Recommendations for future implementation

While the intervention demonstrated good acceptability, several areas for improvement were identified:

- Incorporating better headphones to address the audio problems reported by a small number of participants.
- Building in visual cues prompting users to turn their head to look a certain way would help resolve the difficulties some users had with navigating the virtual environment.
- Incorporating instructions to participants to slowly move their head whilst wearing the headset may reduce oculomotor symptoms.

Future research may also seek to examine the application of the intervention in other populations such as family members and carers, who have been shown to hold stigmatising attitudes towards people with psychosis (Wood et al., 2015).

4.5. Conclusion

The current study aimed to investigate the feasibility of a VR intervention designed to be used in training to enhance empathy and challenge stigmatising attitudes towards psychosis. The sizeable interest in the study and acceptable study materials and procedures demonstrates that a larger trial is feasible with health students at a university in the UK. The study also demonstrated room for improvement regarding the video content and VR equipment. If the results from further investigation support its efficacy, such interventions could influence healthcare education, offering a novel, convenient and cost-effective way to cultivate empathy and challenge stigmatising beliefs towards those living with psychosis.

CRediT authorship contribution statement

Olivia Hannah: Conceptualisation, Data curation, Formal analysis, Methodology, Investigation, Project administration, Resources, Writing – original draft, Writing – review &

editing, Visualisation. **Adrian Leddy:** Conceptualisation, Investigation, Methodology, Supervision, Writing – review & editing. **Jordan Tsigarides:** Conceptualisation, Methodology, Project administration, Software, Supervision, Resources, Writing – review & editing.

Statements and declarations

Declaration of competing interest

The authors declare no conflicts of interest.

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CHAPTER FIVE: Extended methodology and analysis

The purpose of this chapter was to provide additional methodological details that could not be fully covered within Chapter Four. This includes further details on the measures used and additional analysis.

Outcome measures

System Usability Scale (SUS; Brooke, 1996)

Scoring of the SUS is calculated by first summing the score contributions from each item. For items 1,3,5,7,and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. The final value of system usability then obtained by multiplying the sum of the scores by 2.5, yielding a range of scores between 0 to 100. Higher scores indicate a more usable system with scores above 51.7 considered 'Okay', above 71.1 considered 'Good', above 80.8 considered 'Excellent' and above 84.1 considered 'Best Imaginable'. The SUS has demonstrated good reliability, with a Cronbach alpha score of 0.91 (Bangor et al., 2008), even within sample sizes as small as 12 (Tullis & Stetson, 2006). Positive, significant correlations between SUS scores and a ratings of 'user-friendliness', also support of the measure's criterion-related validity (Bangor et al., 2008).

Cybersickness in Virtual Reality Questionnaire (CSQ-VR; Kourtesis et al., 2023)

The CSQ-VR produces a Total Score and three sub scores (i.e., a Nausea Score, a Disorientation Score, and a Oculomotor Score). The total score is the sum of the three scores, with a minimum score of 2 for each subscale, and a maximum score of 14. Higher scores indicate the participant experienced more severe cybersickness. Tests for internal consistency by original authors revealed an average Cronbach alpha score of 0.87 across the three symptoms.

Jefferson Scale of Physician Empathy – Student version© (JSPE-S; Hojat, Gonnella, et al., 2003)

The total score for the JSPE-S is the sum of all item scores, with higher scores indicating a more empathic orientation. The coefficient alpha reliability for the original JSPE has ranged from .80 to .89 for samples of medical students, residents (Hojat et al., 2001), physicians (Hojat et al., 2002), and nurse practitioners (Hojat, Fields, et al., 2003). Conditional use of this measure was granted by the Thomas Jefferson University.

Attributions Questionnaire (AQ-27; Corrigan et al., 2003)

The AQ-27 is a measure of stigmatising attitudes consisting of 27 items with nine-point Likert scales. These 27 items divide into subscales that represent 9 stereotypes about people with mental illness factors (with 3 items each) which include: responsibility, pity, anger, dangerousness, fear, help, coercion, segregation, and avoidance. Higher scores typically indicate greater stigmatising attitudes or negative perceptions toward individuals with mental illness. Research by Brown (2008) has supported the validity and reliability of this measure, with acceptable values of internal consistency and good test-retest reliability.

Virtual Reality Intervention

Upon arrival at their session, participants were asked to complete a background survey and the pre-intervention measures electronically. Participants were then invited to participate in the VR intervention, sat down on a chair, in the middle of the room with space around them. The researcher demonstrated how to put the headset on and how to use the joystick to control elements of the VR intervention. Participants were given a brief explanation of what they could expect from the intervention as well as providing instructions of how to use the VR

headset. Participants were also advised that should they experience any symptoms of sickness or dizziness that they should take the headset off. The researcher then supported the participant to put on the headset, asking the participant to make adjustments to the headset settings if the picture of the video was out of focus or not sitting correctly on their head. Participants navigated the joystick to the control panel of the video and asked to play the video content. Participants could also use the joystick to control their perspective within the VR video. Following this, the researcher then left the room. After experiencing the VR content, the participants were then invited to complete the post-intervention measures, again electronically.

Virtual Reality equipment

Figure 7

Example of VR intervention setup with head mounted display

Figure 8

Example of a scene from the VR video

Analysis

Exploratory analysis was conducted to explore the whether experience with psychosis influenced empathy scores and stigmatising attitude scores. This analysis was exploratory as the small sample size of the study was insufficient to draw definitive conclusions.

Two-way ANOVAs were conducted to examine whether experience with psychosis influenced empathy scores and stigmatising attitude scores. The results indicated that previous experience with psychosis did not have a significant effect on changes in empathy following the intervention ($F(1,28) = 3.03$, $p = .093$). Participants without prior experience had a post-intervention empathy score of M = 115.32, SD = 8.39, while those with prior experience had a score of M = 111.55, SD = 9.35. Previous experience with psychosis did not have a significant effect on stigmatising attitude following the intervention, $F(1,28) = 0.41$, $p = .841$. Participants without prior experience had a post-intervention empathy score of M = 76.84, SD = 19.51, while those with prior experience had a score of M = 80.27, SD = 16.60.

CHAPTER SIX: Extended discussion and critical evaluation

Summary of the thesis aims

The current thesis sought to investigate the potential of Virtual Reality (VR) as a tool for advancing both the therapeutic treatment and stigmatisation of psychosis. The thesis firstly synthesised the VR literature on immersive and non-immersive VR interventions for the treatment of psychosis. Meta-analytic methods were used to investigate differences in participant dropout between the two types of VR. An empirical study was then conducted to investigate the feasibility of an immersive VR intervention designed to improve empathy and decrease stigmatising attitudes in health and medical students. The findings from these studies are summarised and critically evaluated below. Finally, recommendations for future research and clinical practice are presented at the end of this chapter.

Main contributions of the research

A systematic review and meta-analysis (Chapter Two) identified an overall dropout rate of 15% among non-immersive and immersive VR therapy. Separately however dropout rates did not significantly differ between these two therapies. These results challenge assumptions held within the literature that cybersickness and technical difficulties lead to higher attrition in IVR. The dropout rate for VR overall is comparable to or lower than other psychosis treatments, suggesting strong engagement and the potential mitigation of side effects.

