

**Exploring the Impact of a Brief Virtual Reality Dementia  
Simulation on Healthy Adults' Willingness to Care, Dementia  
Worry and Ageing Anxiety**

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**Thesis declaration form**

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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## Overview

Walking in the shoes of another and experiencing the world from their perspective has become possible with the aid of simulation technology such as virtual reality (VR). Dementia and ageing simulations are increasingly used to train individuals working with older adults to improve empathy and attitudes. Volume one of this thesis explores both the benefits and potential unintended consequences resulting from such simulations and considers the implications for psychological theory and practice.

**Part one** is a systematic review of recent literature investigating the impact of ageing and dementia simulations on individuals' attitudes, empathy and anxiety. Fifteen studies were identified and included in a narrative synthesis. Empathy towards older adults and people with dementia was found to consistently improve in response to simulation. The impact on attitude was inconclusive and anxiety was underexplored.

**Part two** is a quantitative investigation of healthy adults' willingness to care for people with dementia, dementia worry and ageing anxiety following exposure to a brief online VR dementia simulation. The simulation was accessible and immersive, and individuals reported a high level of compassion towards people with dementia following the experience. However, there was no measurable impact on willingness to care, dementia worry or ageing anxiety. Self-reported ability to care for people with dementia, fear of old people and psychological concerns about ageing, were found to be significantly predictive of willingness to care for people with dementia.

**Part three** is a critical appraisal of the research process. Reflections are provided on key areas of personal learning and some of the challenges associated with conducting internet-mediated research.

## **Impact Statement**

There are over 800,000 people living with dementia in the UK and more than 50 million globally. Ultimately, the discussions within Volume One of this thesis aim to contribute to improved quality of life for people living with dementia and their carers. The systematic review and empirical research directly address two of the current UK and international research priorities in dementia; (1) how to develop effective training for people working with or caring for people with dementia (PwD) and (2) how to reduce the stigma associated with dementia.

The discussions provide evidence-based guidance on the development and delivery of ageing and dementia simulation. This is an important gap to address as these simulation approaches are popular but under-researched. The paper demonstrates evidence that it is worthwhile continuing research into ageing and dementia simulation to maximise the benefits from these new approaches, and importantly, to minimise the possibility of any unintended consequences among recipients.

For developers of simulations, inadvertent harm can be minimised by ensuring that the overall narrative or image of the condition being simulated is not a pessimistic one. Instead, unhelpful stereotypes must be challenged. For example, efforts could be made to include elements of overcoming common challenges within the simulated condition and to emphasise the supportive role others can provide. Virtual reality (VR) simulations will likely benefit from development that allows users to be matched with a simulated identity of the same sex, and if appropriate, a similar age.

Those wishing to use dementia and ageing simulations should not continue to take the popularity of these approaches as an indicator of their effectiveness. This review and research paper, along with existing literature, can inform best-

practice. Likelihood of effectiveness, likelihood of harm, resources needed, and alternative interventions should all be considered before using an ageing or dementia simulation. Ethical consideration should be given to the use of ageing games which have been found within this review, and others, to have limited effectiveness, and at times worsen attitudes. Instead, it may be more appropriate to draw on recent developments such as VR or immersive multi-sensory experiences. Where possible, delivery of a simulation should incorporate the monitoring and addressing of inadvertently perpetuated anxieties about ageing and dementia. This might be in the form of a post-simulation reflective discussion.

An impact of the research more broadly, stems from the predictive model presented in the empirical paper. Interventions aiming to improve willingness to care for PwD may be more effective if the predictive factors of perceived ability to care, fear of old people and psychological concerns are targeted.

Any parties attempting to simulate a mental health condition to improve caring and emotional caring towards an identified group, or who wish to draw on brief VR simulation for psychological purposes (e.g. healthcare staff trainers, public health workers, charities, developers of commercial health products, schools) may benefit from the discussions presented within this research. Publication of the findings within an academic research journal, along with more informal public dissemination via relevant networks (e.g. a research poster for conference presentation, feedback to Alzheimer's Research UK, presenting findings to NHS staff meetings, Twitter) will ensure the potential impact of this research, as described above, is realised.

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## **Part One: Systematic Literature Review**

### **The Impact of Experiencing an Ageing or Dementia Simulation**

## **Abstract**

**Aim:** Dementia and ageing simulations are an increasingly popular method of seeking to improve attitudes towards people with dementia (PwD) and older adults. This systematic review investigates how dementia and ageing simulations are conducted, and their impact on adults' attitudes, empathy and anxiety towards older adults and PwD.

**Method:** PsycInfo, Embase and CINAHL were searched for papers meeting review criteria published in the period January 2000 to January 2018. A hand-search of grey literature sites, key authors and journals was also conducted. The quality of papers was assessed using an adapted version of the Effective Public Health Practice Project tool. Study findings were summarised using a narrative synthesis.

**Results:** Fifteen studies were included in the review. Study quality was mixed. Simulation methods identified included Ageing Equipment, Standardised Ageing Games, Immersive Multi-Sensory Experiences and virtual reality. Empathy consistently improved in response to simulation, but attitude findings were inconclusive. Few studies measured anxiety and there was some indication it heightened in response to simulation.

**Conclusions:** Dementia and ageing simulations likely improve empathy in individuals, but they do not consistently improve attitudes. There is potential for unintended consequences regarding attitudes and anxiety. Simulation training must therefore be used with careful consideration. The developing area of dementia simulation requires further investigation to ascertain how it affects behaviour towards older adults and PwD.

## **Introduction**

Life expectancy is rising globally, resulting in increasingly ageing populations (United Nations [UN], Department of Economic and Social Affairs, 2017).

Predictions indicate that by 2050, the number of people living beyond 80 years old will triple and those over 60 will make up 25 percent of most national populations (UN, Department of Economics and Social Affairs, 2017). Given this trend, there is a worldwide emphasis on improving quality of life for older adults and for continued research into age-related problems, such as dementia and ageism (World Health Organisation [WHO], 2017a, 2017b).

## **Dementia**

Dementia is a progressive neurological syndrome comprising symptoms such as memory impairment, cognitive functioning difficulties and personality changes (Alzheimer's Society, 2014). As symptoms progress they lead to considerable impairment of daily functioning (Alzheimer's Society, 2014). The risk of dementia increases significantly with age and over 90 percent of diagnoses are made in people over 65 years old (Alzheimer's Society, 2014). There are currently 50 million people with dementia (PwD) worldwide and this number is predicted to double over the next 20 years (WHO, 2017a). A recent systematic review highlighted the continued global prevalence of stigma towards PwD, from both lay public and healthcare providers (Herrmann et al., 2018).

## **Ageism**

Ageism refers to the systematic bias and prejudice of older adults in society, underpinned by negative attitudes and stereotypes (Butler, 1969; Swift, Abrams, Drury, & Lamont, 2016). Research continues to indicate ageist attitudes are common across age, gender and culture (Kite, Stockdale, Whitley, & Johnson, 2005;

Nelson, 2016; North & Fiske, 2015). In addition to the challenges already posed by dementia symptoms, older PwD are vulnerable to the 'double jeopardy' of dementia-stigma and ageism (Milne, 2010, p. 231). This combined burden has a profoundly negative effect on quality of life (Burgener, Buckwalter, Perkhounkova, & Liu, 2015; Nelson, 2011; Vernooij-Dassen et al., 2005; Werner & Heinik, 2008).

## **Dementia and Ageing Simulations**

One potential approach to address the issues described above is the use of dementia and ageing simulation training, which has been found to improve attitudes towards PwD and older people (Beville, 2002; Eymard, Crawford, & Keller, 2010). Through simulation, individuals gain first-hand experience of the common challenges posed by dementia and ageing. Simulation-based education is already a popular approach in the geriatric health field, and 'ageing games', which use role-play and physical props to demonstrate challenges older people face day-to-day, have been in use for several decades (e.g. Pacala, Boulton, Bland, & O'Brien, 1995; Pacala, Boulton, & Hepburn, 2006; Williams, 1985). However, a recent systematic review did not find evidence to support their effectiveness in improving attitudes towards older people (Alfarah, Schünemann, & Akl, 2010).

With advancements in technology there are, however, more immersive simulation technologies being developed (Adefila, Graham, Clouder, Bluteau, & Ball, 2016; Bennett, Moore, & Wenham, 2016; Beville, 2002). In recent years the 'Ageing Suit' has been widely adopted by providers of dementia and geriatric training for healthcare students and staff, on the premise that it can improve attitudes and empathy towards older adults and PwD (Bennett et al., 2016; Care, 2017; Spanswick, 2016; Tremayne, Burdett, & Utecht, 2011). Examples include the Premature Ageing Unisex Leisure (PAUL) Suit (Bennett et al., 2016) and the Age Gain Now Empathy System (AGNES; Massachusetts Institute of Technology, 2014).

Ageing suits comprise full-body wearable equipment (e.g. ear plugs, poor vision goggles, joint straps) that create age-related physical changes in the wearer, primarily related to gait, mobility and sensory function (Bennett et al., 2016; Tremayne et al., 2011). Simulations more tailored to dementia have also begun to emerge, for example, The Virtual Dementia Tour (Beville, 2002). Dementia-tailored simulations tend to incorporate environmental stimuli, wearable equipment and sometimes virtual reality (VR), to create sensory and perceptual distortions that are akin to the experiences of PwD (Beville, 2002; Spanswick, 2016).

These simulation approaches have gained popularity in the media, become commercially and publicly available, and are increasingly being incorporated into older adult healthcare training programmes (BBC, 2017; Beville, 2002; Hamilton, 2016). There have been some encouraging findings suggesting that these newer simulation experiences may improve attitudes and empathy towards older adults and PwD (Adefila et al., 2016; Lavallière et al., 2017). Research has demonstrated that the embodied experience gained through immersive simulation is more effective in promoting positive attitudes and helping behaviour than traditional perspective-taking methods (Ahn, Le, & Bailenson, 2013).

However, consideration must also be given to any problematic aspects of simulations. A recent systematic review of the literature on hallucination simulations, used to reduce stigma towards people with schizophrenia, found contradictory results (Ando, Clement, Barley, & Thornicroft, 2011). Whilst empathy towards people with schizophrenia consistently improved, the effects on attitude were inconsistent (Ando et al., 2011). Concerningly, there was an increased desire for social distance from individuals with schizophrenia (Ando et al., 2011). It follows then that perhaps dementia and ageing simulations may similarly have the potential for both positive and harmful effects. In the context of increasing popularity, advancing methods, potential benefit and harm, it is therefore imperative that a

systematic review of the recent approaches to dementia and ageing simulation is conducted to provide clarity on the available evidence.

## **Research Questions**

This review addresses the following questions:

1. Which populations are being exposed to dementia and ageing simulations?
2. Through what methods are researchers simulating dementia and/or ageing?
3. What is the impact of a dementia or ageing simulation on individuals': (a) attitudes towards PwD and older people; (b) empathy towards PwD and older people; (c) anxiety about ageing or fear of dementia?

## **Method**

### **Search Strategy**

An electronic database search of PsycINFO, Embase and CINAHL was performed in February 2018. The following search terms (and synonyms) were combined: 1) 'simulation', 2) 'dementia' or 'ageing', and 3) 'attitude', or 'empathy', or 'anxiety'. A combination of text word and subject heading searches were used. The full list of search terms used is provided in the appendices (Appendix A). A secondary hand-search was conducted using the following methods: reviewing reference lists, forward citations and first authors of included studies, contacting experts in the field and checking grey literature (e.g. newspaper articles and editorials) through the use of Google searches.

All hits were downloaded into Zotero reference manager software. Several screening stages took place to identify the final papers for inclusion in the review. The initial screening steps included identifying and removing all duplicates, followed by reviewing all titles and removing any clearly irrelevant studies not relating to the



subject matter under review. The abstracts of all remaining papers were read and checked against the eligibility criteria. The remaining papers were reviewed in full.

**Inclusion and exclusion criteria.** This review included studies that met the following criteria:

- Design: Randomised Controlled Trials (RCTs), Controlled studies, single-arm pre-post studies or interrupted time series experiments.
- Participants: The participants were adults (over 18 years old) without a diagnosis of dementia.
- Intervention: The simulation technology altered participants' physical and/or perceptual experience in real-time. All participants in the simulation group personally experienced the dementia or ageing simulation. Studies were excluded if they relied on imagination, role-play or standardised patient methods.
- Outcomes: At least one of the following quantitative outcomes was reported: a) attitudes towards older adults or PwD, b) empathy towards older adults or PwD, c) anxiety about ageing or dementia. Studies were excluded if they only reported on participants' knowledge about ageing or dementia, or if the outcomes of interest were reported qualitatively.
- Publishing: The study was published in the English language, in a peer reviewed journal, between January 2000 and January 2018. Studies conducted before the year 2000 were excluded because this review was interested in recent advances in simulation technology.

### **Quality Assessment**

The methodological quality of included studies was assessed using an adapted version of the Effective Public Health Practice Project (EPHPP) Quality

Assessment Tool for Quantitative Studies (Appendix B) and the supplementary Dictionary (Appendix C) (Hamilton, 1998; Thomas, Ciliska, Dobbins, & Micucci, 2004) . The EPHPP tool was adapted by dropping one of the six quality criteria (Blinding) that would normally contribute to the global quality rating given to a study. It was considered improbable that participants in a control trial would be blind to receiving a simulation intervention. The EPHPP tool has two additional quality criteria (Intervention Integrity and Analyses) that do not contribute towards the global quality rating given to a study and were therefore not used in this review.

Guided by the EPHPP tool and dictionary, all studies included in the review were initially judged as either 'weak', 'moderate' or 'strong' on the following criteria; a) Selection Bias, b) Study Design, c) Confounders, d) Data Collection Methods, e) Withdrawal and Dropouts. Following this, a global quality rating was derived based on the following EPHPP guidance:

- Strong: Studies with no weak rating
- Moderate: Studies with one weak rating
- Weak: Studies with two or more weak ratings

Study sample size was considered in addition to the EPHPP criteria, although it did not contribute to the rating given. Studies demonstrating that the sample size used provided sufficient power to the research were considered as more robust than those that were under-powered or those that were not clear in their reporting of this (Cohen, 1988). Where it was unclear, a general rule of thumb was applied whereby larger samples were deemed to be more favourable (Barker, Pistrang, & Elliott, 2002).

## **Synthesis**

All papers meeting inclusions criteria were reviewed in full. Data regarding the study design, simulation methods and outcome variables of interest (attitudes, empathy and anxiety) were extracted and tabulated. A narrative synthesis method was used to describe, and summaries similarities, differences, patterns and exceptions found across the studies.

## **Results**

The electronic database search yielded a total of 925 hits. Following the removal of duplicates and irrelevant studies ( $n = 815$ ), 110 abstracts were screened. Typical reason for excluding studies at this stage were a) the 'simulation' was purely role-play based, b) participants interacted with a standardised patient but did not receive a simulation themselves, c) the outcome variable was knowledge of ageing or dementia, and d) the findings were qualitative. Thirty-four papers were reviewed in full and 12 of these met criteria for inclusion in the review. An additional three papers from the hand-search met criteria, resulting in a total of 15 studies for inclusion in the review. Figure 1 illustrates the studies removed and included at each stage of the search process.

## **Study Quality**

Table 1 presents the quality ratings given to each study using the adapted EPHP criteria. Overall study Quality was mixed, with 60.0 percent ( $n = 9$ ) rated as strong, 26.7 percent ( $n = 4$ ) rated as moderate and 13.3 percent ( $n = 2$ ) rated as weak. Multi-arm-controlled studies and single-arm pre-post studies are discussed separately.

