VIRTUAL REALITY THERAPY TAKES GREENSPACE TO OLDER NURSING

HOME RESIDENTS: A PILOT STUDY

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A Dissertation

presented to

the Faculty of the Graduate School

at the University of Missouri-Columbia

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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by

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DECEMBER 2020

The undersigned, appointed by the dean of the Graduate School, have examined

the dissertation entitled:

VIRTUAL REALITY THERAPY TAKES GREENSPACE TO OLDER NURSING

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presented by Jody S. Blankenship,

a candidate for the degree of Doctor of Philosophy of nursing,

and hereby certify that, in their opinion, it is worthy of acceptance.

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DEDICATION

This dissertation is dedicated to my parents, Theodore and Carolyn Pifer, who fostered my inquisitive and creative nature from an early age. It is also dedicated to my husband, Larry and sons, David and Matthew, who kept me motivated on this journey. To my baccalaureate professor, Laurie Pierce, I hold a special feeling of gratitude for inspiring me to pursue a doctorate degree. She helped me believe in my own ability, to realize my internal drive, and to clarify my goals. In addition, I extend my deepest appreciation to my first graduate advisor and mentor, Dr. Lorraine Phillips, who is a true savant: she repeatedly conveyed energy and excitement regarding nursing research and scholarship which I found contagious. Lastly, I must thank my dog, Ozzy, for never leaving my side no matter how long I sat in front of the computer.

ACKNOWLEDGEMENTS

First, and most of all, I wish to thank my advisor and dissertation chairperson, Dr. Kari R. Lane, for her expertise, understanding, patience, guidance, encouragement, and support throughout my doctoral education. I consider myself extremely fortunate to have had such a wonderful mentor who continually displayed a passion not only for research, but for teaching. Without your guidance this dissertation would not have been possible.

Completion of this project was also made possible by the efforts and cooperation from my wonderful committee members, Dr. Deidre Wipke-Tevis, Dr. Nancy Birtley, and Dr. Rachel Proffitt. First, I want to thank each of you for believing in my research ideas. Secondly, I want each of you to know that I am extremely grateful for the guidance, support, and inspiration which empowered me to achieve my goal.

A special thank you to Dr. Chelsea Deroche, for her assistance with the data analysis for this study. I am grateful to you for sharing your knowledge and expertise with me to enable my understanding and interpretation of the data from this study.

I want to extend my appreciation to the University of Missouri (MU) for affording me the opportunity for so many remarkable learning opportunities. The faculty at MU are not only extremely knowledge, but are enthusiastic, patient, and supportive. I cannot have imagined a more suitable university for my doctoral studies.

Lastly, I want to acknowledge the participants who were involved with this study. My sincere gratitude goes out to every person who donated time and shared their experiences with me in the pursuit of advancing knowledge in the care of older nursing home residents. I am forever indebted for the kindness each one of you bestowed on me.

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LIST OF ABBREVIATIONS

APA   American Psychological Association

BDI-II   Beck's Depression Inventory-II (tool)

BIMS   Brief Interview of Mental Status (tool)

CDC   Centers for Disease Control and Prevention

CMS   Centers for Medicare and Medicaid Services

DSM-V   Diagnostic and Statistical Manual of Mental Disorders-5th Edition

GAD   Generalized Anxiety Disorder

GAI   Geriatric Anxiety Inventory (tool)

GDS-SF   Geriatric Depression Scale-short form (tool)

HIPAA   Health Insurance Portability and Accountability Act

HMD   Head Mounted Display

ID   Identification

M   Mean

Md   Median

MoCA   Montreal Cognitive Assessment (tool)

MU   University of Missouri

NH   Nursing Home

NIMH   National Institute of Mental Health

NINR   National Institute of Nursing Research

OERS   Observed Emotion Rating Scale (tool)

PHQ-9   Patient Health Questionnaire-9 (tool)

PI   Primary Investigator

POMS 2-A   Profile of Mood States 2nd Edition-Adult Version (tool)

PROMIS   Patient-Reported Outcomes Measurement Information System

            Depression Scale (tool)

RCT   Randomized Controlled Trial

VR   Virtual Reality

VRT   Virtual Reality Therapy

ViRT-Ta-GO Virtual Reality Therapy Takes Greenspace to Older Residents

VIRTUAL REALITY THERAPY TAKES GREENSPACE TO OLDER

NURSING HOME RESIDENTS: A PILOT STUDY

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Abstract

Older nursing home (NH) residents receiving antidepressant, anxiolytic, or sedative-hypnotic medications for depression or anxiety are at increased risk of falling, sustaining injury, social isolation, and dying. Virtual reality (VR) therapy may provide a safe alternative or adjunct to the traditional pharmacological approach for managing depressive and anxiety symptoms, but the use of VR technology has not been studied in the NH setting. Preliminary work for this study indicated that a fully immersive VR intervention was feasible in a similar population and identified barriers that might hinder success in a subsequent trial. Two main barriers identified were usability of the head-mounted display system and content within the VR application. Modifications were made to the intervention with the intent of reducing or eliminating these problems. For this study, a quasi-experimental, pretest-posttest design was used to pilot test ViRT-Ta-GO: Virtual Reality Therapy Takes Greenspace to Older NH residents on depressive and anxiety symptoms. Findings demonstrate the usefulness of the intervention within the NH population, suggesting that it will be advantageous to evaluate the application of ViRT-Ta-GO through controlled clinical trials.

Keywords: nursing home, older residents, virtual reality, depression, anxiety

CHAPTER ONE

INTRODUCTION

Background and Significance

In the United States, depression and anxiety are highly prevalent among older adults living in long-term care settings. The Centers for Disease Control and Prevention report that 46.3% of NH residents and 30.9% of assisted living residents have depression (Harris-Kojetin et al., 2019). Whereas, 19.4% of long-term care residents are affected by threshold anxiety and 11.7% by subthreshold anxiety (Creighton et al., 2018). Risk factors for developing these disorders include chronic medical illness, many stressful life events, perceived poorer health, sleep disturbances, and adverse medication effects (Blanco et al., 2014; Sözeri-Varma, 2012). While causes of depression are likely multifactorial, NH residents have identified a lack of engagement in outside activities as a significant cause of their depressive symptoms (Choi et al., 2008). However, in long-term care settings, institutional barriers, adverse environmental conditions, and residents' limitations may prevent involvement in outdoor activities.

Depression is a mood disorder that leads to profound feelings of sadness or loss of interest or pleasure. Depression is associated with somatic and cognitive changes that substantially affect an older adult's ability to function (American Psychiatric Association [APA], 2013). Some of the negative consequences of depression include lack of energy, loss of appetite, disturbed sleep, feelings of worthlessness or guilt, and restlessness (APA, 2013). Furthermore, depression is associated with frequent falls (Eggermont et al., 2012; Wang et al., 2012), reduced social interaction, recurrent thoughts of death, inability to participate in self-care activities, increased mortality (Blazer, 2003), increased

psychological stress (Areán & Reynolds, 2005; Bruce, 2002), frequent hospitalizations (Chuan et al., 2008), and higher health-related medical costs (Unutzer et al., 2009). Depressed older adults spend about $20,046 per year on health-related costs, whereas non-depressed individuals spend about $11,956 per year (Unutzer et al., 2009). These costs are related to skilled nursing, outpatient and inpatient care, physician fees, and medical equipment (Unutzer et al., 2009).

Anxiety often accompanies late-life depression (Kvaal et al., 2008; Lenze, 2003). Older adults with generalized anxiety disorder (GAD) experience significant physical, cognitive, and emotional symptoms that inhibit their ability to function normally (APA, 2013). Significant anxiety symptoms are shortness of breath, excessive worry, restlessness, and irritability (APA, 2013). In the older adult population, anxiety is often characterized by difficulty concentrating, sleep disturbances, and increased muscle tension (APA, 2013). If left untreated, anxiety can lead to a decline in one's ability to perform daily tasks (Gulpers et al., 2016), poorer health (Brenes et al., 2005), and decreased life satisfaction (Porensky et al., 2009).

The typical approach for managing depression and anxiety in the long-term care setting is pharmacological (National Institute of Mental Health [NIMH], n.d.), but older adults are particularly vulnerable to antidepressant, anxiolytic, and sedative-hypnotic medications' adverse side effects. These medications' common side effects include dizziness, fatigue, somnolence, nausea, vomiting, diarrhea, and alterations in blood pressure (Crocco et al., 2017). Research shows that older adults taking antidepressants, anxiolytics, and sedative-hypnotics are more likely to fall and more likely to sustain hip fractures (Cox et al., 2016; Meeks et al., 2016). Furthermore, these older adults are less

likely to participate in social activities and activities of daily living (Galik & Resnick, 2013). When it comes to treatment for depression, research has shown that older adults favor psychosocial approaches over pharmaceutical approaches (Hanson & Scogin, 2008; Raue et al., 2009). The preference of psychosocial approaches to depression may be related, at least in part, to the adverse effects associated with medications. The prevalence of depressive and anxiety symptoms in long-term care settings, their correlation with a disability, and their negative interaction with physical health significantly impact the quality of life and well-being of older residents making this a significant public health concern.

The National Institute of Nursing Research (NINR; 2016) recognizes the need to identify, develop, and test appropriate non-pharmacological interventions to manage adverse symptoms better and improve health outcomes. The Institute is committed to research to help people improve their quality of life, particularly with innovative interventions that are easily tailored to underserved groups (NINR, 2016). With new advances in computer technology and increased commercial availability, there is a growing interest in using virtual reality (VR) interventions for psychological health and well-being. VR allows participants to feel actual existence in specific situations and may offer a safe, innovative, non-invasive alternative or adjunct to the traditional pharmacological approach for managing depression and anxiety.

In healthcare, VR applications have been used for rehabilitation therapy and behavioral medicine with some success. VR is a type of technology wherein humans participate in a computer-generated, interactive setting which provides a sense of presence in a simulated environment (Heeter & Allbritton, 2015; Steuer, 1992). VR has

been investigated for balance and gait training in patients with Parkinson's disease (Wang et al., 2012), stroke (de Rooij et al., 2016), multiple sclerosis (Casuso-Holgado et al., 2018), and brain injury (Tay et al., 2018). Furthermore, research has demonstrated the positive impact of VR-based rehabilitative approaches on depression- and anxiety-related outcomes (Mestre et al., 2011; Plante et al., 2006). Regarding behavioral and mental health, VR-based treatments for various disorders have also demonstrated positive findings. VR applications have been studied in the treatment of post-traumatic stress disorder (Gamito et al., 2010), eating disorders (Gutiérrez-Maldonado et al., 2016), phobias (Rothbaum et al., 2000), and chronic pain (Llobera et al., 2013). More specifically, VR exposure therapy has grown in popularity in the treatment of depression and anxiety, with mounting evidence suggesting that VR exposure therapy is an effective strategy for symptom management (McCann et al., 2014; Krijn et al., 2004; Powers & Emmelkamp, 2008; Valmaggia et al., 2016; Falconer et al., 2016). Existing literature concerning the effects of VR applications primarily focuses on rehabilitative therapy and mental health issues across the lifespan, with little attention given to VR treatments specially targeted at depression and anxiety in older adults. The proposed VR intervention uses VR technology to create a pleasant outdoor event that might offer older residents a brief break from the ongoing stress associated with living in a NH. This intervention may promote a positive mood and relaxation. Findings from the proposed study will extend knowledge about the feasibility and efficacy of a fully immersive VR intervention to treat depression and anxiety symptoms in the NH setting and may bring about changes in practice, which may decrease the prevalence of these disorders.

Purpose of Research

This pragmatic study aimed to pilot a fully immersive VR intervention among older NH residents and extend knowledge about its use to treat depressive and anxiety symptoms in the NH setting. Preliminary work included a small group of assisted living residents with no more than mild cognitive impairment ($n = 4$) to determine if a VR study could and should be done. This study utilized quantitative methods and a post-intervention satisfaction survey to test the feasibility and acceptability of the fully immersive VR intervention, ViRT-Ta-GO, among older assisted living residents and assess the impact of ViRT-Ta-GO on overall mood and the negative mood states of depression and anxiety. Based on the preliminary work findings, which demonstrated that VR is feasible and acceptable to assisted living residents and identified barriers to participation, this dissertation study was developed to pilot test ViRT-Ta-GO on depressive and anxiety symptoms in older NH residents without cognitive impairment. This study was guided by the following specific aims and research questions:

Specific Aim 1

Test preliminary efficacy of a fully immersive VR intervention on depressive and anxiety symptoms among cognitively intact NH residents aged 60 years and older.

Research Question 1. Does VR intervention decrease depressive symptoms among participants?

Research Question 2. Does VR intervention decrease anxiety symptoms among participants?

Specific Aim 2

Secondarily obtain estimates of effect sizes on outcome measures.

Research Question 3. What is the estimated effect size on the outcome measure for the severity of depressive symptoms, the Patient Health Questionnaire-9?

Research Question 4. What is the estimated effect size on the outcome measure for the severity of anxiety symptoms, the Geriatric Anxiety Inventory?

Specific Aim 3

Test the feasibility and acceptability of a fully immersive VR intervention among cognitively intact NH residents aged 60 years and older.

Research Question 5. Are study procedures and VR intervention acceptable to participants?

Research Question 6. What are the person-level barriers and facilitators to participation in VR study?

Research Question 7. To what extent is the VR intervention acceptable and appealing to participants?

Research Question 8. What, if any, unexpected adverse events occur during the study period?

Variables

The independent variable for this study was the VR intervention. The dependent variables were depression and anxiety. Depression was measured using a valid instrument that screens for signs and symptoms of depression using a Likert-scale format. Anxiety was measured using a valid and reliable instrument with an agree and disagree format.

In research, **feasibility** is a broad term that refers to the likelihood and to what extent an intervention will be efficacious in the future (Bowen et al., 2009). Conducting feasibility studies enables researchers to assess whether an intervention should be

endorsed for further testing and what aspects of the research methods need to be modified (Bowen et al., 2009). Quantitatively, feasibility was determined by the number of participants recruited, VR sessions attended, and the number of participants who completed the 4-week VR intervention. **Acceptability** refers to how participants react to the intervention (Bowen et al., 2009). Quantitatively, acceptability was determined by the percentage of participants who would recommend VR to a friend.

Definitions of Terms

Depression. Late-life depression has multiple etiologies and is defined as a mood disorder in adults aged 60 years or older (Aziz & Steffens, 2013). Symptoms of depression typically fall under two categories: 1) somatic symptoms (e.g., unexplained pain or gastrointestinal problems, fatigue, sleep disturbance, appetite changes) and 2) cognitive symptoms (e.g., persistent sadness, excessive worries, pessimism) (APA, 2013). Unlike younger adults, depressed older adults are more likely to present with somatic symptoms than cognitive symptoms (Fiske et al., 2009). According to the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5;* APA, 2013) criteria, an individual must be experiencing five or more depressive symptoms during the same 2-week period and include either depressed mood or loss of interest or pleasure to be diagnosed with depression (APA, 2013). A diagnosis of depression is made if symptoms cause clinically significant distress or impairment in social, occupational, or other essential functioning (APA, 2013).

Anxiety. People with generalized anxiety disorders (GADs) experience excessive anxiety and worry, which occurs more days than not over six months (APA, 2013). Older adults with GAD find controlling the worry severe (APA, 2013). Significant anxiety

symptoms are restlessness, feeling edgy, fatigue, difficulty concentrating, irritability, muscle tension, and sleep disturbance (APA, 2013). Similar to depression, a diagnosis of anxiety is made if symptoms cause clinically significant distress or impairment in social, occupational, or other essential functioning (APA, 2013).

Virtual Reality (VR). For this dissertation study, VR was defined as the interaction between a human and a computer-generated environment delivered using a head-mounted display (HMD), creating a fully immersive VR experience. VR therapy (VRT) is a type of immersion therapy wherein individuals are actively involved participants engaged in a 3-dimensional, computer-generated, interactive setting, which allows them to feel actual existence in situations correlated to their presenting problem (North & North, 1997).

Theoretical Framework

This dissertation research was guided by the revised version of the Cognitive Theory of Stress and Coping (Lazarus, 1966; Lazarus & Folkman, 1984; Folkman, 1997), which incorporates distress, mean-focused coping, and positive emotions in the coping process. According to Folkman's (1997) revised model, an individual may experience distress, positive emotions, and favorable outcomes, even when a stressful situation is not resolved successfully. Folkman (1997, 2008; Folkman & Moskowitz, 2007) proposes that meaning-focused coping strategies (e.g., infusing ordinary events with positive meaning, reordering priorities, benefit finding, adaptive goal processes, benefit reminding) support psychological well-being, especially during chronically stressful situations and that positive emotions provide relief from distress. Previous research has demonstrated that positive psychology interventions intended to induce positive emotions significantly

decrease depressive and anxiety symptoms in older adults (Ramirez et al., 2014; Smith & Hanni, 2019). For this study, a VR intervention was created based on the meaning-focused coping strategy of infusing ordinary events with positive meaning, and distress was conceptualized as symptoms of depression and anxiety.

Folkman's (1997, 2008) Revised Stress and Coping Model infers that psychological stress is not caused by a single factor, but rather by the continuous interaction between an individual and their environment. The critical components of this model are appraisal, coping, and emotions. An appraisal is a process of deciding, consciously or unconsciously, whether an event or situation is stressful (i.e., primary appraisal) and if so, whether personal coping resources will be taxed or exceeded (i.e., secondary appraisal) (Lazarus & Folkman, 1984; Folkman, 1997). Negative emotions such as anger, sadness, anxiety, or fear, and positive emotions such as confidence, eagerness, or excitement have been associated with different stress appraisals (Folkman & Lazarus, 1985). Appraisal of a situation as stressful (i.e., harm/loss, threat, challenge) triggers the coping response (Lazarus & Folkman, 1984; Folkman, 1997). Coping refers to the cognitive and behavioral efforts someone makes to deal with stressful situations' internal and external demands (Folkman & Lazarus, 1985; Folkman, 1997). The coping response may directly affect the stressful situation (i.e., problem-focused coping) or attempt to reduce negative emotions associated with the stressful situation indirectly through emotion-focused coping (Lazarus & Folkman, 1984; Folkman, 1997). If the stress-provoking situation, problem, or event is resolved successfully, positive emotions such as pride, solace, or joy rise to the surface (Lazarus & Folkman, 1984; Folkman, 1997). If the stressful situation is not resolved favorably, the appraisal-emotion-coping-

emotion-reappraisal process repeats (Lazarus & Folkman, 1984; Folkman, 1997). If this cycle continues over a long period, chronic stress conditions develop, and a person's coping resources may be depleted (Folkman, 1997). As hypothesized by Folkman (1997), repeated attempts to resolve a stressful situation prompt residents' use of meaning-focused coping mechanisms. Meaning-focused coping produces positive emotions and appraisals, which help replenish depleted resources and motivate them to sustain coping across an extended period (Folkman & Moskowitz, 2007). Research has shown that positive emotions help people find positive meaning in adverse situations (Tugade & Fredrickson, 2004), safeguard against depression, and promote thriving (Fredrickson et al., 2003). The meaning-focused coping mechanism, infusing ordinary events with positive meaning, encompasses generating a brief psychological respite by purposefully permeating an otherwise neutral event with positive meaning (Folkman et al., 1997). Taking notice of a beautiful rainbow, snowfall, or beach, reflecting on a cordial comment made by another person, or appreciating good music are just a few examples of positive events that may offer individuals a short reprieve from the ongoing stress they may be experiencing.

According to the revised stress and coping model, cognitive appraisals pave how personal and environmental factors change the psychological response, and consequently, emotions followed by their associated biological alterations. Negative emotions experienced during a stressful period are historically known for initiating the fight or flight response, thereby narrowing one's attention to the immediate problem to ensure survival (Cannon, 1939; Frijda, 1988). Prolonged negative emotions experienced during periods of chronic stress have been found to have detrimental effects on health and well-

being, such as anxiety and depression (Tafet & Bernardini, 2003). However, positive emotions experienced during stressful periods have been found to broaden one's attentional focus and behavioral array, thus replenishing physical, social, and intellectual resources (Fredrickson, 1998). Research has shown that people experiencing positive moods tend to feel that their life has meaning and are more sensitive to a situation (King et al., 2006). Furthermore, beneficial biological responses such as daytime cortisol patterns and systolic blood pressure are related to positive affect (Steptoe et al., 2007).

Within the NH setting, many environmental factors may affect residents' cognitive appraisals of the situation. NH residents themselves have identified loss of autonomy, lack of privacy, inconvenience of sharing a bathroom, staff turnover and shortage, lack of meaningful activities, uncertainty towards cognitively impaired residents, ever-present death and grief, lack of continuity with their past life, and feelings of loneliness and social isolation as stressors associated with living in an NH (Choi et al., 2008). Quantitative research measuring primary and secondary appraisals of stress associated with moving to or living in NHs are sparse. Among senior housing residents, functional independence has been negatively correlated to harm/loss appraisals and positively benign and challenge appraisals (Gass et al., 1992). Morale has been negatively correlated to harm/loss (Gass et al., 1992) and threat appraisals (Armer, 1993; Gass et al., 1992) and positively to challenge appraisals (Armer, 1993; Gass et al., 1992).

In response to perceived stress associated with living in an NH, residents have employed various meaning-focused coping strategies such as watching television, listening to music, participating in recreational activities, talking with friends and family (Bangerter et al., 2016; Hunter & Gillen, 2009), praying, reading, or attending spiritual

services (Bangerter et al., 2016; Choi et al., 2008; Scandrett & Mitchell, 2009). Research about using meaning-focused coping strategies, particularly infusing ordinary events in the NH setting, is limited. A study that asked older adults to reflect on a positive experience (i.e., present, past, or future) for five minutes twice a day demonstrated that savoring positive moments increased happiness and decreased depressive symptoms (Smith & Hanni, 2019). Given that positive emotions promote coping (Gloria & Steinhardt, 2016), using interventions that elicit pleasant events may reduce NH residents' distress.

NH residents perceive that not being able to get out of the facility to engage in outside activities such as planting flowers or going for a drive as they had done before living in the NH as a significant stressor contributes to their depressive symptoms (Choi et al., 2008). Indeed, contact with nature has been shown to reduce stress (Brown et al., 2013; Hunter et al., 2019; Ward-Thompson et al., 2012). Research demonstrates that walking in the forest significantly decreases depression (Morita et al., 2007), and visiting gardens improves mood and sleep (Rappe & Kivela, 2005). Among older adults living in residential care centers, garden visits promote a sense of being away from the facility (Dahlkvist et al., 2016). However, for many NH facilities, lack of readily accessible green space, limited availability of staff, inclement weather, and residents' physical limitations hinder NH residents' engagement in these types of outdoor activities (Kearney & Winterbottom, 2005). One way to overcome these barriers is with VR technology. VR allows residents to view themselves outdoors and in pleasant settings without leaving the facility. Research has demonstrated that stress recovery is possible within a virtual forest-

like setting (Annerstedt et al., 2013). Connecting residents with nature through VR may help reduce the negative outcomes associated with prolonged stress.

Inspired by Folkman's (1997) Revised Theory of Stress and Coping, this dissertation research sought to develop an intervention, **ViRT-Ta-GO** (**Vi**rtual **R**eality **T**herapy **Ta**kes **G**reenspace to **O**lder NH residents), to reduce symptoms of depression and anxiety in older NH residents. This intervention uses a VR nature-based application to create a positive event that might offer a psychological time-out from the stress associated with living in an NH. The following chapters describe small-scale feasibility testing of ViRT-a-GO and subsequent pilot testing, which included a modified design to reduce or eliminate the problems identified during the preliminary study.

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CHAPTER TWO

REVIEW OF THE LITERATURE

Chapter Two includes a comprehensive review of the literature on the use of virtual reality (VR) interventions and their effects on depressive and anxiety symptoms in older adults. The review is divided into the following sections: a) Therapeutic Applications of VR in Older Adult Populations, b) Effects of VR on Depression-Related Outcomes, c) Effects of VR on Anxiety-Related Outcomes, d) Role of Reminiscence, e) Perceptions of VR, f) Risks and Challenges of VR.

Purpose

Virtual reality (VR) is a type of technology wherein humans participate in a computer-generated, interactive setting which provides a sense of presence in a simulated environment (Heeter & Allbritton, 2015; Steuer, 1992). In healthcare, interventions using VR technology have been used to prevent and treat mental health issues, including depression and anxiety. For this review, VR was defined as the interaction between a human and a computer-generated environment which was delivered by the use of a head-mounted display (HMD), creating a fully immersive experience through the use of projected images on walls, ceiling, and floors creating a semi-immersive experience, or through the use of flat screens, computer or television, creating a non-immersive experience.