The empirical study (Chapter Four) found results which supported the feasibility of the immersive VR intervention in healthcare students. Recruitment to the study was successful and surpassed the expected recruitment time, with participants experiencing minimal cybersickness and reporting that the VR equipment was easy to use. Although the study did not aim to demonstrate efficacy, participants' empathy scores increased and stigmatising attitudes decreased, following the intervention, with moderate and moderate-to-large effect

respectively. Participants recruited to the study reported that the intervention was a useful tool in understanding the experiences of people with psychosis. Some users noted limitations in content realism and navigation. Based on these results, a larger-scale clinical trial would be justified.

Strengths of the research

Systematic review

The systematic review protocol was pre-registered on the International Prospective Register of Systematic Reviews (PROSPERO). This is important for reducing bias, and enhancing transparency and reproducibility of research (Page et al., 2018). A secondary reviewer independently screened the titles and abstracts of 20% papers retrieved during the initial search and the full text search of the literature, further reducing the potential for bias. Screening processes aimed to maximise the chance of including studies which met the inclusion criteria, by integrating varied VR terminology previously identified by previous literature into the search terms (Abbas et al., 2023). This has been neglected by previous systematic reviews (Chan et al., 2023). The review outlined clear inclusion criteria regarding participant diagnosis and clear definitions of type of VR intervention to reduce the impact of heterogeneity. The systematic review was also restricted to published papers since 2014 with the aim of capturing studies using modern VR technology, aligning with contemporary understandings and applications of VR. This timeframe helped to exclude outdated systems that may not represent current advancements in hardware and software. It also allows for a more accurate examination of dropout rates, without the confounding influence of technological disparities between immersive and non-immersive studies (which tend to be older).

Empirical study

The empirical study utilised validated instruments to measure empathy and attitudes, alongside validated measures for cybersickness and system usability. This reduced the possibility for measurement error and increased researchers confidence that the significant results found by the study were due to the intervention rather than inconsistencies in the assessment tools. A variety of different recruitment methods improved the ability of researchers to reach potentially eligible participants, enabling data collection to surpass the expected recruitment time. Whilst some participants reported nausea and vestibular symptoms, most participants experienced largely absent or mild symptoms. This is an important finding as cybersickness has been shown to hinder the immersive qualities of VR (Servotte et al., 2020), a key mechanism for empathy related changes (Ventura et al., 2020). This suggests that the steps that were taken to reduce the extent of cybersickness symptoms, including the purchasing of a high quality headset to ensure higher frame rates (Wang et al., 2023), the minimisation of scene motion to reduce sensory conflict (So et al., 2001), and having participants view the video while seated (Zielasko & Riecke, 2021), were successful in reducing symptoms and enhancing participant comfort.

Limitations of the research

Systematic review

To reduce variability in the studies included, the review outlined clear inclusion criteria in participant diagnosis and definitions of VR intervention. Despite this, there remained considerable heterogeneity across studies. The clear definitions for VR interventions also meant that researchers had to exclude some notable papers that utilised elements of VR that did not meet that criteria. For example Craig et al. (2018) which utilised avatar therapy in the context of VR did not meet the criteria for non-immersive VR methods as it did not include

the navigation of a virtual environment. This exclusion illustrates a potential limitation in the rigid application of the inclusion criteria, as such studies that do not fit neatly within predefined categories may still contribute valuable insights to the field of VR in psychosis treatment. This dilemma highlights the growing breadth of VR applications and underscores the challenge of balancing inclusivity with maintaining consistency across studies.

It is also important to note that the estimates for dropout rates were drawn from controlled trials which utilised experimental conditions. These may not generalise to 'real world' clinical settings, as research often has access to additional resources that may not be available in typical clinical environments. Furthermore, participants in these trials typically represent a self-selecting group who have consented to take part in a VR intervention, and therefore aren't likely to be representative the broader clinical population (Kennedy-Martin et al., 2015; Taipale et al., 2022). For the current review, this is likely to have implications with regards to dropout rates, as those observed may not be predictive of acceptability or adherence to VR interventions in standard care. As the research surrounding VR is still in its infancy, the reliability of dropout rate estimates is also likely to be affected by the relatively small number of studies and small numbers of participants across the included studies.

Empirical study

Whilst 360-video holds merit as a medium to influence empathy (Ventura et al., 2021) the passive nature of the experience presents a limitation. Participants could not actively explore all the components of the environment or engage dynamically with it, which may limit the sense of agency and immersion - important factors involved in the facilitation of learning (Makransky & Petersen, 2021). Another limitation pertains to the fact that the measurement of stigma and empathy was only obtained through self-reported questionnaires, and therefore possibly influenced by social desirability and unconscious biases. Participants might have felt

compelled to provide responses that aligned with the perceived goals of the intervention. This aligns with previous research which has suggested in general, health students will minimise their stigma-related responses to align with perceived professional and ethical expectations (Giralt et al., 2022).

Research has also suggested that 360 degree VR experiences may only promote feelings of emotional empathy in the short term, as opposed to cognitive empathy or long term empathic gains (Martingano et al., 2023). The increase in empathy that was observed in the current study may therefore only reflect the increase in emotional empathy. This has implications as it suggests that VR interventions may only address the emotional aspects of a complex psychological process. This is important as the work of Lamm et al. (2007) points to an interaction between the two processes, suggesting that whilst an affective response to the pain of others is automatically elicited, it is modulated by cognitive and motivational processes. This in turn can influence empathic concern, an important instigator for helping behaviour.

Implications of the research and recommendations for future directions

The findings of this thesis contribute to the growing body of evidence of VR in both therapeutic and educational contexts related to psychosis. The results of the meta-analysis suggest that VR could offer an engaging and accessible form of treatment for a patient group that often struggles to engage in treatment (Lecomte et al., 2008). This is encouraging, as dropout rates are a concern for research as well as clinical settings, often hindering the effectiveness of therapies. Previous reviews have concluded that VR holds potential in its treatment of psychosis (Chan et al., 2023), especially when utilising elements of CBT, however its overall efficacy in improving clinical outcomes for psychosis remains unclear. Ultimately, more high quality, large scale studies are needed to determine whether VR can

offer sustained therapeutic advantages beyond traditional interventions. Addressing this is essential to determine whether VR can provide sustained therapeutic benefits beyond traditional interventions.

Beyond questions of efficacy, translating this potential into routine clinical use faces additional challenges. Various barriers have been cited in the literature including a lack in infrastructure to support the technology within services (e.g. suitable clinical space and ongoing technical support) combined with the high upfront and maintenance costs of VR equipment (Bell et al., 2020). This limits the ability of many services to adopt and sustain the technology. This challenge is compounded the lack of standardised, evidence-based, commercially available VR programmes that can easily be accessed and used by clinicians and researchers (Bell et al., 2020). This problem is made worse by the quick advancement of technology, causing hardware to become outdated, and by proprietary restrictions that prevent VR applications from working on newer platforms (Bell et al., 2020). Another key issue is the lack of training and support for clinicians: many healthcare professionals are unfamiliar and have not received the training or guidance needed to set up, operate, and integrate VR systems into treatment plans. Indeed, research has found that alongside this issue, many clinicians hold concerns that VR could hinder therapeutic engagement or even replace aspects of their professional role, contributing to uncertainty about the potential value of VR in specific clinical settings (Levac & Miller, 2013). For these reasons, it is imperative that new VR systems and intervention are developed that hold in mind the systems and context in which they are designed to be implemented (Mohr et al., 2017).