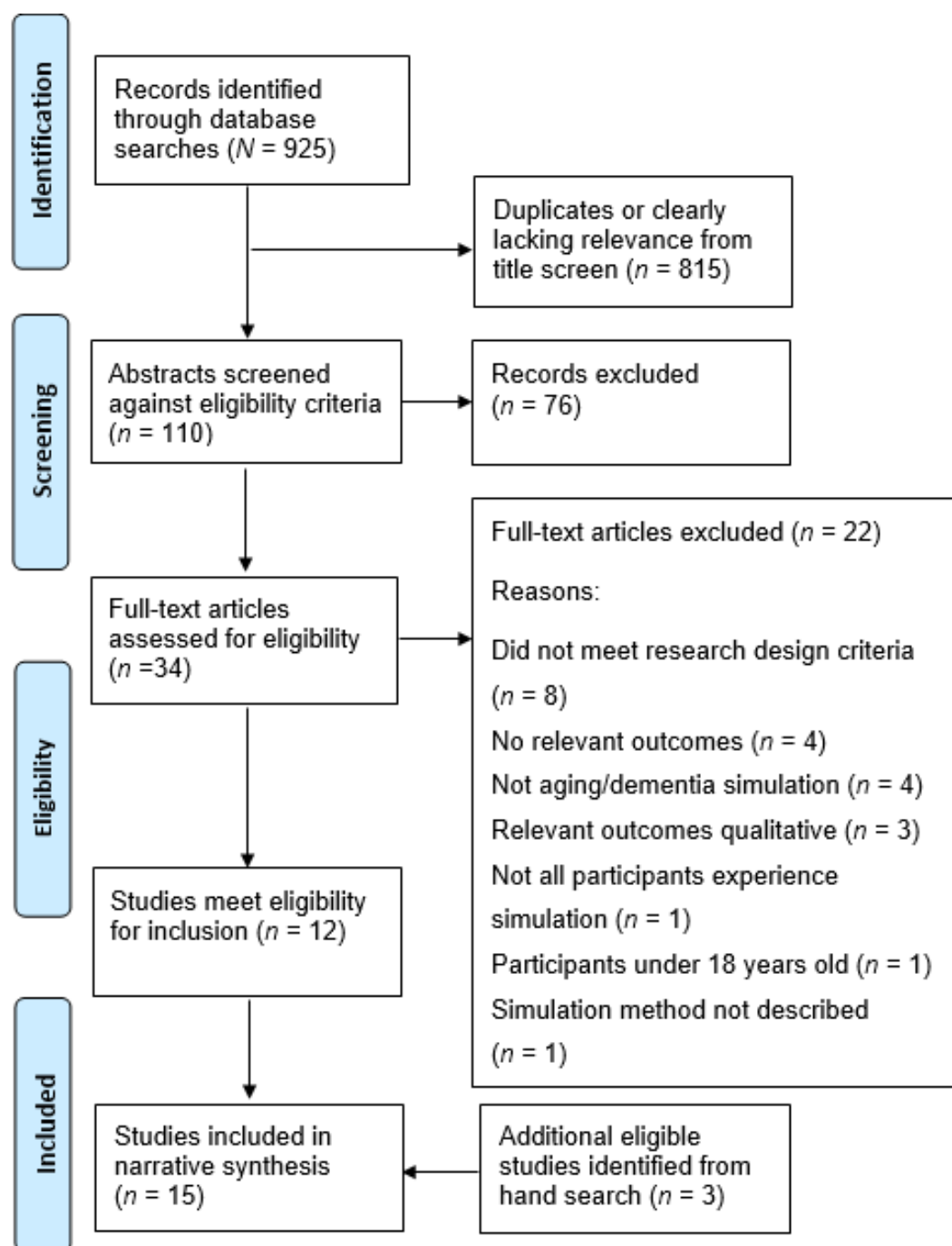


Figure 1. Flow diagram of the systematic search process.

Table 1.

*Quality Assessment Rating of Studies Included in the Review*

Study	Selection Bias	Study Design	Confounders	Data Collection	Withdrawals and Dropouts	Overall	Sample Size <i>N</i> ( <i>n</i> per group)
<i>Controlled studies</i>							
Henry et al. (2011)	Moderate	Strong	Strong	Strong	Moderate	STRONG	124 (62)
Lucchetti et al. (2017)	Moderate	Strong	Strong	Moderate	Strong	STRONG	230 (≥72)
Gilmartin-Thomas et al. (2018)	Moderate	Strong	Strong	Strong	Strong	STRONG	276 (≥89)
Yu & Chen (2012)	Moderate	Strong	Moderate	Moderate	Strong	STRONG	83 (≥40)
<i>Single-arm pre-post studies</i>							
Adefila et al. (2016)	Weak	Moderate	N/A	Weak	Strong	WEAK	55
Beville (2002)	Weak	Moderate	N/A	Weak	Weak	WEAK	146
Chen et al. (2015a)	Moderate	Moderate	N/A	Moderate	Weak	MODERATE	58
Chen et al. (2015b)	Strong	Moderate	N/A	Moderate	Strong	STRONG	156
De Abreu et al. (2017)	Weak	Moderate	N/A	Strong	Strong	MODERATE	49
Evans et al. (2005)	Strong	Moderate	N/A	Weak	Strong	MODERATE	102
Halpin (2015)	Strong	Moderate	N/A	Strong	Strong	STRONG	476
Henry et al. (2007)	Moderate	Moderate	N/A	Strong	Moderate	STRONG	156
Robinson & Rosher (2001)	Moderate	Moderate	N/A	Strong	Weak	MODERATE	49
Varkey et al. (2006)	Strong	Moderate	N/A	Moderate	Strong	STRONG	84
Wijma et al. (2017)	Moderate	Moderate	N/A	Strong	Strong	STRONG	42

**Multi-arm-controlled studies.** Four studies utilised a multi-arm controlled design and all had an overall quality rating of strong (Table 1). Simulation was compared to an inactive control group in two of these studies (Gilmartin-Thomas et al., 2018; Yu & Chen, 2012), a comparison activity in one (Henry, Ozier, & Johnson, 2011), and both in another (Lucchetti, Lucchetti, de Oliveira, Moreira-Almeida, & da Silva Ezequiel, 2017). These studies have enhanced control of confounding variables in comparison to a single-arm design, and are therefore more facilitative of drawing causal inferences (Shadish, Cook, & Campbell, 2001).

However, some limitations were noted. None of these studies were RCTs. Whilst Henry et al. (2011) employed a method of randomisation (randomly allocating 12 pre-existing teaching groups to either the intervention or the control group), it was not at the individual level and did not give every participant an equal chance of being in either group. Therefore, the threat to internal validity on the basis of non-equivalent groups remained (Shadish et al., 2001). All four controlled studies were likely to be susceptible to selection bias due to use of non-random convenience sampling, limiting the generalisability of the findings (Barker et al., 2002).

Measures were demonstrated to be psychometrically robust in only two of the studies (Gilmartin-Thomas et al., 2018; Henry et al., 2011). Lucchetti et al. (2017) used widely recognised validated tools, however, some were demonstrated to have only moderate reliability in the study (e.g. Cronbach's alpha of 0.618). Yu and Chen (2012) created their own measurement tool, and whilst they reported the content validity index (good) and reliability (acceptable), no thorough psychometric evaluation was conducted. Therefore, the internal validity of the study is compromised (DeVellis, 2017).

Statistical control of confounding variables was demonstrated to be strong in all but one of the studies (Yu & Chen, 2012). Yu and Chen (2012) reported

significant age and experience differences between groups at baseline which were not controlled for in the analyses and may have influenced the findings (Shadish et al., 2001). All studies clearly reported withdrawals and drop outs and all but one (Henry et al., 2011) demonstrated high completion rates of over 80 percent. Based on the EPHPP criteria Gilmartin-Thomas et al. (2018) was considered the most robust of the controlled studies, and Yu and Chen (2012) the weakest. Taking sample size into consideration, these two studies remained strongest and weakest, respectively.

**Single arm pre-post studies.** The single arm pre-post studies were mixed in quality. Five received a quality rating of strong (Chen, Kiersma, Yehle, & Plake, 2015b; Halpin, 2015; Henry, Douglass, & Kostiwa, 2007; Varkey, Chutka, & Lesnick, 2006; Wijma, Veerbeek, Prins, Pot, & Willemse, 2017), four of moderate (Chen, Kiersma, Yehle, & Plake, 2015a; de Abreu, Hinojosa-Lindsey, & Asghar-Ali, 2017; Evans, Lombardo, Belgeri, & Fontane, 2005; Robinson & Rosher, 2001) and two weak (Adefila et al., 2016; Beville, 2002).

Halpin (2015) received the highest number of strong ratings across the EPHPP criteria and was therefore considered the most robust of the single-arm pre-post studies. Additionally, the sample size was comparatively large and provided sufficient power ( $N = 467$ ). Conversely, Beville (2002) demonstrated the most methodological weaknesses across the EPHPP criteria. The study used a self-selecting convenience sample, created new measurement tools, without providing validity or reliability information, and did not report withdrawals. These factors significantly weaken the conclusions of this study and the generalisability of the findings (Barker et al., 2002).

**Quality and range of measures used.** Notably, there was great disparity across studies concerning the questionnaires used to measure the variables of

attitude, empathy and anxiety. Following this, there was large variation in the quality of the tools used in each study which warrants discussion. A list of measures used in each study is provided within Table 2.

***Attitude measures.*** All studies that conducted an ageing simulation measured the impact on participants' attitudes towards older adults. Despite this, there was very limited consistency in the tools used to tap into this construct. Ten different questionnaires were identified and only half of them were published measures that had undergone psychometric evaluation. The Aging Semantic Differential (ASD) (Rosencranz & McNevin, 1969) was used in one study, and its later revised version (Polizzi, 2003) used in three studies, making it the most consistently used measure of attitudes towards older people. The ASD is a widely-used tool, although it is now generally considered out-dated and lacking in validity, hence the refined version (Polizzi, 2003; Wilson, Kurrle, & Wilson, 2018). The refined ASD was demonstrated to have good reliability in the included studies but has been criticised for having a poor-fit to its proposed one-factor structure and thus lacking in validity (Gonzales, Tan, & Morrow-Howell, 2010).

With regards to attitudes towards PwD, a total of two different tools were used across three studies; the Approaches to Dementia Questionnaire (ADQ; Lintern, 2001) and the Dementia Attitude Scale (DAS; O'Connor & McFadden, 2010). Both were demonstrated to have good psychometric properties.

***Empathy measures.*** Empathy measures varied greatly, with a total of seven different tools used across nine studies. Four of the measures had published psychometric properties. Of these, the most consistently used was the empathy section of the modified Maxwell-Sullivan Attitudes Survey (MSAS; Maxwell & Sullivan, 1980) ( $n = 3$ ). The MSAS is un-validated, but was demonstrated to have acceptable reliability in the included studies (Varkey et al., 2006). Psychometrically



stronger measures included the Kiersma-Chen Empathy Scale (KCES; Kiersma, Chen, Yehle, & Plake., 2012) ( $n = 2$ ), the Jefferson Scale of Empathy - Health Professions Scale (JSE-HPS; Hojat et al., 2001) ( $n = 2$ ) and a subscale of the Interpersonal Reactivity Index (IRI; Davis, 1980) ( $n = 1$ ).

Three studies used one-item empathy scales created by their authors for the purpose of the research, without psychometric evaluation (Adefila et al., 2016; Beville, 2002; Evans et al., 2005). Consequently, the validity and reliability of these tools is significantly limited. Only Adefila et al. (2016) indicated reasons for creating their own scale and critically appraised the problems associated with this.

**Anxiety measures.** Anxiety was the least investigated variable, appearing in only four studies. Two studies used a previously researched tool with acceptable psychometric properties, the Anxiety about Aging Scale (AAS; Lasher & Faulkender, 1993). The other two looked at non-specific anxiety (i.e. not age-related) and both asked participants to rate their subjective level of anxiety on a five-point Likert scale. This approach has no guaranteed validity or reliability. No studies measured anxiety about dementia.

## **Data Extraction and Synthesis of Evidence**

Table 2 presents a summary of the key characteristics of the included studies. Data is synthesised separately to address each research question in turn.

**Research question 1: Which populations are being exposed to dementia and ageing simulations?** Most of the included studies took place in the USA ( $n = 10$ ) and one was conducted in each of Australia, Brazil, the Netherlands, Taiwan and the United Kingdom.

Table 2.

*Summary of Evidence from Studies Included in the Systematic Review*

Study	Intervention Name (minutes)	Participants N, age (years), gender	Measures	Findings
<i>Controlled studies</i>				
Henry et al. (2011), USA	TAG (90) vs. ALT (75)	127 nursing and nutrition students: 84% under 25, 84% female.	rASD ( <i>Att</i> ); MSAS ( <i>Emp</i> ); AAS ( <i>Anx</i> )	<ul style="list-style-type: none"> <li>NSD in <i>Att</i> within or between groups</li> <li>NSD in <i>Emp</i> within or between groups</li> <li>NSD in <i>Anx</i> within or between groups</li> <li>Sig. – <i>Anx</i> in whole sample post-test (<math>p = .05</math>)</li> </ul>
Lucchetti et al. (2017), Brazil	TAG (120) vs. ALT (120) vs. Control	230 medical students. TAG: $M_{age}$ 18.71, 63.4% female; ALT: $M_{age}$ 19.73, 60.5% male	UCLA-GAS, FAQ, mMSAS ( <i>Att</i> ); mMSAS ( <i>Emp</i> )	<ul style="list-style-type: none"> <li>Sig. – <i>Att</i> after TAG (UCLA <math>r = 0.36_M</math>; FAQ <math>r = 0.66_L</math>; MSAS <math>r = 0.37_M</math>)</li> <li>Sig. better <i>Att</i> after ALT compared to TAG (UCLA <math>p = .001</math>, FAQ <math>p = &lt;.001</math>, MSAS <math>p = .009</math>)</li> <li>NSD in <i>Att</i> between TAG and Control post-test</li> <li>Sig. + <i>Emp</i> after TAG (<math>r = 0.46_M</math>)</li> <li>NSD in <i>Emp</i> between groups</li> </ul>
Gilmartin-Thomas et al. (2018), Australia	VRDS (90) vs. Control	278 medical and pharmacy students: $M_{age}$ 22.5, 66.2% female.	DAS ( <i>Att</i> )	<ul style="list-style-type: none"> <li>Sig. + <i>Att</i> after VRDS (<math>p = &lt;.01</math>)</li> <li>Sig. better <i>Att</i> post-test in VRDS compared to Control (<math>p = &lt;.001</math>)</li> </ul>

**Note. Intervention column:** TAG = The Aging Game; ALT = an alternative activity on ageing; VRDS = a virtual reality dementia simulation; IMSE = immersive multi-sensory experience. GMG = Geriatric Medication Game. **Participant column:**  $M_{age}$  = Mean age. **Measures column:** *Att* = attitude, *Emp* = empathy, *Anx* = anxiety. ASD = Aging Semantic Differential; rASD = refined ASD; mMSAS = modified Maxwell-Sullivan Attitudes Survey (this measure has both an attitude and an empathy scale); AAS = Anxiety about Aging Scale; UCLA-GAS = University of California Los Angeles Geriatric Attitude Scale; FAQ = Facts about Aging Quiz; DAS = Dementia Attitude Scale; ASES = Ageing Simulation Experience Survey; KCES = Kiersma-Chen Empathy Scale; JSE-HPS = Jefferson Scale of Empathy – Health Professions Scale; ADQ = Approaches to Dementia Questionnaire; IRI = Interpersonal Reactivity Index. **Findings column:** NSD = no significant difference; Sig. = significant; + = improved; – = worsened; diff. = difference;  $L$  = large effect size,  $M$  = medium effect size.