In the United States, 623,939 nursing home (NH) residents and 250,754 assisted living residents were diagnosed with depression between 2015 and 2016 (Harris-Kojetin et al., 2019). Late-life depression has multiple etiologies and is defined as a mood disorder in adults aged 60 years or older (Aziz & Steffens, 2013). Symptoms of

depression typically fall under two categories: 1) somatic symptoms (e.g., unexplained pain or gastrointestinal problems, fatigue, sleep disturbance, appetite changes) and 2) cognitive symptoms (e.g., persistent sadness, excessive worries, pessimism) (American Psychiatric Association [APA], 2013).

While not as well studied as depression, anxiety is also common among NH residents. A recent study reported an overall prevalence of threshold anxiety disorders was 19.4%, and subthreshold anxiety was 11.7% among senior housing residents (Creighton et al., 2018). People with generalized anxiety disorders experience excessive anxiety and worry, which occurs more days than not over six months, and they find controlling the worry severe (APA, 2013). Significant anxiety symptoms are restlessness, feeling edgy, fatigue, difficulty concentrating, irritability, muscle tension, and sleep disturbance (APA, 2013).

This integrative review aimed to explore what is known about the use of VR interventions in older adults aged 60 years or more and examine their effects on depressive and anxiety symptoms. The research question guiding this review is: Other than exercise-based applications, how has VR been used among older adults aged 60 years and older to alleviate depression- and anxiety-related symptoms?

Considering the dearth of VR studies found during the initial search, an integrative review is appropriate to systematically analyze current research evidence (Whittemore & Knafl, 2005). Utilizing this method allowed for the inclusion of diverse data sources to thoroughly understand the use of VR in managing depressive and anxiety symptoms among older adults, appraise the quality of evidence, and detect gaps in research (Whittemore & Knafl, 2005).

Methods

This review followed the steps outlined by Whittemore & Knafl (2005): problem identification, literature search, data evaluation, data analysis, and presentation. The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement was consulted for reporting findings from the study (Moher et al., 2009).

Eligibility Criteria

Inclusion criteria for this review were

- research studies from peer-reviewed scholarly journals;

- studies published from January 2000 through December 2019;

- studies published in the English language;

- studies that utilized fully immersive, semi-immersive, or non-immersive virtual reality interventions;

- interventional studies targeted at older adults aged 60 years or older; and

- studies that assessed depression- and anxiety-related outcomes.

Exclusion criteria were

- literature reviews;

- commentaries;

- books and book chapters;

- interventional studies primarily focused on rehabilitative exercise, strength, or balance modalities;

- interventional studies targeted at caregivers;

- studies examining the use of VR as a diagnostic tool, and

- articles describing study protocols or intervention development.

The specified date range was chosen because of the considerable advances in computer technologies since 2000 (Oulasvirta et al., 2012).

Literature Search

A systematic literature search was conducted by one reviewer using the databases, PubMed, Scopus, and Medline (Ovid). Searches included the following combination of keywords: "depression," OR "anxiety," AND "virtual reality," AND "older adults." Ancestry searches of reference lists of relevant publications were hand searched.

Study Selection

One reviewer used the pre-specified inclusion and exclusion criteria to assess the relevance of identified articles.

Quality Assessment

Joanna Briggs Institute (JBI) Critical Appraisal Tools were used to assess the included studies' quality. The JBI Critical Appraisal Checklist for Randomized Controlled Trials (RCTs), which consists of 13 items, was used to appraise true experimental studies (Tufanaru et al., 2017). The JBI Critical Appraisal Checklist for Quasi-Experimental Studies, which consists of nine items, was used to critique non-randomized experimental trials (Tufanaru et al., 2017). Items on these checklists referred to methodology, baseline characteristics, outcome measures, and statistical analysis validity and reliability. The JBI Critical Appraisal Checklist for Qualitative Research, which consists of 10 items about methodology, philosophical and theoretical perspectives, data analysis and representation, and potential influences, was used to assess the qualitative component of mixed methods research (Lockwood et al., 2015).

Each checklist provided options to specify if predetermined criteria were existent (e.g., "yes"), missing (e.g., "no"), "unclear," or "not applicable."

Data Collection

Methods, setting, level of evidence, theoretical framework, intervention details, therapeutic approach, quantitate findings, qualitative findings, adverse reactions, strengths, and limitations were extracted and rendered into a matrix table (see Appendix A for detailed matrix). The table allowed for a comparison of study details.

Data Analysis

Data amongst all studies were compared systematically. A constant and repetitious data examination method permitted recognizing patterns, themes, and relationships (Whittemore & Knafl, 2005). One reviewer performed conclusion-drawing.

<center>**Results**</center>

Search Outcome

The three electronic databases' primary searches identified 132 articles published between 2003 and 2019 (see Appendix B for Prisma Diagram). Ancestry searches of reference lists of relevant publications yielded an additional 16 articles which met the inclusion and exclusion criteria. Seven research articles were identified and included in this review.

Study Characteristics

Amid the seven studies under review, two were RCTs (McDonald et al., 2013; McDonald et al., 2012), three were mixed methods studies (Benham et al., 2019; Brimelow et al., 2019; Moyle, 2018), one was a quasi-experimental trial (Shaunfield et al., 2014), and one was a counterbalance crossover study (Reynolds et al., 2018). Four

were pilot studies (McDonald et al., 2013; McDonald et al., 2012; Moyle, 2018; Reynolds et al., 2018), and three were feasibility studies (Benham et al., 2019; Brimelow et al., 2019; Shaunfield et al., 2014). Five of the studies were conducted in the United States (Benham et al., 2019; McDonald et al., 2013; McDonald et al., 2012; Reynolds et al., 2018; Shaunfield et al., 2014) and two in Australia (Brimelow et al., 2019; Moyle, 2018), depicting international interest in VR applications in the prevention and treatment of health-related issues among older adults. Study sites were diverse as four were conducted in assisted-living or residential care facilities (Brimelow et al., 2019; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014), one in a senior daycare center (Benham et al., 2019), one in an ambulatory care clinic (McDonald et al., 2012), and one in a primary care setting (McDonald et al., 2013). Not all studies reported age ranges, but the mean age across all studies ranged from 68.1 to 89 years (Benham et al., 2019; Brimelow et al., 2019; McDonald et al., 2013; McDonald et al., 2012; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014). Populations varied, including older adults with pain (Benham et al., 2019; McDonald et al., 2013; McDonald et al., 2012), older adults with dementia (Brimelow et al., 2019; Moyle, 2018; Reynolds et al., 2018), and older adults who merely resided in an assisted living facility (Shaunfield et al., 2014). Across all studies, the sample size was small, ranging from 10 to 23 participants with a median of 14 (Benham et al., 2019; Brimelow et al., 2019; McDonald et al., 2013; McDonald et al., 2012; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014). Regarding the type of VR, two studies used fully immersive VR (e.g., head-mounted display) (Benham et al., 2019; Brimelow et al., 2019) while the other five utilized a non-immersive approach (e.g., flat computer or television screens) (McDonald et al., 2013;

McDonald et al., 2012; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014). Not all studies reported the length of VR exposure per session. However, exposure time ranged from four to 60 minutes (Benham et al., 2019; Brimelow et al., 2019; Moyle, 2018; Reynolds et al., 2018). A total number of VR sessions ranged from one to 12 sessions, with the course varying from one day to six weeks (Benham et al., 2019; Brimelow et al., 2019; McDonald et al., 2013; McDonald et al., 2012; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014). All seven studies explored the effects of VR interventions on depression- and anxiety-related outcomes (Benham et al., 2019; Brimelow et al., 2019; McDonald et al., 2013; McDonald et al., 2012; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014). Measures applied to evaluate outcomes related to depression included Beck's Depression Inventory-II (BDI-II) (McDonald et al., 2013; McDonald et al., 2012), the Geriatric Depression Scale short form (GDS-SF) (Shaunfield et al., 2014), and the Patient-Reported Outcomes Measurement Information System Depression Scale (PROMIS) (Benham et al., 2019). Measures used to assess anxiety outcomes included the Observed Emotion Rating Scale (OERS) (Brimelow et al., 2019; Moyle, 2018; Reynolds et al., 2018). Other outcomes examined include mood (Brimelow et al., 2019; Moyle, 2018), apathy (Brimelow et al., 2019; Moyle, 2018), emotion (Brimelow et al., 2019; Reynolds et al., 2018), pain (Benham et al., 2019; McDonald et al., 2013; McDonald et al., 2012), quality of life (Benham et al., 2019), engagement (Moyle, 2018), heart rate (Reynolds et al., 2018), agitation (Reynolds et al., 2018), and general physical and mental health (Shaunfield et al., 2014). In addition to quantitative data, six studies also collected qualitative data, but only four examined

perceptions of the VR experience (Benham et al., 2019; Brimelow et al., 2019; Moyle, 2018; Reynolds et al., 2018).

Quality

The assessment of quality showed low-quality across all studies (Table 2.1). Insufficient details to minimize performance bias in RCTs, lack of comparison groups in non-randomized trials, and the absence of details describing potential influences on qualitative data in mixed methods studies compromised their quality.

Table 2.1
Quality Appraisal Summary

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
RCTs													
McDonald et al. (2012)	Y	Y	Y	UC	Y	UC	UC	Y	Y	Y	Y	Y	Y
McDonald et al. (2013)	Y	Y	Y	UC	Y	UC	UC	Y	Y	Y	Y	Y	Y
Non-Randomized													
Shaunfield et al. (2014)	Y	N	N	N	Y	Y	N/A	Y	Y				
Reynolds et al. (2018)	Y	N	N	N	Y	Y	N/A	Y	Y				
Mixed Methods													
Quantitative Comp													
Moyle (2018)	Y	N	N	N	Y	Y	N/A	Y	Y				
Benham et al. (2019)	Y	N	N	N	Y	Y	N/A	Y	Y				
Brimelow et al. (2019)	Y	N	N	N	Y	Y	N/A	Y	Y				
Mixed Methods													
Qualitative Comp													
Moyle (2018)	N	N/A	Y	Y	Y	N	Y	Y	Y	Y			
Benham et al. (2019)	N	Y	Y	Y	Y	N	N	Y	Y	Y			
Brimelow et al. (2019)	N	N/A	Y	Y	Y	N	N	Y	Y	Y			

Note. Comp = Component; N = no; N/A = not applicable; RCTs = Randomized Controlled Trials; UC = unclear; Y = yes.

Therapeutic Applications of VR in Older Adult Populations

Recent research with VR applications, excluding those utilizing VR-based physical exercise platforms, has explored the effects of VR interventions in older adults with dementia ($n = 3$), pain ($n = 3$), and merely residing in an assisted living facility ($n = 1$). These studies utilized fully immersive and non-immersive VR interventions in conjunction with several different therapeutic approaches such as distraction, relaxing

leisure activity, stress-restoration, patient education, and engagement to test the feasibility of VR interventions in this population.

Two approaches, distraction and pain communication education, were used with VR to create interventions targeted at reducing pain among community-dwelling older adults. Still, only the fully immersive VR intervention using a distraction technique (Benham et al., 2019) was found to reduce pain ($M = 0.9$, $p = .002$) significantly. This effect was seen after 15 minutes of VR exposure (Benham et al., 2019). However, a non-significant trend in pain intensity reduction was seen with a non-immersive VR pain communication education intervention that enabled participants to rehearse talking with physicians about pain via a virtual pain coach (McDonald et al., 2013). No differentiation was made between chronic and acute pain in these studies, but the underlying mechanisms contributing to these two sensations may be completely different. VR approaches that work well for alleviating acute pain may not be as effective for chronic pain and vice versa. Therefore, future pain management research using VR applications must make this delineation.

All three studies that examined VR's use among older people with dementia used nature-based interventions involving relaxing scenes and environments. Still, each study used a different approach (i.e., leisure activity, engagement, and stress-restoration). Reynolds et al. (2018) alternately used a non-immersive virtual nature experience and a generational movie in the same participants; 14 residents within one memory care unit with varying severity levels of dementia, associated behaviors, and negative emotions. It was found that when compared to a movie, a nature-based VR experience can reduce stress, agitation, and anger in people with dementia (Reynolds et al., 2018). Neither

Brimelow et al. (2019) nor Moyle et al. (2018) used controls. Both studies still demonstrated positive effects on individuals with varying dementia levels with trends towards better emotional states using a fully immersive and non-immersive VR intervention. Unlike Brimelow et al. (2019), however, Moyle et al. (2018) did discover that participants with dementia expressed higher levels of fear/anxiety during the VR experience and that some participants with early dementia became bored during the intervention. With only one study comparing a virtual nature intervention to a different type of experience, it is hard to conclude that the observed effects were related to the VR nature experience.

Using a small group of residents ($n = 21$) residing in an assisted living facility, one study looked at the use of theme-based activities, which included VR field trips delivered weekly over one month to facilitate social and cognitive stimulation through engagement with other people outside of the facility (Shaunfield et al., 2014). This study (Shaunfield et al., 2014) demonstrated that non-immersive virtual field trips could significantly increase mental health ($p < .011$). Non-significant trends towards reducing depressive symptoms and improvements in physical health and social support pretest to posttest were also observed (Shaunfield et al., 2014). This study demonstrates VR field trips' potential to improve the quality of life and mental health among senior housing residents, but further research is needed to better understand its effects.

Effects of VR on Depression-Related Outcomes

No studies were found that attempted to explore the effects of VR interventions on depressed older people per se. Still, depression-related outcomes were examined in all seven studies included in this review. VR interventions which exposed participants with

dementia to non-immersive virtual environments such as forests, mountains, beaches, waterfalls, and farmyards resulted in a significant increase in pleasure and alertness (Moyle et al., 2018) as well as the non-significant trend increases in pleasure (Brimelow et al., 2019; Reynolds et al., 2018). A significant reduction in apathy ($p = .005$) (Brimelow et al., 2019), heart rate ($p = .03$), agitation ($p = .003$), and anger ($p = .028$) (Reynolds et al., 2018), suggests that exposure to virtual nature environments improved mood among older people with dementia. Overall, a limited significant change in depression-related outcome scores may result from not having populations with clinically diagnosed depression in the first place and the limited sample sizes in these studies.

Effects of VR on Anxiety-Related Outcomes

Non-pharmacological interventions, such as relaxation therapy, can help reduce anxiety and anxiety-related behaviors. Anxiety-related behaviors such as wandering, repetitive yelling, agitation, or irritability are commonly seen in people with dementia. In the three studies that examined the effects of VR on anxiety-related outcomes, all used relaxing scenes found in nature. Each used a different approach, including relaxing leisure activity (Brimelow et al., 2019), engagement (Moyle et al., 2018), and stress-restoration (Reynolds et al., 2018). A feasibility study which applied a VR headset to fully immerse assisted living residents with and without dementia in relaxing scenes such as beaches, farmyards, and snowscapes found significantly improved apathy ($z = -2.818$, $p = .005$), and no significant increase in fear and anxiety related to the intervention (Brimelow et al., 2019). However, during a non-immersive virtual forest activity, a pilot study found a significant increase in fear/anxiety among people with dementia than a normative sample ($p = .016$) (Moyle et al., 2018). When the effects of a non-immersive

virtual nature-based intervention were compared to a generational movie, a significant

decrease in agitation ($p = .003$), anger ($p = .028$), and heart rate ($p = .03$) was found

among people with dementia (Reynolds et al., 2018). Trends towards decreased anxiety

and increased pleasure were also observed within 10 minutes of VR nature exposure

(Reynolds et al., 2018). This pilot study (Reynolds et al., 2018) indicates that a VR

nature-based intervention can decrease negative emotions and stress associated with

dementia. Overall, results concerning the effectiveness of VR interventions on anxiety-

related outcomes are inconsistent, but the small sample sizes in these feasibility and pilot

studies may have impacted statistical significance. Further research is needed with larger

sample sizes and different older populations to identify which VR treatment factors

contribute to successful outcomes.

Role of Reminiscence

Reminiscence is the method of recollecting significant past experiences, thoughts,

and feelings, which can positively affect mental health by enhancing coping strategies

and assisting older adults in overcoming psychological distress (Satorres et al., 2018). A

theme of reminiscence was identified in four out of seven studies (Brimelow et al., 2019;

Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014). VR interventions provided

participants with opportunities to reminiscence about past events facilitating pleasure and

positive emotions. For example, when immersed in a virtual farmyard scene, one resident

replied, "Marvelous…I use to milk goats when I was younger" (Brimelow et al., 2019).

In addition to childhood memories, some participants reminisced about past pets and past

travels (Moyle et al., 2018; Reynolds et al., 2018; Shaunfield et al., 2014). While

reminiscence was not a specific approach taken by researchers in these studies, it is not

surprising that the realistic images and sounds of animals and natural landscapes produced through VR elicited memories and conversations about said memories.

Perceptions of VR

Qualitative findings in four out of seven studies presented in the preceding paragraphs indicate that participants, family members, and caregiving staff mostly perceive VR as a positive and enjoyable experience for older adults. However, there was some negative feedback. In a study of 12 community-dwelling seniors with self-reported pain, Benham et al. (2019) found that 100% of participants enjoyed the fully immersive VR experience and would recommend it to peers, while 91.7% reported they would continue to use VR if given the opportunity. Similarly, Brimelow et al. (2019) found that among 13 assisted living residents with and without dementia, 92% of participants would participate with the fully immersive VR intervention again. During a study that exposed 14 assisted living residents with dementia to a non-immersive nature-based intervention, some residents expressed delight in immersing in the virtual environments and a desire to continue viewing.

In contrast, negative remarks included dislike with being immersed and feeling cornered (Reynolds et al., 2018). The majority ($n = 6$) of 10 assisted living residents with dementia in another study expressed that the non-immersive VR forest experience provided a pleasant and enjoyable opportunity (Moyle et al., 2018). However, one participant felt the virtual forest activity was boring, two were confused by the experience, and one felt a lack of control with the device (Moyle et al., 2018). Since participants were in different dementia stages, the level of cognitive impairment may have impacted how individual users perceived VR technology.

In addition to exploring participants' perceptions of VR, one study also collected qualitative data from family members and caregivers. Nine out of 10 family members in the Moyle (2018) study reported improvements in mood, interaction, and sense of self-efficacy among participants living with dementia following non-immersive VR. Many family members also expressed that the scenery and objects within the VR forest experience were well designed. One family member thought that the scenes lacked variety leading to repetitiveness (Moyle et al., 2018). Eight out of 10 family members agreed that 5 – 10 minutes of exposure to the VR forest was long enough (Moyle et al., 2018). All nine staff members who were interviewed expressed that VR positively impacted most residents, especially commenting on mood and the calming effect (Moyle et al., 2018). Realizing that individual residents respond differently to VR, eight out of nine staff members suggested that the severity of dementia and physical functioning level indicated whether participants would enjoy VR (Moyle et al., 2018). For example, some staff members expressed that residents with mild dementia became bored quickly with VR, while those with advanced dementia were more stimulated by VR (Moyle et al., 2018).

Risks and Challenges of VR

Using VR interventions among older adults involves certain risks and challenges. Symptoms related to cybersickness were the most reported adverse responses associated with VR interventions. In one study, four out of 12 participants wearing an HMD system experienced nausea and dizziness with certain aspects of the VR experience, such as at high altitudes, moving quickly in the simulated environment, or tight spaces (Benham et al., 2019). In a different study, cybersickness was recorded for two residents with

impaired vision who experienced blurred vision while wearing the HMD and one resident who became giddy during an acute behavioral episode (Brimelow et al., 2019). For one participant with visual impairment, scenes with contrasting black and white images were more comfortable to see than colorful scenes (Brimelow et al., 2019). The weight of an HMD system caused discomfort to one participant by sliding down their face and caused neck discomfort for another participant by aggravating a previously reported musculoskeletal disorder (Benham et al., 2019; Brimelow et al., 2019). One participant with severe cognitive impairment became anxious shortly after an HMD was applied but changing the scene from waterscape to landscape mediated the reaction (Brimelow et al., 2019). Two studies reported that some participants living with dementia became anxious even with the non-immersive VR type of intervention delivered via sizeable high-definition television screens (Moyle, 2018; Reynolds et al., 2019). Therefore, older adults' physical and mental capabilities must be considered when using VR applications in this population.

Discussion

In this integrative review, information has been presented that describes VR's therapeutic applications, the effects of VR on depression- and anxiety-related outcomes; the role reminiscence plays in VR, perceptions of VR, and the risks and challenges associated with the use of VR with older adult populations. Altogether, results suggest the following:

1. VR has been used as a distraction tool for community-dwelling seniors with self-reported pain from various origins (Benham et al., 2019), as a patient communication educational tool for self-reported osteoarthritis pain (McDonald et al., 2013; McDonald et

al., 2012), as a relaxing leisure activity for older people with and without dementia (Brimelow et al., 2019), for stress-restoration in older people with dementia (Reynolds et al., 2018), and to promote engagement in older adults with dementia (Moyle et al., 2018), and for residents merely living in an assistive living facility (Shaunfield et al., 2014). Five out of the seven included studies indicated VR interventions positively affect targeted outcomes (Benham et al., 2019; Brimelow et al., 2019; Moyle, 2018; Reynolds et al., 2018; Shaunfield et al., 2014), but not in secondary outcomes of depression and anxiety. Type, duration, and frequency of VR exposure varied widely from study to study. Therefore, the ideal dose of VR exposure is unclear. Even though these studies have limitations to their generalizability, findings suggest that VR is feasible and may improve older adults' quality of life and well-being.

2. There is insufficient evidence to conclude that VR interventions have a positive effect on depression-related and anxiety-related outcomes. While depression- and anxiety-related outcomes were examined in the included studies, no studies were found that attempted to investigate the effects of VR in older people with depression. Of the three studies exploring the use of VR in the treatment of pain, no significant effect on depressive symptoms was found, and anxiety-related outcomes were not examined. However, in an RCT, McDonald et al. (2013) observed a non-significant trend in depressive symptom reduction in the treatment group after a virtual pain coach intervention.

Among the three studies exploring the use of VR interventions in people with dementia, there were inconsistent reports of the effect VR had on mood, anxiety, emotions, and agitation. Moyle (2018) found that older people with dementia experienced

a significant increase in fear/anxiety during the VR experience, but a significant increase in pleasure. However, Brimelow et al. (2019) found no significant increase in fear/anxiety during the VR experience and a non-significant trend towards increased pleasure. Interestingly, Reynold et al. (2018) observed a non-significant trend towards increased pleasure and decreased anxiety within only 10 minutes of VR exposure, with a significant decrease in agitation and anger.

Furthermore, qualitative data from Moyle (2018) indicated that most participants, family members, and staff perceived that VR had a positive effect on older people with dementia. Some families and some staff members noted improvements in participants' mood while other staff remarked on VR's calming effect (Moyle, 2018). Participants with and without dementia in the Brimelow et al. (2019) study reported that VR was an enjoyable experience with low emotional discomfort.

In an assisted living facility setting, Shaunfield et al. (2014) found that a theme-based activity program that incorporated VR field trips had a significant positive effect on mental health. All residents living at the center during the study were invited to participate regardless of condition or past medical history. Shaunfield et al. (2014) also reported that, while not significant, the mean comparison showed a decrease in depressive symptoms pretest to posttest.

3. VR experiences provide opportunities for some participants to reminisce. In four of the studies reported, nature-based and field-trip based VR experiences sparked pleasant memories among participants with and without dementia living in assisted-living and residential care centers across the United States and Australia. Conversations about said memories appear to have evoked positive emotions and pleasure. For example, one

participant from the Brimelow et al. (2019) study, in response to a beach scene, talked endearingly about living in a similar location. The relationship between VR technology, reminiscence, and mental health is unclear. As research in the area of VR grows, researchers need to continue thinking critically about the role reminiscence plays in VR interventions and its effects on depression- and anxiety-related symptoms among older adults.

4. The research team learned that most older participants perceive fully immersive and non-immersive VR technology as an enjoyable experience that is feasible as a distraction tool, stress-restoration tool, relaxing leisure activity, and an activity to promote engagement. Older adults living in the community (Benham et al., 2019) and a residential care facility (Brimelow et al., 2019) stated they wanted to participate in VR again. Family members and residential care staff also reported that VR positively impacted residents (Moyle, 2018). However, caregiving staff also acknowledged that the level of physical capability and severity of dementia were indicators of whether residents would enjoy VR or not as those with mild impairment were easily bored. In contrast, those with severe impairment were more stimulated by VR technology (Moyle et al., 2018). These studies suggest the feasibility and acceptability of using VR interventions among older adults residing in the community, residential care facilities, and assisted living centers.