With regards to participant attrition, a consideration of future research should also include the reporting of demographic characteristics of participants who dropped out from treatment. This information was excluded by most studies in this meta-analysis. Ultimately, this has important implications considering the comparison of immersive and non-immersive

VR, as it becomes unclear whether dropout differences are due to the acceptability of the type of VR or participant characteristics such as age, gender, and prior VR exposure which have all been linked with dropout in VR (Ramaseri-Chandra & Reza, 2024). Future research should therefore aim to describe participants who do and do not complete treatment in more detail, as recommended by CONSORT guidelines (Moher et al., 2001).

Another issue that complicates the evaluation of VR in psychosis treatment is the variability in how VR interventions are defined. The term 'virtual environment' appears across both of the definitions of VR in the current review, however this term itself is difficult to define (Schroeder, 2008). This highlights a wider issue with regards to the variability in the definition of VR interventions identified by previous literature (Abbas et al., 2023). It also relates to previous research which has criticised the inclusion of non-immersive VR technologies within the categorisation and definition of VR treatments (Freeman et al., 2017). Standardising definitions and classification criteria will be crucial for ensuring consistency in future research and for accurately assessing the role of different VR modalities in psychosis treatment.

The empirical study demonstrated the feasibility of immersive VR in fostering empathy and reducing stigma toward psychosis among healthcare students. The success of study recruitment and the acceptability of the intervention indicate a readiness among health students to engage with VR as a learning tool. This is encouraging, highlighting its potential for integration into medical and healthcare training curricula. Their engagement in the research suggest that they may also be receptive to using such interventions in clinical practice. Given the importance of empathy in clinical practice and the persistent stigma surrounding psychosis, these findings suggest that VR interventions could play a crucial role in shaping future healthcare professionals' attitudes and behaviours. The broad reach of psychosis experiences means that this may also have the potential to impact clinical decision

making and patient care beyond psychotic disorders alone. Indeed, VR training may prepare future clinicians to engage more thoughtfully and skilfully with a range of patient populations.

Future studies could seek to compliment included self-reported measures of stigma and empathy with behavioural measures, such as intended social distance from individuals with psychosis. Foster et al. (2017) suggest that one step further to this, researchers could integrate objective measures such as tracking participants interactions with virtual patients using biometric data. Using these methods would allow researchers to track users facial expressions and physiological responses, which Foster et al. (2017) suggest could provide deeper insights into how VR influences both emotional and behavioural aspects of empathy. If future studies confirm the effectiveness of VR interventions in enhancing empathy and reducing stigma, researchers should explore whether these effects translate into measurable prosocial behaviours. Specifically, studies could examine whether increased empathy fosters a greater willingness to engage with or advocate for individuals with psychosis in real world settings. This would help ensure that VR interventions lead not only to attitudinal changes but also to meaningful social impact, as theorised by the empathy-attitude-action model (Batson et al., 2002).

Conclusion

In conclusion, this thesis demonstrates the promising application of VR as a tool for both the therapeutic treatment and reduction of stigma surrounding psychosis. The systematic review and meta-analysis implicate VR as an acceptable intervention in terms of participant attrition for patients with psychosis. Future research in this area should focus on developing large scale clinical trials, establishing treatment efficacy and examining dropout demographics to understand who may be more likely to drop out of treatment. The empirical study

demonstrated the feasibility of VR in reducing stigma and increasing empathy among healthcare students. A future trial should incorporate behavioural measures of empathy, assess the long term impact of VR interventions, and explore their influence on real world clinical interactions. Addressing these gaps will be crucial in determining VR's effectiveness in both therapeutic and educational settings.

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Appendices

Appendix A

Guide for Psychiatry Research Journal

About the journal

Aims and scope

This journal provides rapid publication of complete research reports and reviews in the field of psychiatry.
The scope of the journal encompasses:
1. Biochemical, physiological, neuroanatomic, genetic, neurocognitive, and psychosocial determinants of psychiatric disorders.
2. Diagnostic assessments of psychiatric disorders.
3. Evaluations that pursue hypotheses about the cause or causes of psychiatric diseases.
4. Evaluations of pharmacologic and non-pharmacologic psychiatric treatments.
5. Basic neuroscience studies related to animal or neurochemical models for psychiatric disorders.
6. Methodological advances, such as instrumentation, clinical scales, and assays directly applicable to psychiatric research. These will be
considered only if the scales and assays are included as an appendix to the manuscript in English. If they are too long, the way to obtain
them without cost to the reader must be carefully stated in the methods section of the manuscript.
7. Reviews of timely topics in psychiatric research
8. Letters to the editor will be considered for case reports, comments about previously published papers, or secondary data analyses.
Papers with a primary focus on imaging techniques, can be submitted to Psychiatry Research: Neuroimaging .

Article types

Review Articles/Full-Length Articles
Although exceptions will be considered, manuscripts should not exceed 5,000 words, and shorter manuscripts (e.g. 3,000 words) are preferred.
Each article should contain the following major headings:
Introduction (preceded by arabic number 1.), Methods (preceded by number 2.), Results (preceded by number 3.), Discussion (preceded by
number 4.), Acknowledgement (optional section following the discussion, which should not be preceded by a numeral), and References (should
not be preceded by a numeral).
Subheadings should follow the numbering system used in the major heading; for example, the subheading "Subjects" within the Methods
section should be flush left on a separate line and designated 2.1., the subheading "Procedures" should be designated 2.2., etc. Lower level
headings, if required, should also be numbered (e.g.,
"2.1.1. Patients.
" as a lower order heading under "2.1. Subjects.
"). Only the first letter of the
first word of each heading should be capitalized.
Short Communications
Short Communications (formally called Brief reports) are brief reports on preliminary new findings limited to 2,500 words, excluding abstract,
references, figure legends, acknowledgement and disclosures. Authors may include up to 4 figures and up to 2 tables.
Correspondence

Correspondence items (formally Letters to the Editor) should be 750-1,000 words or less. It should not include a title page, abstract of keywords.
Authors' names and affiliations should be listed at the end of the letter, along with the corresponding author's email address. There should be
no more than 5 references, and no tables or figures.
Commentary
This section contains commentaries that accompany papers published in PSY or on issues of wide-reaching concern in psychiatry. Comments
linked to policy decisions are welcomed. Most commentaries are commissioned but unsolicited commentaries (no more than 2,000 words, 15
references and one figure or small table) are also welcome. Commentaries may be peer reviewed. At the editors' discretion, commentaries may
be shortened in the interest of space.
Case Reports
Case Reports are welcome in Psychiatry Research Case Reports.

Peer review

This journal follows a single anonymized review process. Your submission will initially be assessed by our editors to determine suitability for
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Our editors are not involved in making decisions about papers which:
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2. Drafting the article or revising it critically for important intellectual content.
3. Final approval of the version to be submitted.
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tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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gender
race
ethnicity
culture
sexual orientation
disability or health condition
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" or "he/she.
"
No assumptions should be made about the beliefs of readers and writing should be free from bias, stereotypes, slang, reference to dominant
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avoid ambiguity or conflation of terms and the constructs to which they refer.
We advise you to read the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER checklist (PDF) on the EASE website, which offer
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For further information we suggest reading the rationale behind and recommended use of the SAGER guidelines.
Definitions of sex and/or gender
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guidelines, EU Directive 2010/63 for the protection of animals used for scientific purposes or the NIH (National Research Council) Guide for the
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You are required to provide a concise and factual abstract which does not exceed 250 words. The abstract should briefly state the purpose of your research, principal results and major conclusions. Some guidelines:

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Avoid references. If any are essential to include, ensure that you cite the author(s) and year(s).