Table 2. (Continued)

*Summary of Evidence from Studies Included in the Systematic Review*

Study	Intervention Name (minutes)	Participants N, age (years), gender	Measures	Findings
<i>Controlled studies</i>				
Yu and Chen (2012), Taiwan	Ageing Equipment (60) vs. Control	83 nursing assistants: $M_{age}$ 48, 98.8% female.	Nursing Assistants' Attitudes Towards Older Adult Scale ( <i>Att</i> )	<ul style="list-style-type: none"> <li>· Sig. + <i>Att</i> within simulation group (<math>p = &lt; .001</math>)</li> <li>· NSD in <i>Att</i> between simulation and Control post-test</li> </ul>
<i>Single arm pre-post studies</i>				
Adefila et al. (2016), UK	VRDS	55 health and social care students	A 10cm line scale of compassion ( <i>Emp</i> )	<ul style="list-style-type: none"> <li>· Sig. + <i>Emp</i> (<math>d = .51_M</math>)</li> </ul>
Beville (2002), USA	IMSE dementia simulation	146 elder care employees	A single-item 5-point Likert scale ( <i>Emp</i> ); A single-item 5-point Likert scale ( <i>Anx</i> )	<ul style="list-style-type: none"> <li>· + <i>Emp</i> (93-point variance pre- to post)</li> <li>· - <i>Anx</i> (99-point variance pre- to post)</li> </ul>
Chen et al. (2015a), USA	GMG (180)	58 nursing students: 94.8% 19- 21, 87.9% female.	ASES ( <i>Att</i> ); KCES; JSE-HPS ( <i>Emp</i> )	<ul style="list-style-type: none"> <li>· Sig. + on 7/13 ASES items (<math>p = &lt; .05</math>)</li> <li>· Sig. + <i>Emp</i> (KCES <math>p = .015</math>; JSE-HPS <math>p = &lt; .001</math>)</li> </ul>
Chen et al. (2015b), USA	GMG (180)	156 pharmacy students: 66.7% 19-21, 60.9% female.	ASES ( <i>Att</i> ); KCES; JSE- HPS ( <i>Emp</i> )	<ul style="list-style-type: none"> <li>· Sig. + on 9/13 ASES items (<math>p = &lt; .001</math>)</li> <li>· 77% participants stated their <i>Att</i> +</li> <li>· Sig. + <i>Emp</i> (KCES <math>p = .001</math>; JSE-HPS <math>p = .001</math>)</li> </ul>

**Note. Intervention column:** TAG = The Aging Game; ALT = an alternative activity on ageing; VRDS = a virtual reality dementia simulation; IMSE = immersive multi-sensory experience. GMG = Geriatric Medication Game. **Participant column:**  $M_{age}$  = Mean age. **Measures column:** *Att* = attitude, *Emp* = empathy, *Anx* = anxiety. ASD = Aging Semantic Differential; rASD = refined ASD; mMSAS = modified Maxwell-Sullivan Attitudes Survey (this measure has both an attitude and an empathy scale); AAS = Anxiety about Aging Scale; UCLA-GAS = University of California Los Angeles Geriatric Attitude Scale; FAQ = Facts about Aging Quiz; DAS = Dementia Attitude Scale; ASES = Ageing Simulation Experience Survey; KCES = Kiersma-Chen Empathy Scale; JSE-HPS = Jefferson Scale of Empathy – Health Professions Scale; ADQ = Approaches to Dementia Questionnaire; IRI = Interpersonal Reactivity Index. **Findings column:** NSD = no significant difference; Sig. = significant; + = improved; – = worsened; diff. = difference;  $L$  = large effect size,  $M$  = medium effect size.

Table 2. (Continued)

*Summary of Evidence from Studies Included in the Systematic Review*

Study	Intervention Name (minutes)	Participants N, age (years), gender	Measures	Findings
<i>Single arm pre-post studies</i>				
De Abreu et al. (2017), USA	IMSE ageing and dementia simulation (10)	49 psychiatry rotation learners: $M_{age}$ 27.44 years.	ADQ ( <i>Att</i> )	· Sig. + <i>Att</i> ( $d=.61_M$ )
Evans et al. (2005), USA	GMG (180)	102 pharmacy students: $M_{age}$ 21, 55% female.	Agreement with 12 statements about the elderly ( <i>Att</i> ); A single-item 5-point Likert scale ( <i>Emp</i> ); A single-item 5-point Likert scale ( <i>Anx</i> )	· Sig. diff. on 8/12 statements about the elderly ( $p<.05$ ) · 80% participants stated their <i>Emp</i> + · Mean <i>Anx</i> score =3 (5= very anxious)
Halpin (2015), USA	Ageing Equipment (26)	476 veteran affairs medical centre employees $M_{age}$ 40.5, 68.3% female.	Kogan's attitudes towards old People Scale ( <i>Att</i> )	· Sig. + <i>Att</i> ( $p=<.001$ )
Henry et al. (2007), USA	TAG (80)	156 allied health students; 81% < 25, 84% female.	rASD ( <i>Att</i> ); AAS ( <i>Anx</i> )	· Sig. – <i>Att</i> ( $p=>.001$ ) · Sig. – <i>Anx</i> ( $p=>.001$ )

**Note. Intervention column:** TAG = The Aging Game; ALT = an alternative activity on ageing; VRDS = a virtual reality dementia simulation; IMSE = immersive multi-sensory experience. GMG = Geriatric Medication Game. **Participant column:**  $M_{age}$  = Mean age. **Measures column:** *Att* = attitude, *Emp* = empathy, *Anx* = anxiety. ASD = Aging Semantic Differential; rASD = refined ASD; mMSAS = modified Maxwell-Sullivan Attitudes Survey (this measure has both an attitude and an empathy scale); AAS = Anxiety about Aging Scale; UCLA-GAS = University of California Los Angeles Geriatric Attitude Scale; FAQ = Facts about Aging Quiz; DAS = Dementia Attitude Scale; ASES = Ageing Simulation Experience Survey; KCES = Kiersma-Chen Empathy Scale; JSE-HPS = Jefferson Scale of Empathy – Health Professions Scale; ADQ = Approaches to Dementia Questionnaire; IRI = Interpersonal Reactivity Index. **Findings column:** NSD = no significant difference; Sig. = significant; + = improved; – = worsened; diff. = difference; L = large effect size, M = medium effect size.

Table 2. (Continued)

*Summary of Evidence from Studies Included in the Systematic Review*

Study	Intervention Name (minutes)	Participants N, age (years), gender	Measures	Findings
<i>Single arm pre-post studies</i>				
Robinsons and Roshier (2001), USA	Ageing Equipment (80)	49 medical students.	rASD ( <i>Att</i> )	<ul style="list-style-type: none"> <li>NSD in <i>Att</i> overall</li> <li>Sig. + <i>Att</i> on Instrumental subscale only (<math>p=.003</math>)</li> </ul>
Varkey et al. (2006), USA	TAG (180)	84 medical students: 78.3% 20-25, 54.8% female.	ASD ( <i>Att</i> ); MSAS ( <i>Emp</i> )	<ul style="list-style-type: none"> <li>Sig. – <i>Att</i> on ASD autonomy (<math>p=.001</math>) and acceptability (<math>p=.005</math>) subscales</li> <li>NSD in <i>Att</i> on ASD instrumental subscale</li> <li>Sig. + <i>Att</i> on 6/8 MSAS items (<math>p=.049</math>, <math>p=.003</math>, <math>p=.024</math>, <math>p=.001</math>, <math>p=.006</math>, <math>p=.023</math>)</li> <li>Sig. – <i>Att</i> on 1/8 MMS items (<math>p=.001</math>)</li> <li>Sig. + <i>Emp</i> 2/3 items (<math>p=.001</math>, <math>p=.002</math>)</li> </ul>
Wijma et al. (2017), Netherlands	VRDS (13)	42 informal carers of people with dementia: $M_{age}$ 55.1, 77% female.	Person-centred subscale of ADQ ( <i>Att</i> ); Perspective-taking subscale or IRI ( <i>Emp</i> )	<ul style="list-style-type: none"> <li>NSD in <i>Att</i></li> <li>Sig. + <i>Emp</i> (<math>d=0.42_M</math>)</li> </ul>

**Note. Intervention column:** TAG = The Aging Game; ALT = an alternative activity on ageing; VRDS = a virtual reality dementia simulation; IMSE = immersive multi-sensory experience. GMG = Geriatric Medication Game. **Participant column:**  $M_{age}$  = Mean age. **Measures column:** *Att* = attitude, *Emp* = empathy, *Anx* = anxiety. ASD = Aging Semantic Differential; rASD = refined ASD; mMSAS = modified Maxwell-Sullivan Attitudes Survey (this measure has both an attitude and an empathy scale); AAS = Anxiety about Aging Scale; UCLA-GAS = University of California Los Angeles Geriatric Attitude Scale; FAQ = Facts about Aging Quiz; DAS = Dementia Attitude Scale; ASES = Ageing Simulation Experience Survey; KCES = Kiersma-Chen Empathy Scale; JSE-HPS = Jefferson Scale of Empathy – Health Professions Scale; ADQ = Approaches to Dementia Questionnaire; IRI = Interpersonal Reactivity Index. **Findings column:** NSD = no significant difference; Sig. = significant; + = improved; – = worsened; diff. = difference; L = large effect size, M = medium effect size.

**Health and Social Care students.** Under-graduate and pre-professional health and social care students were the most frequently recruited from population ( $n = 12$ ). This included a broad range of disciplines; medicine, pharmacy, nursing, psychiatry, nutrition, physical therapy, mental health nursing, psychology, occupational therapy and social work. However, participants were most often students of nursing, medicine or pharmacy. Simulation with these groups was primarily of a form of training, designed to improve interest, knowledge, empathy and attitudes towards older people and PwD.

**Employees and Carers supporting older adults.** Employees working with older adults were recruited for three of the studies and this included both clinical and non-clinical staff. Simulation was used primarily as a form of training to enhance empathy and attitudes towards older adults and PwD and to improve their care. One study conducted simulations with informal carers of PwD (Wijma et al., 2017). The simulation in this study could be conceptualised more as an intervention, designed to improve understanding and empathy in the carers and result in better relationships between carers and PwD.

**Young adults.** Given the largely student-based population used in the studies, young adults made up the majority of participants. Eight studies reported the mean age of their sample to be under 25 years old. Four studies reported a higher mean participant age, ranging between 27.44 years and 55.10 years. The remaining three studies did not report participant age.

**Females.** All studies that reported the gender of their participants ( $n = 11$ ) had a majority female sample with a mean percentage of between 55.00 and 98.80.

**Research question 2: Through what methods are researchers simulating dementia and/or ageing?** Ageing simulation was conducted more

often ( $n = 10$ ) than dementia simulation ( $n = 5$ ), and all those that simulated dementia also incorporated generic ageing elements into the experience. Four different methods of simulation were identified: a) Ageing Equipment; b) Immersive Multi-Sensory Experience (IMSE); c) Standardised Ageing Game; d) VR (Table 2). The key features, similarities and differences of each method are discussed.

***Ageing Equipment.*** In this method, equipment, such as ear plugs, goggles, gloves and body-weights are worn to simulate common age-related impairments (e.g. loss of hearing, macular degeneration, cataracts, reduced manual dexterity and mobility difficulties), whilst everyday tasks are carried out. Examples of the tasks include tying shoelaces, counting and sorting objects, completing forms, reading an article, moving around and preparing a meal. The aim is primarily to demonstrate the functional challenges, and likely frustrations, that some older adults may face on a day-to-day basis. This method was only used to simulate ageing, not dementia, and was the intervention of choice for three of the included studies (Halpin, 2015; Robinson & Rosher, 2001; Yu & Chen, 2012). However, ageing equipment formed a component of all the other simulation methods identified, except VR.

Whilst the three studies using the Ageing Equipment method followed the general format described above, there were differences with regards to the exact equipment used, the number and type of tasks given, whether all props were worn together ( $n = 2$ ) or separately ( $n = 1$ ), the length of the simulation and whether there was a post-simulation group discussion ( $n = 2$ ) or not ( $n = 1$ ). The length of the ageing simulation activity via this method ranged from 26 minutes to 3 hours. Interestingly, one study instructed participants to complete the everyday tasks for a second time, with the addition of helpful functional adaptations (Robinson & Rosher, 2001a). This was an attempt to demonstrate the helpful effect that simple environmental changes (e.g. to the colour of an object) can have in aiding older adults.

**IMSE.** This method of simulation is used to simulate dementia and common age-related changes together. In addition to ageing equipment (as previously described), multi-sensory stimuli (e.g. sounds, lights, objects) are incorporated into the simulation to create cognitive, perceptual and emotional difficulties similar to those experienced by PwD. For example, auditory disturbances, such as distracting sounds, voices, static and laughter are played to participants via headphones creating confusion and concentration difficulties. As with the other simulation methods described so far, participants are given everyday tasks to complete, however these are conducted within an immersive environment e.g. a residential flat, for a more realistic experience. The IMSE method is a shorter but more intense simulation method than with Ageing Equipment. The two included studies using IMSE (Beville, 2002; de Abreu et al., 2017) had simulations lasting for 10 minutes.

The two studies differed on some of the multi-sensory components. For example, to create cognitive confusion and a memory loss experience, de Abreu and colleagues (2017) provided participants with complex multi-step instructions, for 10 tasks, all in one go. In the 'Virtual Dementia Tour' study, a transparency of an older person's face was placed on the bathroom mirror to create a sense of not recognising one's self (Beville, 2002). Lights were also dimmed, and a camera flash went off to create confusion, and a sense of vulnerability.

**Standardised Ageing Games.** Standardised Ageing Games rely on the Ageing Equipment method to create age-related functional impairments in participants, whilst additionally incorporating role-play and game elements that follow a standardised format. Players are asked to assume the identity of an older adult and several facilitators act as 'healthcare professionals' who are instructed to exhibit either compassion or little compassion towards the players. Players are asked to navigate to various 'stations' in a room which are set up to represent



different aspects of life (e.g. a GP surgery, a nursing home) and complete various day-to-day tasks. Throughout the simulation the game element causes player to wear more, or less, ageing equipment and experiences changes to their abilities.

Standardised ageing games were the most common method for simulating ageing (n = 7). Two different ageing games were used; 'The Ageing Game' (TAG) (Henry et al., 2007, 2011; Lucchetti et al., 2017; Varkey et al., 2006) and 'The Geriatric Medication Game'(GMG) (Chen et al., 2015a, 2015b; Evans et al., 2005). Both TAG and the GMG include health-related tasks, but the GMG focuses more on those involving medication, such as sorting similarly coloured pills. The tasks are designed to highlight the functional difficulties and frustrations that older adults may frequently encounter in the healthcare system. TAG incorporates a debriefing and reflective discussion after the simulation as an essential part of the method. All ageing game sessions were between eighty minutes and three hours long, with an average duration of 144.28 minutes.

**VR dementia simulation.** In this method of simulation, participants are given VR equipment allowing them to enter and interact with several virtual environments, whilst taking the first-person perspective of a person with dementia. The VR functionality allows for the visual content to correspond to the participants' real-time movements, making the simulation immersive and interactive. Symptoms and common emotional experiences in dementia are simulated through both the visual and audio content. For example, objects in the virtual environment can be manipulated so that they disappear, move or re-appear creating confusion, disorientation, memory difficulties and frustration.

The VR dementia simulation method was used in three studies and was therefore the most common method of simulating dementia (Adefila et al., 2016; Gilmartin-Thomas et al., 2018; Wijma et al., 2017). Each of these studies used a

different VR simulation leading to some minor differences between them. Wijma et al, (2017) created a thirteen minute 360-degree film called 'Into D'mentia' which was played to participants as on a VR headset. It was designed to accurately reflect a normal day at home for PwD and consisted of both tasks (e.g. put the groceries away) and interactions (e.g. talking to your daughter). Audio content was used to enhance the experience and an inner voice that narrated the thoughts and feeling of the person with dementia corresponded to the sex of the participant. The inclusion of virtual interactions with others also allowed participants to experience communication difficulties and common reactions and behaviours of others towards people with dementia.

The 'MyShoes' VR simulation created by Adefila and colleagues (2016) was also watched on a VR headset but movement was controlled with a mouse and keyboard. Participants in this study were given free range to explore the virtual home environment and conduct tasks as they wished (e.g. make a cup of tea, take out the bins, have a shower). Age-related filters were also incorporated into this experience to simulate common visual problems (e.g. cataracts and glaucoma) and auditory disturbances (e.g. tinnitus) common in older PwD. The length of the simulation was not reported.