5. There are certain risks and challenges associated with the use of VR interventions in the older adult population. Symptoms of cybersickness while wearing an HMD system were reported in two of the included studies. In the Benham et al. (2019) study, high altitudes, quick movements, and tight spaces within the VR experience

triggered nausea and dizziness in some participants. Whereas, blurred vision and giddiness among a few participants were reported as cybersickness in the Brimelow et al. (2019) study. The weight of the HMD also caused some physical discomfort in the same two studies as it aggravated an old neck injury for one participant and caused the device to slide down the face of another participant, respectively (Benham et al. & Brimelow et al.). Some emotional discomfort also occurred with exposure to VR technology. One participant became anxious when immersed in a virtual scene involving water, which subsided when the scene was changed to a farm scene (Brimelow et al., 2019). Lastly, two reported studies also observed that some dementia participants became anxious when exposed to a non-immersive nature-based intervention (Moyle, 2018; Reynolds et al., 2018).

Limitations

A significant limitation of this review is the number of articles included. While the literature on the use of VR interventions among older adults has grown over the last decade, only seven have explored non-exercise-based VR interventions on depression- and anxiety-related outcomes. More studies are needed to understand this phenomenon better. Another limitation is the type of studies used, as all included studies had comparable methodological weaknesses, which limited the ability to conclude the use of VR interventions in older adults.

Included studies were either feasibility or pilot studies and used data from convenience samples. Only one out of seven studies carried out sample size calculation for the primary outcome measure, and while the minimum sample size was met, a sample size of 14 could still be thought of as small. All studies had relatively small sample sizes,

which increased the likelihood that results contained type I error. Lack of external validity is also a concern in studies with small sample sizes. Effect size calculations on outcome measures were only conducted in one out of seven studies. Lastly, there was inconsistency in the tools used to measure depressive and anxiety symptoms across studies.

While the interventions used in the included studies fell under the group "VR," each used a different system from non-immersive electronic screens to fully immersive HMD systems. Content viewed through the VR systems varied as well. Different VR systems and different content may have different levels of effectiveness on depressive and anxiety symptoms. Furthermore, there was a wide variation in the duration of VR sessions and the number of VR sessions.

Due to limitations in methodologies such as small sample sizes, demographic characteristics of participants, and lack of uniformity with instruments measuring depressive and anxiety symptoms, the generalizability of extant findings is limited. While VR interventions have shown potential for decreasing depressive symptoms and reducing anxiety in older adults, it has not been studied among NH residents.

Implications

The use of VR interventions among older adults is a relatively new area that needs further investigation. While various VR platforms were examined, this review established that VR might offer a safe, innovative, non-invasive alternative or adjunct to the traditional pharmacological approach to managing depressive and anxiety symptoms among adults aged 60 years and older. Among senior housing residents, nature-based and field-trip based VR interventions were explored. Older adults living in long-term care

settings represent a significant portion of the aging population in the United States, with 15,600 NHs, and 28,900 assisted living facilities operating in 2016 (Harris-Kojetin et al. 2019). Most studies were conducted in residential care or assisted living facilities, but none were conducted in NHs. Considering the prevalence and devastating nature of depression and anxiety in older NH residents, it would be beneficial to explore VR interventions' viability in this population. Some implications for further research include: (a) research with more substantial and more representative samples, (b) high-quality controlled studies, (c) investigation of optimum type, content, duration, and frequency of VR exposure, (d), exploration of the association between VR interventions and reminiscence, and comparison of individual and group VR sessions.

Researchers exploring the effects of therapeutic VR technology on depression and anxiety provided preliminary data indicating the feasibility and acceptability of using fully immersive and non-immersive VR interventions in older adults. This beckons gerontologists to investigate further the implications of using VR applications to help alleviate symptoms of depression and anxiety in older adults, particularly those in congregate housing, and inform the development of future VR interventions that may improve well-being and the quality of life in this population. Gerontologists need to be aware of the role reminiscence plays in VR experiences and explore how reminiscence approaches might be incorporated into VR interventions.

Conclusion

This review presents current literature in VR use and its effects on depression and anxiety in older adults. The most salient issues in this area were presented. While VR interventions have shown promise for improving psychological well-being and the

quality of life in the aging population through various approaches, it is evident that this field of study still has much work that needs to be done. Many questions still need to be answered. Research needs to include older NH residents, particularly those who are depressed or anxious. This lacked in the current literature. More research is needed to answer such questions as:

- Are VR interventions appealing to and well-tolerated by NH residents?
- Which VR approach is the most effective for alleviating depressive and anxiety symptoms among older NH residents?
- What is the optimal dose of VR exposure?
- How can reminiscence be better incorporated into VR experiences?

Research like this will help develop better, more effective VR interventions for older adults and NH residents and potentially improve their well-being and quality of life.

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CHAPTER THREE

Preliminary Research: Virtual Reality Therapy Takes Greenspace to Older

Residents to Improve Mood

Abstract

Depression and anxiety are prevalent among older adults residing in assisted living

facilities. In long-term care settings, residents perceive not being able to engage in

outdoor activities as they had done before relocating to the facility as a significant

stressor that contributes to their depressive symptoms. Unfortunately, facility- and

person-level barriers often hinder residents' engagement in outdoor activities. Virtual

reality (VR) technology may help overcome these barriers by allowing residents to view

themselves outside in pleasant settings. A single-group, pretest-posttest, quasi-

experimental study was conducted in August of 2018 to examine the fully immersive VR

intervention's feasibility and preliminary efficacy, ViRT-Ta-GO on total mood and the

negative mood states of depression and anxiety. Four residents with no more than mild

cognitive impairment were recruited from an assisted living facility in Missouri to

participate in one 10-minute ViRT-Ta-GO session. Participants' mood was measured

immediately before and after the VR session using the Profile of Mood States 2nd Edition

Adult Short Form (POMS 2-A). Total mood disturbance (TMD) and two subscale scores,

depression-dejection (DD) and tension-anxiety (TA), were analyzed using Wilcoxon

signed-rank tests. Effect size estimates were calculated using Rosenthal's equation

(Rosenthal, 1994). Following the ViRT-Ta-GO session, participants were also asked ten

open-ended questions about their experience. Overall, this study suggested the feasibility

and acceptability of using ViRT-Ta-GO in an assisted living care setting but did not find

a significant change in mood or the negative mood states of depression and anxiety. Results indicated that ViRT-Ta-GO had moderate to large treatment effects on total mood disturbance ($r = .26$), depression ($r = -.33$), and anxiety ($r = -.58$). Post-intervention satisfaction survey data indicated that ViRT-Ta-GO was well-tolerated and suitable to most residents. Barriers that might hinder success in a subsequent trial were identified, including usability of the head-mounted display system, VR content, and somewhat burdensome testing procedures. Modifications were made to the intervention and study procedures with the intent of reducing or eliminating these problems. No adverse effects were observed. Findings from this study provided preliminary data for a pilot study examining the feasibility and effectiveness of the ViRT-Ta-GO intervention on depressive and anxiety symptoms in older nursing home residents.

Keywords: older adults, assisted living, virtual reality, mood, depression, anxiety

Depression and anxiety are debilitating psychiatric disorders plaguing older adults living in nursing homes and assisted living facilities. Assisted living facilities are sometimes referred to as residential care facilities. These facilities, types of long-term care institutions, provide a safe environment for older adults who need some assistance with activities of daily living such as bathing or taking medications, but not 24-hour skilled nursing care as provided in the nursing home (NH) setting. The prevalence of depression among assisted living residents in the United States has been reported as 30.9% (Harris-Kojetin et al., 2019). A recent study (Creighton et al., 2018) of long-term care residents has shown that depression is strongly associated with anxiety. These conditions are typically treated with antidepressants and anxiolytics (Drageset et al., 2013), but residents taking these types of medications are more likely to fall, more likely to sustain hip fractures (Cox et al., 2016; Meeks et al., 2016), and less likely to participate in activities of daily living (Galik & Resnick, 2013).

Within long-term care settings, institutional constraints such as loss of continuity with past life and lack of meaningful activities play a role in forming depressive symptoms (Choi et al., 2008). Furthermore, residents have reported that they feel trapped in long-term care and have expressed a deep desire to get outside of the facility more often (Choi et al., 2008). Previous research among residents in assisted living demonstrates that visiting outdoor gardens provides the feeling of being away (Dahlkvist et al., 2016) and improves mood (Rappe & Kivela, 2005). Walking in forests has significantly reduced depressive symptoms (Morita et al., 2007). However, limited access to greenspace, staff shortage, and unfavorable environmental conditions may prevent residents' engagement in outdoor activities (Kearney & Winterbottom, 2005). New

virtual reality (VR) technology may offer a way of getting around these barriers. With VR, residents can actively participate in a 3-dimensional computer-generated, interactive setting, allowing them to view themselves outdoors in pleasant settings without leaving the facility.

Feasibility studies showed that VR is well tolerated in adults age 18 to 65 (Benoit et al., 2015; Manera et al., 2016; Shah et al., 2015). Findings from other studies showed that VR induced positive moods and positive emotions (Baños et al., 2006), increased relaxation (Felnhofer et al., 2014; Serrano et al., 2016), and decreased depressive and anxiety symptoms (Shah et al., 2015). Among individuals with post-traumatic stress disorder, VR significantly reduced depression and anxiety (Gamito et al., 2010). Furthermore, VR significantly increased joy and relaxation among community-dwelling older adults aged 58 to 79 (Baños et al., 2012). Due to limitations in methodologies such as small sample sizes and participants' demographic characteristics, the generalizability of extant findings is limited. While some VR studies have examined VR's effects on mood, depression, and anxiety, there is little evidence regarding its use among older assisted living residents.

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Purpose

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This study aimed to evaluate the feasibility and preliminary efficacy of the fully immersive VR intervention, ViRT-Ta-GO: Virtual Reality Therapy Takes Greenspace to Older Residents, among assisted living residents aged 60 years and older and extend knowledge about its use to improve mood in the long-term care setting. The specific aims and the research questions this preliminary study sought to answer are as follows:

Specific Aim 1. Test the feasibility and acceptability of ViRT-Ta-GO among assisted living residents aged 60 years and older.

Research Question 1. Are study procedures and VR intervention acceptable to participants?

Research Question 2. What are the person-level barriers and facilitators to participation in VR study?

Research Question 3. To what extent is the intervention acceptable and appealing to participants?

Research Question 4. What, if any, unexpected adverse events occur during the study period?

Specific Aim 2. Assess the secondary outcome of ViRT-Ta-GO intervention among assisted living residents aged 60 years and older.

Research Question 5. Does ViRT-Ta-GO intervention improve the total mood among participants?

Research Question 6. Does ViRT-Ta-GO intervention improve the negative mood state of depression among participants?

Research Question 7. Does ViRT-Ta-GO intervention improve the negative mood state of anxiety among participants?

Methods

Study Design

This quasi-experimental study conducted in August 2018 included a one-group, within-subject, pretest-posttest design. After completing the ViRT-Ta-GO session, post-intervention satisfaction survey data were collected using a brief, verbally administered

participant feedback survey. This study was conducted at a 54-apartment assisted living

facility in mid-Missouri that provides safe housing and various aging-in-place package

options for senior citizens. A quasi-experimental methodology was appropriate for what

this study sought to discover (Bowen et al., 2009). This method facilitated understanding

the extent to which the ViRT-Ta-GO intervention and study procedures were feasible and

acceptable for older assisted living residents, the perceived person-level facilitators and

barriers to participation, and the possible effects of the intervention on mood.

Recruitment

After receiving written consent from the Operations Director of the facility,

informational posters were placed in common areas for recruitment (see Appendix C for

flyer). The recruitment period remained open for one week. Residents who signed-up for

additional information about the study were contacted by the primary investigator (PI).

Each potential participant was given a complete explanation of inclusion and exclusion

criteria, all study procedures, ViRT-Ta-GO protocol, data collection procedures,

participants' rights, expectations of participants, all potential risks and benefits of

participating in the study, and time to ask questions. All questions were answered to the

best of the PI's ability. The PI waited for the potential participant to decide if they wanted

to participate before screening for eligibility.

Prospective candidates who expressed an interest and willingness to participate in

the ViRT-Ta-GO study were given an informed consent form to read. Residents were

queried throughout the meeting to ensure that the study's purpose and procedures were

understood. Potential participants were provided with reassurance that participation was

voluntary and could be withdrawn at any time. After providing consent (see Appendix

D), prospective candidates were screened for eligibility and completed the Montreal

Cognitive Assessment test (MoCA; Nasreddine et al., 2005). The MoCA is a clinician-

administered test that was designed as a rapid screening tool for mild cognitive

dysfunction. It assesses different cognitive domains: attention and concentration,

executive functions, memory, language, visuo-constructional skills, conceptual thinking,

calculations, and orientation (Nasreddine et al., 2005). Test-retest reliability (.92),

internal consistency (.83), sensitivity (.90) & specificity (.87) have been established

(Nasreddine et al., 2005). A score of 26 or above is considered normal (Nasreddine et al.,

2005). However, a cut-off score of 18 is often used to separate mild cognitive impairment

from Alzheimer's disease (Nasreddine et al., 2005). A cut-off score of 18 was used for

this study. MoCA scores were obtained from consenting participants to determine

eligibility.

Participants who met inclusion and exclusion criteria and expressed a willingness

to participate were provided a HIPAA Authorization Form to read, written at a 6th-grade

reading level (see Appendix E). Questions were answered, and the PI waited for the

prospective candidate to decide if they wanted to sign the HIPAA Authorization form.

Permission to use MoCA for research purposes was granted by Kathleen Gallant, MSOT,

Occupational Therapist and Psychometrician on behalf of Dr. Ziad Nasreddine,

Neurologist, MoCA© Copyright Owner (see Appendices F and G for tool and

permission).

Sample

Before beginning the study, it was determined that a small sample size of 3 - 5

individuals would be sufficient for this preliminary feasibility study. The sample size was

based on Whitehead et al., (2015) estimation of pilot study sample-sized for randomized controlled trials with a 90% power and two-sided significance of 5%, and large effect size. Smith et al. (2015) described the best method to conduct preliminary research in individuals who would not be included in the main trial to avoid having to go back to the same individuals to collect similar data in the main trial. This project followed these recommendations.

For this small-scale feasibility study, four residents were recruited from an assisted living facility located in mid-Missouri (see Appendix H for a participant progression). Residents aged 60 years or older were eligible for participation if they spoke English and expressed a willingness to participate in the ViRT-Ta-GO intervention. Individuals who could not express themselves effectively were not included. Residents with epilepsy or other seizure disorder, more than mild cognitive impairment as indicated by a Montreal Cognitive Assessment (MoCA) Score < 18, legal blindness, and recent head, neck, and eye surgery or injury were excluded.

Intervention

The PI created the ViRT-Ta-GO intervention for this study using a *Samsung Gear VR* head-mounted display (HMD) system, a *Samsung Galaxy 7* smartphone, and the *Guided Meditation VR* app downloaded from Oculus.com. An HMD provides a fully immersive VR experience by offering the participant a 360-degree view of a computer-generated interactive environment. HMD systems like the *Samsung Gear VR* were used in two other studies with older adults (Dahlkvist et al., 2016; Rappe & Kivela, 2005). Participants thought the headset was easy to use, reported no unusual sensations or

cybersickness, and indicated that they would be willing to use the VR intervention again (Dahlkvist et al., 2016; Rappe & Kivela, 2005).

The *Guided Meditation VR* app was developed as a virtual relaxation app intended to induce peaceful calm states through relaxing environments and optional guided meditation instruction. The virtual environments and sounds depicting beaches, gardens, prairies, deserts, and forests were preloaded on the smartphone. The phone was inserted into the HMD system and applied to the participant's face. Velcro straps secured the HMD in place and aided in weight distribution. Images on the phone were magnified and viewed through the HMD, which covered the eyes like an oversized pair of goggles. With slight movements of the eyes or head, the participant moved through nature or just sat and enjoyed looking at it. Guided meditation instruction, as well as the sounds and music, were optional. The virtual intervention in this study intended to improve mood by generating a pleasant event in nature using VR. Positive psychologists Seligman and Csikszentmihalyi (2000) propose that positive experiences can improve quality of life and help prevent disease that occurs when life seems empty and worthless.

Data Collection

After receiving Institutional Review Board (IRB) approval from the University of Missouri-Columbia (see Appendix I), data were collected using the following methods:

(a) **Profile of Mood States 2nd Edition-Adult Short** (POMS 2-A; Heuchert & McNair, 2012) was used to assess resident mood immediately before and after the ViRT-Ta-GO session. The validity and reliability of the POMS 2-A have been established to measure the positive and negative mood states, including depression and anxiety (Heuchert & McNair, 2012). Test-retest reliability (.72) and internal consistency (.97)

have been established for the POMS 2-A in a clinical sample of older adults (Heuchert & McNair, 2012). The depression-dejection subscale correlated with sadness (.70) and tension-anxiety associated with fear (.57) on the Positive and Negative Affect Schedule-Expanded Form (PANAS-X; Watson & Clark, 1994), establishing convergent validity for these domains (Heuchert & McNair, 2012). The POMS 2-A has been used previously to measure older assisted living residents' short-term mood changes in response to different landscapes (Goto et al., 2013). This tool consists of 35 adjectives relating to mood and feelings with reactions using a 5-point Likert-type scale ranging from not at all to extremely. The POMS 2-A contains a summary scale titled Total Mood Disturbance (TMD), six subscales (i.e., mood states) including Anger-Hostility (AH), Confusion-Bewilderment (CB), Depression-Dejection (DD), Fatigue-Inertia (FI), Tension-Anxiety (TA), and Vigor-Activity (VA), and one complement subscale called Friendliness which is not used in calculating mood scores. The TMD score is calculated by adding the subscales AH, CB, DD, FI, and TA, and then subtracting the VA subscale score. Positive and negative mood state scales such as DD and TA range from 0 to 20 while the TMD scale ranges from -20 to 100 with larger values indicating a more significant mood disturbance. This study focused on three measures from the POMS 2-A: TMD (total mood disturbance), DD (depression), and TA (anxiety). Permission to use the POMS 2-A was obtained, and forms were purchased online through the Multi-Health Systems Incorporated website (see Appendices J and K for tool and permission).

(b) **Post-Intervention Satisfaction Survey Data.** The PI created this participant feedback survey. Following the completion of the ViRT-Ta-GO session, participants

were asked a series of 10 open-ended questions to assess their perceptions of person-

level facilitators and barriers of the VR experience (see Appendix L for the survey).

Participants' responses were transcribed verbatim to a paper version of the survey and

later typed into a Word Document.

(c) **Demographic and Health Form.** Baseline demographic and health data were

collected from participants' medical records by the facility's nurse manager.

Demographic variables included age, sex, race, relationship status, length of stay,

medications used to treat depressive and anxiety symptoms including selective

serotonin reuptake inhibitors, selective norepinephrine reuptake inhibitors, tricyclic

antidepressants, monoamine oxidase inhibitors, atypical antidepressants (i.e.,

bupropion, mirtazapine, nefazodone, trazodone, vilazodone, and vortioxetine), mood

stabilizers such as lithium and anticonvulsants in the absence of recorded seizure

disorder, and first- and second-generation antipsychotic medications, and medications

use to treat anxiety including benzodiazepines, buspirone, and hydroxyzine (see

Appendix M for the form).

Also, participants were observed for signs of cybersickness, a phenomenon that can occur

with VR applications. Symptoms of cybersickness mimic those of motion sickness but

are usually less severe and have a low incidence. Signs and symptoms include dizziness,

nausea, increased saliva production, burping, headache, blurred vision, difficulty focusing

or concentrating, stomach discomfort, and fatigue (Jones et al., 2004). Residents were

also observed for signs of general discomfort in restlessness and frequent attempts to

adjust the HMD.

Data Analysis

Post-intervention satisfaction survey data were reviewed for accuracy and analyzed by the PI. The analysis plan involved five topic areas related to feasibility, acceptability, facilitators, barriers, and suggestions for improvement. The ten open-ended survey questions were intended to gain insight into participants' perceptions of these areas. The PI read participants' transcripts several times to familiarize themself with the data. The content of narrative responses was categorized by topic area.

For quantitative data, the analysis was performed using IBM SPSS statistics software version 25. Demographic characteristics were analyzed using descriptive statistics. Because of the small sample size, Wilcoxon signed-rank tests were used to compare pretest-posttest differences in the POMS 2-A total mood disturbance (TMD), depression-dejection (DD), and tension-anxiety (TA) sum scores. Wilcoxon signed-rank test does not assume normality in the data and may be used when samples are paired, and dependent variable data are continuous and ordinal (Field, 2013). Effect size estimates were calculated using Rosenthal's equation, an alternative to Cohen's formula when assumptions have been violated (Rosenthal, 1994). Criteria to approximate the magnitude of ViRT-Ta-GO's effect on total mood disturbance and the negative mood states of depression and anxiety followed Cohen's (1988) recommendation of 0.1 for a small effect, 0.3 for a moderate effect, and 0.5 for a large effect. For analyses, significant changes between pretest and posttest results were considered statistically significant if the two-tailed p-value was $\leq .05$. Recruitment and session completion rates were used to indicate the feasibility of VR in the assisted living setting. Acceptability was determined by the number of participants who would recommend VR to a friend.

Results

The sample of four participants had a mean age of 87 years. The youngest and oldest participants were 84 and 89 years old, respectively. Participants in the sample were all white ($n = 4$), with the majority being female (75.0%, $n = 3$). Among participants, 75.0% ($n = 3$) were widowed and 25.0% were married ($n = 1$). Length of stay ranged from nine months to nine years two months. Nursing managers reported participant history of hypertension ($n = 2$), heart disease ($n = 2$), diabetes ($n = 1$), arthritis ($n = 1$), hyperlipidemia ($n = 2$), and GERD ($n = 2$). No history of depression or anxiety diagnoses, and no history of antidepressant or anxiolytic use were reported.

Feasibility

Four assisted living residents were recruited for this study, which fell within $3 - 5$ participants' recruitment goals. Each participant was offered the opportunity to attend one individual 10-minute ViRT-Ta-GO session. No sessions were stopped early by a participant or the PI. All participants ($n = 4$) completed the 10-minute session in its entirety. No adverse events occurred.

All four residents completed the post-intervention satisfaction survey about their VR experience. Participants' responses indicated that the ViRT-Ta-GO intervention is acceptable to older assisted living residents. The enjoyability of VR is a potential facilitator for future use, the usability of the HMD, and a limited variety of virtual landscapes are potential barriers. Moreover, three suggestions to improve the upcoming VR pilot study' approach emerged from the survey data.

Acceptability

The majority ($n = 3$) of residents reported positive perceptions of the ViRT-Ta-Go intervention and recommended it to friends. One resident felt the experience did not

provide enough information to pass judgment and hence make referrals. Residents talked

about the appealing and satisfying features of VR. One resident found the virtual

experience with nature new, different, and beautiful and was surprised how it affected her

mood. Another resident thought the experience was restful and made [her] mood better.

One resident felt ViRT-Ta-GO enhanced her ability to relax while another resident

perceived it would have helped her relax if she had done it longer. One resident perceived

no change in mood or relaxation following the intervention. Another resident described

her mood as tired and stated that VR did not affect her ability to relax, which was found

to be related to completing the questionnaires and not the intervention upon further

investigation. Three residents talked about how the images seemed close, picturesque,

and clear. One resident felt the pictures were not clear, but the lenses of the HMD

appeared smudged when the device was removed.

Facilitators

Three residents indicated that ViRT-Ta-GO was enjoyable. For example,

engaging in ViRT-Ta-GO brought back childhood memories of California for one

resident. Another resident thought that the VR activity was better than Bingo, and one

resident expressed that it would be acceptable for ViRT-Ta-GO to be offered alongside

other activities. When compared to other activities at the facility, one resident felt that

ViRT-Ta-GO was not as appealing. Considering most residents ($n = 3$) indicated they

liked ViRT-Ta-GO, enjoyability may be a possible facilitator for future use.

Barriers

Lack of variety in virtual scenes, landscapes, or destinations in the VR application

and issues with the VR delivery system are potential barriers hindering future use of

ViRT-Ta-GO by older residents. One resident expressed that some of the virtual scenes were interesting but did not contain enough variety to hold interest. When asked how VR could be improved, one resident stated, "different sites, scenery, and places such as the Grand Canyon." Lastly, one resident became frustrated navigating within the virtual environment and expressed that the buttons on the HMD were overly sensitive to touch.

Suggestions for Improvement

Lastly, three suggestions to improve the methods and procedures for a subsequent ViRT-Ta-GO study emerged from post-intervention satisfaction survey data. First, one resident had trouble operating the HMD, believed the buttons were overly sensitive and felt the images were not clear. Therefore, the PI recommends changing the HMD to one that is more user-friendly. Second, three residents chose not to use the meditation features offered in the VR application. The one resident who opted to use this feature reported that the meditation guide minimally enhanced the VR experience. Also, residents expressed a desire to view more familiar scenic destinations. Therefore, the PI recommends changing the current VR app to incorporate national parks and not meditation features. Lastly, at the end of the data collection process, one resident reported her mood as tired and remarked negatively on the length of time. Upon investigation, this was a result of study procedures. Therefore, the PI recommends using less burdensome instruments and allowing more time to study procedures.