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You are required to provide 1 to 7 keywords for indexing purposes. Keywords should be written in English. Please try to avoid keywords consisting of multiple words (using "and" or "of").

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Highlights

You are required to provide article highlights at submission.

Highlights are a short collection of bullet points that should capture the novel results of your research as well as any new methods used during your study. Highlights will help increase the discoverability of your article via search engines. Some guidelines:

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Ensure the image is a minimum of 531 x 1328 pixels (h x w) or proportionally more and is readable at a size of 5 x 13 cm using a regular screen resolution of 96 dpi.

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Strunk Jr., W., White, E.B., 2000. The Elements of Style, fourth ed. Longman, New York.
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Mettam, G.R., Adams, L.B., 2023. How to prepare an electronic version of your article, in: Jones, B.S., Smith, R.Z. (Eds.), Introduction to the
Electronic Age. E-Publishing Inc., New York, pp. 281–304.
Reference to a website:
Cancer Research UK, 2023. Cancer statistics reports for the UK.
http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/
(accessed 13 March 2023).
Reference to a dataset:

Oguro, M., Imahiro, S., Saito, S., Nakashizuka, T., 2015. Mortality data for Japanese oak wilt disease and surrounding forest compositions
[dataset]. Mendeley Data, v1. https://doi.org/10.17632/xwj98nb39r.1.
Reference to software:
Coon, E., Berndt, M., Jan, A., Svyatsky, D., Atchley, A., Kikinzon, E., Harp, D., Manzini, G., Shelef, E., Lipnikov, K., Garimella, R., Xu, C., Moulton, D.,
Karra, S., Painter, S., Jafarov, E., & Molins, S., 2020. Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88) [software]. Zenodo.
https://doi.org/10.5281/zenodo.3727209.
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Appendix B

Mixed Methods Appraisal Tool (MMAT)

Category of study designs	Methodological quality criteria	Responses			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	S1. Are there clear research questions?				
	S2. Do the collected data allow to address the research questions?				
	Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Is the qualitative approach appropriate to answer the research question?				
	1.2. Are the qualitative data collection methods adequate to address the research question?				
	1.3. Are the findings adequately derived from the data?				
	1.4. Is the interpretation of results sufficiently substantiated by data?				
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?				
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed?				
	2.2. Are the groups comparable at baseline?				
	2.3. Are there complete outcome data?				
	2.4. Are outcome assessors blinded to the intervention provided?				
	2.5 Did the participants adhere to the assigned intervention?				
3. Quantitative non-randomized	3.1. Are the participants representative of the target population?				
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?				
	3.3. Are there complete outcome data?				
	3.4. Are the confounders accounted for in the design and analysis?				
	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question?				
	4.2. Is the sample representative of the target population?				
	4.3. Are the measurements appropriate?				
	4.4. Is the risk of nonresponse bias low?				
	4.5. Is the statistical analysis appropriate to answer the research question?				
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?				
	5.2. Are the different components of the study effectively integrated to answer the research question?				
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?				
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?				
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?				

From: Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M. P., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M. C., & Vedel, I. (2018). *Mixed Methods Appraisal Tool (MMAT) version 2018 user guide*. Canadian Intellectual Property Office, Industry Canada. http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf

Appendix C

Highlights for Systematic Review and Meta Analysis

Highlights

- A meta-analysis was conducted to investigate dropout rates in virtual reality interventions for psychosis.
- The overall estimate of dropout from all virtual reality interventions was 15%.
- Dropout rates did not significantly differ between immersive (11.9%) and non-immersive therapies (22.46%).
- Dropout rates for virtual reality interventions are acceptable and lower than other treatments for psychosis.

Appendix D

Highlights for Empirical Paper

Highlights

- A Virtual Reality (VR) simulation of psychosis to reduce stigma and increase empathy toward patients, was conducted on health and medical students from a UK university.
- Improvements in empathy and stigma, with moderate and moderate-to-large effect sizes found.
- Participants experienced mild cybersickness and rated the VR system as easy to use.
- The intervention was feasible and acceptable, and holds potential to enhance empathy and challenge stigma.

Appendix E

Background Survey

This survey is intended to gather demographic and background information from participants in the study. This is to enable us to analyse the data according to subgroups of participants, to understand the reach of the study.

This information will be kept strictly confidential and only used for the trial with no dissemination to third parties. It will be securely stored with access restricted to the research team only.

1. *How do you identify your gender?*
    - *Male*
    - *Female*
    - *Genderqueer/Non-binary*
    - *Other*
    - *Prefer not to say*

2. *What is your age?*

    _____

3. *What race or ethnicity best describes you?*
    - *White / Caucasian*
    - *Asian / Asian British*
    - *Black / Black British / Caribbean / African*
    - *Mixed or multiple ethnic groups*
    - *Other ethnic group*
    - *Prefer not to say*

4. *What year of the MBBS Medicine Programme are you in?*
    - *Year 1*
    - *Year 2*
    - *Year 3*
    - *Year 4*
    - *Year 5*

5. *Have you had any previous experience of using virtual reality simulation type training?*
    - *Yes*
    - *No*

    If YES please state:

    _____

    _____

6. *Have you had any previous contact or experience working with people with lived experience of psychosis?*
    - *Yes*
    - *No*

    If YES please state:

    ---

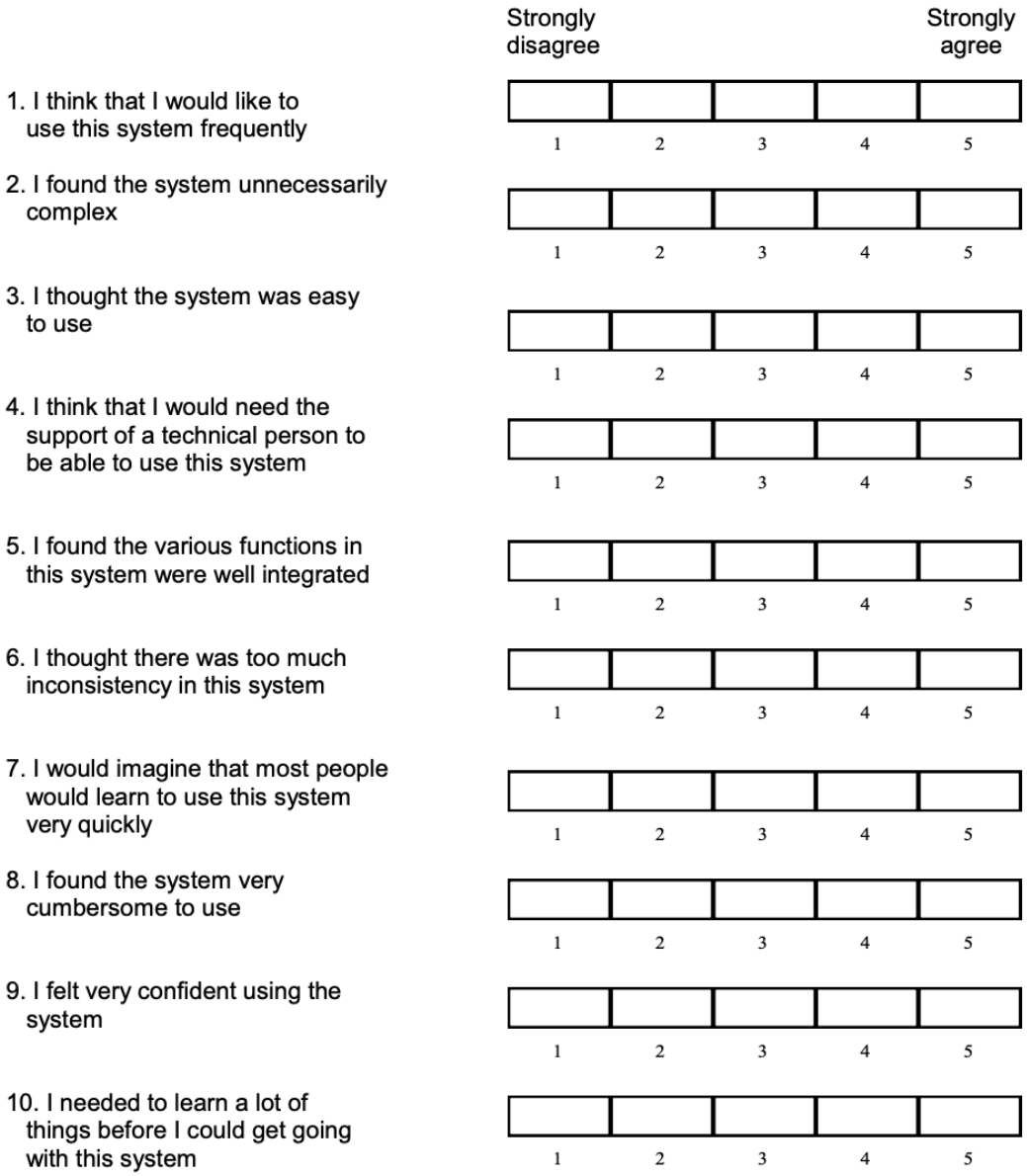
7. *How did you first hear about the study?*
    - *Word of mouth*
    - *An advert via email*
    - *Social media*
    - *An in-person advertisement*
    - *Other*