The VR simulation used in Gilmartin-Thomas et al. (2017) was the one and a half hour long 'Virtual Dementia Experience' (VDE) created by Alzheimer's Australia Vic. The VDE virtual environment is projected onto a ten by two metre screen in front of the participant. Surround sound and lighting effects are also used to create the dementia symptoms. After the individual simulation a facilitated group reflection is conducted as part of VDE.

**Research question 3: What is the impact of experiencing an ageing or dementia simulation on adults' attitude, empathy and anxiety regarding ageing and dementia?** The findings of each study presented in Table 2 are synthesised separately for each variable of interest (attitude, empathy and anxiety) and within this, separately for ageing and dementia simulations. Stronger studies are discussed first, followed by the research of a comparatively lower quality.

***Ageing simulation and attitude towards older people.*** A total of ten studies investigated the effect of ageing simulation on attitudes towards older adults. Three of these were controlled studies and they reported mixed results, with no improvements and some harm detected (Henry et al., 2011; Lucchetti et al., 2017; Yu & Chen, 2012). The strongest of the three, Lucchetti et al. (2017), found that participating in TAG significantly worsened medical students' attitudes towards older people across three attitude measures, with large and medium effect sizes. Attitude scores were significantly better for participants who had completed the alternative activity (a quiz about the myths of ageing) compared to those who took part in TAG and those who were in the control group. On the other hand, the other two studies found no significant change in attitudes towards older people from pre- to post-ageing simulation or between groups (Henry et al., 2011; Yu & Chen, 2012).

Attitude findings from the strong single-arm studies were mixed ( $n = 4$ ). The strongest demonstrated significantly improved attitudes from pre- to post-simulation (Halpin, 2015). Others detected some improvements on individual items of attitude questionnaires, but no overall change (Chen et al., 2015b; Varkey et al., 2006). However, one of these found contradictory results with significant worsening on one item of the same attitude questionnaire (MSAS) and significant worsening on two of three subscales (Autonomy and Acceptability) on another attitude questionnaire (ASD; Varkey et al., 2006). Negative effects were also evident in the study by Henry et al. (2007), whereby exposure to TAG significantly worsened attitudes about older

adults, in allied health students. Worsening effects were more significant in students under the age of 25, or who had prior course-work on ageing. Notably, all strong studies reporting worsened attitudes towards older people after simulation used an ageing game method of simulation (Henry et al., 2007; Lucchetti et al., 2017; Varkey et al., 2006).

The comparatively weaker studies indicated significant improvement on some attitude items and no change on others (Chen et al., 2015a; Evans et al., 2005; Robinson & Rosher, 2001).

***Dementia simulation and attitude towards PwD.*** Three of the four dementia simulation studies measured attitudes towards PwD and found mixed results, with either improvement or no change in attitude. The strongest of these found a VR Dementia Simulation significantly improved medical and pharmacy students' attitudes towards PwD from pre- to post-simulation and raised attitudes significantly higher than those of controls participants (Gilmartin-Thomas et al., 2018). Similarly, a study of moderate quality, found that learners on a psychiatry rotation had significantly improved attitudes towards PwD from pre- to post-IMSE simulation, with a medium effect size (de Abreu et al., 2017).

Another relatively strong study did not detect any change in attitudes towards PwD after a VR dementia simulation (Wijma, 2017). However, this study had a comparatively small sample size and used a different population to the other studies: informal carers of PwD.

***Ageing simulation and empathy towards older adults.*** Six studies explored the impact of ageing simulation on participants' empathy towards older adults (Chen et al., 2015a; Chen et al., 2015b; Evans et al., 2005; Henry et al., 2011; Lucchetti et al., 2017; Varkey et al., 2006). The two strongest demonstrated

mixed findings. One demonstrated significantly improved empathy in medical students from pre- to post- TAG, with a medium effect size (Lucchetti et al., 2017). However, no significant difference was found post-test between the TAG, comparison and control groups. The other study did not detect any change in empathy from pre- to post-playing TAG, nor between the TAG and comparison group post-intervention (Henry et al., 2011).

The four remaining studies, demonstrated simulation to have a positive effect on empathy, although two were of comparatively low quality (Chen et al. 2015a; Evans et al., 2005). Chen et al. (2015a; 2015b) and Varkey et al. (2006) found standardised ageing games significantly improved empathy in pharmacy, nursing and medical students, respectively. In the Evans et al. (2005) study, 80 percent of participants stated that their empathy improved in response to the GMG and female participants were significantly more likely than male participants to report improved empathy. This method of measuring empathy is, however, much less reliable or valid than the methods used by others.

***Dementia simulation and empathy towards PwD.*** Three studies measured participant empathy in response to a dementia simulation and all found positive effects (Adefila et al., 2016; Beville, 2002; Wijma et al., 2017). The strongest found a VR dementia simulation significantly improved empathy towards PwD in informal carers of PwD, with a medium effect size (Wijma et al., 2017). The other two studies were of weak quality but found improved empathy; one using VR (Adefila et al., 2016) and the other, IMSE Beville (2002).

***Ageing simulation and anxiety about ageing.*** Two studies explored the impact of ageing simulation on participants' anxiety about ageing using the AAS. The stronger of the two found no significant change between anxiety scores before and after TAG, but did find that the entire sample had significantly heightened

anxiety at post-test (Henry et al., 2011). The most increased anxiety factor of the AAS scale was 'Fear of losses'. The other study found significantly heightened anxiety about ageing after TAG and when looking at the individual subscales found significantly worsening scores on 'Fear of losses' and 'Psychological concerns' (Henry et al., 2007). The authors reported that over 25-year-olds demonstrated a lesser increase in anxiety on the 'Fear of losses scale' than younger participants. Previous experience was also found to influence the change in anxiety whereby participants were found to have a lesser increase in anxiety on the 'Fear of losses' subscale if they had experience of contact with older adults.

One other study included a finding about non-specific anxiety and reported that on average, participants rated their level of anxiety during the GMG as three on a Likert scale of one (not at all anxious) to five (very anxious) (Evans et al., 2005). The most intensely felt emotion was 'frustration', rated as a five on the scale by most.

***Dementia simulation and anxiety about dementia.*** No studies explored the impact of a dementia simulation on anxiety or fear about dementia however, an IMSE dementia simulation was associated with an increase in reported level of anxiety in one study pre- to post-simulation (Beville, 2002). This related to general anxiety rated on a Likert scale and came from a study with significant methodological weaknesses.

***Contradictory results within studies.*** As evident in Table 2, many of the included studies explored more than one variable. Some of these found internally consistent results such as no change in attitude, empathy or anxiety about ageing from pre- to post-TAG (Henry et al., 2011), or significant worsening on both attitudes and anxiety post TAG (Henry et al., 2007), or improved attitudes and improved empathy after the GMG (Chen et al., 2015a, 2015b; Evans et al., 2005). Others

found more surprising, contradictory results. For example, in one robust study, attitudes towards old people were significantly worse across three attitude measures after TAG, yet empathy was significantly improved (Lucchetti et al., 2017). However, only attitudes were significantly different between intervention and control participants at post-test. Some similarly mixed findings can be seen in the Varkey et al (2006) study, in which a significant worsening of attitudes was detected on two attitude subscales of the ASD after TAG, yet empathy was significantly improved. This paper also reported improved attitudes on six out of eight individual MSAS attitude items. Two dementia simulation studies also found contradictory findings amongst study variables. The better quality of the two found that empathy towards PwD improved after VR simulation whilst attitudes did not change (Wijma et al., 2017). Beville (2002) found an IMSE dementia simulation improved empathy towards PwD but increased participants' general level of anxiety.

## **Discussion**

This systematic review identified a body of 15 research papers that, since January 2000, have simulated either ageing or dementia in individuals and explored the impact on their anxiety, empathy or anxiety. This review identified that ageing simulation research is conducted either with Ageing Equipment or Standardised Ageing Game such as TAG or the GMG. Whereas, dementia simulations draw on more recent advances to technology and utilise IMSE or VR. Simulations are primarily conducted with individuals working or training within the healthcare system.

### **The Impact of Experiencing an Ageing Simulation**

The findings regarding the impact of experiencing an ageing simulation on attitudes towards older people is inconclusive. Evidence drawn from the most methodologically sound papers suggests that ageing simulation either has no impact

on attitude, or more concerningly, that it can in fact worsen attitudes. This finding is in line with Ando et al.'s (2011) systematic review of hallucination simulations which found a mixed and inconclusive impact on attitudes schizophrenia, as well as the unintended consequence of increasing desire for social distance from people with the diagnosis. Notably, however, this current review finds that the evidence regarding worsened attitudes and no change in attitudes towards older adults, came only from research that used TAG to simulate ageing. This finding is not dissimilar from a previous systematic review which found ageing games are not effective in improving attitudes towards older adults (Alfarah et al., 2010).

It could be argued that some ageing game simulations have the potential to worsen attitudes towards older adults if they reinforce existing ageist stereotypes. Most of the ageing simulation papers reviewed here focused largely on the problematic aspects of ageing such as functional decline due to mobility, vision and hearing difficulties. This may present a one-sided image of ageing to those involved in the simulation, that inadvertently confirms problematic stereotypes of the elderly as 'frail, ill and dependent' that are currently widespread (Swift et al., 2016, p. 2).

This review found evidence that experiencing an ageing simulation is likely to improve individuals' feelings of empathy towards older adults. Given that empathy is fundamental to all helping relationships this is a highly desirable finding (Reynolds & Scott, 1999). This is of course particularly pertinent for the populations who were found to be receiving ageing simulations, as they consisted entirely of individuals who were in, or would eventually be in, some form of formal or informal helping relationship with older adults. Ageing simulations give individuals an opportunity to face some of the same challenges as older adults and therefore experience some of the same emotions (Evans et al., 2005; Henry et al., 2011). This experience is likely to provide them with a perspective from which they can more easily understand and empathise with an older person.



This systematic review of the literature also found some contradictory findings which warrant discussion. Empathy can improve in individuals after an ageing simulation even if their attitude does not change or, indeed, worsens. This finding echoes the conclusions drawn by Adno et al (2011) who found improved empathy for people with schizophrenia could be present after a hallucination simulation exercise, even when stigmatising attitudes were heightened. Perhaps the mixed impact of simulation on attitudes and empathy reflects the inherently mixed way in which we tend to view older adults. Ageism research has consistently identified culturally and temporally pervasive combined negative-positive stereotypes, whereby older adults are viewed as high in warmth, wisdom and friendliness, but low on competence, status and independence (Cuddy, Norton, & Fiske, 2005). This mixed societal attitude towards older adults has been conceptualised as the 'warm but incompetent' stereotype by some and is associated with feelings of pity towards older people (North & Fiske, 2012, p. 985).

It could be argued that ageing simulations elicit feelings of pity in individuals, rather than genuine empathy. Given that the measurement of empathy is fraught with difficulty (Pedersen, 2009) and the measures detected within this review were often subject to reliability and validity problems, it is feasible to suggest that feeling sorry for, or pitying, older adults may well have been captured in addition to, or instead of genuine empathy. This is problematic because as Cuddy, Norton and Fiske (2005) argue, pity may lead to interactions that cause older adults to feel helpless and dependent. Again, if this is the case, pervasive negative stereotypes of older adults will be reinforced and this has a detrimental impact on the wellbeing of our ageing population and our future selves (Nelson, 2016; Swift et al., 2016). This is perhaps most strikingly demonstrated by the 'Ohio Longitudinal Study of Aging and Retirement' which identified a life longevity disadvantage of more than

seven years in individuals with less positive self-perceptions about ageing compared to those with more positive self-perceptions (Levy, Slade, Kunkel, & Kasl, 2002).

This review found that research into ageing simulation has largely neglected to consider the potential impact on individuals' anxieties about ageing. This is surprising given that ageing is an inevitable part of healthy life, and therefore the simulation of ageing is self-relevant. Ageing simulations tend to focus on the challenges posed by ageing and it may be expected that anxiety becomes raised in response. This review found evidence, based on a limited number of studies, that ageing simulation, or indeed, any ageing based activity, can raise individuals' anxieties about their own ageing process. Fear of ageing has been associated with negative attitudes about older adults (Harris & Dollinger, 2003) and one study included in this review found anxiety and attitude were both significantly worsened after TAG.

### **The Impact of Experiencing a Dementia Simulation**

This review identified that compared with ageing simulation, dementia simulation research and practice is very much in its infancy. A limited body of literature exists, therefore, conclusions drawn from this review are tentative. That said, the early indications are promising. Dementia simulation was found to consistently improve attitude towards PwD in healthcare students. No change was detected in carers, but attitudes were relatively positive to begin with and the sample was small. As with ageing simulation, empathy was found to consistently improve after dementia simulation and did so across three different populations; healthcare students, healthcare employees and informal carers of PwD. There was a gap in the literature with regards to exploring how dementia simulation may influence individuals' anxieties or fears about dementia.

Unlike the ageing simulations identified in this review, and hallucination simulations identified in previous reviews (Ando et al., 2011), no unintended harmful consequences were identified after dementia simulation. Previous research has demonstrated that highly immersive simulation creates an embodied experience for individuals that lends itself more effectively to the promotion of positive attitudes and helping behaviours compared to more traditional perspective-taking exercise (Ahn et al., 2013). Given that this review identified dementia simulations to be conducted using far more immersive and realistic methods than ageing simulations, it could be argued that participants have access to a more embodied experience with beneficial results.

### **Clinical Implications and Future Research**

Given the sometimes negative and certainly inconclusive findings with regard to ageing simulation and ageist attitudes, their clinical use should be considered carefully. Future providers of ageing simulation training may wish to consider some of the following ideas: ageing simulation experiences may benefit from the inclusion of elements that give a balanced picture of ageing or provide opportunities for negative stereotypes to be addressed. For example, one of the reviewed studies found the comparison activity, a myths of ageing quiz, that focused on dispelling myths about ageing had a significantly positive effect on individuals' attitudes and empathy towards older adults (Lucchetti et al., 2017). This type of activity could be combined with simulation. Alternatively, drawing on the approach used in the 'Half-full' ageing simulation, positive metaphors and helpful functional adaptations could be incorporated into the simulation, affording individuals an opportunity to see how age-related functional difficulties can be overcome (Robinson & Rosher, 2001). Finally, perhaps post-simulation discussions could be facilitated to elicit and address any reinforced ageist stereotypes that have resulted from the simulation experience.

Ageing simulations may also benefit from being updated with more immersive technology such as VR and IMSE.

Ageing simulation suits (e.g. the GERT suit, the PAUL suit, AGNES) are increasingly being used within healthcare training exercises, yet there is a complete lack of quality research into their effectiveness. During the process of the review, some ageing-suit literature was identified, however it was mostly of an editorial nature, only measured qualitative outcomes or the design was not suitable for inclusion in this review. Further robust research is necessary to investigate whether ageing suits are effective and check for unintended harm. A review of qualitative literature may also be useful in this regard.

Given the early positive signs that dementia simulation may have significant benefits, research in this area should continue. Where randomised controlled trials are not possible or not warranted, future quantitative research in this area should have an emphasis on robust design and strive to use validated measures with good psychometric properties. This is particularly important with the measurement of empathy which has so far been relatively poor.

The concepts of attitudes and empathy are of a nature that make them inherently difficult to measure because they are highly susceptible to social desirability biases and are complex and multi-faceted. One potential way to address this problem, whilst addressing a gap in the literature, could be to measure how actual behaviour towards older adults and PwD is influenced by simulations. Direct observations of behaviour may be difficult to achieve in practice however, and perhaps psychometrically evaluated measures that tap into individuals' behavioural intentions or motivations to care for older PwD could be utilised. The literature would also benefit from more evidence with regards to how anxiety about ageing

and dementia are influenced by simulation exercises and whether any increases in anxiety are brief or sustained.