Total Mood and Negative Mood States of Depression and Anxiety

For total mood, a Wilcoxon signed-ranks test indicated that the distribution of TMD posttest scores, $Md = 7.5$, were not statistically significantly lower than the median TMD pretest scores, $Md = 19$, $t = -.73$, $p = .465$, $r = -.258$. As for the depression subscale,

a Wilcoxon signed-ranks test indicated that the distribution of DD posttest scores, $Md =$ 1, were not statistically significantly lower than the median DD pretest scores, $Md = 2$, $t = -.921$, $p = .357$, $r = -.326$. For the anxiety subscale, a Wilcoxon signed-ranks test indicated that the distribution of TA posttest scores, $Md = .5$, were not statistically significantly lower than the median TA pretest scores, $Md = 2$, $t = -1.633$, $p = .102$, $r = -.577$. Table 3.1 shows a summary of total mood (TMD) and the negative mood states of depression (DD) and anxiety (TA) statistics.

Table 3.1

Summary of Statistics for Study Variables

Variables	n	Pretest			Posttest			t	p	r
		M	SD	Md	M	SD	Md			
TMD	4	11.00	9.83	19	8.25	12.34	7.5	-.730[b]	.465	-.258
DD	4	2.00	1.83	2	1	.82	1	-.921[b]	.357	-.326
TA	4	2.25	1.26	2	.75	.96	.5	-1.633[b]	.102	-.577

M = mean; Md = median; n = sample size; SD = Standard deviation; * Wilcoxon sign test $p < 0.05$; b = based on negative ranking; r = effect size statistic

Results indicated that the ViRT-Ta-GO intervention had a moderate to large effect on mood states. The approximate magnitude of ViRT-Ta-GO's effect on improving the negative mood state of anxiety was large ($r = -.577$). Results indicate that ViRT-Ta-GO had a moderate treatment effect ($r = -.326$) on improving the negative mood state of depression. Similarly, a moderate treatment effect ($r = -.258$) was observed for total mood disturbance.

Non-significant trend improvements were observed in raw scores for two residents across all three domains. For instance, the TMD score decreased from 4 to -6, DD score decreased from 1 to 0, and the TA score decreased from 4 to 0, suggesting that

mood, depression, and anxiety improved for resident one after ViRT-Ta-GO. Similarly, the TMD score decreased from 15 to 9. DD score decreased from 3 to 1, and the TA score decreased from 2 to 1, suggesting that mood, depression, and anxiety also improved for resident three following the ViRT-Ta-GO intervention.

Discussion

The purpose of this small-scale feasibility study was to ascertain assisted living residents' perceptions of facilitators and barriers to a fully immersive VR intervention and examine the preliminary efficacy of the intervention on total mood and the negative mood states of depression and anxiety. Recruitment and session completion rates indicated that the fully immersive ViRT-Ta-GO intervention was feasible for use in the assisted living setting. The majority ($n = 3$) indicated they would recommend VR to a friend indicating the acceptability of ViRT-Ta-GO. Furthermore, post-intervention satisfaction survey data revealed that ViRT-Ta-GO was an appealing activity. Enjoyability appears to be a potential facilitator of future use. Limited variety of landscapes and difficulty operating the HMD appear to be potential barriers. There was no significant effect on total mood or the negative mood states of depression and anxiety.

Residents could choose one of four virtually rendered nature scenes (i.e., forest, desert oasis, ocean, or mountains) for this intervention and could use the meditation guide feature if they wanted. Most residents chose not to use the meditation feature, indicating a lack of interest in this relaxation technique. While perceptions of the virtual content were mostly positive, one resident perceived that it was not interesting enough to hold interest, which is a potential barrier. Residents felt that the experience could be improved by including more familiar scenic destinations such as national parks or landmarks. The

ViRT-Ta-GO intervention provided the opportunity for some residents to reminisce. For example, one resident commented she wanted to see the Grand Canyon because she took the kids when they were little. Another resident stated that the VR experience was nice as it reminded her of California, where she was born. This is important, not only because it contributes to enjoyability, but because recalling past events and feelings may help older residents adapt to their current situation and decrease depressive symptoms (Chao et al., 2008; Korte et al., 2011).

Some residents perceived that ViRT-Ta-GO effectively enhanced their mood and aided in their ability to relax even though they chose not to use the meditation feature. Improved mood (McCaffrey, 2007; Rappe & Kivela, 2005), reduced stress (Hawkins et al., 2011; Morita, 2006), and decreased anxiety (Gascon et al., 2018) from nature-based activities are consistent with previous research among older adults. Manipulating the navigation buttons on the side of the HMD was particularly challenging for one resident, causing this resident to be frustrated. Therefore, the usability of the HMD is a potential barrier for continued use. Cutaneous sensation in the hands diminishes significantly with increased age (Bowden & McNulty, 2013). This must be considered moving forward with VR research. During the post-intervention survey, one resident described her mood as tired. When asked how VR could be improved, the same resident remarked, a shorter time. Upon further investigation, this appeared to be related to testing procedures and not the intervention. The single-session study in which all consenting, screening, and data collection procedures was conducted when the intervention was delivered.

Three suggestions for modifications to incorporate into the upcoming pilot study emerged from the post-intervention satisfaction survey data. The first recommendation

was to replace the current HMD with a more user-friendly headset, enhancing the overall viewer's experience, decreasing frustration, and promoting the ongoing use of ViRT-Ta-GO. The second recommendation was to change the current virtual application, which focuses on meditation with an app that takes the viewer to more familiar destinations such as national parks or landmarks. This will help increase interest, help hold residents' attention, enhance enjoyability, and promote continued use of ViRT-Ta-GO. The third recommendation was to allow more time between consenting, screening, and data collection procedures. Furthermore, less burdensome data collection instruments should be considered for future studies.

As for the secondary aim, this study did not find a statistically significant impact of ViRT-Ta-GO on POMS 2-A TMD, DD, or TA measures overall. However, raw score comparison showed non-significant improvements in total mood and the negative mood states of depression and anxiety pretest to posttest for some residents. These findings, in part, are consistent with findings from current literature. A pilot study conducted by Reynolds et al. (2018) into the use of non-immersive virtual nature experience in an assisted living facility revealed a non-significant decrease in anxiety within 10 minutes of virtual exposure. A feasibility study conducted by Shaunfield et al. (2014) into using a non-immersive virtual field trip intervention in an assisted living facility revealed a non-significant decrease in depressive symptoms post-intervention.

Furthermore, improved mood (Rappe & Kivela, 2005), depression (McCaffrey, 2007), and anxiety (Gascon et al., 2018) from exposure to nature-based activities are consistent with previous research among older adults. Furthermore, effect size estimates showed that the magnitude of ViRT-Ta-GO's effect on improving total mood,

depression, and anxiety was moderate to large, suggesting the possible clinical significance of the intervention in the assisted living setting. The lack of statistically significant changes in mood measures may be due to the small sample size, the fact that no participants were clinically diagnosed with a mood disorder, and the intervention's one-time experience.

Limitations

Several limitations must be considered when generalizing the results of this study. First, the sample size was small, which means that the study was probably underpowered. This may have contributed to the lack of statistically significant intervention effect. Second, sampling took place at only one location. Third, participants' demographic characteristics were a limitation as the sample was primarily women, and all participants were white. Lastly, no control group was established.

<div align="center">

Conclusion

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ViRT-Ta-Go was created using fully immersive VR technology to improve mood states of older adults living in long-term care facilities by helping them reconnect with the outdoors, thereby creating a pleasant event. Findings suggested that ViRT-Ta-GO may be a feasible, acceptable, and enjoyable activity that may improve mood among older adults in assisted living. Person-level facilitators and barriers were identified. Furthermore, this study provided preliminary data for an upcoming pilot study examining the impact of ViRT-Ta-GO on depressive and anxiety symptoms among older NH residents.

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CHAPTER FOUR

METHODOLOGY

Study Design

This quasi-experimental study with a one-group, pretest-posttest design tested the feasibility and preliminary efficacy of the fully immersive VR intervention, ViRT-Ta-GO, on depressive and anxiety symptoms. The intervention's completion was followed by an open-ended survey questionnaire to ascertain participants' perceptions of person-level facilitators and barriers of the ViRT-Ta-Go program. This study was conducted at two NHs in northwestern Pennsylvania that provide 24-hour skilled nursing care to adults with various conditions and functioning levels.

Participant Identification and Recruitment

Four NHs in northwestern Pennsylvania were invited to participate in this study. Invitational letters, telephone calls, and face-to-face visits were used in recruitment efforts to engage NHs (see Appendix N for facility recruitment letter). Information within the letter included the study's significance, possible impact on residents' health status, study procedures, recruitment procedures, and eligibility criteria. An overview of the Primary Investigator's (PI) qualifications, the study's noninvasive nature, and the limited amount of work imposed on the NH staff was emphasized. The return of the invitational letter signed by the operations director of each home was evidence of their consent to participate in the VR study.

After consent was received from three NHs, operation directors asked the PI to write a generic family notification letter regarding the VR study. Operation directors sent copies of this letter along with a copy of the recruitment flyer to all residents' families

informing them that the study would be taking place in their respective facility and requested that the letters be returned with a signature indicating agreement or disagreement for their loved one to participate in the study if they expressed interest (see Appendix O for family notification). Operations directors notified the PI when signed notification letters returned. The PI placed posters in common areas within the facilities that informed residents of the study, the location of a sign-up sheet, and where and when the study would occur (see Appendix C for similar flyer). With the help of activities' directors, the PI gave brief presentations to groups of residents gathered in common areas. Placing their name on the sign-up sheet was considered giving their permission to be contacted by the PI about the study. The PI checked and collected sign-up sheets twice weekly for four weeks. Family approval was verified with the operations directors before meeting with any prospective candidates.

The PI met with interested candidates in a private location within their respective facilities. In private, each prospective participant received a complete explanation of inclusion and exclusion criteria, screening procedures, all study procedures, the VR protocol, data collection procedures, participants' rights, expectations of the participants, and potential risks and benefits of participating in the study. Each potential participant was offered the opportunity to watch a demonstration of how the head-mounted display (HMD) system and corresponding hand controllers work. During that time, prospective participants were given a chance to hold and examine the HMD and hand controllers. Participants could ask questions. Questions were answered to the best of the PI's ability. The PI waited for the potential participant to decide if they wanted to participate before screening for eligibility.

Prospective candidates who expressed an interest and willingness to participate in the ViRT-Ta-GO intervention study were given an informed consent form to read. The PI read the consent form aloud to those with limited reading ability. Residents were queried throughout the meeting to ensure that the study's purpose and procedures were understood. Potential participants were provided with reassurance that participation was voluntary and could be withdrawn at any time.

After informed consent (see Appendix P) was obtained, prospective candidates were asked to complete the Brief Interview for Mental Status questionnaire (BIMS; Chodosh et al., 2008), a performance-based screening tool for cognitive impairment (see Appendices Q and R for instrument and permission). BIMS includes temporal orientation and recall items. Possible scores range from 0 to 15. A score of 13 or above indicates no cognitive impairment. Internal consistency (.77), sensitivity (.66), and specificity (.88) have been established (Mansbach et al., 2014). BIMS scores were used to determine eligibility for this study. Individuals who scored < 13 were thanked for their interest and respectfully declined.

Residents who met inclusion and exclusion criteria and expressed a willingness to participate were provided a HIPAA Authorization Form to read. The PI read the HIPAA Authorization form aloud to those with limited reading ability. Questions were answered. The PI waited for each prospective candidate to decide if they wanted to sign the HIPAA Authorization form. After HIPAA Authorization was received, an appointment was scheduled for a return visit to obtain baseline data on outcome measures. An illustration of participant progression through the pilot study can be found in Appendix S.

Patient Population

In the United States during the year 2016, long-term care services were provided by 15,600 nursing homes (NHs) to an estimated 1,125,246 residents over the age of 64 years (Harris-Kojetin et al., 2019). Depression is highly prevalent among the NH population, with 46.3% of residents having this diagnosis (Harris-Kojetin et al., 2019). An effort was made to include men, women, and minorities in the current study to the extent to which they lived at the study sites, met the recruitment criteria, and were willing to participate. Based on Pennsylvania (PA) state demographic data of the NH population aged 60 years and older in seven counties located in northwestern, PA, it was anticipated that roughly two-thirds (66.4%) would be women (Pennsylvania Department of Health, 2016). On average, 94.2% of persons living in these seven counties are white. Therefore, it was anticipated that 5.8% or less of residents would be racially diverse (United States Census Bureau, n.d.). The proportion of Pennsylvania NH residents who are white (87.9%) is slightly more significant than the proportion of whites in the national NH population (78.7%) (CMS, n.d.). In contrast, national data suggest that 21.3% of the national NH population is racially diverse (CMS, n.d.).

Sampling Plan

Non-probability convenience sampling was used to enroll older NH residents who met the following inclusion criteria:

- were 60 years of age or older
- were cognitively intact as indicated by a Brief Interview of Mental Status (BIMS) score > 12
- were English-speaking

- could communicate effectively

- had no history of seizure disorder

- were not legally blind

- had no new head, neck, or eye surgery or injury

The recruitment goal was 20 participants.

Sample Size

This small pilot study intended to examine whether the trial would be successful when conducted in full as a randomized trial. Before beginning this study, it was determined that a small sample size of 20 individuals would be sufficient. This sample size was based on Whitehead and colleagues' (2015) estimation of pilot study sample-sized for randomized controlled trials with a 90% power and two-sided significance of 5%, and large effect size. Smith et al. (2015) described the best method to conduct the pilot study in individuals or a cluster that will not be included in the main trial, to avoid having to go back to the same individuals to collect similar data in the main trial. This project followed that recommendation. Therefore, a power analysis was not performed.

Setting

This study was conducted in two northwestern Pennsylvania NHs with a capacity of 100 - 138 beds. These facilities provide 24-hour skilled nursing care, long-term care living, and short-term rehabilitative stays following a surgery, illness, or injury, which may require physical therapy, occupational therapy or speech therapy. Each facility also houses a specialized memory unit for dementia care. Formal permission was obtained from each facility's administrator before conducting the study.

Procedure

Once eligibility was confirmed, and consents were obtained, participants were scheduled for a private face-to-face visit to complete the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) and the Geriatric Anxiety Inventory (GAI; Pachana et al., 2007) to establish baseline data on outcome measures for depressive and anxiety symptom severity, respectively. After completion of pre-intervention testing, appointments were scheduled for the administration of the VR intervention. Upon return, the PI administered private individual sessions of the VR intervention via an HMD in conjunction with a gaming computer, a preloaded VR application, and two hand controllers. During the first VR session, participants were introduced to the HMD and the hand controllers. Participants could ask questions and voice concerns. Once all questions and concerns were addressed to the participant's satisfaction, and the participant verbalized readiness to begin, the HMD was fitted to the individual. During the fitting process, participants were asked if the HMD was causing any discomfort or excessive pressure to face or head. Participants were instructed that while the HMD was on, they would see natural landscapes and hear natural sounds. Participants were instructed that while immersed in the simulated environment, it would appear as if they were riding a kayak through the Grand Canyon on the Colorado River, but not to worry as they would be guided through the exercise. Verbal instructions were provided on how to navigate the system and how to stop the session at any time by verbally saying "stop" or signaling stop by raising their hand. During each VR session, the PI observed participants for signs of discomfort or distress, such as restlessness or frequent attempts to reposition the HMD. Residents were monitored for signs of cybersickness, a phenomenon that can occur with VR applications. Symptoms of cybersickness mimic those of motion sickness but are

usually less severe and have a low incidence. Signs and symptoms include dizziness, nausea, increased saliva production, burping, headache, blurred vision, difficulty focusing or concentrating, stomach discomfort, and fatigue (Jones et al., 2004).

The PI remained in the room with each participant for the entire session, answered questions, and addressed concerns. Exposure time was limited to 10 minutes. Sessions were not videotaped or audio recorded. After the final VR session, the PI scheduled appointments to return for post-intervention data collection using the Patient Health Questionnaire (PHQ-9), Geriatric Anxiety Inventory (GAI), and a series of 10 open-ended questions related to the VR experience. Baseline demographic, medication and health data were collected from participants' medical records by nurse managers and social workers at each facility. Demographic data included age, sex, race, relationship status, length of stay, chronic conditions and diagnoses, medications used to treat symptoms of depression and anxiety, and the length of time the resident received these medications. Nurse managers and social workers at each facility were given copies of the demographics and health form to record this information, but they chose not to use them. Instead, one facility provided printed documents from residents' electronic records, and the other facility provided handwritten notes on plain white paper. The PI collected all pre-intervention and post-intervention questionnaire data and post-intervention feedback survey data in private locations.

Intervention

VRT is a type of immersion therapy wherein individuals are actively involved participants engaged in a 3-dimensional, computer-generated, interactive setting, which allows them a feeling of actual existence in situations correlated to their presenting

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problem (North & North, 1997). For this study, the PI created the intervention, **ViRT-Ta-GO,** which stands for **V**irtual **R**eality **T**herapy **Ta**kes **G**reenspace to **O**lder NH residents. This intervention consisted of the *Grand Canyon Experience VR* app available from Oculus VR, LLC, an MSI gaming computer, an *Oculus Rift S* HMD, and *Oculus Touch* controllers. The *Grand Canyon Experience VR* was developed as a virtual relaxation app to induce peaceful calm states through exposure to relaxing environments. This app was preloaded to the gaming computer connected to the HMD system and used in conjunction with two hand controllers. Images were viewed through an HMD, which covered the eyes like a pair of oversized goggles. With slight movements of the eyes or head, the individual moved through nature or just sat and enjoyed looking at it. Residents adjusted the kayak's speed, fed fish, splashed water, rang bells, or reached butterflies by using the hand controllers. Sounds were heard through the HMD. The interventional program was composed of 10-minute sessions delivered individually three times per week for four weeks. Altogether, this activity was intended to induce positive emotions by creating a pleasant nature experience.

Data Collection

After receiving Institutional Review Board (IRB) approval from the University of Missouri-Columbia (see Appendix T), data were collected using the following instruments:

Patient Health Questionnaire-9 (PHQ-9; Spitzer et al., 1999). The PHQ-9 is a valid instrument that screens for signs and symptoms of depression using the presence and frequency of nine mood symptoms and takes about three minutes to complete (Kroenke et al., 2001). Total possible scores range from 0 - 27. Scores 0 - 4 suggest no

depression, 5 - 9 mild depression, 10 - 14 moderate depression, 15 - 19 moderately severe depression, and 20 - 27 severe depression. A score of 10 or higher has a high specificity (.88) and sensitivity (.88) for detecting major depression (Kroenke et al., 2001). PHQ-9 scores were obtained and recorded by the PI before the first VRT sessions to get a baseline and after the last sessions to assess any depressive symptoms changes. Permission to use the PHQ-9 was obtained from Donna Burgett on behalf of Dr. Kurt Kroenke (see Appendices U and V for tool and permission).

Geriatric Anxiety Inventory (GAI; Pachana et al., 2007). The GAI is a clinician-administered questionnaire that uses agree and disagree with 20 items to assess the severity of anxiety symptoms, typically seen in older adults (Pachana et al., 2007). It takes about five minutes to administer the GAI. Within the GAI, somatic symptoms measurements are limited to minimize confusion between symptoms common to anxiety and general medical conditions (Pachana et al., 2007). The GAI uses language commonly used by older adults to describe anxiety (e.g., nerves, butterflies in my stomach). The total possible score ranges from 0 – 20. A cut-off score of 8 is commonly used to identify people with an anxiety disorder (Johnco et al., 2015). Interrater (.89) and test-retest reliability (.86), and concurrent validity (.85) of the GAI have been established in older adults without dementia (Johnco et al., 2015). Internal consistency (.93), interrater (.99), and test-retest reliability (.91), concurrent validity (.80), specificity (.84), and sensitivity (.75) have been established in older adults with depressive and anxiety symptoms (Pachana et al., 2007). Licensure to use the GAI was obtained online through the official Uniquest website (see Appendices W and X for tool and permission). GAI scores were

obtained and recorded by the PI before the first VRT sessions to get a baseline and after the last sessions to assess any changes in the severity of anxiety symptoms.

Post-Intervention Satisfaction Survey. The PI created this feedback survey consisting of 10 open-ended questions to ascertain participants' perceptions of person-level facilitators and barriers to ViRT-Ta-Go. These questions were aimed at understanding how ViRT-Ta-GO might be acceptable and appealing to residents. Participants' responses were transcribed verbatim to a paper version of the survey and later typed into a Word Document (see Appendix Y for the survey).

Demographic and Health Form. Baseline demographic and health data were collected from participants' electronic medical records by nurse managers and social workers at each facility. This included age, sex, race, relationship status, length of stay, chronic conditions, medications used to treat depressive and anxiety symptoms, and length of time receiving these medications (see Appendix L for form).

Also, the PI observed residents for signs of cybersickness and general discomfort. Symptoms of cybersickness mimic those of motion sickness but are usually less severe and have a low incidence. Signs and symptoms include dizziness, nausea, increased saliva production, burping, headache, blurred vision, difficulty focusing or concentrating, stomach discomfort, and fatigue (Jones et al., 2004). Residents were also observed for general pain in the form of restlessness or frequent attempts to reposition the HMD.

Data Management

To assure participants' right to privacy, the PI assigned study identification (ID) numbers to each participant. The PI was the only investigator to have access to these randomly assigned codes. Only the assigned ID numbers were used on study instruments

and with data sets created for analyses. Participants' names and other possible identifiers were not used. All data collected from participants and their medical records were recorded electronically using a laptop computer and Microsoft Office Software. A separate electronic folder was created for each participant's data. The PI was the only person to access the computer and the only person to know the password to log in. All related study documents were stored on the PI's hard drive and saved in a password-protected file. When not at a data collection site, the laptop was locked in the PI's room or office. The PI constructed the data sets. Only the PI viewed study instruments and data sets. Per the University of Missouri policy, all study materials will be retained for three years.

Data Analysis

Demographic data, participant rates, and attendance were analyzed using descriptive statistics (mean, standard deviation, and percentages). Feasibility was determined by the number of participants recruited, VR sessions attended, and the number of participants who completed the 4-week ViRT-Ta-GO program. The percentage of participant-reported endorsements determined acceptability. Considering the small sample size, comparisons on outcome variables were conducted using Wilcoxon signed-rank tests to reduce the risk of biased conclusions (Wilcoxon, 1945). Wilcoxon signed-rank test is the non-parametric equal to the paired samples *t*-test (Field, 2013). Signed-rank test is appropriate to use when there is one independent variable with two levels, participants undertake both conditions, and dependent variable data are continuous and ordinal (Field, 2013). The size of the treatment effect was measured following Rosenthal's (1994) recommendation to convert *z*-score into effect size

estimate, *r* when assumptions for Cohen's *d* formula have been violated. The effect's estimated size is based on Cohen's (1988) criteria of 0.1 for a small effect, 0.3 for moderate effect, and 0.5 for large effect.

Post-intervention satisfaction survey data were reviewed for accuracy and analyzed by the PI. The analysis plan involved five topic areas related to feasibility, acceptability, facilitators, barriers, and suggestions for improvement. The ten open-ended survey questions were intended to gain insight into participants' perceptions of these areas. The PI read participants' transcripts several times to familiarize themself with the data. The content of narrative responses was categorized by topic area.

Methodological Concerns

A concern with the proposed study was the recruitment of participants. Recruitment may have been affected by potential participants' unfamiliarity with VR devices and fear of the unknown. Recruitment may also have been affected by nurses' concerns about how the study will impact their existent workload or skepticism regarding the efficacy of using a new technological approach to treat depressive symptoms in frail older adults. To recruit the desired sample size, attempts were made to educate staff and potential participants about VRT, its uses, effectiveness, safety, and any associated adverse effects.

Another concern was the variation in implementation protocol, which is a potential threat to intervention fidelity. Intervention fidelity refers to the degree in which study groups receive the intervention as described in the study protocol (Faulkner, 2012). Adherence and competence are two key concepts of intervention fidelity. Adherence refers to how well the researcher's behaviors follow the protocol (Faulkner, 2012).

Competence involves the researcher's proficiency in delivering the intervention (Faulkner, 2012). To help reduce this threat and maintain the internal validity of the study, the PI enacted possible solutions in the areas of resources (i.e., facility, copy of protocol), number of intervention implementers, and treatment delivery.