    If other please state:

    _____

Appendix F

System Usability Scale (SUS)



Scoring SUS

SUS yields a single number representing a composite measure of the overall usability of the system being studied. Note that scores for individual items are not meaningful on their own.

To calculate the SUS score, first sum the score contributions from each item. Each item's score contribution will range from 0 to 4. For items 1,3,5,7,and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of SU.

SUS scores have a range of 0 to 100.

The following section gives an example of a scored SU scale.

Appendix G

CyberSickness in Virtual Reality Questionnaire (CSQ-VR)

Please, from 1 to 7, **circle** the response that better corresponds to the presence and intensity of the symptom.

Nausea A: Do you experience nausea (e.g., stomach pain, acid reflux, or tension to vomit)?

1	2	3	4	5	6	7
Absent Feeling	Very Mild Feeling	Mild Feeling	Moderate Feeling	Intense Feeling	Very Intense Feeling	Extreme Feeling

Please write below any additional comments relevant to the question above:

Nausea B: Do you experience dizziness (e.g., light-headedness or spinning feeling)?

1	2	3	4	5	6	7
Absent Feeling	Very Mild Feeling	Mild Feeling	Moderate Feeling	Intense Feeling	Very Intense Feeling	Extreme Feeling

Please write below any additional comments relevant to the question above:

Vestibular A: Do you experience disorientation (e.g., spatial confusion or vertigo)?

1	2	3	4	5	6	7
Absent Feeling	Very Mild Feeling	Mild Feeling	Moderate Feeling	Intense Feeling	Very Intense Feeling	Extreme Feeling

Please write below any additional comments relevant to the question above:

Vestibular B: Do you experience postural instability (i.e., imbalance)?

1	2	3	4	5	6	7
Absent Feeling	Very Mild Feeling	Mild Feeling	Moderate Feeling	Intense Feeling	Very Intense Feeling	Extreme Feeling

Please write below any additional comments relevant to the question above:

Oculomotor A: Do you experience a visually induced fatigue (e.g., feeling of tiredness or sleepiness)?

1	2	3	4	5	6	7
Absent Feeling	Very Mild Feeling	Mild Feeling	Moderate Feeling	Intense Feeling	Very Intense Feeling	Extreme Feeling

Please write below any additional comments relevant to the question above:

Oculomotor B: Do you experience a visually induced discomfort (e.g., eyestrain, blurred vision, or headache)?

1	2	3	4	5	6	7
Absent Feeling	Very Mild Feeling	Mild Feeling	Moderate Feeling	Intense Feeling	Very Intense Feeling	Extreme Feeling

Please write below any additional comments relevant to the question above:

Appendix H

Permission to use the Jefferson Scale of Physician Empathy – Student version (JSPE-S)

Hi Olivia,

My apologies for sending you the incorrect version. Please find the S-version attached, as requested for use with medical students. Please delete the HP-version PDF.

For sake of formal records:

With your agreement to all conditions stated in our previous emails, you have our permission to administer the S-version of the JSE to 30 medical students at 3 timepoints using your secure online platform for the single not-for-profit study that you described.
Please note that no one except TJU is authorized to provide permission to use the scale. Please do not share the attached files with anyone not involved with this project. I have attached a copy of the scale, the User's Guide and the scoring algorithm. In addition to instructions for administering the JSE, the User Guide gives a detailed account of the creation of the JSE, its evolution and validity studies, etc., written by Dr. Hojat. It also contains an extensive bibliography. Please note that you are welcome to take advantage of the optional fields in case you'd like to track any additional information.

We wish you luck with your research! Please keep us informed of your progress.

Kind regards,

Shira Carroll
Empathy Project Coordinator | Assessment Scales
Asano-Gonnella Center for Research in Medical Education & Health Care

Appendix I

Attribution Questionnaire (AQ-27) and scoring guide

AQ-27
Name or ID Number_____ Date _____

PLEASE READ THE FOLLOWING STATEMENT ABOUT HARRY:

Harry is a 30 year-old single man with schizophrenia. Sometimes he hears voices and becomes upset. He lives alone in an apartment and works as a clerk at a large law firm. He had been hospitalized six times because of his illness.

NOW ANSWER EACH OF THE FOLLOWING QUESTIONS ABOUT HARRY. CIRCLE THE NUMBER OF THE BEST ANSWER TO EACH QUESTION.

1. I would feel aggravated by Harry.

1 2 3 4 5 6 7 8 9
not at all very much

2. I would feel unsafe around Harry.

1 2 3 4 5 6 7 8 9
no, not at all yes, very much

3. Harry would terrify me.

1 2 3 4 5 6 7 8 9
not at all very much

4. How angry would you feel at Harry?

1 2 3 4 5 6 7 8 9
not at all very much

5. If I were in charge of Harry's treatment, I would require him to take his medication.

1 2 3 4 5 6 7 8 9
not at all very much

6. I think Harry poses a risk to his neighbors unless he is hospitalized.

1 2 3 4 5 6 7 8 9
none at all very much

7. If I were an employer, I would interview Harry for a job.

1 2 3 4 5 6 7 8 9
not likely very likely

8. I would be willing to talk to Harry about his problems.

1 2 3 4 5 6 7 8 9
not at all very much

9. I would feel pity for Harry.

1 2 3 4 5 6 7 8 9
none at all very much

10. I would think that it was Harry's own fault that he is in the present condition.

1 2 3 4 5 6 7 8 9
no, not at all yes, absolutely so

11. How controllable, do you think, is the cause of Harry's present condition?

1 2 3 4 5 6 7 8 9
not at all under personal control completely under personal control