Future research in this field may benefit from considering how different populations respond to simulation. As it stands, ageing and dementia simulation research has been conducted almost entirely with healthcare students and staff. However, simulations are becoming more widely available, outside of the healthcare training context, and research must be conducted with non-healthcare populations to explore whether responses differ. This review identified that current research is overwhelmingly based on majority female samples, and there were mixed findings as to whether gender influenced the way in which simulations impacted individuals' attitudes, empathy or anxiety. It may be useful, therefore, for future research to draw on male populations. More research with informal carers is also warranted.

### **Strengths and Limitations**

This literature review benefits from a systematic approach with the possibility of replication. A comprehensive search strategy using multiple databases and additional hand-searching was used. Several outcome variables were considered and reviewed providing a rich picture of how simulations impact individuals. A further strength of this review is the detailed critical appraisal of the quality of included studies, including a thorough examination of the measurement tools used. This quality assessment was guided by a validated quality assessment tool, albeit with a minor adaption, providing a systematic framework to the appraisal.

The quality of the literature examined was mixed and whilst the majority was considered strong, some considerable weaknesses were identified. Whilst design and measurement quality limitations have been highlighted where present, the lack of high quality controlled research such as RCTs with psychometrically strong

measurement tools must be considered when reading the conclusions of this review. A further limitation of this study is that it has only considered quantitative findings. Qualitative research in this field may provide rich and detailed information about the personal impact of simulation on individuals and perhaps give further insight into the underlying mechanisms of change with regards to attitudes, empathy and anxiety. The highly heterogeneous nature of the studies included and great variation in measures excluded the possibility of conducting a meta-analysis.

Whilst systematic and thorough, the search excluded studies that were not in the English language and studies not published in peer reviewed journals. It is therefore possible that some evidence is missing from narrative synthesis presented here and the generalisability of the results should be carefully considered. Finally, the review has been conducted by a single author thus decisions regarding inclusions, exclusion, quality ratings and data extraction may be subject to the author's bias. Involving other researchers in this process in the future would allow for inter-rater reliability checks.

## **Conclusion**

Whilst ageing simulations have been around for some time, recent advances in technology are making it possible to simulate more complex problems such as dementia. This systematic review indicates that dementia simulation research is still very much in its infancy and ageing simulation continues to make up much of the literature. The evidence base is considerably mixed with regards to whether ageing simulation is beneficial in combating ageist attitudes. There is a need for more research, particularly in the dementia simulation field, where early results are promising with regards to improved empathy and attitudes towards PwD. More rigorous research designs with validated measures and larger sample sizes are required.

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## **Part Two: Empirical Paper**

### **Exploring the Impact of a Brief Virtual Reality Dementia Simulation on Healthy Adults' Willingness to Care, Dementia Worry and Ageing Anxiety**

## **Abstract**

**Aim:** The aims of this study were to investigate the feasibility of delivering a brief virtual reality (VR) dementia simulation using participants' own devices; to evaluate the impact of the simulation on healthy adults' attitudes towards willingness to care (WTC) for people with dementia (PwD), dementia and ageing; and to explore predictors of WTC.

**Method:** The study was conducted online via Qualtrics. Healthy adult participants were randomly allocated to one of two groups, VR dementia simulation (VRDS) or Control, stratified according to previous experience of dementia. VRDS participants were exposed to a brief VR dementia simulation prior to completing self-report measures of WTC, dementia worry (DW) and ageing anxiety (AA). Control participants completed the measures prior to exposure to the simulation. All participants completed post-simulation ratings on usability of the VR and compassion. Between group comparisons were conducted using ANCOVAs and a hierarchical logistic regression was performed to ascertain predictors of WTC.

**Results:** There were 247 participants (124 VRDS, 123 Control) aged between 18 and 80 years old, 80.4% were female and 77.3% had prior experience of dementia. Participants reported high levels of compassion towards PwD after experiencing the simulation but there was no difference between simulation and control groups regarding WTC ( $F(1, 196) = .118, p = .732$ ), DW ( $F(1, 196) = 1.030, p = .331$ ) or AA ( $F(1, 196) = .518, p = .472$ ). Contrary to expectations, 38.8% of participants related more to the family carer, than the person with dementia, during the simulation. Significant predictors of higher WTC were high perceived ability to care, low fear of old people and low psychological concerns about ageing.

**Conclusion:** It is feasible to deliver brief VR dementia simulation on participants' own devices during which compassion towards PwD is felt. This

method of dementia simulation does not necessarily result in a 'first person' immersive experience and did not have a measurable positive impact on adults' WTC. This study finds no evidence of simulation resulting in a negative impact on anxiety about dementia or ageing.

## **Introduction**

Since the launch of 'Global Action Against Dementia' in 2013, dementia research has become a worldwide priority (World Health Organisation [WHO] Ministerial Conference on Global Action Against Dementia, 2015). The number of people living with some form of dementia worldwide is expected to triple from 50 million to 150 million over the next 30 years (WHO, 2017). In the UK alone, there are 850,000 people with dementia (PwD), two thirds of whom are supported to live in the community by an estimated 700,000 family carers (Carers Trust, 2015). The impact of dementia is far reaching for affected individuals and families, for national governments and for the international research community (World Health Organisation & Alzheimer's Disease International, 2012). Dementia continues to be stigmatised by the public and amongst healthcare professionals, with adverse quality of life consequences for PwD (Herrmann et al., 2018; Milne, 2010). Currently, determining the most effective and high quality training for carers of PwD (paid and family) and improving public understanding of and attitude towards dementia are amongst the top research priorities in the UK and internationally (Department of Health, 2016; Pickett et al., 2017; Shah et al., 2016).

## **Simulating Dementia**

Simulation of physical and mental health conditions is becoming a widely adopted approach in healthcare education and training (Williams, Reddy, Marshall, Beovich, & McKarney, 2017) and has been demonstrated to effectively improve attitudes towards stigmatised and stereotyped conditions such as intellectual disability (Billon et al., 2016), psychosis (Riches et al., 2017), and old age (Fisher & Walker, 2014). The simulation of dementia is a recent development within the simulation field and there are emerging examples of its use within a healthcare training context (Adefila, Graham, Clouder, Bluteau, & Ball, 2016; Gilmartin-Thomas



et al., 2018a, 2018b; Slater, Hasson, Gillen, & Colchar, 2017) and within public awareness campaigns (Alzheimer's Research UK, 2016). Dementia simulation experiences are also commercially available (Beville, 2002) and attracting media attention (BBC, 2017; Hamilton, 2016).

Dementia is a neurodegenerative syndrome, with over 200 different forms, characterised by a progressive impairment to cognitive functioning (e.g. difficulties with memory, concentration, planning, decision-making and communication), behavioural changes and a decline in daily functioning (Alzheimer's Society, 2014; World Health Organisation [WHO], 2017). It is caused by organic brain diseases such as Alzheimer's disease (Alzheimer's Society, 2014). The complex neurological nature of dementia makes it particularly challenging to simulate in a healthy individual. However, increased accessibility to advanced technology has enabled researchers to create dementia-like experiences, giving individuals the chance to view the world from the point of view of PwD.

### **Virtual Reality (VR)**

A potentially promising line of development is the creation of dementia simulation using VR technology, often designed in consultation with PwD (Adefila et al., 2016; Alzheimer's Research UK, 2016; Gilmartin-Thomas et al., 2018a, 2018b; Wijma, Veerbeek, Prins, Pot, & Willemse, 2017). Wearing a VR headset, individuals can take the first-person perspective of a person living with dementia and experience a virtual environment that moves around with their real-time movements (Adefila et al., 2016; Alzheimer's Research UK, 2016). Within the virtual world visual stimuli create common dementia-like symptoms such as visual misperceptions, recognition difficulties and memory difficulties; e.g. colours and distances are distorted; a stranger momentarily looks like a familiar person; the milk you just used can no longer be found in the kitchen (Adefila et al., 2016; Alzheimer's Research

UK, 2016; Gilmartin-Thomas et al., 2018a). Corresponding audio content provides insights into the thoughts and feeling that PwD may commonly experience (e.g. confusion, disorientation, anxiety) as well as the typical responses of others (e.g. concern, compassion, aid) (Alzheimer's Research UK, 2016; Wijma et al., 2017).

**Embodied experience in VR.** The realistic, multi-sensory and immersive experience of VR creates an embodied perspective-taking opportunity. Research has demonstrated that VR leads to a greater sense of self-other merging (i.e. feeling similar to, or at one with, an identified other), than that which occurs through simple cognitive perspective-taking (Ahn et al., 2013). Self-other merging has been found to underpin improved attitudes, increased desire to help and actual helping behaviour, towards the 'other' (Ahn et al., 2013). VR dementia simulations that enable an embodied self-other merging experience may therefore result in improved attitudes, empathy and helping behaviour towards PwD.

### **VR Dementia Simulation Improves Attitudes and Empathy**

Only a small body of research currently exists on the effects of VR dementia simulation, but the available evidence is promising. A robust controlled trial conducted in Australia ( $N = 278$ ), demonstrated significantly improved attitude towards PwD, in pharmacy and medicine undergraduate students, after experiencing a VR dementia simulation (Gilmartin-Thomas et al., 2018a). However, a smaller scale Dutch study without a control group ( $N = 35$ ), detected no change in attitude amongst family carers of PwD after VR simulation (Wijma et al., 2017). This study did however find that delivering VR simulations to family carers was feasible, acceptable, and led to significant improvements in empathy ( $d = .42$ ), trust in own caring abilities ( $d = .36$ ), resilience ( $d = .32$ ) and positive interactions in the relationship with the person with dementia ( $d = -.62$ ). A pilot study with health and social care trainees (e.g. mental health nurses; clinical psychologists; social

workers;  $N = 55$ ) found exposure to a VR dementia simulation led to significantly improved empathy and compassion towards PwD ( $d = .51$ ; Adefila et al., 2016). The empathy measure was however a rudimentary one-item, un-validated scale.

Gilmartin-Thomas and colleagues also conducted a qualitative evaluation ( $N = 53$ ) in which students described the VR dementia simulation as interesting, engaging and leading to improved attitudes and understanding of dementia (Gilmartin-Thomas et al., 2018b). Similarly, students in the Adefila et al. (2016) study fed-back that the experience was eye-opening and helpful. Both studies found that students used the VR experience as a basis for reflective discussion on how they might improve their future practice with PwD (Adefila et al., 2016; Gilmartin-Thomas 2018b). Although VR dementia simulation is now more accessible than ever, and available to the public (Alzheimer's Research UK, 2016), no research to date has explored the impact of VR dementia simulation in a general population.

Further to the above, improved empathy following simulation is consistently reported within the literature on ageing simulation ( e.g. Chen, Kiersma, Yehle, & Plake, 2015a, 2015b; Lucchetti, Lucchetti, de Oliveira, Moreira-Almeida, & da Silva Ezequiel, 2017; Varkey, Chutka, & Lesnick, 2006).

### **Potential Unintended Consequences**

It is imperative that potential unintended negative consequences are considered alongside the benefits of VR dementia simulation. No existing literature reports harm from VR dementia simulation, however, findings from non-VR simulations, and simulation of other conditions, highlight potential problems and challenges.

**Attitudes.** The systematic literature review conducted in Part One of this thesis found evidence regarding the impact of educational ageing simulations on attitudes towards older adults to be inconclusive. The picture was considerably mixed, with some studies reporting improved attitudes (e.g. Halpin, 2015), others no change (e.g. Henry, Ozier, & Johnson, 2011) and most concerningly, some good quality studies reporting significantly worsened attitudes (Douglass, Henry, & Kostiwa, 2008; Lucchetti A.L. et al., 2017).

**Anxiety.** Simulation has sometimes been found to inadvertently heighten individuals' anxiety about the simulated condition. For example, a systematic review of hallucination simulation studies demonstrated evidence of increased desire for social distance from people with schizophrenia following simulation, potentially resulting from a fear response (Ando, Clement, Barley, & Thornicroft, 2011). Young adults viewing their aged self within a VR age progression simulation reported heightened ageing anxiety and increased negative ageing stereotypes following the exercise (Rittenour & Cohen, 2016). Some ageing game simulation studies have reported heightened ageing anxiety, particularly fear of losses and psychological concerns, in response to simulation (Douglass et al., 2008; Henry, Douglass, & Kostiwa, 2007). However, other ageing game simulations have reported no change in anxiety or demonstrated heightened ageing anxiety to be a common response to any activity that requires individuals to consider their own ageing process (Henry et al., 2011).

The Virtual Dementia Tour ®, a non-VR immersive multi-sensory experience (IMSE) of dementia, reported heightened frustration, anxiety and blood pressure in participants following the exercise (Beville, 2002). The author claimed this to demonstrate the authenticity of the dementia experience, however, others have criticised these findings as evidence of the overly pessimistic nature of the

simulation in which the individual receiving it is treated in a hostile manner (Merizzi, 2018).

***Ageing anxiety.*** Whilst dementia is not a normal function of ageing, the risk increases with age and 90 percent of diagnoses are made in older adults (Alzheimer's Society, 2014). It could be argued that given the strong associations between dementia and ageing, VR dementia simulations have the potential to raise individuals' ageing anxiety (AA). AA is defined as the combined anticipation and fear regarding the physical, mental and personal losses associated with becoming old (Lasher & Faulkender, 1993). Despite the inevitability of ageing and increased longevity, anxiety associated with the process is commonplace in the population (Brunton & Scott, 2015). Problematically, AA is associated with stereotyped beliefs about older adults, worse attitudes towards older people and ageism (prejudice against older adults) (Harris & Dollinger, 2003; Nelson, 2016). Not only do ageist attitudes lead to poorer treatment of older adults, they also become internalised and can prevent healthy adjustment to ageing (Levy, Slade, Kunkel, & Kasl, 2002; Nelson, 2005, 2011). Factors such as poor health and lower quality contact with older adults are associated with increased AA (Brunton & Scott, 2015). No existing VR dementia simulation research has measured AA in response to simulation.

***Dementia worry.*** Another possibility, yet to be considered, is whether VR dementia simulation experiences can inadvertently raise individuals' fears about having dementia. In recent years, dementia worry (DW) has been identified as a unique construct, distinct from AA, defined as an "emotional reaction to the perceived threat of developing dementia, independent of chronological age and cognitive status" (Kessler, Bowen, Baer, Froelich, & Wahl, 2012, p. 277). DW has become increasingly prevalent in the healthy adult population (Kessler et al., 2012). For example, a survey of more than 9,000 British people over the age of 50,

demonstrated that individuals feared developing dementia more than any other disease (Saga, 2016).

As with AA, DW has adverse consequences. Studies have demonstrated that DW negatively influences memory performance, self-assessment of subjective cognitive performance, psychological wellbeing and health outcomes (Cutler & Hodgson, 2013, 2014; Kinzer & Suhr, 2016; Lineweaver, Bondi, Galasko, & Salmon, 2014). Clearly, it is important to ensure VR dementia simulation does not heighten DW.

### **Psychological Theories of DW**

Several psychological theories provide possible explanations for the development and perpetuation of DW; these are briefly considered.

**Threat to sense of self.** Kessler and colleagues (2012) argued that the concept of dementia threatens our sense of self and our experience of reality. It is argued that the symptoms of dementia (e.g. memory loss; communication difficulties; personality changes) lead us to assume we would feel alone and less able to lead a meaningful life if we had dementia. Encounters with dementia may therefore remind us of this disturbing thought and raise our anxiety. Evidence for this theory comes from studies which demonstrate that people with more Alzheimer's-related experience (i.e. a family member with the diagnosis) are generally more fearful of it (Page, 2013).

**Health anxiety.** Based on theoretical models of health anxiety (e.g. Warwick & Salkovskis, 1990), the level of concern individuals feel about developing dementia will be influenced by personal experience with dementia (e.g. having a relative with dementia, being exposed to information about dementia) and individual factors (e.g. generalised anxiety, attitudes towards ageing) (Kinzer & Suhr, 2016) .