Potential Risks

The risks of participating in this study were minimal. Coercion was a potential risk of participating as participants may have feared being treated differently by their caregivers if they chose not to participate. Still, this risk was minimized by selecting a liaison (i.e., social worker) at each facility to act as a neutral party during the recruitment and throughout the study. There was also minimal risk of a phenomenon called cybersickness, which can occur with VR applications, but the risk was low. Participants remained in a seated position either in their wheelchair or in a hard-backed chair with armrests while engaging in the intervention to minimize this risk. Since the HMD was shared among all participants, there was minimal risk of skin infection spread. Therefore, the HMD was wiped clean with disposable alcohol swabs and allowed to air dry before and after every use. Also, disposable hygienic shields were placed between the HMD and the participant's skin and immediately discarded after each use.

Wearing an HMD potentially could cause physical discomfort because of its weight or emotional distress in the form of increased anxiety because the eyes are covered; however, this was unlikely. Participants were instructed that they could pause or terminate a VR session if they experienced any discomfort or for any other reason. Furthermore, the PI observed participants during every VR session for signs of discomfort or distress, such as restlessness or frequent attempts to reposition the HMD.

There was also a risk that participants could have experienced emotional distress when completing surveys. Every effort was made to protect subjects from emotional distress. If any signs of distress had been noted, the PI would have asked the participant if they needed a break. If participants had experienced any form of distress, they would have been referred to the social worker or the RN supervisor for additional monitoring and follow up. There were no financial risks to participants. No adverse events occurred during this study. If an adverse event had occurred, it would have been reported per the University of Missouri Health Services IRB's protocol.

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CHAPTER FIVE

Virtual Reality Therapy Takes Greenspace to Older NH Residents: A Pilot Study

Abstract

Effective nonpharmacological interventions to alleviate depression and anxiety symptoms among older adults residing in nursing homes (NHs) are urgently needed. Over 46% of all NH residents carry a depression diagnosis. Compounding this issue, nearly 50% of older adults with depression also experience anxiety. These conditions are typically treated with antidepressants, anxiolytics, and sedative-hypnotics. In this population, however, pharmacological treatment is often associated with serious adverse effects. Virtual reality (VR) technology can offer a safe alternative or adjunctive approach for symptom management. Still, the effect of fully immersive VR interventions on depression- and anxiety-related outcomes in the NH setting is unknown.

The current study's primary aim was to pilot ViRT-Ta-GO: Virtual Reality Therapy Takes Greenspace to Older NH residents. The secondary aim was to obtain estimates of the effect sizes on the following outcome measures: Patient Health Questionnaire-9 and Geriatric Anxiety Inventory. This quasi-experimental study with a one-group, pretest-posttest design was conducted with nine cognitively intact residents (M_{age} = 81, SD = 10.23) in two Pennsylvania NHs. Residents participated individually in three 10-minute VR sessions per week for four weeks. After the intervention, residents completed a post-intervention satisfaction survey to provide feedback about their VR experience. There were no adverse effects. Participant attrition and self-report indicated that the ViRT-Ta-GO intervention was feasible and acceptable. At posttest, Wilcoxon Signed-Rank test showed a significant decrease in anxiety symptoms (z = -2.02, p = .04) with a large effect

size ($r = -.48$). Nonsignificant trend improvements in depression were observed ($p = .08$), pretest to posttest. The 4-week VR intervention was effective in reducing symptoms of anxiety. Preliminary findings demonstrate utility within an older NH population, suggesting that it will be advantageous to evaluate ViRT-Ta-GO through controlled clinical trials.

Keywords: nursing homes, virtual reality, depression, anxiety, older adults

Depression and anxiety are common disorders plaguing older NH residents. The CDC reports that 46.3% of all NH residents carry a depression diagnosis (Harris-Kojetin et al., 2019). Reported prevalence rates for anxiety disorders range from 3.2% to 20% and have a high correlation with depressive symptoms (Creighton et al., 2015; Creighton et al., 2019). However, depression and anxiety are likely more prevalent in NHs than previously reported. A study of 227 NH residents aged 65-102 years old without cognitive impairment found that twice as many residents had symptoms of depression, anxiety, or both as were diagnosed with these disorders (Drageset et al., 2013). These conditions are typically treated with antidepressants, anxiolytics, and sedative-hypnotics. In this population, however, pharmacological treatment is often associated with severe adverse effects. Research shows that residents taking these types of medications are more likely to fall, more likely to sustain injuries (Bulat et al., 2008; Cox et al., 2016; Meeks et al., 2016), and less likely to participate in social activities and activities of daily living (Galik & Resnick, 2013; Glass et al., 2005). Considering the remarkable prevalence of depression and anxiety in the NH setting and the potential adverse medication effects, there is now more than ever, a need to discover new approaches for managing symptoms associated with these disorders.

While several factors may contribute to late-life depression such as biological, psychosocial, and situational, a sample of 65 older NH residents identified (a) loss of continuity with a past life, (b) social isolation and loneliness, (c) lack of privacy and frustration with sharing a room, (d) loss of autonomy, (e) ambivalence toward cognitively impaired residents, (f) ever-present death and grief, (g) staff turnover and shortage, (h) stale activity programming, (i) and lack of meaningful activities as causes of their

depressive symptoms (Choi et al., 2008). More specifically, NH residents attribute not being able to get out of the facility to engage in outside activities such as planting flowers and going for drives as they had done before living in the NH as a significant stressor contributing to depression (Choi et al., 2008). Cognitive appraisals made when facing a stressful situation, such as living in an NH, are related to outcomes and depend on the individual's evaluation of their capacity to cope with the perceived stress (Lazarus & Folkman, 1984; Folkman, 1997). To deal with losses and lifestyle changes, older adults employ coping strategies to adapt to adverse situations.

Folkman's (1997, 2008) revised stress and coping model proposes that infusing ordinary events with positive meaning, a coping process utilized by people during stressful periods, produces positive emotions that support adaptive coping by restoring depleted resources (Folkman 2008). Positive emotions experienced during a time of stress provide a momentary break from the ongoing stress allowing for restoration (Folkman 1997, 2008). Direct contact with nature has been shown to reduce stress (Brown et al., 2013; Hunter et al., 2019; Ward-Thompson et al., 2012). However, for many NH facilities, lack of readily accessible green space, limited availability of staff, inclement weather, and residents' physical limitations hinder NH residents' engagement in these types of outdoor activities (Kearney & Winterbottom, 2005). One way to overcome these barriers is with new innovative technology. VR therapy, a type of immersion therapy wherein individuals, are actively engaged in a 3-dimensional computer-generated, interactive setting (North & North, 1997), allows residents to view themselves outdoors and in pleasant settings. Furthermore, a nature-based VR intervention has demonstrated that this innovative technology is feasible with stress recovery (Annerstedt et al., 2013).

Re-connecting residents with the outdoors using VR may offer a safe alternative to direct contact, may produce positive emotions, and may help reduce the adverse outcomes associated with stress.

Preliminary work for this study indicated that the fully immersive VR intervention, ViRT-Ta-GO, was well tolerated by adults in an assisted living facility. However, the head-mounted display (HMD) system's usability was troublesome for one resident, familiar scenic destinations are preferred over guided meditation, and data collection procedures were somewhat burdensome. Based on preliminary findings, modifications were made to the intervention and study procedures to reduce or eliminate any potential issues that might hinder this project's success. The current study undertakes similar VR technology to pilot test the fully immersive nature-based ViRT-Ta-GO intervention on depressive and anxiety symptoms in older NH residents without cognitive impairment.

Methods

Design

This quasi-experimental pilot study, which included a within-subject, pretest-posttest design, and a post-intervention satisfaction survey, was used to examine the fully immersive VR intervention's feasibility and efficacy. The University of Missouri Health Sciences Institutional Review Board (IRB) provided ethical approval for this study.

Sample

The analysis was conducted from pre- and post-intervention data on nine participants. Convenience sampling was used to enroll older adult NH residents who met the following inclusion criteria:

- were 60 years of age or older

- were cognitively intact as indicated by a Brief Interview of Mental Status
  (BIMS) score > 12

- were English-speaking

- could communicate effectively

- had no history of seizure disorder

- were not legally blind

- had no new head, neck, or eye surgery or injury

Four NHs in northwestern Pennsylvania were invited to participate; three consented.
Despite recruitment efforts, no residents expressed interest at one of those three facilities.
Participants were recruited from two northwestern Pennsylvania NHs with the use of
flyers and presentations. Eleven NH residents met the inclusion criteria. Ten agreed to
participate, but only nine participants completed the study as one was lost due to illness
before receiving the intervention. Written consent was obtained from residents who were
deemed capable of giving informed consent by the operations directors and nursing
directors.

Cognitive Impairment

The Brief Interview measured cognitive impairment for the Mental Status
Questionnaire (BIMS; Chodosh et al., 2008), a performance-based screening tool that
includes temporal orientation and recall items. Possible scores range from 0 to 15, with
lower scores indicating more significant impairment. Scores 0 - 7 suggest severe
cognitive impairment, 8 - 12 moderate impairment, and 13 - 15 indicate no cognitive
impairment. BIMS scores were used to determine eligibility.

Intervention

For this study, VR was defined as the interaction between a human and a computer-generated environment, delivered using an HMD, creating a fully immersive experience. The intervention, ViRT-Ta-GO, which stands for Virtual Reality Therapy Takes Greenspace to Older NH residents, was created for this study by the primary investigator (PI). This intervention was comprised of the *Grand Canyon Experience VR* app available from Oculus VR, LLC, an MSI gaming computer, and an *Oculus Rift S* HMD with accompanying *Oculus Touch* hand controllers. The *Grand Canyon Experience VR* was developed as a virtual relaxation app to induce peaceful calm states through exposure to relaxing environments. During the intervention, residents viewed simulated natural environments and heard sounds replicating those associated with the Grand Canyon and the Colorado River. In the virtual environment, residents drifted down the river on a motorized kayak, stopped and explored scenic viewing areas, and just sat and enjoyed looking at the landscape. Residents could stop or adjust the speed of the kayak with the use of the hand controller. Residents chose daytime or nighttime tours of the canyon. ViRT-Ta-GO was administered for 10 minutes, three times a week, for four weeks.

Intervention Fidelity

Several strategies were taken to ensure ViRT-Ta-Go was delivered as planned, and the internal validity of the study was maintained. First, a quiet private room at each facility was reserved for three days each week for a month. On each intervention delivery day, ViRT-Ta-GO was administered after lunch at facility one and before dinner at facility two. Second, only the PI set up, cleaned, and administered the intervention. The

PI followed the steps outlined in the implementation protocol to ensure ViRT-Ta-GO was

delivered in the same manner each time. Third, tape on the floor ensured that participants

were placed in the same location within the room and faced the same direction. Lastly,

only the PI collected outcome data.

Data Collection

Depression

The severity of depressive symptoms was measured before and after the

intervention using the Patient Health Questionnaire-9 (PHQ-9; Spitzer et al., 1999). Total

possible scores range from 0 – 27, with higher scores indicating more symptoms

(Kroenke et al., 2001). Scores 0 - 4 suggest no depression, 5 - 9 mild depression, 10 - 14

moderate depression, 15 - 19 moderately severe depression, and 20 - 27 severe

depression (Kroenke et al., 2001).

Anxiety

The severity of anxiety symptoms was measured before and after the intervention

using the Geriatric Anxiety Inventory (GAI; Pachana et al., 2007). This questionnaire

uses to agree and disagree with 20 items to assess the severity of anxiety symptoms

typically seen in older adults. Total scores range from 0 - 20 with 0, indicating no anxiety

symptoms (Pachana et al., 2007). A cut-off score of 8 is commonly used to identify

people with an anxiety disorder (Johnco et al., 2015).

Post-Intervention Satisfaction Survey

The Post-Intervention Satisfaction Survey was created by the PI and consisted of

10 open-ended questions. After completing the intervention, participants were asked a

series of questions to ascertain their perceptions of person-level facilitators and barriers

of ViRT-Ta-GO. These questions were aimed at understanding how ViRT-Ta-GO might be acceptable and appealing to residents. Participants' responses were transcribed verbatim to a paper version of the survey and later typed into a Word Document.

Demographic and Health Information

The PI created the Demographic and Health Form for this study. Baseline demographic and health data were collected from participants' electronic medical records by a nurse manager and social worker. Demographic data included age, sex, race, relationship status, length of stay, chronic conditions, medications used to treat depressive and anxiety symptoms, and length of time receiving these medications.

Also, the PI observed residents for signs of cybersickness and general discomfort. Symptoms of cybersickness mimic those of motion sickness but are usually less severe and have a low incidence. Signs and symptoms include dizziness, nausea, increased saliva production, burping, headache, blurred vision, difficulty focusing or concentrating, stomach discomfort, and fatigue (Jones et al., 2004). Residents were also observed for general discomfort in restlessness or frequent attempts to reposition the HMD.

Data Analysis

For quantitative data, the analysis was performed using IBM SPSS statistics software version 25. Demographic data, participant rates, and attendance were analyzed using descriptive statistics (mean, standard deviation, and percentages). Feasibility was determined by the number of participants recruited, VR sessions attended, and the number of participants who completed the 4-week VR intervention. The number of participant-reported endorsements determined acceptability. Wilcoxon signed-rank test was used to compare the total PHQ-9 and GAI pretest and posttest scores. Effect size

estimates were calculated using Rosenthal's (1994) proposed equation and followed

Cohen's (1988) criteria to approximate the magnitude of VR's effect on depression and

anxiety. For analyses, significant differences between pretest and posttest distributions

were considered statistically significant if the two-tailed *p*-value was ≤ 0.05.

Post-intervention satisfaction survey data were reviewed for accuracy and

analyzed by the PI. The analysis plan involved three topic areas related to facilitators,

barriers, and suggestions for improvement. The ten open-ended survey questions were

intended to gain insight into participants' perceptions of these areas. The PI read

participants' transcripts several times to familiarize themself with the data. The content of

narrative responses was categorized by topic area.

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Results

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Demographic Characteristics

The sample of nine participants had a mean age of 81 years (SD = 10.23). The

youngest and oldest participants were 70 and 95 years old, respectively. Participants in

the sample were all white (*n* = 9) with the majority being female (88.9%, *n* = 8). Among

participants, 55.6% (*n* = 5) were widowed, 22.2% (*n* = 2) were divorced or separated,

11.1% were married (*n* = 1), and 11.1% were single (*n* = 1). Length of stay (LOS) ranged

from nine months to four years ten months. The majority (44.4%, *n* = 4) resided in their

respective NH 1 – 3 years, 33.3% (*n* = 3) resided in the NH 3 - 5 years, and 22.2% (*n* = 2)

had a LOS of < 1 year. Social workers and nurse managers reported participant history of

depression (*n* = 5), anxiety (*n* = 2), insomnia (*n* = 2), chronic pain (*n* = 7), heart disease (*n*

= 6), asthma/emphysema/other breathing problem (*n* = 4), and arthritis (*n* = 4). Reports

included current antidepressant use ($n = 5$), anxiolytic use ($n = 2$), and sleep aid ($n = 2$). The two NHs where this study was conducted were very similar.

Feasibility and Acceptability

Each participant was offered opportunities to attend 12 individual VR sessions, three per week for 10 minutes per day for four weeks. All VR sessions lasted 10 minutes. No sessions were stopped early by the participant or the PI. No adverse effects were observed during this study. The participants registered 92% attendance; the average attendance was 8.25 sessions (SD = .28). Three participants attended every session (33.3%), four attended 11 sessions (44.4%), one attended ten sessions (11.1%), and one attended nine sessions (11.1%). Reasons for non-attendance were family visits, acute illness, and medical appointments out of the facility. Retention rate was 100% ($n = 9$). Concerning acceptability, 100% of participants expressed they would recommend ViRT-Ta-GO to a friend.

PHQ-9

At baseline, depression scores suggest possible depression among participants. PHQ-9 pretest scores indicate that four participants were experiencing symptoms of mild depression (44.4%), two were experiencing symptoms of moderately severe depression (22.2%), and three were not displaying signs of depression (33.3%). A Wilcoxon signed-ranks test indicated that the distribution of PHQ-9 posttest scores, $Md = 4$, were not statistically significantly lower than the distribution of PHQ-9 pretest scores, $Md = 6$, $t = -1.78$, $p = < .075$, $r = -.42$ (see Table 5.1). The estimated effect size was moderate.

Table 5.1

Dependent Variables at Pretest and Posttest

Variable	*n*	Pretest			Posttest			*t*	*p*	*r*
		M	*SD*	*Md*	*M*	*SD*	*Md*			
PHQ-9*	9	6.00	6.23	6	4.00	4.09	4	-1.78[b]	.075	-.42
GAI*	9	8.56	7.59	8	5.56	6.88	3	-2.02[b]	.043	-.48

M = mean; *Md* = median; *n* = sample size; *SD* = Standard deviation; * Wilcoxon sign test *p* < 0.05; b = based on negative ranking; *r* = effect size statistic

A nonsignificant trend, however, was observed for reduced severity of depressive symptoms pretest to posttest. Looking at individual participants' PHQ-9 scores, the severity of depressive symptoms decreased from moderately severe at baseline to mild at posttest (*n* = 1), from moderately severe at baseline to moderate at posttest (*n* = 1), and from mild at baseline to none at posttest (*n* =3). No change was seen in the severity of depressive symptoms for four participants pretest to posttest (see Table 5.2).

Table 5.2

Participant PHQ-9 scores and posttreatment outcome

Participant	PHQ-9 pretest	Severity of symptoms at baseline	PHQ-9 posttest	Severity of symptoms after VR	Posttreatment Outcome
1	6	mild	8	mild	No change
2	16	moderately severe	9	mild	Improved
3	0	not present	1	not present	No change
4	7	mild	4	not present	Improved
5	0	not present	0	not present	No change
6	0	not present	0	not present	No change
7	8	mild	4	not present	Improved
8	15	moderately severe	10	moderate	Improved
9	2	mild	0	not present	Improved

GAI

Anxiety scores at baseline (M = 8.56, SD = 7.58) suggest some possible anxiety among participants. Pretest GAI scores indicate that five participants experienced anxiety (55.6%), while four were not (44.4%). A Wilcoxon signed-ranks test indicated that the distribution of GAI posttest scores, Md = 3, were statistically significantly lower than the distribution of GAI pretest scores with a large effect size, Md = 8, t = -2.023, p = < .043, r = -.48 (see Table 5.1). Furthermore, individual GAI scores revealed that all nine participants reported either less or no change in anxiety symptoms from pretest to posttest (see Table 5.3).

Table 5.3

Participant GAI scores and posttreatment outcome

Participant	GAI pretest	Severity of symptoms at baseline	GAI posttest	Severity of symptoms after VR	Posttreatment Outcome
1	15	present	13	present	No change
2	17	present	7	not present	Improved
3	0	not present	0	not present	No change
4	8	present	5	not present	Improved
5	2	not present	2	not present	No change
6	0	not present	0	not present	No change
7	11	present	3	not present	Improved
8	20	present	20	present	No change
9	4	not present	0	not present	No change

Post-Intervention Satisfaction Survey Data

All nine residents completed the post-intervention satisfaction survey about their VR experience. Participants found the VR experience appealing and satisfying. Also, three suggestions to improve ViRT-Ta-GO emerged from the survey data.

Facilitators

VR Experience was Exciting and Enjoyable. All participants found the overall ViR-Ta-GO experience enjoyable and exciting. VR residents stressed that they liked the opportunity to see new destinations. Engaging in VR was doing things residents had never had in the past, such as kayaking down the Colorado River. Hence, VR residents found the activity more interesting and exciting than other NH activities. One resident described the VR experience as educational. VR residents felt the visuals were beautiful, pretty, extraordinary, and impressive. VR residents felt the experience was enhanced by the audio feedback describing the sounds as very nice, and perfect. For one resident, the experience brought back pleasant memories of being at the Grand Canyon which she shared with the PI. Sharing sentimental stories suggests a reminiscent component of viewing VR environments.

VR Provided Feeling of Being Away. Participants indicated that ViRT-Ta-GO provided the feeling of being away from the facility. VR residents talked about the realistic nature of the landscapes, sounds, and animals. A few residents remarked on the ability of VR to take you right there and provide the feeling of travel. Residents indicated they were immersed in the virtual Grand Canyon environment. For example, one resident stated, "It blew my mind seeing the height of the rocks, but it didn't scare me." Another VR resident commented on how a deer was well hidden in the scenery. Furthermore, VR residents expressed interest in viewing videos of other travel destinations. These suggestions typically accompanied reflections of no longer physically or financially travelling to locations they wanted to see.

VR Evoked Positive Emotions. Participants indicated that participating in VR evoked positive emotions beyond excitement and enjoyment, such as joy, eagerness, and contentment. Residents talked about how engaging in VR made them feel happy and good. One resident said, "It made me feel so free. It was so important to me. I loved it and hated to leave." Another said, "I really looked forward to doing it each time."

Residents Want to do VR Again and Would Recommend to Friends and Other NHs. Compared to other NH activities, residents felt that participating in VR was as good as or better than other NH activities. For example, one resident said, "No comparison, this [VR] is much better." Another resident said, "The other activities occur over and over again. I would like to see more VR. I feel we have only seen a smidge of what is available out there." All participants in the study stated they would tell friends to try VR. Residents felt that their friends and other NH residents would enjoy VR, find it interesting, and enjoy how it feels to be there.

VR Perceived as Useful. All but one participant perceived VR as useful in improving their mood and ability to relax. One resident stated, "I think it helps me, especially if I feel bad." Another resident said, "It is a way for me to deal with it [life in an NH]." Three other residents said VR, "perked my day up," "lifted my spirits," and "made it [mood] better." Also, all but one resident expressed that VR aided relaxation. For example, one resident stated, "It helped me relax. It was calming." Another resident said, "I relaxed and was at ease." A different resident commented on how riding in the kayak helped with relaxation.

Barriers

Suggestions for Improvement. The only aspects of ViRT-Ta-GO that residents indicated that they did not like were the length of the sessions, the program's length, and the limited variety of virtual content. Two residents commented that they wished the sessions would have been longer than 10 minutes, and three residents hoped the program would have been longer than a month. When asked what she did not like about VR, one resident commented, "Only that it was repeated. I thought it would be new every day." Only two residents suggested how VR could be improved by replying, "Maybe just have more of it" and "Continue to come longer than just one month."

Discussion

This pragmatic study aimed to pilot test the fully immersive VR intervention, ViRT-Ta-GO, among older NH residents and extend knowledge about its effectiveness on depressive and anxiety symptoms, which has not been previously reported. Preliminary work conducted at an assisted living facility supported this four-week interventional study that focused on delivering the ViRT-Ta-GO program to improve depression and anxiety among older NH residents.

Recruitment of nine participants, the 92% attendance rate, and the 100% retention rate at the end of four weeks documented the feasibility of the ViRT-Ta-GO intervention among older NH residents. Results indicated that VR was well tolerated. Residents found ViRT-Ta-GO an appealing, exciting, and enjoyable experience that they want to do again. These findings are consistent with current literature suggesting fully immersive VR technology in long-term care (Brimelow et al., 2019). Furthermore, ViRT-Ta-GO was acceptable to NH residents as 100% of participants stated they would recommend VR to a friend. No adverse effects were observed during this study.

Unfortunately, there were barriers to recruitment. First, four NHs were invited to participate in this study. However, the operations director from one facility did not respond to postal mail or voicemail invitations sent by the PI. Perhaps, the director was unfamiliar with VR technology or thought the study procedures would interfere dramatically with daily operations. Second, residents from one of the three facilities who agreed to participate showed no interest in the study. Recruitment at this facility may have been affected by residents' unfamiliarity with VR technology and fear of the unknown. Recruitment may also have been affected by nurses' concerns about how the study would impact their existent workload or skepticism regarding the efficacy of using a new technological approach to treat depressive and anxiety symptoms in frail older adults.

This study examined the effects of the four-week fully immersive VR intervention, ViRT-Ta-GO, on depressive and anxiety symptoms in cognitively intact older NH residents. The results indicated that ViRT-Ta-GO is effective in significantly reducing anxiety symptoms ($p < .05$) over four weeks. Furthermore, all but one participant reported that the ViRT-Ta-GO intervention improved their ability to relax. Residents enjoyed the virtual environment and felt it had a calming effect. While not significant $(p = .075)$, a trend decrease in the severity of depressive symptoms was observed in five out of nine residents. The majority ($n = 8$) of participants perceived that the ViRT-Ta-GO intervention positively affected their mood. The calming effect of VR and its perceived positive impact on mood is consistent with previous research among residents in residential care (Moyle, 2018). Perceptions of improved mood and ability to relax emphasize the importance of potentially using VR as a symptom management tool.