12. How irritated would you feel by Harry?

1 2 3 4 5 6 7 8 9
not at all very much

13. How dangerous would you feel Harry is?

1 2 3 4 5 6 7 8 9
not at all very much

14. How much do you agree that Harry should be forced into treatment with his doctor even if he does not want to?

1 2 3 4 5 6 7 8 9
not at all very much

15. I think it would be best for Harry's community if he were put away in a psychiatric hospital.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all								very much

16. I would share a car pool with Harry every day.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not likely								very much likely

17. How much do you think an asylum, where Harry can be kept away from his neighbors, is the best place for him?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all								very much

18. I would feel threatened by Harry.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
no, not at all								yes, very much

19. How scared of Harry would you feel?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all								very much

20. How likely is it that you would help Harry?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
definitely would not help								definitely would help

21. How certain would you feel that you would help Harry?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all certain								absolutely certain

22. How much sympathy would you feel for Harry?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
none at all								very much

23. How responsible, do you think, is Harry for his present condition?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all responsible								very much responsible

24. How frightened of Harry would you feel?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all								very much

25. If I were in charge of Harry's treatment, I would force him to live in a group home.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not at all								very much

26. If I were a landlord, I probably would rent an apartment to Harry.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
not likely								very likely

27. How much concern would you feel for Harry?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
none at all								very much

Appendix J

Subjective Experience Survey

1) Was there anything you liked about the programme?

2) Was there anything you disliked about the programme?

3) Do you have any suggestions for future application that would have improved your experience of the virtual reality simulation today?

4) Is there anything else you would like to share about your experience with the virtual reality intervention?

Appendix K

Participant Information Sheet

Faculty of Medicine & Health Sciences
Norwich Medical School
University of East Anglia
Norwich Research Park
Norwich, NR4 7TJ
United Kingdom

Electronic Participant Information Sheet

Virtual Reality Simulation for Psychosis in Health Students: A Feasibility Study

Thank you for taking the time to consider taking part in this study.

This is a research project conducted as part of the requirements for a postgraduate course of study at the Faculty of Medicine and Health Sciences, University of East Anglia, Norwich. The principal investigator for this project is Olivia Hannah, supervised by Dr Adrian Leddy and Dr Jordan Tsigarides, both experienced researchers at the University of East Anglia, Norwich.

Before you decide to complete the study, it is important for you to understand why the research is being conducted and what participation will involve. Please take some time to read the following information carefully and raise any questions you may have with our researchers (Olivia Hannah: o.hannah@uea.ac.uk , Dr Adrian Leddy: a.leddy@uea.ac.uk , or Dr Jordan Tsigarides: j.tsigarides@uea.ac.uk)

What is this study about? Why is this research being done?
Over the years, virtual reality (VR) techniques have increased in popularity across healthcare and medicine, in particular, in its use as an educational tool for students. The simulation of psychotic disorders in particular presents an attractive concept in the application of VR. This has the advantage of providing students with a first-hand experience, not only of hallucinations, but other elements of patient's experience such as paranoia.

At present, it is not known whether the immersive experience of wearing a 'virtual reality' headset leads to an increase appreciation for the experiences that this population may experience. The current study aims to investigate the feasibility of recruiting health professions students' to a larger trial which may seek to investigate this. Alongside this, it

aims to investigate the acceptability of the virtual reality intervention to users and the general study procedures. This will hopefully lay the groundwork for a future study.

Why have I been invited?
Anyone participating in a nursing or medical programme at UEA is invited, with exclusions for below conditions:

- Personal history of receiving treatment for a mental health condition that required secondary care intervention
- Current chronic headaches, vertigo, seizures or medical conditions significantly affected by flashing lights and/or viewing of screens
- Current significant hearing or visual impairment that may affect use of a VR system
- Current facial injury that may make use of a VR system uncomfortable or impractical

Taking part is voluntary, you can choose to withdraw at any point with no consequences by navigating away from this page in your browser.

Do I have to take part?
No, it is your choice whether you would like to take part in the study. Your participation is entirely voluntary. You may withdraw at any time without needing to provide a reason. Should you choose to not be involved in this study or withdraw later on, your current standing nor your future progression as a health professions student will be affected in any way.

What will I have to do if I agree to take part?
If you do choose to participate, you will be asked a few questions to ensure you are eligible for the study. Following this, you will be asked to provide your unidentifiable UEA email address. You will then be emailed with your participant ID number and a link to a website from which you will be able to choose a date and time to attend a location at the University of East Anglia.

At this appointment will be presented with some information about what psychosis is. Following this you will participate in the virtual reality (VR) intervention. The VR simulation will display a 360-degree video, capturing a fictional journey of someone with psychosis accessing community services. The simulation will replicate audio hallucinations and visual hallucinations within the video alongside symptoms of paranoia and delusion. The video simulation will last between 10-15 minutes.

Before and after the VR intervention, you will be asked to answer questions about your attitudes towards those with psychosis. Your attendance in person will take about 30-40 minutes to complete from start to finish.

During the simulation, there will be one of the research team present to troubleshoot any problems that may occur. You can withdraw from the survey at any time should you choose to, by indicating this to the research team or during the simulation by simply taking off the VR headset.

Are there any risks and/or disadvantages with participating in this study?
Viewing 360-degree video using a virtual reality headset has been known to cause feelings of nausea and/or dizziness in some people. This is usually mild and settles quickly once the headset has been removed.

Whilst careful consideration has been given to developing video content that is not too distressing, the research team acknowledge that there may be some level of stress, anxiety, fear or discomfort that comes from viewing simulations of psychotic symptoms.

Should you experience any discomfort when viewing the 360-degree video, in relation to physical side effects or emotional side effects, please let a member of the research team know immediately. For the safety of those participating, there are certain groups of people that have been excluded for the study as a precaution against these risks.

Are there any benefits associated with being in the study?
This study hopes to allow students to experience 'first hand' the symptoms associated with living with psychosis. Your participation may help to inform a larger trial, and the potential to incorporate virtual simulation into teaching materials for future students.

At the end of the study, you will be asked if you are happy to be contacted about future research and whether you would like to receive a summary of the study once it has been completed. **You will also have the opportunity to be entered into a prize draw with the opportunity to win one of four £20 shopping vouchers.**

What will happen to information about me that is collected during the study?
The information collected will be kept strictly confidential. Any personally identifiable information obtained (such as your email address) will be stored securely and only accessible to members of the research team. This will be stored separately to information collected at the time of the VR intervention which will be anonymised.

In accordance with the General Data Protection Regulation Act (2018) and the University of East Anglia Research Data Management Policy (2019), this data will be made available for 10 years. After the expiration of this 10 years, a member of the research team will securely delete the data.

Will I be told the results of the study?
The results of the study will be written up into a doctoral thesis in 2025 and submitted to a relevant journal.

What if I would like further information, a complaint or concerns about the study?
Should you need more information about the research study, please do not hesitate to contact me at o.hannah@uea.ac.uk and raise any questions you may have.

If you are concerned about the way this study is being conducted or you wish to make a complaint, please contact the University administration team by emailing (med.reception@uea.ac.uk) addressed for the attention of Professor Sian Coker (as the independent point of contact) and they will direct your concerns.

What to do now
If you wish to take part in the study, please follow the link below.

If you have any further questions relating to this study, please get in touch with the main researcher using the contact details included in this information sheet.