People with high levels of concern about dementia are more likely to misinterpret everyday memory lapses as evidence of cognitive decline and be hypervigilant for other signs and symptoms (Cutler & Hodgson, 1996; Suhr & Kinkela, 2007). Heightened hypervigilance and anxiety can impede every day functioning and subjective perception of cognitive performance resulting in a cycle of increasing 'symptoms' and increasing DW (Kessler, Südhof, & Frölich, 2014). A misdiagnosis of Mild Cognitive Impairment (MCI) becomes more likely, which in turn, can result in further anxiety for the individual, inappropriate treatment and missed opportunities for the effective treatment of other factors that may be contributing to the subjective cognitive decline (e.g. mood and anxiety)(Kessler, Südhof, & Frölich, 2014).

**Dementia stereotypes.** Factors associated with heightened DW include being middle-aged or older and related to a person with dementia, having more experience of dementia, and believing in, or being exposed to, negative stereotypes about dementia (Kessler et al., 2012; Kinzer, 2013; Kinzer & Suhr, 2016; Page, 2013; Sun, Gao, & Coon, 2015). Day-to-day dementia encounters are on the rise; it is increasingly likely we will personally know someone with it and the subject is attracting more attention in the media (Kessler et al., 2012). Rising DW in the population could therefore be a consequence of increased encounters with and awareness of dementia, in the context of prevailing negative stereotypes (Hodgson & Cutler, 2003). The images of PwD, and older people in general, conveyed to society remain mostly negative and stereotypical (Cuddy, Norton, & Fiske, 2005). For example, older adults are seen as incompetent and senile (North & Fiske, 2015) and PwD stereotyped as without identity, dignity and control (Mukadam & Livingston, 2012; O'Connor & McFadden, 2012). Perhaps to avoid raising DW, useful dementia simulations would actively challenge the perpetuation of such stereotypes.

**Terror Management Theory.** One theory may explain both adherence to negative stereotypes and anxiety after ageing or dementia simulation is Terror Management Theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986; Rittenour & Cohen, 2016). TMT states that reminders of our inevitable death, termed ‘mortality salience’, leave us with a sense of dread (Greenberg et al., 1986). An investigation into the role of TMT in ageism and attitudes towards dementia found that participants who were primed to think either about older people or people with dementia, generated greater numbers of death-related words compared to participants primed to think of either younger people or people with another health condition respectively (O’Connor & McFadden, 2012). TMT states that, due to our instinct towards self-preservation, we manage the threat and anxiety rising from awareness of our inevitable death through ‘distal death’ defences (Greenberg et al., 1986). Such defences may include avoiding situations and interactions that remind us of our death, denying the human body’s physicality or vulnerability and adhering to a cultural worldview such as the afterlife (Chonody & Teater, 2016; Greenberg et al., 1986).

Encounters with dementia or ageing, such as a simulations, may serve as real-world primers for death and increase an individual’s mortality salience resulting in high levels of anxiety (Chonody & Teater, 2016; O’Connor & McFadden, 2012). Individuals may then reduce this anxiety by employing a distal death defence such as distancing themselves from people with dementia or seeing them as ‘other’ and different (O’Connor & McFadden, 2012). This could negatively affect care-giving, attitudes and empathy towards PwD.

### **Rationale for the Current Study**

Finding effective training interventions for paid and family carers of PwD and improving public understanding and perception of dementia are national and



international research priorities. VR dementia simulation, a newly developing area, may contribute to addressing these key priorities. There is some evidence that VR dementia simulation can significantly improve attitude and empathy towards PwD, but this is based on a very small number of existing studies, some of which are subject to methodological and measurement weaknesses. Additionally, the public can now access VR dementia simulations, but no research has been conducted with a general population.

Existing research on VR dementia simulation has focused on measuring attitudes and empathy towards PwD. The measurement of empathy has been inconsistent and problematic. The terms empathy, perspective-taking and compassion have been used interchangeably and un-validated and psychometrically weak tools have been relied on. Concerningly, phrases such as 'feel sorry for', gathered in qualitative feedback have been taken as evidence of empathy (Adefila et al., 2016, p. 97). Feeling sorry for someone is more akin to pity, a much less helpful emotion in relation to older PwD (Milne, 2010; Nelson, 2016). Furthermore, it is not clear how either improved attitude or empathy generated from VR dementia simulation affects actual behaviour towards PwD, particularly as the systematic literature review in Part One identified that improved empathy can occur in the context of worsened attitudes. Observing and measuring behaviour directly is difficult. Arguably, measurement of a variable such as Willingness to Care (WTC), which taps into caring behaviour intentions, would be more useful and applicable to research in this field. Previous dementia research has measured WTC for PwD with a validated measure, and the WTC construct incorporates elements of emotional caring, for which empathy is likely required (Abell, 2001).

Finally, for VR dementia simulation to provide effective benefits, clearly it must not lead to unintended problematic consequences such as raised anxiety. Indeed, the most effective interventions for improving the quality care for PwD and

tackling dementia stigma and ageism would reduce AA and DW. The impact of VR dementia simulation on DW and AA has not been explored. Further investigation is particularly pertinent given the increasing availability of VR dementia simulation.

## **Research Questions**

**Question 1: Feasibility.** The first research questions will investigate whether it is feasible to deliver brief online VR dementia simulation to participants, enabling them to take the perspective of a person with dementia and feel compassion for PwD.

- i. Are participants able to successfully access the VR dementia simulation on their own devices for an immersive experience?
- ii. Are participants able to take the first-person perspective of a person with dementia during the VR simulation?
- iii. Do people feel compassionate towards PwD after the VR dementia simulation?

**Question 2: Impact.** The primary focus of the study will be to explore the impact of a VR dementia simulation on several potentially key variables; WTC, DW and AA. Previous research indicates that WTC, DW and AA are influenced by prior contact and experience with older adults and PwD (Page, 2013; Nelson, 2005; Parveen, Morrison, & Robinson, 2013). DW and AA are greater in people who have higher generalised anxiety (Brunton & Scott, 2015; Kessler et al., 2012; Page, 2013). For these reasons, both previous experience of dementia and generalised anxiety will be measured and controlled for in the study.

- i. Does exposure to a VR dementia simulation affect adults' WTC for PwD, whilst controlling for previous experience of dementia?

- ii. Does exposure to VR dementia simulation affect adults' DW or AA, whilst controlling for generalised anxiety, and previous experience of dementia?

**Question 3: Predicting WTC.** Increased WTC would be a desired outcome of VR dementia simulation, particularly if used within training. This research will therefore examine whether any of the other study variables are predictive of adults' WTC for PwD. Of particular interest is whether DW or AA have a role in predicting WTC, given that some previous literature has found unintended increases in anxiety as a result of simulation.

1. Do the variables of DW, AA, generalised anxiety and previous experience of dementia predict WTC for PwD in adults?

## **Method**

### **Setting**

This study was conducted online via Qualtrics, a secure web-based survey platform, accessible from any device with an internet connection. Participation was entirely via the internet and therefore from any convenient location of the participants' choice. There was no contact between the participants and the researchers, who were based at University College London (UCL).

### **Ethics**

Ethical approval was obtained by the action of the Ethics Chair of the UCL Clinical, Educational and Health Psychology (CEHP) Research Department, to conduct this study under the existing departmental 'Fear of Dementia' programme (Ethics ID: CEHP\_2015\_529). All approved documents are included in the appendix. Guidance on ethical considerations specific to online research was

sought from the British Psychological Society's (BPS) publication on internet-mediated research (IMR) (2017). No participant contact details or personally identifiable information was obtained at any point during the study. All data was collected anonymously and held securely. Compensation to individual participants was not feasible, therefore the financial incentive was a £1 donation per participant, made to Alzheimer's Research UK (ARUK).

## **Design**

This online study was designed as a between-groups, control experiment, with stratified randomisation to either level of the independent variable: exposure to a VR dementia simulation (VRDS), or no exposure (Control). The three primary dependent variables were WTC, DW and AA. To minimise participation time and burden, data were collected at one time point only in each group; baseline data was collected from the Control group and post-simulation data from the VRDS group. A cross-over element was used which gave participants in the Control group the opportunity to opt-in to experiencing the VR simulation after their baseline data was collected. The design is illustrated in Figure 1.

## **Sample Size Calculation**

Considering the exploratory nature of this study, feasibility and statistical power, a sample size estimation for a small-medium effect size ( $f = 0.2$ ) was selected. An a priori power calculation conducted within G-Power 3.1, with alpha set at 0.05 and 90% power, for an ANCOVA with fixed effects, found a sample of 265 was required.

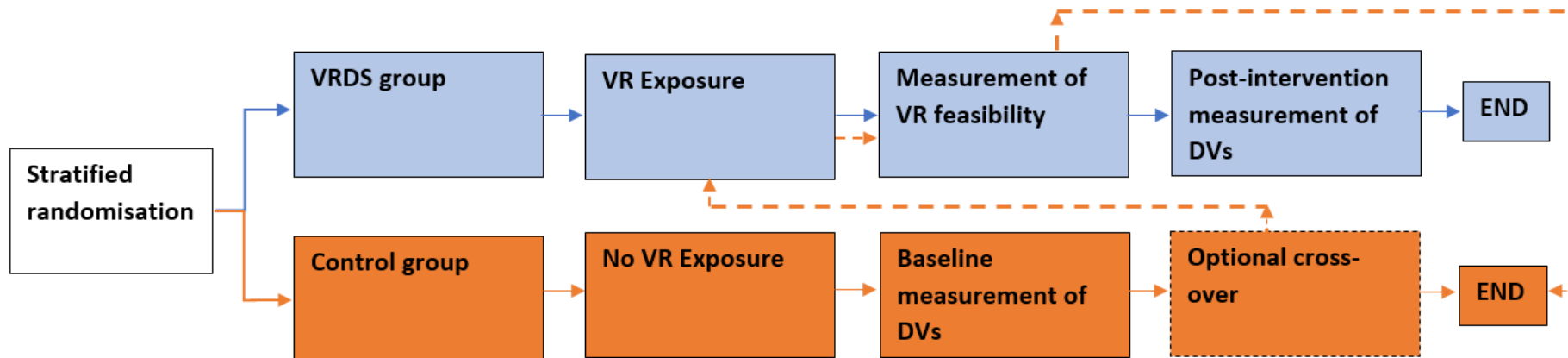


Figure 1. An illustration of the two-group cross-over design of the study.

Note. DVs = dependent variables. Dotted arrow indicates pathway of control participants who opted in to the VR simulation experience.

## **Recruitment**

Participants were recruited from the general adult population. Recruitment was primarily conducted via internet-based methods. Online advertisements were posted on social media platforms (e.g. Facebook and Twitter), on a research recruitment website ([www.callforparticipants.com](http://www.callforparticipants.com)) and circulated via group email systems. Paper posters were placed around UCL. An example advertisement is provided in the appendices (Appendix D).

## **Eligibility**

### **Inclusion criteria.**

- Aged 18 years or older
- English-speaking
- Access to the internet via a smart-phone/tablet device
- Access to the YouTube app

### **Exclusion criteria.**

- Uncorrected visual or auditory impairments
- Diagnosis of dementia, Alzheimer's disease or Mild Cognitive Impairment
- Referred to, or attended, a memory clinic for investigation of memory or thinking problems

## **Selection of VR Dementia Simulation**

**'A Walk Through Dementia' (AWTD).** The VR dementia simulation used in this study was taken from AWTD, an app freely available in the public domain (<http://www.awalkthroughdementia.org/>) created by ARUK in collaboration with Google, UCL and PwD (ARUK, 2016). AWTD features several interactive 360-

degree films of every-day scenarios ('At the Shops', 'At Home' and 'On the Road') within which the viewer takes the perspective of a person with dementia. The virtual environment moves around 360 degrees, in conjunction with the viewer's real-time movements. The visual and audio content is used to simulate common dementia symptoms including:

- Cognitive difficulties: disorientation, memory and recognition difficulties
- Visual impairments and perceptual difficulties
- Emotional difficulties such as anxiety

**'On the Road'.** After testing all AWTD scenarios, 'On the Road' ([https://www.youtube.com/watch?v=R-Rcbj\\_qR4g](https://www.youtube.com/watch?v=R-Rcbj_qR4g)) (ARUK, 2016) was selected for this study because it was judged to be both the most realistic and the most accessible of the scenarios. During the 3 minute and 21 second simulation, the viewer is given the perspective of woman with dementia whilst she walks home accompanied by her son (a family carer). Figure 2 provides examples the specific dementia symptoms featured in On the Road and how these were simulated.

**Functionality testing.** Functionality testing established that On the Road was best viewed on a smartphone or tablet device via the YouTube app. The 360-degree virtual environment moved around as the device was moved around. A VR headset was compatible with this set up for added immersion in the virtual environment but was not compulsory. On the Road could be played on a computer/laptop via the YouTube website and the 360-degree functionality worked by clicking and dragging the mouse but it felt less immersive. Launching the simulation in a quiet private environment and using headphones to listen to the sound improved the experience on any device. Based on this testing, several sets of instructions were created to support participants in having the most immersive

Simulated dementia symptoms	360-deegree visual content	Corresponding audio content
<b>Cognitive:</b> poor memory, orientation difficulties  <b>Perceptual:</b> visual disturbances  <b>Emotions/feelings:</b> anxiety, confusion; disorientation, fear	<ul style="list-style-type: none"> <li>➤ You see a garden with the white flowers</li> <li>➤ When you look again the flowers are red</li> <li>➤ You try to take a shortcut</li> <li>➤ The shortcut does not lead anywhere</li> <li>➤ Your vision blurs</li> <li>➤ You turn around to your son</li> <li>➤ You can't see your son anywhere</li> </ul>	<ul style="list-style-type: none"> <li>➤ Your internal voice indicates you recognise the garden with the white flowers</li> <li>➤ You correct yourself, the flowers are red</li> <li>➤ Your heart beat quickens indicating anxiety</li> <li>➤ Your internal voice indicates you are unable to recognise where you are, and you feel lost</li> </ul>
<b>Cognitive:</b> recognition difficulties  <b>Emotions/feelings:</b> confusion, embarrassment	<ul style="list-style-type: none"> <li>➤ You look for your son and see him walking towards you</li> <li>➤ As you look at him, his face changes</li> <li>➤ Now he looks like a stranger</li> <li>➤ Your son comes from the other direction</li> </ul>	<ul style="list-style-type: none"> <li>➤ You call out your son's name when you see him</li> <li>➤ The stranger asks if you are ok and explains you have mistaken him for somebody else</li> <li>➤ Your internal voice indicates confusion</li> <li>➤ Your son calls out to you and apologies to the stranger</li> <li>➤ Your son indicates he was worried because you disappeared while he was on the phone</li> </ul>
<b>Perceptual:</b> visual misperception  <b>Emotions/feelings:</b> confusion, fear	<ul style="list-style-type: none"> <li>➤ You suddenly see a gaping hole in the street</li> <li>➤ Your son is about to walk into it</li> <li>➤ As you get closer the hole turns into a puddle</li> </ul>	<ul style="list-style-type: none"> <li>➤ You shout out repeatedly for your son to watch out for the hole</li> <li>➤ He reassures you it is just a puddle</li> <li>➤ Your internal voice indicates confusion</li> </ul>

Figure 2. Example dementia symptoms and simulation methods featured in On the Road.



experience available to them, depending on what type of device they had access to (Appendix E).

## **Procedure**

**Consent and eligibility check.** Once launched, the Qualtrics web link presented individuals with further information about the research including details of compulsory and recommended equipment for the simulation (Appendix F). Following this, participants completed a fully-informed consent questionnaire (Appendix G). Those who consented to take part were then asked to complete an eligibility checklist to ascertain their suitability for participation in the research (Appendix H).