Furthermore, the results indicated that the ViRT-Ta-GO program had a large effect ($r = -.48$) on reducing the severity of anxiety symptoms and a moderate effect ($r = -.42$) on the severity of depressive symptoms, which suggests the clinical significance of the intervention in the NH setting.

Residents indicated that engaging in the ViRT-Ta-GO intervention provided a sense of being away or being transported to the Grand Canyon. Perceptions of away suggesting a vacationing component of viewing selected VR content highlights the importance of potentially using VR as a relaxing leisure activity. Furthermore, the post-intervention satisfaction survey data showed that engagement with ViRT-Ta-GO evoked positive emotions such as joy, eagerness, and contentment. Increased joy from viewing VR is consistent with previous research among community-dwelling older adults (Baños et al., 2012). Similarly, another study demonstrated VR induced positive emotions among university students (Baños et al., 2006). The ability of meaningful VR content to elicit positive emotions accentuates the importance of potentially using VR as a positive psychology intervention.

Residents suggested that ViRT-Ta-GO be offered more often with longer exposure time and a wider variety of virtual environments. This, too, is consistent with current literature suggesting that older adults enjoy and tolerate fully immersive VR sessions lasting 15 to 45 minutes for six weeks (Benham et al., 2019). Findings from this small pilot study demonstrated the utility of fully immersive VR within an older NH population, suggesting that it will be advantageous to evaluate ViRT-Ta-GO through controlled clinical trials.

Study Strengths

The strengths of this study include: (a) provided the first study with older NH residents measuring the impact of a fully immersive VR intervention on depressive and anxiety symptoms; (b) included post-intervention survey data to gain insight into residents' perceptions of the VR experience, and (c) demonstrated feasibility and acceptability of the ViRT-Ta-GO intervention.

Study Limitations

Although findings from this pilot study are encouraging, limitations may have affected the results. One limitation was the small sample size, which may have impacted the results' statistical significance. Expanded sample size would increase the possibility of the significance of the results. Another limitation was the nonprobability convenience approach used. Hence, the sample population lacked racial diversity limiting the generalizability of findings. Lastly, the lack of a control group makes it impossible to draw meaningful conclusions about the effects of ViRT-Ta-GO on outcome variables.

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Conclusion

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The creation of ViRT-Ta-GO has been a unique innovation in the use of fully immersive VR technology to decrease depressive and anxiety symptoms among older NH residents. In this small pilot study, indications would suggest that ViRT-Ta-GO positively impacts anxiety among older NH residents. Results surrounding depressive symptoms warrant further investigation. While direct contact with the outdoors is preferred, this study indicates that ViRT-Ta-GO offers a possible adjunct strategy for managing depressive and anxiety symptoms in the NH setting. More rigorous research (i.e., controlled clinical trials) with more substantial and more representative samples are needed to examine ViRT-Ta-GO's effectiveness further.

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CHAPTER SIX

CONCLUSION

The prevalence of depressive and anxiety symptoms in nursing homes (NHs),

their correlation with a disability, and their adverse interaction with physical health

significantly impact the quality of life, well-being, and health-related medical costs of

older residents making this a significant public health concern. NH residents have

expressed that not being able to get out of the facility to engage in outside activities

contributes profoundly to their depressive symptoms (Choi et al., 2008). Virtual reality

therapy (VRT), a type of immersion therapy, has been shown to improve mood and

reduce anxiety, which may, in turn, lead to improved psychological well-being, quality of

life, and emotional functioning. However, the impact of VRT on symptoms of depression

and anxiety among older NH residents has not been previously studied. This dissertation

research led to developing the fully immersive VR intervention, ViRT-Ta-GO, which

stands for Virtual Reality Therapy Takes Greenspace to Older NH Residents. Preliminary

work for the study included a small-scale study to evaluate the feasibility and efficacy of

ViRT-Ta-GO among assisted living residents aged 60 years and older with no more than

mild cognitive impairment and extend knowledge about its use to improve mood in the

long-term care setting. This study did not find a significant change in mood or the

negative mood states of depression and anxiety but suggested the feasibility of using

ViRT-Ta-GO in older residents in assisted living. Based on the preliminary study

findings that identified usability issues with the head-mounted delivery system, user

preferences regarding virtual content, and somewhat burdensome testing procedures,

modifications were made to the ViRT-Ta-GO intervention and study protocol for the

current dissertation research study. This pilot study, using quantitative methods and a post-intervention satisfaction survey, sought to examine the feasibility and the effectiveness of a fully immersive VR intervention on symptoms of depression and anxiety in older NH residents without cognitive impairment. This is the first study to examine the effect of a fully immersive VR nature experience on depressive and anxiety symptoms in the older NH population. Key findings include residents found fully immersive VR exciting and enjoyable; VR provided the feeling of being away from the facility; residents perceived that VR positively impacted their mood and ability to relax; and VR evoked positive emotions. ViRT-Ta-GO significantly improved anxiety with no significant effect on the severity of depressive symptoms. More importantly, older NH residents have expressed interest in ViRT-Ta-GO as an activity they want to engage in again. An encouraging finding was the non-significant trend for reduced severity of depressive symptoms pre-intervention to post-intervention. This study indicates that fully immersive ViRT-Ta-GO may be a feasible and enjoyable adjunct strategy for managing depressive and anxiety symptoms in the NH setting.

The findings fall within Folkman's (1997; 2008) revised stress and coping model in that a positive event like those generated with VR may provide a psychological time-out from the ongoing stress associated with living in an NH, and thereby, may facilitate adaptive coping. Residents perceived a sense of being away from the facility while engaging in VR and expressed positive emotions following the intervention. Positive emotions that occur during periods of stress help restore psychological well-being (Folkman, 2008). Stress, particularly chronic stress, contributes to developing depressive and anxiety symptoms (Tafet & Bernardini, 2003).

Implications

Findings from this dissertation research are promising in that ViRT-Ta-GO presents a possible adjunct strategy for managing depressive and anxiety symptoms in the NH setting. VR interventions can serve as a cost-effective alternative to direct contact with the outdoors when inclement weather, lack of readily accessible green space, limited availability of staff, or residents' physical limitations hinder engagement in outside activities. Therefore, NHs should consider implementing pleasant VR activities to promote positive emotions in their residents' daily lives. Findings from this research suggest that fully immersive VR interventions like ViRT-Ta-GO can reduce depressive and anxiety symptoms commonly seen in NH residents. Future research should investigate how VR helps residents generate positive emotions and further explore their adaptational significance on psychological and physiological outcomes such as depression, anxiety, and stress.

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APPENDICES

Appendix A: Literature Review Matrix

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Appendix W: Geriatric Anxiety Inventory (GAI)

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Appendix Y: Post-Intervention Satisfaction Survey-Pilot Study

Literature Review Matrix

Study & Location	Sample & Setting	Methods	Intervention	Results
Benham et al., 2019 United States	N: 12 Age range: NR Mean age: 70.2 % female: 66.7 % Non-Caucasian: NR Disease/Condition: Pain Setting: Senior day center	Design: Mixed Methods; pretest-posttest; feasibility Follow up: NR % Attrition: 0 Control: None Measures: PROMIS, WHOQOL-BREF, open-ended survey	Theory: NR Primary Outcomes: Pain Secondary Outcomes: Depression, QOL Approach: Distraction Intervention: activities/games-pets, exploration of animals, interactive music games, and travel from *Viveport* or *Steam VR* website libraries. Delivery: *HTC Vive* HMD, two hand controllers, computer monitor display Type of VR: Fully immersive Dose: twelve 15-45-minute sessions over 6 weeks	Quantitative Findings: Significant decrease in pain ($p = .002$) No effect on depression and QOL Effect size: Large (Cohen's $d = -1.54$) Qualitative Findings: 100% reported positive experiences 100% reported VR positively affected pain levels 91.7% would continue to use VR if had chance 100% would recommend VR to others 47.1% experienced an undesirable symptom, but could be avoided Immersion/Sense of Presence: Not measured Adverse reactions: 4 reported symptoms of nausea & dizziness 1 reported neck discomfort Other findings: suggests VR may be a feasible, enjoyable method for the management of pain Strengths: length and duration of sessions reported; quantitative & qualitative data Limitations: Small sample size, no control, no follow up
Brimelow et al., 2019 Australia	N: 13 Age range: 66-93 Mean age: 82 % female: 69 % Non-Caucasian: NR Disease/Condition: Dementia	Design: Mixed Methods; pretest-posttest; feasibility Follow up: none % Attrition: 0 Control: None Measures: OERS, PEAR, structured interview	Theory: NR Primary Outcomes: Engagement, mood and apathy Secondary Outcomes: feasibility Approach: Leisure activity (relaxing)	Quantitative Findings: Significantly reduced apathy (Z=-2.818, p = 0.005; trend increase in pleasure (z = -1.725, p = 0.084) and general alertness (z = -1.639, p = 0.101); no impact on observed emotion measures; no significant increase in fear/anxiety. Effect size: NR

			Intervention: Preloaded VR library consisting of relaxing scenes, such as underwater themes, beaches, farmyard animals, travel destinations, and snowscapes created for aged care industry. Delivery: Samsung Galaxy S7 phone and Gear VR HMD Type of VR: Fully immersive Dose: One 4-5 min. session; choice of group or individual session	Qualitative Findings: VR was enjoyable with low levels of physical and emotional discomfort; 12 wanted VR again; reminiscence was observed; Immersion/Sense of Presence: Not measured. Adverse reactions: 2 reported blurred vision; 1 said HMD was slightly uncomfortable & slid down; During an acute episode, 1 said VR made her ''giddy,'' Other findings: VRI not helpful during episodes of acute neuropsychiatric and behavioral symptoms. Suggests feasibility of using immersive VR in older adults with and without dementia. Remarks on reminiscence. Strengths: quantitative & qualitative data Limitations: Small sample, no control, one session, no follow up
	Setting: Residential Care			
McDonald et al., 2012 United States	N: 18 Age range: 60-82 Mean age: 68.1 % female: 94.4 % Non-Caucasian: 18.2 Disease/Condition: Pain Setting: Ambulatory Care	Design: RCT; pilot Follow up: none % Attrition: 38 Control: Pain communication education-only group Measures: BDI, Brief Pain Inventory	Theory: Communication Accommodation Primary Outcomes: Pain and depression Secondary outcomes: None Approach: Patient education (re: pain communication/self-management) Intervention: Virtual pain coach & 3-min pain communication education video Delivery: Laptop computer screen Type of VR: Non-immersive Dose: NR	Quantitative Findings: No significant difference for pain or depressive symptoms at posttest (1 month later). Effect size: NR Qualitative Findings: Content analysis for virtual pain group coach responses only. Immersion/Sense of Presence: NR Adverse reactions: NR Other findings: More older adults in the virtual pain coach group reported a change from nonuse to use of opioids at 1 month, 50% vs 0% of the education only group, Fisher's exact test, $P = 0.023$. Strengths: control group Limitations: small sample size; sample primarily female; no follow-up; relatively large

|				attrition rate; no feedback about VRI
McDonald et al., 2013 United States	N: 23 Age range: NR Mean age: 74.3 % female: 82.6 % Non-Caucasian: 17.4 Disease/Condition: Pain Setting: Primary Care	Design: RCT; pilot Follow up: none % Attrition: 8 Control: Pain communication education-only group Measures: BDI, Brief Pain Inventory	Theory: Communication Accommodation Primary Outcomes: Pain and depression Secondary outcomes: None Approach: Patient education (re: pain communication/self-management) Intervention: Virtual pain coach & 3-min pain communication education video Delivery: Laptop computer Type of VR: Non-immersive Dose: NR	Quantitative Findings: No significant differences. A nonsignificant trend in pain intensity and depressive symptoms reduction resulted in VR group 1 month later. Effect size: NR Qualitative Findings: Content analysis for virtual pain group coach responses only. Immersion/Sense of Presence: NR Adverse reactions: NR Other findings: VR group described significantly more pain source information and were prescribed significantly more osteoarthritis pain treatments than older adults in the control group. Strengths: Control group Limitations: Small sample size; sample primarily female; no follow up; no feedback about VRI
Moyle, 2018 Australia	N: 10 Age range: NR Mean age: 89 % female: 70 % Non-Caucasian: NR Disease/Condition: Dementia Setting: Residential Care	Design: Mixed Methods; pilot study Follow up: None % Attrition: NR Control: none Measures: OERS, PEAR, Types of Engagement, and semi-structured interview	Theory: NR Targeted Outcomes: Engagement, apathy, mood states Secondary outcomes: None Approach: Engagement Intervention: Virtual Reality Forest (VRF) Activity. Delivery: High-definition television screen Type of VR: Non-immersive Dose: One session; up to 15-min max.	Quantitative Findings: more pleasure ($p = .008$) & greater level of alertness ($p < .001$) & greater level of fear/anxiety compared to normative sample ($p = .016$). Effect size: NR Qualitative Findings: perceived by majority of residents (n=6), family members (n=9), and staff to have a positive effect (n=9). Some family and staff noted improvements in residents' mood. Staff also noted the calming effect of VR. Immersion/Sense of Presence: Not measured Adverse reactions: NR Other findings: Most residents used VR for 5-10 minutes (not

				15 minutes) perhaps due to boredom or fatigue. Remarks on reminiscence. Strengths: quantitative & qualitative data Limitations: small sample size; sample primarily female; no control; no follow up; inconsistencies between two sites where intervention was delivered; only one session.
Reynolds et al., 2018 United States	N: 14 Age range: NR Mean age: 85.5 females; 84.7 males % female: 57 % Non-Caucasian: 7 Disease/Condition: Dementia Setting: Memory unit in assisted living facility	Design: Counterbalanced Crossover; pilot Follow up: None % Attrition: 12.5 Control: Generational movie in typical style room Measures: OERS, ABS	Theory: NR Targeted Outcomes: Emotions, anxiety, agitation Secondary outcomes: NR Approach: Stress-restoration (reduce negative emotions) Intervention: Nature video showing waterfall in foreground & mountains in background, with natural sounds Delivery: 65-inch high definition television Type of VR: Non-immersive Dose: Three 1-hour sessions in both conditions (treatment and control); alternating exposure days; 1-day washout period b/t treatment and control interventions, and a week between trials of interventions.	Quantitative Findings: Significant decrease in HR (p =0.03), agitation (P=0.003), and anger (p=0.028) after VR. Nonsignificant increase in pleasure and decreased anxiety within only 10 minutes of VR exposure was observed. Effect size: NR Qualitative Findings: During VR, 5 comments r/t agitation and anxiety, 15 r/t pleasure, 8 r/t reminiscence, and 4 actions demonstrating relaxation and falling asleep. Immersion/Sense of Presence: NR Adverse reactions: NR Other findings: Indicates VRI can reduce stress, negative emotions & increase pleasure. Remarks on reminiscence. Strengths: Control intervention comparison; Limitations: Small sample size; no follow up
Shaunfield et al., 2014 United States	N: 21 Age range: 63-99 Mean age: 85.1 % female: 86	Design: Quasi-experimental; one-group; pretest-posttest; feasibility Follow-up: None % Attrition: 29	Theory: Self-determined motivation Targeted outcomes: Depressive symptoms, social support, general physical & mental health Secondary outcomes:	Quantitative Findings: significant improvement in mental health subscale (p < .011). Nonsignificant decrease in depressive symptoms (3.66 to 2.46, respectively) & improvements in physical health and social support, pretest to posttest.

	% Non-Caucasian: 0 Disease/Condition: Adults living in long term care Setting: Assisted Living	Control: None Measures: GDS-15, LSNS, SF-12	Approach: Engagement Intervention: Theme-related VR field trips and face-to-face visits Delivery: For VR aspect of intervention, laptop computers with internet access; secure website, big screen T.V., and web-based videoconferencing platform (Virtual Interactive Families) were used. Type of VR: Non-immersive Dose: A series of theme-based activities delivered over 4 weeks with a different theme each week	Effect size: NR Qualitative Findings: None Immersion/Sense of Presence: NR Adverse reactions: NR Other findings: Demonstrates viability of VR as part of resident care. Remarks on reminiscence. Strengths: Duration of intervention Limitations: Small sample size; sample primarily female; relatively large attrition rate; no control; no follow up

Note. ABS = Agitated Behavior Scale; BDI = Beck's Depression Inventory; GDS-15 = Geriatric Depression Scale-15; HMD = head-mounted display; HR = heart rate; LSNS = Lubben Social Network Scale; PEAR = Person-Environment Apathy Rating Scale; PROMIS = Patient-Reported Outcomes Measurement Information System Depression Scale; PTSD = post-traumatic stress disorder; N/A = not applicable; NR = not reported; OERS = Observed Emotion Rating Scale; QOL = quality of life; RCT = randomized controlled trial; SF-12 = Short Form Health Survey; VR = virtual reality; VRF = Virtual Reality Forest; VRI = virtual reality intervention; WHOQOL-BREF = World Health Organization Quality of Life Scale.

APPENDIX B

PRISMA Diagram Flowsheet
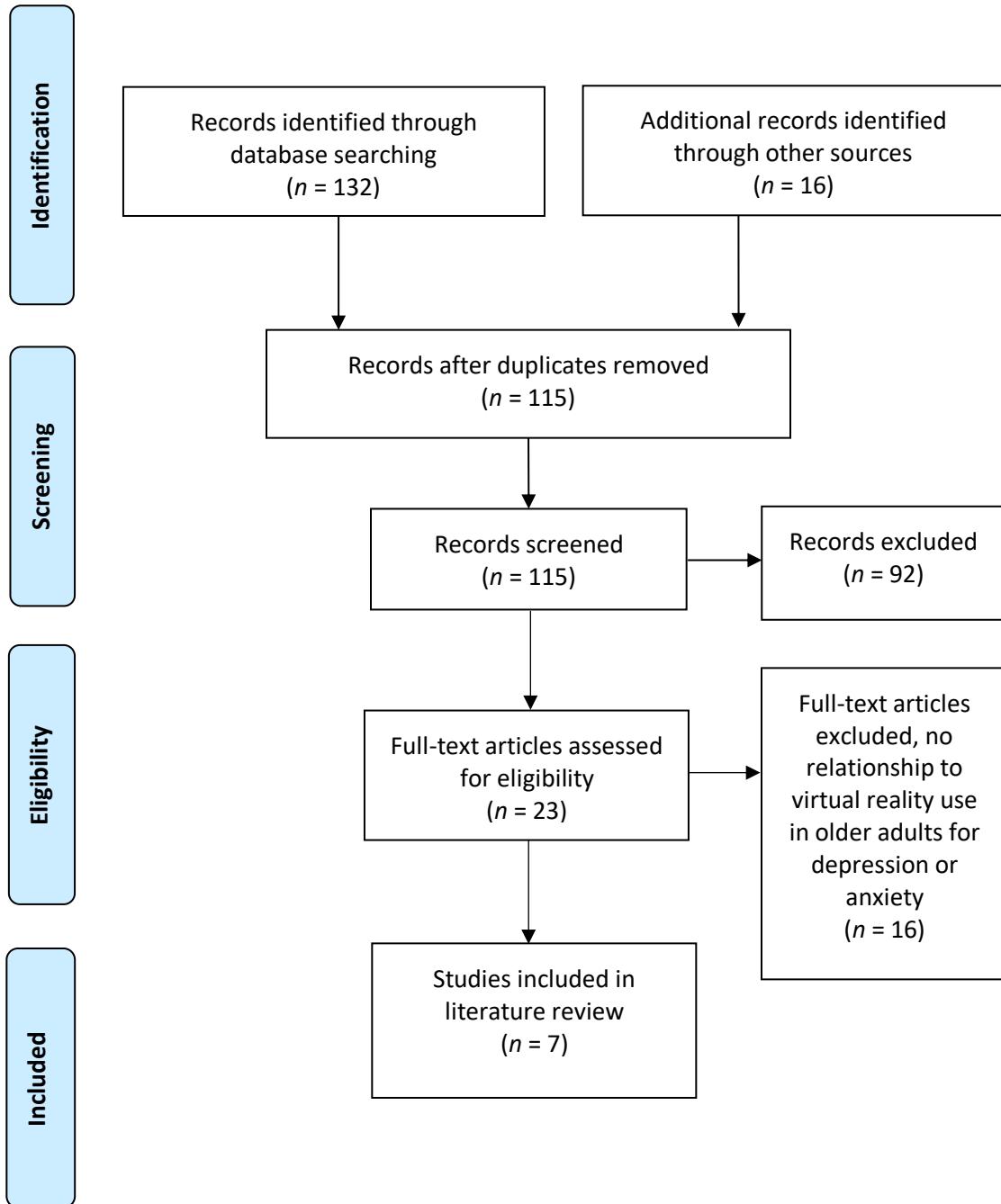
Recruitment Flyer for Preliminary Study

Older Adults Needed for Study Using Virtual Reality

Thursday August 16ᵗʰ 6 p.m. – 8 p.m.
Friday August 17ᵗʰ 9 a.m. – 10 a.m.

WHAT ARE THE GOALS FOR THIS RESEARCH STUDY?

- The purpose of this research study is to evaluate the feasibility and acceptability of immersive virtual reality nature experiences among senior housing residents.

WHO CAN BE A PART OF THIS RESEARCH STUDY?

Residents at TigerPlace who:

- Are 60 years or older
- Speak English
- Express a willingness to participate
- Have no more than minimal cognitive impairment
- Do not have a history of seizures, or recent head, neck, or eye surgery or injury
- Are not legally blind

WHAT WILL PARTICIPANTS BE ASKED TO DO?

- Wear a virtual reality headset which allows you to view yourself outdoors and in pleasant settings.
- Complete questionnaires and brief interview.

I WANT TO HELP! HOW DO I SIGN UP?

- If you are interested in participating in this study or want to learn more about it, please place your name on the sign-up sheet located at the front desk.

MU Health
University of Missouri

APPENDIX D

Consent to Participate in Preliminary Study-Page 1

CONSENT FORM TO PARTICIPATE IN A RESEARCH STUDY

Researcher's Name(s): Jody Blankenship, BSN, RN (PI) and Dr. Kane Lane, PhD, RN (co-investigator)

Project Number: 2011364

Project Title: ViR-Ta-GO: Virtual reality experiences of nature among senior housing residents with depressive symptoms, a feasibility study

INTRODUCTION

This consent may contain words that you do not understand. Please ask the investigator or the study staff to explain any words or information that you do not clearly understand.

You are being asked to participate in a research study. This research is being conducted to evaluate the suitability and acceptability of virtual reality nature experiences among senior housing residents. When you are invited to participate in research, you have the right to be informed about the study procedures so that you can decide whether you want to consent to participation. This form may contain words that you do not know. Please ask the researcher to explain any words or information that you do not understand.

You have the right to know what you will be asked to do so that you can decide whether or not to be in the study. Your participation is voluntary. You do not have to be in the study if you do not want to. You may refuse to be in the study and nothing will happen. If you do not want to continue to be in the study, you may stop at any time without penalty or loss of benefits to which you are otherwise entitled.

This research is funded by personal funds from the Principle Investigator.

WHY IS THIS STUDY BEING DONE?

The purpose of this research is to evaluate the suitability and acceptability of virtual reality nature experiences among senior housing residents.

HOW MANY PEOPLE WILL BE IN THE STUDY?

About 3-5 people will take part in this study.

WHAT AM I BEING ASKED TO DO?

You will be asked to complete the Montreal Cognitive Assessment Scale to determine if you meet the criteria to participate in this study. This test checks for mild cognitive dysfunction and takes about 10 minutes to complete. For this study, you will also be asked to complete the Profile of Mood States Adult questionnaire before and immediately after the virtual reality session. This survey which asks about your feelings and affect takes about 3-5 minutes to complete. When you are ready, you will be introduced to the head-mounted display system which is a device worn over the eyes like a large pair of goggles. You will be given to opportunity to hold the apparatus, ask questions, and voice concerns. Once all questions and concerns are addressed to your satisfaction, you will be asked to choose one of four virtual environments and the head-mounted display will be fitted to your head. You will remain in a seated

MU IRB: CONSENT

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position while wearing the head-mounted display system. With the head-mounted device on, you will see a natural landscape and hear natural sounds. You may also choose to use the audio meditation guide option. Verbal instructions will be given on how to navigate the system and how to stop the session by verbally saying "stop" or signaling stop by raising your hand. The investigator will stop the session early if you become overly upset or distressed and ask you if you need to take a break. The investigator will remain in the room with you for the entire session and will continue to answer questions and address concerns. The virtual reality session will last 10 minutes unless stopped by you or the investigator. Sessions will not be video-taped or audio-recorded. After the session is complete, the investigator will ask you 10 questions about your virtual reality experience. This will take about 3-5 minutes to complete. With your consent, the following information will be collected from your medical record: demographics, length of stay, chronic conditions/diagnoses, medications used to treat symptoms of depression, anxiety, and impaired sleep, and length of time taking these medications.