If you do not wish to take part, please ignore this communication.

https://forms.office.com/Pages/ResponsePage.aspx?id=lYdfxj26UUOKBwhl5djwkOmmU2c5xQhBlriyKr9YZL1UQjg3WkQ0V0hYSzlJR0hCWk9MRE9XNzFTTy4u

Appendix L

Initial Screening Questionnaire

Faculty of Medicine & Health Sciences
Norwich Medical School
University of East Anglia
Norwich Research Park
Norwich, NR4 7TJ
United Kingdom

Initial Screening Questionnaire

Virtual Reality Simulation for Psychosis in Health Professions Students: A Feasibility Study

To ensure the psychological and physical safety of all participants, the following exclusion criteria has been developed. In order to take part in the study, please confirm whether you have:

	Yes	No
Received or are currently receiving treatment for a mental health condition in a secondary care service	☐	☐
Current chronic headaches, vertigo, seizures or medical conditions significantly affected by flashing lights and/or viewing of screens	☐	☐
Current significant hearing or visual impairment that may affect use of a VR system	☐	☐
Current facial injury that may make use of a VR system uncomfortable or impractical	☐	☐

	Yes	No
Please confirm the following: I am a student studying with the University of East Anglia	☐	☐

Appendix M

Consent Form

Faculty of Medicine & Health Sciences
Norwich Medical School
University of East Anglia
Norwich Research Park
Norwich, NR4 7TJ
United Kingdom

Consent Form

Please indicate you consent by selecting the box next to each statement.

I confirm that I have read the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand the purpose, procedure and any benefits or risks involved with the study. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐

I understand that the information collected about me will be used to support other research in the future, and may be shared anonymously with other researchers. ☐

I confirm I have not; received treatment for a mental health condition in a secondary care service; currently got chronic headaches, vertigo, seizures or medical conditions significantly affected by flashing lights and/or viewing of screens; current significant hearing or visual impairment that may affect use of a VR system; current facial injury that may make use of a VR system uncomfortable or impractical. ☐

If I choose to enter my email at the end of the study, I understand that no other personal information or identifiable data will be collected during this research. I agree ☐

that my data gathered in this study apart from my email will be stored anonymously and securely. My email will be stored securely and separately from other data gathered in the survey.

I agree that my anonymised data may be shared with other researchers either at the UEA or outside of the UEA that are conducting similar academic research upon reasonable request. ☐

I understand that this research can be audited by the University of East Anglia or the regulatory authorities. I therefore give permission for these organisations to access my anonymous data. ☐

I agree to take part in this study. ☐

If you agree to take part in this study please provide your unidentifiable UEA email address below. This will allow you to take part in the next stages of the study.

The address should appear in the format: 3 letters 2 numbers 3 letters@uea.ac.uk
For example bwc22sau@uea.ac.uk

_____

Appendix N

Debrief

Faculty of Medicine & Health Sciences
Norwich Medical School
University of East Anglia
Norwich Research Park
Norwich, NR4 7TJ
United Kingdom

Debrief Page

Dear Participant,

Thank you for taking part in this study; your time and participation are greatly appreciated.

What was the aim?

The main aim of this study was to assess the feasibility of recruiting medical students to a future, larger trial. A secondary aim was to investigate whether virtual reality presents an acceptable, and usable intervention in the context of simulating experiences of psychosis. This included an assessment of how user-friendly and intuitive the technology was to use. It also intended to assess the extent to which participants experienced side effects of the VR intervention alongside any effects of psychological distress. The results from the questionnaires assessing empathy and attitudes towards people with psychosis will be used to inform procedures of a future, larger trial. This will be used to establish whether simulations of psychosis can increase the empathy and positive attitudes of medical students towards people with psychosis.

Why is it important?

Although the primary purpose of the study was to establish the feasibility of recruiting medical students to a larger trial, this will hopefully lay the groundwork for a future study. Should a future study find evidence that suggests simulating experiences of psychosis can help to increase positive attitudes in medical students, this holds implications for the implementation of virtual reality as an educational tool in this setting.

This is important as there has been evidence to suggest a global decline of empathy levels in medical students' overtime during medical training. Indeed, whilst some form of empathy-focused training exists on most undergraduate curriculums across the UK, most educators report wanting to offer more. This highlights a clear need to develop training interventions that are evidence-based and acceptable for students.

How to withdraw my data?

Please indicate that you would like to withdraw your data at the time of reading this. You will not be able to withdraw your data after you leave the study room.

What if I want to know more?

The research team recognise the sensitivity of this research. If you feel that you have been impacted emotionally by the topics of the current research, you can access support from the following organisations or people:

- Your General Practitioner (GP)
- NHS 111 (Call 111)

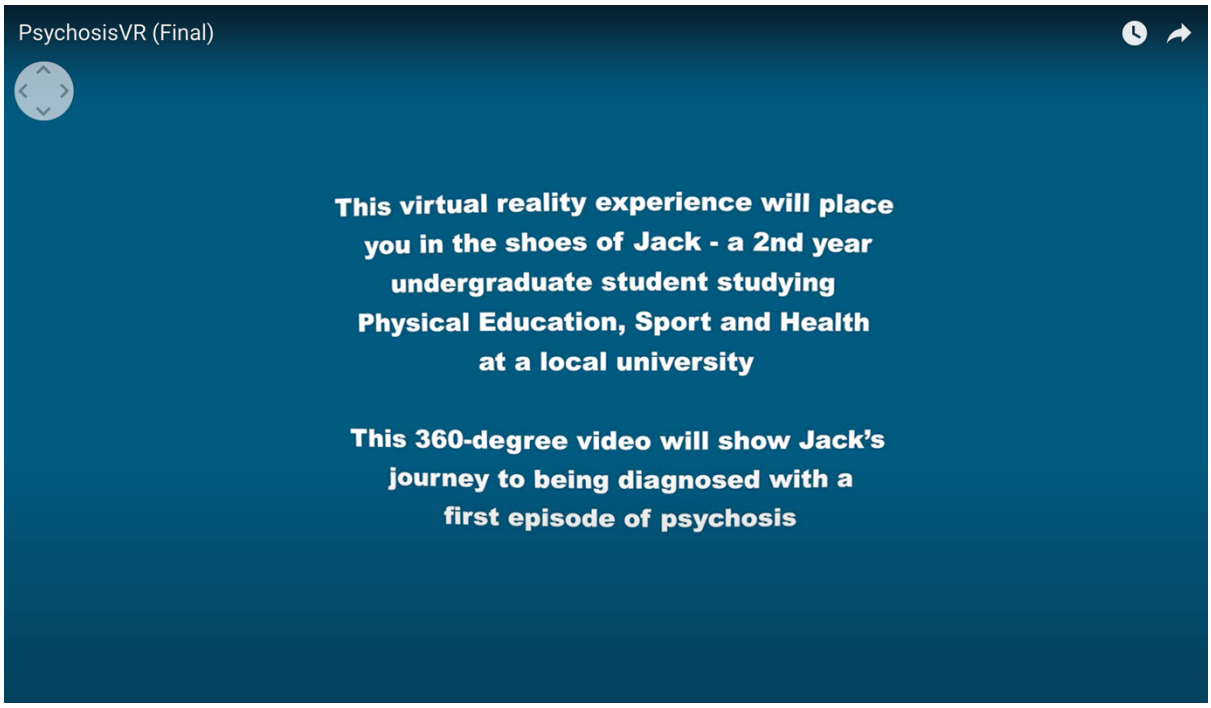
Samaritans is a registered charity aimed at providing emotional support to anyone in distress or struggling to cope. The SANE telephone line is open between 4pm to 10pm, 365 days a year. Call 116 123 or visit their website https://www.samaritans.org/ to access other means of support.