**Stratified randomisation.** The randomiser function in Qualtrics was set up to randomly allocate participants to either the VRDS or Control group in a 1:1 ratio, stratified by their previous experience of dementia. This was to ensure equivalence of previous dementia experience across the two groups, thus controlling for the potential influence of this variable. The stratification was achieved by generating a dementia experience score of between 0 (no experience) and 7 (high experience) based on their answers to four questions (every positive answer generated a score of 1). Qualtrics was programmed to ensure an even spread of scores across the two groups of the study. The questions were designed to capture previous dementia experience across personal and professional domains and were adapted from previous research (Kinzer, 2013; Kinzer & Suhr, 2016):

1. Have you ever received training about dementia (e.g. online, classroom, placement)?
2. If yes, did it include a simulation element (e.g. role-play, simulation suit, VR)?
3. Have you ever known someone, personally or professionally, with dementia?
4. If yes, please indicate which of the following apply:

- a. I have/had a genetic close relative with dementia (e.g. parent, sibling, grandparent)
- b. I have/had a friend or non-genetic close relative with dementia (e.g. life-partner, parent-in-law)
- c. I am/was an unpaid family carer for somebody with dementia
- d. I am/was a paid carer for somebody with dementia (e.g. health or social care assistant, nurse).

**VRDS.** Qualtrics was set up to route VRDS participants straight to the dementia simulation. Participants were asked to choose from the three possible viewing options below and then provided with the corresponding instruction for launching the simulation (Appendix E):

1. Smartphone/Tablet with the YouTube app
2. Smartphone/Tablet with the YouTube app and a VR headset
3. Computer/Laptop

After receiving the simulation, VRDS participants completed a feasibility questionnaire, a battery of self-report measures and demographic details.

**Control.** Control participants were routed via Qualtrics to complete the battery of self-report measures straight away and then to provide demographic details. After completion of the baseline data, control participants were given the option of experiencing the VR dementia simulation. For those opting in, instructions were provided and following the simulation, they were asked to complete the feasibility questionnaire.

**Debrief.** All participants completing the study were taken to a debrief page which provided information from AWTd, a link to the AWTd website and signposting to other dementia related resources (Appendix I).

## Measures

**Feasibility questionnaire.** A questionnaire was created for this study to collect data to address research question 1, regarding feasibility (Appendix J). The questionnaire comprised three separate questions and was administered to all participants immediately after the VR simulation. To capture information about usability problems and enable the researcher to screen for anyone in the VRDS group who was not successfully exposed to the simulation, the first question asked whether participants had successfully watched the VR and, if relevant, to describe any technical difficulties encountered. Given that self-other merging and embodied experience during VR simulation has been found to underpin improved helping behaviours towards the other (Ahn et al., 2013), the second question asked participants whether they related to the mother (person with dementia), or the son (family carer), most, during the VR experience. The third and final question was used to assess whether the participants could feel a high level of compassion towards PwD after the simulation. Participants were asked to indicate their level of compassion towards PwD on line from 0 ('not at all compassionate') to 10 ('very compassionate'). The compassion scores were categorised into high (10-7), medium (6-4) and low (3-0). This approach was taken from a similar study to enable comparison across the literature (Adefila et al., 2016).

**Battery of self-report measures.** The battery of self-report measures included measures of willingness to care (WTC), dementia worry (DW), ageing anxiety (AA) and generalised anxiety (Appendix K).

***The Willingness to Care Scale (WTCS).*** The WTCS was originally created to assess social caregivers' ability to care (ATC) and WTC for individuals with AIDS (Abell, 2001). A version adapted for dementia, previously used by Parveen et al. (2013), was used in this study. The dementia WTCS asks participants to rate, first,

how able ('able' or 'not able') and second, how willing on a scale of 1 ('completely unwilling') to 5 ('completely willing'), they are to perform a list of 30 typical care-related tasks for someone with dementia. The WTCS captures three aspects of caregiving which map onto individual subscales. (a) Emotional (items 1 - 10) which measure willingness to provide comfort and emotional support to PwD e.g. 'comfort someone when they are sad'; (b) Instrumental (items 11 - 20) which measures willingness to perform concrete and practical tasks for PwD e.g. 'do the person's laundry'; (c) Nursing (items 21 - 30) which measures willingness to perform personal-care and health related tasks e.g. 'help someone in the bathroom'. Overall ATC, overall WTC and Emotional WTC scores were calculated in this study.

ATC scores were calculated by summing the number of items marked as 'able' and higher scores indicate higher ATC (possible scores 0 – 30) (Abell, 2001). Overall WTC and Emotional WTC scores were calculated by finding the mean Likert response of all items and all subscale items respectively (Abell, 2001). Abell (2001) demonstrated the validity of the WTCS and reported good reliability (Cronbach's  $\alpha = 0.923$ ). The current study found a Cronbach's  $\alpha$  indicating high internal consistency for the WTCS overall (0.951) and for the Emotional subscale (0.903).

***The Dementia Worry Scale (DWS).*** The DWS (Kessler et al., 2014) measures individuals' level of anxiety about developing dementia. It comprises 10 items that capture two factors of DW; (a) DW cognitions (items 1 - 5) e.g. 'When I notice that I have trouble remembering things, I am afraid this might be the first step toward dementia', and (b) DW emotions (items 6 - 10) e.g. 'When I think about developing dementia, I feel anxious'. Each item is rated on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). In line with the approach used in Kessler et al. (2014) DW scores were calculated by finding the mean of the 10-item z-scores with positive scores indicating above average DW and negative scores indicating below average DW.

The internal consistency of the measure was demonstrated to be high in the original German-language scale (Cronbach's  $\alpha = 0.920$ ; Kessler et al., 2014). This study utilised the English version of the scale, also produced by Kessler and colleagues (2014). The scale was found to have high internal consistency in this current study (Cronbach's  $\alpha = 0.909$ ).

***The Anxiety about Ageing Scale (AAS).*** The AAS (Lasher & Faulkender, 1993) measures individual's concerns about ageing. It comprises 20 statements about ageing and old people with which participants indicate the extent of their agreement on a 5-point Likert scale (1 'Strongly agree' to 5 'Strongly disagree'). The AAS yields scores on four dimensions of anxiety about ageing: (a) Fear of Old People (items 1 - 5) e.g. 'I enjoy talking with old people'; (b) Psychological Concerns (items 6 - 10) e.g. 'I fear it will be very hard for me to find contentment in old age'; (c) Physical Appearance (items 11 - 15) e.g. 'When I look in the mirror, it bothers me to see how my looks have changed with age'; (d) Fear of Losses (items 16 - 20) e.g. 'I get nervous when I think about someone else making decisions for me'. Generally, agreement with items indicated a low anxiety response, however the reverse was true for some items (6, 15 -20) and scoring was reversed accordingly. Subscale scores are generated and summed to give an overall AAS score (ranging from 20-80) with higher scores indicating higher anxiety.

Previously established psychometric properties demonstrate the AAS to have good overall internal consistency (e.g. Cronbach's  $\alpha$  level of 0.8210; Lasher and Faulkender, 1993). The overall consistency of the scale in this study was found to be good (Cronbach's  $\alpha = 0.8220$ ). Alpha was also calculated for the individual subscales in the current study and consistency was good for Fear of Old People (0.904) Psychological Concerns scales (0.815), and moderate for Physical Appearances (0.761) and Fear of Losses (0.730).

***The General Anxiety Disorder Questionnaire (GAD-7).*** The GAD-7 (Spitzer, Kroenke, Williams & Lowe, 2006) is a brief, seven-item, measure used to assess generalised anxiety and was included in this study for control purposes. Items reflect criteria for generalised anxiety disorder (GAD) in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) and ask individual's how much they were bothered by each symptom (e.g. 'feeling nervous anxious or on edge') in the last two weeks. Response options range from 0 ('not at all') to 3 ('nearly every day'). Possible scores range from 0 to 21, with a higher score indicating higher levels of GAD. Previous psychometric evaluation indicates the GAD-7 has high internal consistency (Cronbach's alpha = 0.920) and good test-retest reliability (intraclass correlation = 0.830; Spitzer et al., 2006). The GAD-7 was found to have a Cronbach's alpha of 0.940 in this study.

**Demographic questionnaire.** After completing the study tasks, participants were asked to provide their gender, age and ethnicity (Appendix L). Participants were not required to answer these questions and in response to each demographic item, had the option to select 'prefer not to say'.

## **Data Analysis**

Analyses were conducted using SPSS Statistics (Version 25). Qualtrics data collection was set up so that none of the study measures had missing data items. The only exception to this was demographic items which were not planned into any key analyses and therefore remained optional. All variables were assessed for normality prior to analysis. Variables visually assessed as markedly deviating from normality on a histogram, with a skewness or kurtosis z-score of  $\geq \pm 2$ , and a significant Kolmogorov-Smirnov statistic ( $p = .01$ ) (WTC, ATC and GAD-7) were transformed using the square-root procedure (Field, 2009). Negatively skewed variables (WTC) were first reflected. Un-transformed scores are reported in

descriptive statistics. Outliers were assessed for using box plots and z-scores of  $\geq \pm 3$ . Outliers were altered to be within 3 standard deviations of the mean, using the method of subtracting/adding one unit to the next lowest/highest value and maintaining rank order (Field, 2009). The significance level was set at  $p < .05$  for all analyses and adjusted with a Bonferroni correction to control for familywise error rate (Abdi, 2007). Descriptive statistics were calculated for participant demographics and previous experience of dementia. To check for any significant differences in these participant characteristics between the VRDS and Control groups, and between participants that completed or withdrew, tests of two proportions were conducted (chi-square test of homogeneity and Fisher's exact test).

To address research question one regarding feasibility, descriptive statistics were calculated for participants' a) success in accessing the VR dementia simulation, b) whether they related most to the mother with dementia, or the family carer son, during the simulation, and c) their level of compassion towards PwD immediately following the simulation. A binomial logistic regression analysis was conducted to determine whether participant characteristics previously identified as important in the literature (gender, age and previous experience of dementia; Wijma et al, 2017) were predictive of relating most to the person with dementia (the mother), or the son, during the VR dementia simulation. To enable use in the analysis, the demographic item of age category was converted from a multinomial to a dichotomous variable; 45 years and under/46 years and over (Laerd Statistics, 2017). The dichotomy was determined by approximating the age of the son who appears in the VR simulation (40 years) and using the closest cut-off age available from the pre-existing age categories (45 years). Difference in compassion score between participants relating to the mother and those relating to the son, was assessed for using a Mann-Whitney U test. The population pyramid was inspected

to assess whether distribution of the compassion variable was a similar shape for both groups being compared, and, therefore, whether medians could be compared (Field, 2009). Participants identified as not receiving the VR simulation as intended were removed from these analyses.

Research question two, regarding the impact of the VR dementia simulation on WTC, DW and AA, was addressed by comparing scores from VRDS participants with those of control participants. Participants in the VRDS group who did not receive the VR simulation as intended, were excluded from these analyses. ANCOVAs were used to conduct between group comparisons of WTC, controlling for ATC, and for DW and AA, controlling for GAD. Violation of ANOCVA assumption was checked for using the following methods: a) scatterplots of variables were visually inspected to ascertain existence of linear relationships; b) a non-significant interaction term (significance at  $p > .05$ ) was used to indicate homogeneity of regression slopes; c) a non-significant Shapiro-Wilk's test (significance at  $p > .05$ ) was used to indicated normal distribution of standardised residuals; c) homoscedasticity was checked for with visual inspection of scatterplots and homogeneity of variance with Levene's test ( $p > .05$ ); d) the data were checked for outliers (cases with standardized residuals  $\geq \pm 3$  standard deviations) (Field, 2009; Laerd Statistics, 2017). Where ANCOVAs were not significant, subscales were compared between groups using independent samples t-tests (for normally distributed subscale variables) and Mann-Whitney U tests (for skewed subscale variables) (Field, 2009).

In addressing the final research question, a hierarchical multiple regression was run to explore possible predictors of WTC. The relationship between WTC and the other potentially important study variables was first explored by producing a correlation matrix. Demographic variables were not included as this data was only available for a subset of the sample used for the regression analysis. A Pearson's



correlation (or Spearman's Rho for data not normally distributed) was used for continuous variables and a point-biserial correlation (or Kendall's tau-b for data not normally distributed) was used for the dichotomous variables (Field, 2009). The correlation coefficient effect size was interpreted as small  $0.1 < |r| < .3$ , medium  $0.3 < |r| < .5$  and large  $r = |r| > .5$  (Field, 2009). All variables found to significantly correlate with WTC (at the Bonferroni corrected level) and not highly inter-correlated with one another ( $r = |r| > .8$ ) were entered into the model (Field, 2009). The order in which the variables were entered into the regression was based on perceived theoretical importance of each predictor (Field, 2009). Where relevant, previous theory and research informed known predictors, and these were entered first. Remaining predictors were new and exploratory and therefore were entered in descending order of size of significant correlation relationship with WTC (Field, 2009).

The following visual plots and diagnostic statistics were used to assess whether all multiple regression assumptions were met: a) linearity was assessed by inspection of partial regression plots and a plot of studentized residuals against predicted values; b) a Durbin-Watson statistic of approximately 2 was checked for to ascertain independence of residuals; c) homoscedasticity was checked for with a plot of studentized residuals against unstandardized predicted values; d) multicollinearity was assessed by observing whether any tolerance values were greater than 0.1; e) the output was checked for outliers (studentized deleted residuals  $>\pm 3$  standard deviations), high leverage points ( $> 0.2$ ), and influential points (Cook's Distance  $> 1$ ); f) normality of residuals was assessed by Q-Q Plot inspection (Field, 2009; Laerd Statistics, 2017).

## Results

### Participants

The flow of participants through the study, including points of withdrawal, is presented in Figure 3. A sample size of 263 consenting individuals was achieved. Twelve participants withdrew prior to randomisation and four were excluded due to uncorrected visual or auditory impairments. A total of 247 participants were randomised into the study, with 124 to VRDS and 123 to Control. Forty participants withdrew prior to finishing the study; 207 participants completed (VRDS  $n = 94$ ; Control  $n = 113$ ).

**Previous experience of dementia.** Most participants recruited to the study had prior experience of dementia (Table 1). A large proportion (73.7%) knew or had known someone, either personally or professionally, with dementia. Most often, this was a genetic relative. With regards to previous experience of caring for PwD, a small proportion had unpaid/family carer experience (9.7%) and just over one-fifth had paid/formal carer experience (21.1%). A notable percentage of participants also had prior dementia training (36.4) and for some (8.1% of the total sample), this had included a simulation element such as a role play, a simulation suit or VR.

**Withdrawals.** Of all consenting and eligible participants ( $n = 258$ ), 19.8% ( $n = 51$ ) withdrew before completing the study (Figure 3). A chi-square analysis did not detect any significant difference in previous dementia experience between participants who completed the study and those that withdrew (Table 1). Most withdrawals ( $n = 40$ ) occurred after random allocation of participants to either group of the study. More participants withdrew from the VRDS group ( $n = 30$ , 24.2%) than the Control group ( $n = 10$ , 8.1%). However, a chi-square test found no significant difference in previous experience of dementia between the two groups of the study, after withdrawals were accounted for (Table 2).