HOW LONG WILL I BE IN THE STUDY?

This is a one-session study that will take about approximately 30 – 40 minutes to complete. You can stop participating at any time without penalty.

WHAT ARE THE BENEFITS OF BEING IN THE STUDY?

During and after participating in this study, you may experience a state of relaxation and improved mood. If the findings of the proposed project show that virtual reality interventions are suitable and acceptable to older senior housing residents, results will be used to develop further virtual reality interventions that are aimed at reducing depressive symptoms in older nursing home residents.

WHAT ARE THE RISKS OF BEING IN THE STUDY?

There is minimal risk that you may experience "simulator sickness" which can occur with virtual reality applications. Symptoms of simulator sickness mimic those of motion sickness but are usually less severe and have a low incidence.

There is minimal risk of spread of skin infection. Furthermore, wearing a head-mounted display may cause physical discomfort because of its weight or emotional discomfort in the form of increased anxiety because the eyes are covered, however, this is unlikely.

WHAT ARE THE COSTS OF BEING IN THE STUDY?

There is no cost to you.

WHAT OTHER OPTIONS ARE THERE?

You also have the option of not participating in this study and will not be penalized for your decision.

CONFIDENTIALITY

Information produced by this study will be stored in the investigator's file and identified by a code number only. The code key connecting your name to specific information about you will be kept in a

MU IRB: CONSENT

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Approval Date: July 11, 2018
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Consent to Participate in Preliminary Study-Page 3

separate, secure location. Information contained in your records may not be given to anyone unaffiliated with the study in a form that could identify you without your written consent, except as required by law.

WILL I BE COMPENSATED FOR PARTICIPATING IN THE STUDY?

You will receive no payment for taking part in this study.

WHAT ARE MY RIGHTS AS A PARTICIPANT?

Participation in this study is voluntary. You do not have to participate in this study.

You will also be informed of any new information discovered during the course of this study that might influence your health, welfare, or willingness to be in this study.

WHO DO I CONTACT IF I HAVE QUESTIONS, CONCERNS, OR COMPLAINTS?

Please contact Jody Blankenship, BSN, RN at jsbfb3@mail.missouri.edu or 814-594-8004 if you have questions about the research. Additionally, you may ask questions, voice concerns or complaints to the research team (Dr. Kari Lane at 573-882-0285).

WHOM DO I CALL IF I HAVE QUESTIONS OR PROBLEMS?

If you have any questions regarding your rights as a participant in this research and/or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study, you may contact the University of Missouri Campus Institutional Review Board (which is a group of people who review the research studies to protect participants' rights) at (573) 882-9585 or umcresearchcirb@missouri.edu.

You may ask more questions about the study at any time. For questions about the study or a research-related injury, contact Jody Blankenship, RN at 814-594-8004 or Dr. Kari Lane at 573-882-0285.

A copy of this Informed Consent form will be given to you before you participate in the research.

SIGNATURES

I have read this consent form and my questions have been answered. My signature below means that I do want to be in the study. I know that I can remove myself from the study at any time without any problems.

_____   _____
Subject   Date

_____   _____
Witness   Date

*The presence and signature of an impartial witness is required during the entire informed consent discussion if the subject or subject's legally authorized representative is unable to read.

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Expiration Date: July 11, 2019

APPENDIX E

HIPAA Authorization Form-Page 1

UNIVERSITY OF MISSOURI-COLUMBIA
Institutional Review Board

HIPAA AUTHORIZATION FORM

**Authorization for the Use and Disclosure of Personal Health Information
Resulting from Participation in a Research Study**

Project Title: ViR-Ta-GO: Immersive virtual reality experiences of nature among senior housing residents, a feasibility study

Principal Investigator's Name: Jody S. Blankenship, RN, BSN

Project # 2011364

Purpose:
State and federal privacy laws protect the use and release of your health information. If you decide to give your permission to participate in the study listed above, you must sign this form as well as the Consent Form. This form describes the different ways that the researcher, the study team and the sponsor may use your health information for the research study. Signing this authorization is completely voluntary.

1. **Description of your Protected Health Information that is to be used:**
My authorization applies to the information described below. **By law,** the information must be limited to the minimum necessary information needed to accomplish the purpose of the research.
☒ Name
☒ Contact information such as address, phone number
☒ Demographic information such as age, race etc.
☒ Chronic conditions/diagnoses
☒ Medications (and length of time taking medications)
☒ Questionnaires and/or Surveys
☒ Other (please list) _Length of Stay_____

2. **Permission for certain specific uses:**
If any of the following information will be <u>released</u> you must initial to give your permission:
____ I agree to release of information pertaining to drug and alcohol abuse, diagnosis or treatment
____ I agree to release of information of HIV/AIDS testing information
____ I agree to release of genetic testing information
____ I agree to release of information pertaining to mental health diagnosis or treatment as follows:
_____

3. **Who may receive your information?**
The primary investigator listed at the top and the study team may use and/or disclose your information to the following person(s) or class of persons:
Compliance and Safety Monitors, the MU Health Sciences Institutional Review Board, Government agencies, the sponsor
☐ Other: Dr. Kari Lane and Sinclair School of Nursing Statistician

4. **Purpose of the use or disclosure**
My PHI will be used and/or disclosed upon request for the following purposes:
Publications and presentation that will not identify me, study outcomes including safety and efficacy

HIPAA Authorization

IRB USE ONLY
Acknowledged Date: July 11, 2018

Page 1

APPENDIX E

HIPAA Authorization Form-Page 2

5. Expiration date or event

Unless you revoke (take back) your authorization, your authorization will allow us to use and/or disclose your information will

☒ There will be no expiration date (for example when creating a database)

☐ Other: _____

6. Your right to revoke or withdraw authorization

I understand that I have a right to revoke this authorization at any time. My revocation must be in writing in a letter sent to the Principal Investigator at 6958 Highland Road, Kane, PA, 16735. I am aware that my revocation is not effective to the extent that the persons I have authorized to use and/or disclose my PHI have already acted in reliance upon this authorization.

7. Statement that re-disclosures are no longer protected by the HIPAA Privacy Rule

I understand that my personal health information will only be used as described in this authorization in relation to the research study. I am also aware that if I choose to share the information defined in this authorization to anyone not directly related to this research project, the law would no longer protect this information. In addition, I understand that if my personal health information is disclosed to someone who is not required to comply with privacy protections under the law, then such information may be re-disclosed and would no longer be protected.

8. Right to refuse to sign authorization and ability to condition treatment, payment, enrollment or eligibility for benefits for research related treatment

I understand that I have a right not to authorize the use and/or disclosure of my personal health information. In such a case I would choose not to sign this authorization document I understand I will not be able to participate in a research study if I do not do so. I also understand that treatment that is part of the research project will be conditioned upon my authorization for the use and/or disclosure of my personal health information to and for use by the research team.

9. Suspension of right to access personal health information

I agree that I will not have a right to access my personal health information obtained or created in the course of the research project until the end of the study.

10.

If I have not already received a copy of the University of Missouri Healthcare Privacy Notice, I may request one. If I have any questions or concerns about my privacy rights I should contact, the HS Privacy Officer at 573-882-9054 or the Campus Privacy Officer at 573-882-9500.

11. Individuals' signature and date

I certify that I have received a copy of the authorization.

_____   _____
Signature of Research Participant   Date

_____   _____
Research Participant's Legally Authorized Representative   Date

_____
Describe Representative Authority to Act for the Participant

Montreal Cognitive Assessment Test (MoCA)

MONTREAL COGNITIVE ASSESSMENT (MOCA®)
Version 8.1 English

Name:
Education:
Sex:
Date of birth:
DATE:

VISUOSPATIAL/EXECUTIVE		POINTS
(Trail making: E-End, A, 5, B, 2, 1-Begin, D, 4, 3, C) [ ] Copy cube [ ] Draw CLOCK (Ten past eleven) (3 points) [ ] Contour [ ] Numbers [ ] Hands		__ /5

NAMING

(Lion) [ ]   (Rhinoceros) [ ]   (Camel) [ ]   __ /3

MEMORY			FACE	VELVET	CHURCH	DAISY	RED	
Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.		1ST TRIAL						NO POINTS
		2ND TRIAL						

ATTENTION	Read list of digits (1 digit/ sec.).	Subject has to repeat them in the forward order. [ ] 2 1 8 5 4	__ /2
		Subject has to repeat them in the backward order. [ ] 7 4 2	

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors	__ /1
[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B	

Serial 7 subtraction starting at 100.	[ ] 93	[ ] 86	[ ] 79	[ ] 72	[ ] 65	__ /3
	4 or 5 correct subtractions: 3 pts,		2 or 3 correct: 2 pts,	1 correct: 1 pt,	0 correct: 0	

LANGUAGE	Repeat: I only know that John is the one to help today. [ ]	__ /2
	The cat always hid under the couch when dogs were in the room. [ ]	

Fluency: Name maximum number of words in one minute that begin with the letter F.	[ ] _____ (N ≥ 11 words)	__ /1

ABSTRACTION	Similarity between e.g. banana - orange = fruit [ ] train - bicycle [ ] watch - ruler	__ /2

DELAYED RECALL	(MIS)	Has to recall words WITH NO CUE	FACE [ ]	VELVET [ ]	CHURCH [ ]	DAISY [ ]	RED [ ]	Points for UNCUED recall only	__ /5
Memory Index Score (MIS)	X3								
	X2	Category cue						MIS = _____ /15	
	X1	Multiple choice cue							

ORIENTATION	[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City	__ /6

© Z. Nasreddine MD
Administered by: _____
Training and Certification are required to ensure accuracy

www.mocatest.org

MIS: /15
(Normal ≥ 26/30)
Add 1 point if ≤ 12 yr edu

TOTAL __ /30

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APPENDIX G

Permission for MoCA

Hello Jody,

Thank you for the additional information.

You are welcome to use the MoCA© Test as you described below with no further permission requirements.

No changes or adaptations to the MoCA© Test and instructions are permitted.
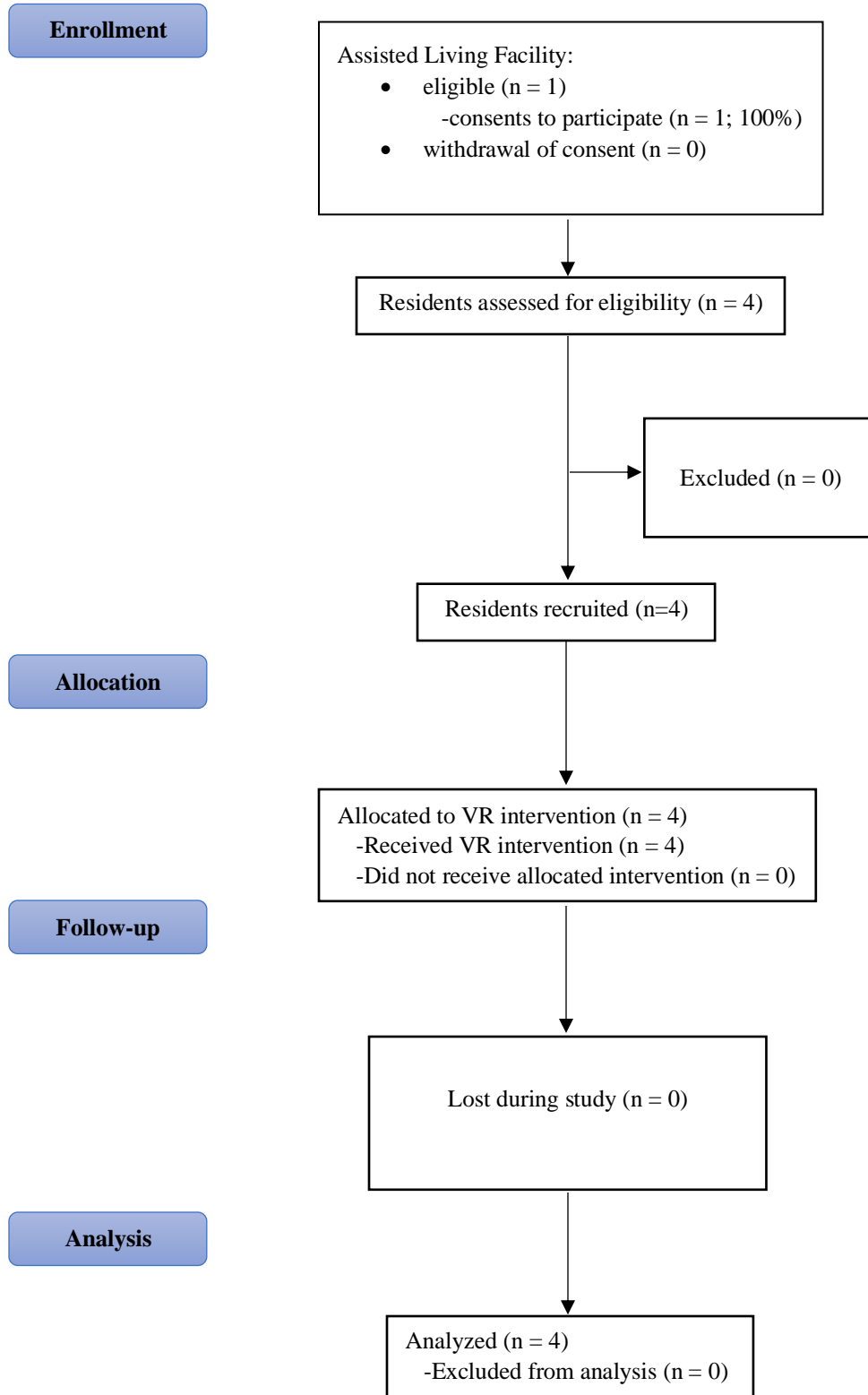
All the best,

Kathleen Gallant, MSOT
Occupational Therapist/ Psychometrician
On behalf of Dr Ziad Nasreddine, Neurologist, MoCA© Copyright Owner
MoCA Clinic & Institute
4896 Taschereau Blvd, suite 230
Greenfield Park, Quebec, Canada, J4V 2J2
Tel : (450) 672-7766 #222 Fax : (450) 672-3899
kathleen.gallant@mocaclinic.ca
www.mocatest.org / www.alzheimer.TV

Get the latest Alzheimer News, brought to you by the MoCA Clinic and Institute:

APPENDIX H

Flowchart of Participant Progression Through Preliminary Study

Assisted Living Facility:
- eligible (n = 1)
    - -consents to participate (n = 1; 100%)
- withdrawal of consent (n = 0)

Residents assessed for eligibility (n = 4)

Excluded (n = 0)

Residents recruited (n=4)

Allocation

Allocated to VR intervention (n = 4)
-Received VR intervention (n = 4)
-Did not receive allocated intervention (n = 0)

Follow-up

Lost during study (n = 0)

Analysis

Analyzed (n = 4)
-Excluded from analysis (n = 0)

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Preliminary Study IRB Approval-Page 1

Institutional Review Board
University of Missouri-Columbia
FWA Number: 00002876
IRB Registration Number: 00000731

482 McReynolds Hall
Columbia, MO 65212
573-882-3181
irb@missouri.edu

July 11, 2018

Principal Investigator: Jody S Blankenship
Department:

Your IRB Application to project entitled ViR-Ta-GO: Virtual Reality Experiences of Nature among Senior Housing Residents with Depressive Symptoms: A Feasibility Study, was reviewed and approved by the MU Institutional Review Board according to the terms and conditions described below:

IRB Project Number	2011364
IRB Review Number	237224
Initial Application Approval Date	July 11, 2018
IRB Expiration Date	July 11, 2019
Level of Review	Expedited
Application Status	Approved
Project Status	Active - Open to Enrollment
Expedited Categories	45 CFR 46.110.a(f)(7)
Risk Level	Minimal Risk
Type of Consent	Written Consent
HIPAA Category	HIPAA Authorization
Internal Funding	Personal funds
Protocol Version/Date	2011364 - 2 - April 23, 2018
Approved Documents	HIPAA Authorization Informed Consent Profile of Mood States V2 Adult Short Form. Virtual reality experience questionnaire Demographic and health-related questionnaire Potential participant sign up sheet VR study protocol Recruitment flyer Montreal Cognitive Assessment TEst TigerPlace permission letter

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:

1. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.

APPENDIX I

Preliminary Study IRB Approval-Page 2

2. All unanticipated problems must be reported to the IRB on the Event Report within 5 business days of becoming aware of the problem. Unanticipated problems are defined as events that are unexpected, related or possibly related to the research, and suggests the research places subjects or others at a greater risk of harm than was previously known or recognized. If the unanticipated problem was a death, this is reportable to the IRB within 24 hours on the Death Report.
3. On-site deaths that are not unanticipated problems must be reported within 5 days of awareness on the Death Report, unless the study is such that you have no way of knowing a death has occurred, or an individual dies more than 30 days after s/he has stopped or completed all study procedures/interventions and required follow-up.
4. All deviations (non-compliance) must be reported to the IRB on the Event Report within 5 business days of becoming aware of the deviation.
5. All changes must be IRB approved prior to implementation unless they are intended to reduce immediate risk. All changes must be submitted on the Amendment Form.
6. All recruitment materials and methods must be approved by the IRB prior to being used.
7. The Continuing Review Report (CRR) must be submitted to the IRB for review and approval at least 30 days prior to the project expiration date. If the study is complete, the Completion/Withdrawal Form may be submitted in lieu of the CRR.
8. Securely maintain all research records for a period of seven years from the project completion date or longer depending on the sponsor's record keeping requirements.
9. Utilize the IRB stamped consent documents and other approved research documents located within the document storage section of eCompliance. These documents are highlighted green.

If you have any questions, please contact the IRB at 573-882-3181 or irb@missouri.edu.

Thank you,
MU Institutional Review Board

APPENDIX J

Profile of Mood States (POMS 2-A)

POMS2 – Adult Short

By Juvia P. Heuchert, Ph.D. & Douglas M. McNair, Ph.D.

Name/ID: _____

Administration Date MM DD Y Y Y Y

Administration Time H H M M ○ AM ○ PM

Birth Date MM DD Y Y Y Y   Age: _____   Gender: ○ Male ○ Female

Shade circles like this: ○   Not like this: ○ ○ ○ ○

To the Respondent:
Below is a list of words that describe feelings that people have. Please read each word carefully, then shade in the circle that best describes:

how you have been feeling during the PAST WEEK, INCLUDING TODAY.

Shade circles like this: ○   Not like this: ○ ○ ○ ○

Columns: Not at all / A little / Moderately / Quite a bit / Extremely

		Not at all	A little	Moderately	Quite a bit	Extremely			Not at all	A little	Moderately	Quite a bit	Extremely
1.	Friendly	0	1	2	3	4	18.	Nervous	0	1	2	3	4
2.	Tense	0	1	2	3	4	19.	Miserable	0	1	2	3	4
3.	Angry	0	1	2	3	4	20.	Muddled	0	1	2	3	4
4.	Worn out	0	1	2	3	4	21.	Bitter	0	1	2	3	4
5.	Lively	0	1	2	3	4	22.	Exhausted	0	1	2	3	4
6.	Confused	0	1	2	3	4	23.	Anxious	0	1	2	3	4
7.	Considerate	0	1	2	3	4	24.	Good-natured	0	1	2	3	4
8.	Sad	0	1	2	3	4	25.	Helpless	0	1	2	3	4
9.	Active	0	1	2	3	4	26.	Weary	0	1	2	3	4
10.	Grouchy	0	1	2	3	4	27.	Bewildered	0	1	2	3	4
11.	Energetic	0	1	2	3	4	28.	Furious	0	1	2	3	4
12.	Panicky	0	1	2	3	4	29.	Trusting	0	1	2	3	4
13.	Hopeless	0	1	2	3	4	30.	Bad-tempered	0	1	2	3	4
14.	Uneasy	0	1	2	3	4	31.	Worthless	0	1	2	3	4
15.	Unable to concentrate	0	1	2	3	4	32.	Vigorous	0	1	2	3	4
16.	Fatigued	0	1	2	3	4	33.	Uncertain about things	0	1	2	3	4
17.	Helpful	0	1	2	3	4	34.	Drained	0	1	2	3	4
							35.	Enthusiastic	0	1	2	3	4

Please ensure you have answered every item.
Thank you for completing this questionnaire.

6607368

6607368

APPENDIX K

Permission for POMS 2-A

Date: Tue, Jul 3, 2018, 8:53 AM
Subject: Case Update: 18737 - MHS Customer ID #222090
To: <nancy@birtley.net>

≋ MHS®
A S S E S S M E N T S

Update for Case 18737 - "MHS Customer ID #222090"

Dear Nancy Birtley,

Thank you creating an account on MHS.com!

Your account credentials are as below and your account number is 222090
Based on your qualification form, you have been approved to purchase B-Level assessments.

APPENDIX L

Post-Intervention Satisfaction Survey-Preliminary Study

POST-INTERVENTION SATISFACTION SURVEY   Participant ID # _____

Study Number: 2011364

PERSON-LEVEL BARRIERS/FACILITATORS	RESPONSES
How would you describe the overall virtual reality experience?	
What did you like most about virtual reality?	
What did you like least about virtual reality?	
How would you describe the visual appearance of the virtual environments?	
How does virtual reality compare to other activities?	
How did the meditation guide enhance the virtual reality experience?	
What would you tell a friend who may be interested in trying virtual reality?	
How did virtual reality affect your mood?	
How did virtual reality affect your ability to relax?	
How could virtual reality be improved?	

APPENDIX M

Demographic and Health Form

DEMOGRAPHIC AND HEALTH FORM

Study Number: 2011364

Participant ID # _____

Age ____ Sex ____ Race _____

Relationship Status _____

Length of stay _____

Medication	Dose	Frequency	Reason for Medication	Date Started

APPENDIX N

Facility Recruitment Letter

Sinclair School of Nursing
University of Missouri

July 29, 2019

Jody S. Blankenship, RN, BSN
6958 Highland Rd.
Kane, PA 16735
Phone: (814) 594-8004
E-mail: jsbfb3@mail.missouri.edu

Facility Name Here

Dear *Operations Director Name Here*|

I am a graduate student enrolled in the PhD program at the University of Missouri Sinclair School of Nursing. For my dissertation project, I am conducting research to examine the effects of virtual reality therapy (VRT) on symptoms of depression and anxiety in older nursing home residents. VRT gives residents the opportunity to view themselves outdoors and in pleasant settings with the use of a display system that is worn like a pair of goggles. *The Grand Canyon VR Experience*, an app designed to induce relaxing emotional states, will deliver the images to the headset. With this app, residents will be able to take a beautiful, serene, and interactive kayak ride through the Grand Canyon. More information about *The Grand Canyon VR Experience* can be found at https://www.immersiveentertainment.com/the-grand-canyon-vr-experience/. I will be conducting this study at long-term care facilities beginning this fall. My hope is that residents participating in VRT will experience less anxiety and depressive symptoms.

I will invite four nursing homes in western Pennsylvania to participate in this project. From facilities agreeing to take part, I aim to recruit a total of 20 older adults who will then be randomly assigned to the intervention group or the control group. Participation is completely voluntary. Residents who are interested in participating will be screened for eligibility. I will meet with consenting participants for 10 minutes three times a week for four weeks. During these sessions, persons in the treatment group will receive VRT intervention and persons in the control group will participate in discussions about activities in general. Participants assigned to the control group will be offered the opportunity to participate in VRT after all data are collected. Appointments will be scheduled accordingly.

I am sensitive to time constraints of nursing home staff, as well as, the need to focus when state surveyors are present. Therefore, I would be willing to schedule sessions at times that do not interfere with work flow and to reschedule as necessary during survey periods. Data collection will be in the form of questionnaires. Background demographic and medical data will be collected from resident charts. Any forms containing resident data will not include identifiable information and will be labeled with a code number only. Documentation with identifiable information, such as a name on a consent form, will be kept in a locked cabinet in my office. Your nursing staff will not be asked to provide assistance with VRT nor will they be asked to obtain consent. Results of the study will be shared with all interested parties.

I hope that you will partner with me in this project because I believe that findings will demonstrate that VRT enhances the quality of life of nursing home residents with symptoms of depression and anxiety. I am happy to meet with you to discuss the project further and to offer a brief presentation. Your agreement at this time is simply an indication of intent and does not mean you could not back out later if circumstances at your facility were to change. As an indication of your intent to participate, I ask that you sign and date a copy of this letter and return to me at the above address (return stamped envelope enclosed). You may also call or email me anytime. I truly appreciate your consideration.