SANE is a registered charity aimed at improve the quality of life for people affected by mental illness. The SANE telephone line is open between 4pm to 10pm, 365 days a year. Call 0300 304 7000 or visit their website https://www.sane.org.uk/ to access other means of support.

Thank you for your participation.

Appendix O

Screenshots of scenes from the video




PsychosisVR (Final)


PsychosisVR (Final)


PsychosisVR (Final)


PsychosisVR (Final)
BREAKIN


PsychosisVR (Final)

Appendix P

Table 1

Content analysis of positive feedback gathered from the Subjective Experience Survey

First round coding	Second round coding	Refined themes and relevant codes
Insightful into the experience of psychosis Good acting – good portrayal VR immersive and good choice Enjoyed the diversity of video – the imagery and different symptoms Empathy/change in perspective attributable to elements of VR Good acting – good portrayal Interesting and engaging Video well-made VR immersive Allows for empathy/change in perspective - important Easy to use VR equipment Good portrayal VR immersive/ felt real Liked that it was at UEA Gave first person perspective Application of VR in healthcare VR immersive/ felt real Gave first person perspective Insightful into the experience of psychosis Liked that it was at UEA Insightful into the experience of psychosis Video of good quality Interesting and engaging Video of good quality VR immersive/ felt real Good set up Interesting and engaging Person was nice Welcoming environment Video of good quality Insightful into the experience of psychosis through VR VR immersive/ felt real Video of good quality Good study set up Gave first person perspective VR immersive/ felt real	Insightful into the experience of psychosis (12) Good portrayal of psychosis (8) VR was immersive / felt real (8) VR medium allowed for empathy and change in perspective (10) Enjoyable and engaging (12) Video well produced (11) Study was set up well (5) Relatable (4) VR as good teaching tool (5)	**Increased understanding towards psychosis** • Insightful into the experience of psychosis • VR medium allowed for empathy and change in perspective • VR as good teaching tool **Immersive Technology and Realism** • Good portrayal of psychosis/ interactions • VR was immersive / felt real • Video well produced • Relatable **Acceptable** • Study was set up well • Enjoyable and engaging • Easy to use VR equipment •

Video of good quality
Interesting and engaging
Allows for empathy/change in perspective
Application of VR in healthcare
Good representation of symptoms
Impact of GP's interactions
Insightful into the experience of psychosis
Insightful into the experience of psychosis
Enjoyed the diversity of video – the imagery and different symptoms
Interesting and engaging
Insightful into the experience of psychosis
VR as good medium for perspective taking
Good acting – good portrayal
Liked that it was at UEA
Video of good quality
Interesting and engaging
Interesting and engaging
Interesting and engaging
Good portrayal of psychosis
Video of good quality
Good training tool
Video of good quality
Good acting – good portrayal
VR immersive/ felt real
Insightful into the experience of psychosis
VR allowed for empathy/change in perspective
Enjoyable, interesting and engaging
Insightful into the experience of psychosis
Application of VR in healthcare
Interesting and engaging
VR allowed for empathy/change in perspective
Good training tool
Enjoyable
Insightful into the experience of psychosis
Ties to UEA – realistic
VR allowed for empathy/change in perspective
Insightful into the experience of psychosis
Insightful into the experience of psychosis
Interesting and engaging
VR allowed for empathy/change in perspective
Video of good quality
Good acting – good portrayal

Table 2

Content analysis of negative/improvement feedback gathered from the Subjective Experience Survey

First round coding	Second round coding	Refined themes and relevant codes
Unrealistic acting Difficulty with visual details Audio problems Difficulty with visual navigation Lightheaded after VR Subtle portrayal of psychosis Need for longer/ extended content. Unrealistic acting Subtle portrayal of psychosis Unrealistic acting Audio problems Need for longer content. Subtle/ more accurate portrayal of psychosis Difficulty with visual navigation Subtle/ more accurate portrayal of psychosis Simulation of other mental health difficulties Difficulty with visual details Need for longer content. Need for longer content. Subtle/ more accurate portrayal of psychosis Simulation of other mental health difficulties Simulation of other mental health difficulties Audio problems Simulation of other mental health difficulties - options for other videos	Unrealistic acting (3) Difficulty with visual navigation/ details (4) Audio problems (3) Side effects (1) Subtle portrayal of psychosis (5) Need for longer/ extended content (4) Desire for simulation of other mental health difficulties (4)	**Acceptability and Usability** Audio problems (3) Side effects (1) Difficulty with visual navigation/ details (4) **Video authenticity** Subtle portrayal of psychosis (5) Unrealistic acting (3) **Video content** Need for longer content (4) Desire for simulation of other mental health difficulties (4)

Appendix Q

Ethical Approval

University of East Anglia
Norwich Research Park
Norwich. NR4 7TJ

Email: ethicsmonitor@uea.ac.uk
Web: www.uea.ac.uk

Study title: Evaluating a Virtual Reality Simulation on Empathy and Attitudes towards Psychosis in Medical Students: A Feasibility Study

Application ID: ETH2223-2761

Dear Olivia,

Your application was considered on 24th January 2024 by the FMH S-REC (Faculty of Medicine and Health Sciences Research Ethics Subcommittee).

The decision is: **approved**.

You are therefore able to start your project subject to any other necessary approvals being given.

If your study involves NHS staff and facilities, you will require Health Research Authority (HRA) governance approval before you can start this project (even though you did not require NHS-REC ethics approval). Please consult the HRA webpage about the application required, which is submitted through the IRAS system.

This approval will expire on **31st October 2025**.

Please note that your project is granted ethics approval only for the length of time identified above. Any extension to a project must obtain ethics approval by the FMH S-REC (Faculty of Medicine and Health Sciences Research Ethics Subcommittee) before continuing.

It is a requirement of this ethics approval that you should report any adverse events which occur during your project to the FMH S-REC (Faculty of Medicine and Health Sciences Research Ethics Subcommittee) as soon as possible. An adverse event is one which was not anticipated in the research design, and which could potentially cause risk or harm to the participants or the researcher, or which reveals potential risks in the treatment under evaluation. For research involving animals, it may be the unintended death of an animal after trapping or carrying out a procedure.

Any amendments to your submitted project in terms of design, sample, data collection, focus etc. should be notified to the FMH S-REC (Faculty of Medicine and Health Sciences Research Ethics Subcommittee) in advance to ensure ethical compliance. If the amendments are substantial a new application may be required.

Please can you send your report once your project is completed to SIRG (student.survey.request@uea.ac.uk).

Approval by the FMH S-REC (Faculty of Medicine and Health Sciences Research Ethics Subcommittee) should not be taken as evidence that your study is compliant with the UK General Data Protection Regulation (UK GDPR) and the Data Protection Act 2018. If you need guidance on how to make your study UK GDPR compliant, please contact the UEA Data Protection Officer (dataprotection@uea.ac.uk).

Please can you send your report once your project is completed to the FMH S-REC (fmh.ethics@uea.ac.uk).

I would like to wish you every success with your project.

On behalf of the FMH S-REC (Faculty of Medicine and Health Sciences Research Ethics Subcommittee)

Yours sincerely,

Dr Paul Linsley