Sincerely yours,

Jody S. Blankenship, RN, BSN

APPENDIX O

Family Notification Letter (sent by NH administration)

Sinclair School of Nursing University of Missouri October 7, 2019	**Jody S. Blankenship, RN, BSN** 6958 Highland Rd. Kane, PA 16735 Phone: (814) 594-8004 E-mail: jsbfb3@mail.missouri.edu

Dear family of *Name of Nursing Home* resident,

I am a doctoral student at the University of Missouri Sinclair School of Nursing, and I am conducting a research project to examine the impact of a virtual reality intervention on symptoms of depression and anxiety in older nursing home residents. Virtual reality (VR) gives residents the opportunity to view themselves outdoors and in pleasant settings with the use of a display system that is worn like a pair of goggles. I am very pleased to announce that the Bradford Ecumenical Home will be partnering with me on this project. The results of this study will extend knowledge about the acceptability of immersive VR nature experiences among nursing home residents and VR's effects on anxiety and depressive symptoms.

My research project aims to recruit a total of 20 residents. Participation in this study is completely voluntary, and participants may withdraw at any time. Any questionnaires containing resident data will not include identifiable information and will be labeled with a code number only. Consent forms which include residents' names will be kept in a locked cabinet. At the end of my study, I will write a detailed report. I believe that findings will demonstrate that VR enhances the quality of life of residents.

Recruitment flyers will be posted in common areas throughout the facility. A copy of the flyer has been enclosed for your review. Please sign below indicating if you agree or do not agree to allow your loved one to participate in this study should they express interest. Please return the signed letter to _____, *Nursing Home Administrator of _____*. I truly appreciate your consideration, and I want to thank you in advance for your support.

Sincerely,

Jody S. Blankenship, RN, BSN
PhD student-University of Missouri

- o I agree to allow _____ (resident's name) to participate in this study

     should he/she express interest. _____ (your signature).

- o I do not agree to allow _____ (resident's name) to participate in this

     study should he/she express interest. _____ (your signature).

CONSENT FORM TO PARTICIPATE IN A RESEARCH STUDY

Researcher's Name(s): Jody Blankenship, BSN, RN and Dr. Kane Lane, PhD, RN

Project Number: 2011364

Project Title: ViR-Ta-GO: Virtual reality experiences of nature among senior housing residents with depressive symptoms, a feasibility study

INTRODUCTION

This consent may contain words that you do not understand. Please ask the investigator or the study staff to explain any words or information that you do not clearly understand.

You are being asked to participate in a research study. This research is being conducted to evaluate the suitability and acceptability of virtual reality nature experiences and its effect on symptoms of depression and anxiety among nursing home residents. When you are invited to participate in research, you have the right to be informed about the study procedures so that you can decide whether you want to consent to participation. This form may contain words that you do not know. Please ask the researcher to explain any words or information that you do not understand.

You have the right to know what you will be asked to do so that you can decide whether or not to be in the study. Your participation is <u>voluntary</u>. You do not have to be in the study if you do not want to. You may refuse to be in the study and nothing will happen. If you do not want to continue to be in the study, you may stop at any time without penalty or loss of benefits to which you are otherwise entitled.

This research is funded by personal funds from the Principle Investigator.

WHY IS THIS STUDY BEING DONE?

The purpose of this research is to evaluate the suitability and acceptability of virtual reality nature experiences and to extend knowledge about its use to treat depressive and anxiety symptoms in nursing home residents aged 60 years and older.

HOW MANY PEOPLE WILL BE IN THE STUDY?

About___20____people will take part in this study at nursing homes located in western Pennsylvania.

WHAT AM I BEING ASKED TO DO?

You will be asked to complete the Brief Interview of Mental Status (BIMS) to determine if you meet the criteria to participate in this study. This test checks for cognitive dysfunction and takes about 3 minutes to complete. For this study, you will be asked to complete the Patient Health Questionnaire (PHQ-9) which takes about 2-3 minutes and the Geriatric Anxiety Inventory (GAI) which takes about 5 minutes to complete before and immediately after the virtual reality session. When you are ready, you will be

---

IRB USE ONLY
<u>IRB USE ONLY</u> **Approval Date: July 2, 2019**

introduced to the head-mounted display system which is a device worn over the eyes like a large pair of goggles. You will be given to opportunity to hold the apparatus, ask questions, and voice concerns. Once all questions and concerns are addressed to your satisfaction, the head-mounted display will be fitted to your head. You will remain in a seated position while wearing the head-mounted display system. With the head-mounted device on, you will see a natural landscape and hear natural sounds. You may also choose to turn off the audio if you desire. Verbal instructions will be given on how to navigate the system and how to stop the session by verbally saying "stop" or signaling stop by raising your hand. The investigator will stop the session early if you become overly upset or distressed. The investigator will remain in the room with you for the entire session and will continue to answer questions and address concerns. You will be randomly assigned to one of two groups. Participants in one group will have the opportunity to participate in virtual reality for 10 minutes three times a week for 4 weeks. Participants in the other group will be offered two 10-minute virtual reality sessions. Each virtual reality session will last 10 minutes unless stopped by you or the investigator. Sessions will not be video-taped or audio-recorded. After the final virtual reality session is complete, the investigator will ask you 10 questions about your virtual reality experience. This will take about 3-5 minutes to complete. Altogether, the study sessions will take about 10-30 minutes to complete. With your consent, the following information will be collected from your medical record: demographics, chronic conditions/diagnoses, medications used to treat symptoms of depression, anxiety, and impaired sleep, and length of time taking these medications.

HOW LONG WILL I BE IN THE STUDY?

This is up to a 12-session study that will take about approximately 10 to 30 minutes to complete each session. You can stop participating at any time without penalty.

WHAT ARE THE BENEFITS OF BEING IN THE STUDY?

During and after participating in this study, you may experience a state of relaxation and improved mood. If the findings of the proposed project show that virtual reality interventions are suitable and acceptable to older nursing home residents, results will be used to develop further virtual reality interventions that are aimed at reducing depressive and/or anxiety symptoms in older nursing home residents.

WHAT ARE THE RISKS OF BEING IN THE STUDY?

There is minimal risk that you may experience "simulator sickness" which can occur with virtual reality applications. Symptoms of simulator sickness mimic those of motion sickness but are usually less severe and have a low incidence.

There is minimal risk of spread of skin infection. Furthermore, wearing a head-mounted display may cause physical discomfort because of its weight or emotional discomfort in the form of increased anxiety because the eyes are covered, however, this is unlikely.

In any research study, there is risk of a loss of privacy or breach of confidentiality.

WHAT ARE THE COSTS OF BEING IN THE STUDY?

There is no cost to you.

WHAT OTHER OPTIONS ARE THERE?

Consent to Participate-Page 3

You also have the option of not participating in this study and will not be penalized for your decision.

CONFIDENTIALITY

Information produced by this study will be stored in the investigator's file and identified by a code number only. The code key connecting your name to specific information about you will be kept in a separate, secure location. Information contained in your records may not be given to anyone unaffiliated with the study in a form that could identify you without your written consent, except as required by law. The information and we collect from you for this study will not be used or shared with other investigators for future research studies. This applies even if we remove all information that could identify you from the data. Research records may be reviewed by agencies who need to ensure the research is being carried out safely; this includes government agencies and the University of Missouri Institutional Review Board. The University of Missouri Institutional Review Board is a group of people who review the research studies to protect participants' rights.

WILL I BE COMPENSATED FOR PARTICIPATING IN THE STUDY?

You will receive no payment for taking part in this study.

WHAT ARE MY RIGHTS AS A PARTICIPANT?

Participation in this study is voluntary. You do not have to participate in this study.

You will also be informed of any new information discovered during the course of this study that might influence your health, welfare, or willingness to be in this study.

WHO DO I CONTACT IF I HAVE QUESTIONS, CONCERNS, OR COMPLAINTS?

Please contact Jody Blankenship, BSN, RN at jsbfb3@mail.missouri.edu or 814-594-8004 if you have questions about the research. Additionally, you may ask questions, voice concerns or complaints to the research team.

WHOM DO I CALL IF I HAVE QUESTIONS OR PROBLEMS?

If you have any questions regarding your rights as a participant in this research and/or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study, you may contact the University of Missouri Institutional Review Board (which is a group of people who review the research studies to protect participants' rights) at (573) 882-3181 or irb@missouri.edu.

If you want to talk privately about your rights or any issues related to your participation in this study, you can contact University of Missouri Research Participant Advocacy by calling 888-280-5002 (a free call), or emailing MUResearchRPA@missouri.edu.

You may ask more questions about the study at any time. For questions about the study or a research-related injury, contact Jody Blankenship, RN at 814-594-8004 or Dr. Kari Lane at 573-882-0285.

A copy of this Informed Consent form will be given to you before you participate in the research.

MU IRB: Consent

| IRB USE ONLY |
| Approval Date: July 2, 2019 |

Page 3 of 4

APPENDIX P

Consent to Participate-Page 4

SIGNATURES

I have read this consent form and my questions have been answered. My signature below means that I do want to be in the study. I know that I can remove myself from the study at any time without any problems.

_____   _____
Subject   Date

_____   _____
Witness   Date

*The presence and signature of an impartial witness is required during the entire informed consent discussion if the subject or subject's legally authorized representative is unable to read.

Brief Interview of Mental Status (BIMS)

Resident Name _____ Identification # _____ Date _____

Brief Interview for Mental Status (BIMS)

<u>Repetition of Three Words</u>

Ask resident: *"I am going to say three words for you to remember. Please repeat the words after I have said all three. The words are:* **sock, blue** *and* **bed***. Now tell me the three words."*

Number of words repeated after first attempt:

☐ 0. None   ☐ 1. One   ☐ 2. Two   ☐ 3. Three

After the resident's first attempt, repeat the words using cues (*"sock, something to wear; blue, a color; bed, a piece of furniture"*). You may repeat the words up to two more times.

<u>Temporal Orientation</u> (orientation to month, year and day)

Ask resident: *"Please tell me what year it is right now."*

Able to report correct year

☐ 0. Missed by > 5 years, or no answer
☐ 1. Missed by 2-5 years
☐ 2. Missed by 1 year
☐ 3. Correct

Ask resident: *"What month are we in right now?"*

Able to report correct month

☐ 0. Missed by > 1 month, or no answer
☐ 1. Missed by 6 days to one month
☐ 2. Accurate within 5 days

Ask resident: *"What day of the week is today?"*

Able to report correct day of the week

☐ 0. Incorrect, or no answer
☐ 1. Correct

<u>Recall</u>

Ask resident: *"Let's go back to the earlier question. What were the three words that I asked you to repeat?"*
If unable to remember a word, give cue (*"something to wear," "a color," "a piece of furniture"*) for that word.

Able to recall "sock"	☐ 0. No - could not recall	☐ 1. Yes, after cueing ("something to wear")	☐ 2. Yes, no cue required
Able to recall "blue"	☐ 0. No - could not recall	☐ 1. Yes, after cueing ("a color")	☐ 2. Yes, no cue required
Able to recall "bed"	☐ 0. No - could not recall	☐ 1. Yes, after cueing ("a piece of furniture")	☐ 2. Yes, no cue required

<u>Summary Score</u>

Add scores for each question and fill in total score (00-15).
Enter 99 if the resident was unable to complete the interview.   _____

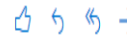# APPENDIX R

Permission for BIMS

Saliba, Debra <saliba@rand.org>
Mon 6/8/2020 8:24 PM
To: Blankenship, Jody Sue (MU-Student)
Cc: Chodosh, Joshua <Joshua.Chodosh@nyumc.org>

Dear Jody
Thanks for checking in.
Absolutely.
The BIMS is in the public domain and available to for you to use in research or clinical activities. If included in products related to your research, it would be great to include the citation. It cannot be monetized, but that is clearly not your intent.
Best of luck with your studies and completing your dissertation. Sounds like a very interesting idea!

All the best,

Debra Saliba, MD, MPH, AGSF
Anna and Harry Borun Endowed Chair in Geriatrics and Gerontology at UCLA
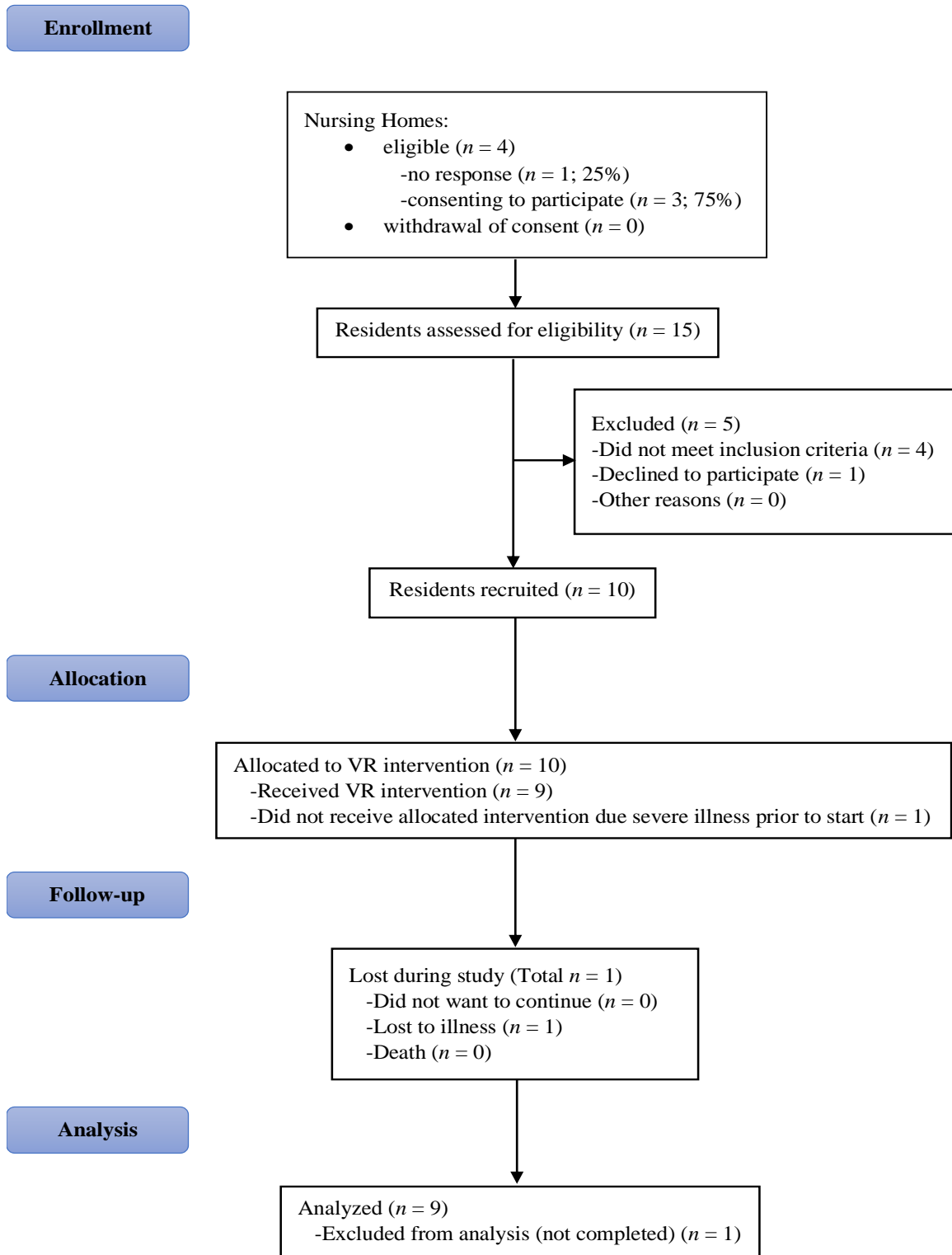VA GLAHS GRECC Physician
VA GLAHS HSR&D Center of Innovation Associate Director for Education
Director, UCLA/JH Borun Center for Gerontological Research
Senior Natural Scientist, RAND Health

APPENDIX S

Flowchart of Progression Through Pilot Study

Enrollment

Nursing Homes:
- eligible ($n = 4$)
  - -no response ($n = 1$; 25%)
  - -consenting to participate ($n = 3$; 75%)
- withdrawal of consent ($n = 0$)

Residents assessed for eligibility ($n = 15$)

Excluded ($n = 5$)
-Did not meet inclusion criteria ($n = 4$)
-Declined to participate ($n = 1$)
-Other reasons ($n = 0$)

Residents recruited ($n = 10$)

Allocation

Allocated to VR intervention ($n = 10$)
  -Received VR intervention ($n = 9$)
  -Did not receive allocated intervention due severe illness prior to start ($n = 1$)

Follow-up

Lost during study (Total $n = 1$)
  -Did not want to continue ($n = 0$)
  -Lost to illness ($n = 1$)
  -Death ($n = 0$)

Analysis

Analyzed ($n = 9$)
  -Excluded from analysis (not completed) ($n = 1$)

MU **Institutional Review Board**
University of Missouri-Columbia
FWA Number: 0002876
IRB Registration Numbers: 00000731, 00009014

482 McReynolds Hall
Columbia, MO 65211
573-882-3181
irb@missouri.edu

July 02, 2019

Principal Investigator: Jody Sue Blankenship (MU-Student)
Department: Nursing-PHD

Your Annual Update to project entitled ViR-Ta-GO: Virtual reality experiences of nature among senior housing residents with depressive symptoms, a feasibility study was reviewed and approved by the MU Institutional Review Board according to the terms and conditions described below:

IRB Project Number	2011364
IRB Review Number	248500
Initial Application Approval Date	July 11, 2018
Approval Date	July 02, 2019
IRB Expiration Date	July 11, 2020
Level of Review	Expedited
Application Status	Approved
Project Status	Active - Open to Enrollment
Risk Level	Minimal Risk
Type of Consent	Written Consent
HIPAA Category	HIPAA Authorization
Approved Documents	Written Consent

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:

1. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
2. All unanticipated problems must be reported to the IRB on the Event Report within 5 business days of becoming aware of the problem. Unanticipated problems are defined as events that are unexpected, related or possibly related to the research, and suggests the research places subjects or others at a greater risk of harm than was previously known or recognized. If the unanticipated problem was a death, this is reportable to the IRB within 24 hours on the Death Report.
3. On-site deaths that are not unanticipated problems must be reported within 5 days of awareness on the Death Report, unless the study is such that you have no way of knowing a death has occurred, or an individual dies more than 30 days after s/he has stopped or completed all study procedures/interventions and required follow-up.
4. All deviations (non-compliance) must be reported to the IRB on the Event Report within 5

APPENDIX T

Pilot Study IRB Approval-Page 2

business days of becoming aware of the deviation.
5. All changes must be IRB approved prior to implementation unless they are intended to reduce immediate risk. All changes must be submitted on the Amendment Form.
6. All recruitment materials and methods must be approved by the IRB prior to being used.
7. The project-generated annual report must be submitted to the IRB for review and approval at least 30 days prior to the project expiration date. If the study is complete, the Completion/Withdrawal Form may be submitted in lieu of the annual report.
8. Securely maintain all research records for a period of seven years from the project completion date or longer depending on the sponsor's record keeping requirements.
9. Utilize the IRB stamped consent documents and other approved research documents located within the document storage section of eCompliance. These documents are highlighted green.

If you have any questions, please contact the IRB at 573-882-3181 or irb@missouri.edu.

Thank you,
MU Institutional Review Board

Patient Health Questionnaire-9 (PHQ-9)

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? (Use "✔" to indicate your answer)	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING ___0___ + _____ + _____ + _____

=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

Developed by Drs. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke and colleagues, with an educational grant from Pfizer Inc. No permission required to reproduce, translate, display or distribute.
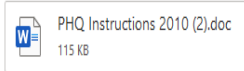
APPENDIX V

Permission for PHQ-9

Burgett, Donna F <dfburget@regenstrief.org>
Tue 6/9/2020 10:41 AM
To: Blankenship, Jody Sue (MU-Student)

📄 PHQ Instructions 2010 (2).doc
   115 KB

Hello,

The PHQ is now in public domain and freely available for use. Copies of the PHQ family of measures, including the GAD-7 are available at the website: www.phqscreeners.com. Translations, a bibliography, and other information are also provided on the website. Attached please find an instruction manual with scoring information that you may find helpful.
Best regards,
   Donna

From: Kroenke, Kurt <kkroenke@regenstrief.org>
Sent: Tuesday, June 9, 2020 10:34 AM
To: Burgett, Donna F <dfburget@regenstrief.org>
Subject: FW: Dissertation Research

From: Blankenship, Jody Sue (MU-Student) <jsbfb3@mail.missouri.edu>
Sent: Tuesday, June 9, 2020 10:33 AM
To: Kroenke, Kurt <kkroenke@regenstrief.org>
Subject: [External] Re: Dissertation Research

This message was sent from a non-IU address. Please exercise caution when clicking links or opening attachments from external sources.

Hello Dr. Kroenke,

I am a graduate student at the University of Missouri working on a PhD in Nursing. For my dissertation, I am examining the effects of a virtual reality intervention on symptoms of depression and anxiety among nursing home residents without cognitive impairment. This is a small feasibility study taking place at two nursing homes in Pennsylvania. May I have your permission to use the PHQ-9 to measure severity of depressive symptoms before and after the intervention?

Jody S. Blankenship, RN, BSN
PhD Student
MU Sinclair School of Nursing
jsbfb3@umsystem.edu

APPENDIX W

Geriatric Anxiety Inventory (GAI)

Please answer the items according to how you've felt in the last week.

Check the column under **Agree** if you mostly agree that the item describes you;
check the column under **Disagree** if you mostly disagree that the item describes you.

	Agree	Disagree
I worry a lot of the time.	| |	| |
I find it difficult to make a decision.	| |	| |
I often feel jumpy.	| |	| |
I find it hard to relax.	| |	| |
I often cannot enjoy things because of my worries.	| |	| |
Little things bother me a lot.	| |	| |
I often feel like I have butterflies in my stomach.	| |	| |
I think of myself as a worrier.	| |	| |
I can't help worrying about even trivial things.	| |	| |
I often feel nervous.	| |	| |
My own thoughts often make me anxious.	| |	| |
I get an upset stomach due to my worrying.	| |	| |
I think of myself as a nervous person.	| |	| |
I always anticipate the worst will happen.	| |	| |
I often feel shaky inside.	| |	| |
I think that my worries interfere with my life.	| |	| |
My worries often overwhelm me.	| |	| |
I sometimes feel a great knot in my stomach.	| |	| |
I miss out on things because I worry too much.	| |	| |
I often feel upset.	| |	| |

APPENDIX X

Confirmation of License for GAI Use

eShop Orders <orders@uniquest.com.au>
Thu 2/27/2020 5:50 PM
To: Blankenship, Jody Sue (MU-Student)

Dear Jody,

I am writing to advise that your 12 month license to use the Geriatric Anxiety Inventory (GAI) expired on 11/01/2020.

If you would like to continue to use the GAI, please apply for a new license. This can be done online at the UniQuest eShop.

We welcome all feedback regarding the use of the GAI and encourage you to keep in touch regarding your experiences.

Kind regards,

Carley Port
Contract Operations Administrator

Australia's leading technology transfer company, managing
the intellectual property of The University of Queensland

APPENDIX Y

Post-Intervention Satisfaction Survey-Pilot Study

POST-INTERVENTION SATISFACTION SURVEY   Participant ID # _____

Study Number: 2011364

PERSON-LEVEL BARRIERS/FACILITATORS	RESPONSES
How would you describe the overall virtual reality experience?	
What did you like most about virtual reality?	
What did you like least about virtual reality?	
How would you describe the visual appearance of the virtual environments?	
How does virtual reality compare to other activities?	
How did the sounds enhance the virtual reality experience?	
What would you tell a friend who may be interested in trying virtual reality?	
How did virtual reality affect your mood?	
How did virtual reality affect your ability to relax?	
How could virtual reality be improved?	

VITA

Jody Sue Blankenship grew up in Cherry Grove, Pennsylvania in the heart of the Allegheny National Forest. She obtained her Associate of Science in Nursing degree and received the academic achievement award from the University Pittsburgh in 2003. After graduation, she worked as a Certified Critical Care Nurse until 2010 when she began working in a long-term care facility. There, she started out as an RN supervisor and Certified Nurse Aide Instructor, but quickly advanced to Nurse Manager then the Director of Nursing. In 2015, she obtained her Bachelor of Science in Nursing (BSN) degree from Clarion University of Pennsylvania. Immediately after graduation she enrolled in the BSN to PhD program at the University of Missouri with a focus on symptom management in the geriatric population. From 2016 to 2018, she worked as a house supervisor for Kane Community Hospital, but realized she missed caring for older adults. In 2018, she returned to the long-term care setting as a nurse manager, but recently stepped away from this position to complete her dissertation research. She will graduate in 2020, at which time she will pursue nurse faculty opportunities at major Universities.