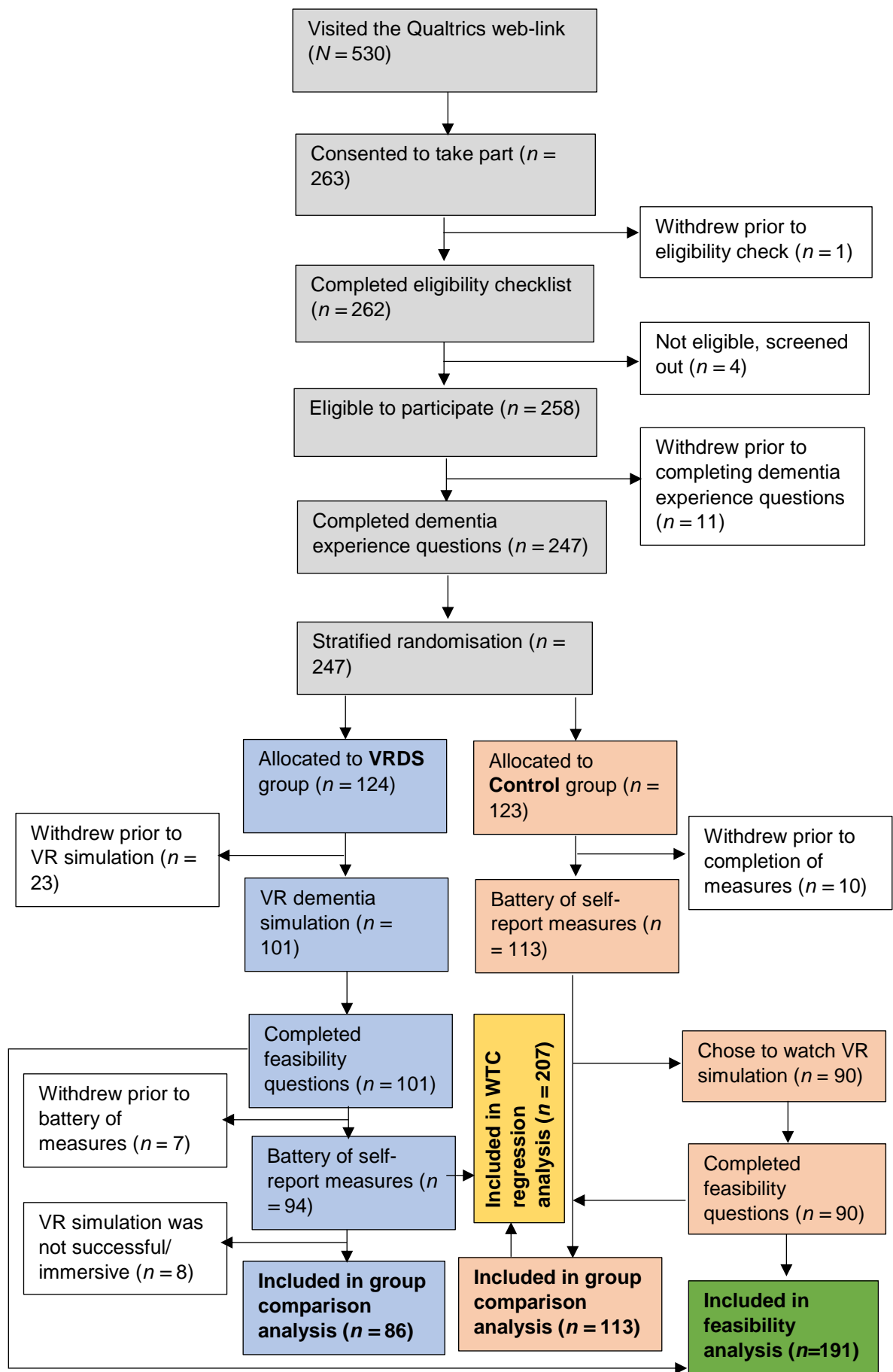


Figure 3. Flow of participants through the study.

Table 1.

*Participants' Previous Experience of Dementia and Chi-Square Comparison of those that Completed and Withdrew*

	Randomised (N = 247)	Completed (N = 207)	Withdrew (N = 40)	X <sup>2</sup> (df)	p- value
<i>Received dementia training</i>	% (n)	% (n)	% (n)		
Yes	36.4 (90)	37.7 (78)	30.0 (12)	.854 (1)	.355
No	63.6 (157)	62.3 (129)	70.0 (28)	-	-
<i>Received dementia simulation</i>					
Yes	8.1 (20)	8.2 (17)	7.5 (3)	-	1.000 <sup>a</sup>
No	91.9 (227)	91.8 (190)	92.5 (37)	-	-
<i>Know(n) somebody with dementia</i>					
Yes	73.7 (182)	75.5 (157)	62.5 (25)	3.079 (1)	.079
No	26.3 (65)	24.5 (50)	37.5 (15)	-	-
<i>Have/had a genetic relative with dementia</i>					
Yes	42.9 (106)	45.4 (94)	30.0 (12)	3.250 (1)	.071
No	57.1 (141)	54.6 (113)	70.0 (28)	-	-
<i>Have/had a non-genetic relative or close friend with dementia</i>					
Yes	33.2 (82)	33.8 (70)	30.0 (12)	.137 (1)	.711
No	66.0 (163)	66.2 (137)	70.0 (28)	-	-
<i>Have/had an unpaid carer role for somebody with dementia</i>					
Yes	9.7 (24)	10.1 (21)	7.5 (3)	-	.775 <sup>a</sup>
No	90.3 (223)	89.9 (186)	92.5 (37)	-	-
<i>Have/had a paid role supporting somebody with dementia</i>					
Yes	21.1 (52)	21.3 (44)	20.0 (8)	.032 (1)	.858
No	78.9 (195)	78.7 (163)	80.0 (32)	-	-

Note. <sup>a</sup>Due to small sample size in one cell, a Fisher's exact test was run to calculate the p-value.

Table 2.

*Comparison of Completing VRDS and Control Participants' Previous Experience of Dementia using a Chi-Square Analysis*

	VRDS completers (N = 94)	Control completers (N = 113)	X <sup>2</sup> (df)	p- value
	% (n)	% (n)		
<i>Received dementia training</i>				
Yes	38.5 (35)	36.3 (41)	.102 (1)	.749
No	61.5 (56)	63.7 (72)	-	-
<i>Prior training had a simulation element</i>				
Yes	8.8 (8)	7.1 (8)	.204 (1)	.651
No	91.2 (83)	92.9 (105)	-	-
<i>Know/known somebody with dementia</i>				
Yes	75.8 (69)	75.2 (85)	.010 (1)	.921
No	24.2 (22)	24.8 (28)	-	-
<i>Have/had a genetic relative with dementia</i>				
Yes	45.1 (41)	46.0 (52)	.019 (1)	.891
No	54.9 (50)	54.0 (61)	-	-
<i>Have/had a non-genetic relative or close friend with dementia</i>				
Yes	26.4 (24)	38.9 (44)	3.581 (1)	.058
No	73.6 (67)	61.1 (69)	-	-
<i>Have/had an unpaid carer role for somebody with dementia</i>				
Yes	9.9 (9)	10.6 (12)	.029 (1)	.865
No	90.1 (82)	89.4 (101)	-	-
<i>Have/had a paid role supporting somebody with dementia</i>				
Yes	24.2 (22)	19.5 (22)	.660 (1)	.417
No	75.8 (69)	85.0 (91)	-	-

Table 3.

*Demographic Details Provided by Completing Participants and Chi-Square Comparison of VRDS and Control Groups*

	Overall (N = 184*)	VRDS (N = 94)	Control (N = 90*)	X <sup>2</sup> (df), p-value
	% (n)	% (n)	% (n)	
<i>Gender</i>				
Female	80.4 (148)	83.0 (78)	77.8 (70)	.790 (1), .374
Male	19.6 (36)	17.0 (16)	22.2 (20)	-
<i>Age</i>				
18 - 30 years	31.5 (58)	29.8 (28)	33.3 (30)	1.408 (1), .843 <sup>a</sup>
31 - 45 years	23.4 (43)	24.5 (23)	22.2 (20)	-
46 - 65 years	40.2 (74)	41.5 (39)	38.9 (35)	-
66 - 80 years	4.3 (8)	4.3 (4)	4.4 (4)	-
Prefer not to say	0.5 (1)	0.0 (0)	1.1 (1)	-
<i>Ethnicity</i>				
White British	77.2 (142)	75.5 (71)	78.9 (71)	3.448 (7), .841 <sup>a</sup>
Other Ethnicity	9.8 (18)	11.7 (11)	7.8 (7)	-
Prefer not to say	13.0 (24)	12.8 (12)	13.3 (12)	-

*Note.* \*Excluding missing data (n = 23). <sup>a</sup>Due to a small sample size in one cell, a Fisher's exact test was run to calculate the p-value.

**Demographics.** Demographic information was asked of participants who completed the study and not those who withdrew. Of those asked, there was missing data for 11.1 percent (n = 23, all in the Control group). Based on the complete data only, the sample was mostly female, within either the age category '46 to 65 years' or '18 to 30 years' and largely of white British ethnicity (Table 3).

### **Question 1: Feasibility.**

**1. (i) Access to an immersive experience.** A total of 191 participants were recorded as attempting to access the VR dementia simulation. Overall, access was largely successful and with only five participants (2.6%) unable to watch the VR at all. All those unable to access the VR were attempting to access the simulation on

their smartphones but it did not load. Of those who were successful in launching the VR ( $n = 186$ ), the majority used a smartphone/tablet device as recommended (79.0%,  $n = 147$ ) and the rest used a laptop/computer (21.0%,  $n = 39$ ). A very small number used a VR headset in conjunction with their smartphone ( $n = 6$ ).

Technical difficulties were reported by 17 participants (5.9%). Reviewing the descriptions of these difficulties (Appendix M) resulted in identification of several participants who experienced poor quality visuals (e.g. blurry screen, slow moving image) that would have prevented them from receiving an immersive experience ( $n = 6$ ). This problem occurred on smartphones ( $n = 3$ ) and computers ( $n = 3$ ) equally. These six individuals were excluded from the further feasibility analyses (1.ii and 1.iii) below for which an immersive experience was necessary. Two additional participants were identified as receiving an incorrect VR experience (1 did not watch the simulation to the end and 1 watched additional dementia-related videos after the simulation) and were also excluded. The other technical issues raised by participants did not relate to the immersive nature of the VR experience (e.g. difficulty returning to the questionnaire after the simulation). Accounting for technical problems, almost all were found to have received the VR simulation as intended and as an immersive experience (95.7%,  $n = 178$ ).

**1. (ii) First-person perspective of dementia.** The majority of people experiencing the immersive VR simulation, related most to the mother (person with dementia) during the simulation ( $n = 109$ , 61.2%). Unexpectedly, a significant minority indicated they related more to the son (the family carer) ( $n = 69$ , 38.8%). The VR dementia simulation was intended to give a first-person perspective of dementia, therefore, predictors of which person (mother or son) participants related to most during the simulation were explored with a binary regression model (Table 4). Variables previously identified as important in the literature were entered into the model: gender, age, having/not having a relative or close friend with dementia, and

Table 4.

*Binary Logistic Regression Predicting Likelihood of taking the Son's Perspective during VR Dementia Simulation*

Variable (reference group)	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
							<i>Lower</i>	<i>Upper</i>
Gender (males)	1.090	.428	6.471	1	.011*	2.974	1.284	6.886
Age (under 45 years old)	.835	.353	5.601	1	.018*	2.306	1.154	4.606
Has/had a relative or close friend with dementia (yes)	.099	.371	.071	1	.790	1.104	.534	2.284
Has/had a caring role (family or professional) for somebody with dementia (yes)	-.360	.373	.928	1	.335	.698	.336	1.450
Constant	-1.150	.422	7.434	1	.006	.317	-	-

*Note.* *N* = 78. \*Indicates statistical significance at  $p = < .05$



having/not having caring experience of dementia. Assumptions of linearity, no multicollinearity and no significant outliers were met. The model was statistically significant ( $\chi^2(4) = 11.614, p = .020$ ), explained 8.9% (Nagelkerke  $R^2$ ) of the variance in perspective taken during the simulation and correctly classified 66.7% of cases. The odds of relating to the son/family carer, instead of the mother/person with dementia, were 2.974 times greater for males than females and 2.306 times greater for participants aged 45 and under.

**1. (iii) Compassion response.** Immediately after experiencing the VR dementia simulation, most participants rated themselves as highly compassionate towards PwD ( $M = 9.24, SD = 1.39$ ) (Table 5). Compassion scores appeared slightly higher for those relating to the mother, rather than the son, during simulation. However, no statistically significant difference in mean scores was detected ( $U = 3,589.000, z = -.599, p = .549$ ).

Table 5.

*Compassion Towards People with Dementia Following VR Dementia Simulation*

	All Participants ( $N = 178^a$ )	First-person dementia perspective ( $n = 109$ )	Family carer perspective ( $n = 69$ )
	% ( $n$ )	% ( $n$ )	% ( $n$ )
<i>Compassion Category</i>			
Low (0 - 3)	1.1 (2)	0.9 (1)	1.5 (1)
Medium (4 – 6)	3.4 (6)	2.8 (3)	4.4 (3)
High (7 – 10)	95.5 (169)	96.3 (105)	94.2 (65)
<i>Compassion Score</i>			
	$M (SD)$	$M (SD)$	$M (SD)$
	9.24 (1.39)	9.29 (1.26)	9.14 (1.57)

*Note.* <sup>a</sup> Excluding 13 participants who did not receive the VR dementia simulation as intended.

Table 6

	<u>All Participants</u>					<u>First-Person Dementia Perspective</u>				
	VRDS Group		Control Group		Difference	VRDS Group		Control Group		Difference
	(N = 86 <sup>a</sup> )		(N = 113)			(N = 59 <sup>b</sup> )		(N = 48 <sup>b</sup> )		
	<i>M</i> ( <i>SD</i> )	<i>95% CI</i> <i>Lower - Upper</i>	<i>M</i> ( <i>SD</i> )	<i>95% CI</i> <i>Lower - Upper</i>	<i>M</i>	<i>M</i> ( <i>SD</i> )	<i>95% CI</i> <i>Lower - Upper</i>	<i>M</i> ( <i>SD</i> )	<i>95% CI</i> <i>Lower - Upper</i>	<i>M</i>
<i>WTC</i>	3.97 (.64)	3.83 - 4.11	3.94 (.72)	3.80 - 4.07	.03	4.00 (.58)	3.85 - 4.16	3.84 (.85)	3.59 - 3.95	.16
<i>Emotional WTC</i>	4.45 (.52)	4.34 - 4.57	4.46 (.66)	4.34 - 4.58	-.01	4.49 (.47)	4.37 - 4.62	4.39 (.82)	4.15 - 4.62	.10
<i>ATC</i>	26.87 (3.77)	26.06 - 27.68	26.35 (4.05)	25.60 - 27.11	.52	26.73 (3.98)	25.69 - 27.77	26.25 (4.29)	25.25 - 27.75	.48

*Willingness to Care (WTC) and Perceived Ability to Care (ATC) in VRDS and Control Participants*

*Note.* <sup>a</sup>Excluding participants who did not receive the immersive VR simulation as intended ( $n = 8$ ). <sup>b</sup>Excluding participants who related most to the son/family carer during the VR dementia simulation (VRDS  $n = 27$ ; Control  $n = 65$ ).

## Question 2: Impact

**2. (i) Between group comparison of WTC.** Table 6 presents mean WTC, Emotional WTC and ATC scores for the VRDS and Control groups. No significant difference was detected between groups for the control variable ATC ( $t(197) = -.392, p = .696$ ). All ANCOVAs met assumptions of normality, homoscedasticity, homogeneity of variance and no significant outliers.

WTC and Emotional WTC were similar across the two groups, albeit minor differences indicated higher scores for individuals in the VRDS group. This slight difference was more apparent when considering only participants who related most to the mother. However, after adjustment for ATC, an ANCOVA detected no statistically significant difference in WTC between the VRDS and Control groups ( $F(2, 196) = .118, p = .732, \text{partial } \eta^2 = .001$ ). Similarly, no difference was detected in Emotional WTC, between VRDS and control participants ( $U = 4,483.00, z = -.943, p = .346$ ). A comparison of only those who related to the mother during simulation did not detect any difference between groups in WTC, whilst controlling for ATC ( $F(2, 104) = .774, p = .381, \text{partial } \eta^2 = .007$ ), or in Emotional WTC ( $U = 1,373.500, z = -.269, p = .788$ ).

**2. (ii) Between group comparison of AA and DW.** Table 7 presents mean AAS, DWS and GAD-7 scores for the VRDS and Control groups. No significant difference between groups was detected in the control variable GAD-7 ( $t(197) = -.1022, p = .308$ ). All ANCOVAs met the assumptions of normality, homoscedasticity, homogeneity of variance and no significant outliers.

Mean DW and overall AA appeared slightly higher in the VRDS group, compared to the Control group, with physical appearance concerns exhibiting the largest between group difference. These differences slightly increased when

Table 7

	<u>All participants</u>					<u>Participants relating to person with dementia</u>				
	VRDS Group (N = 86 <sup>a</sup> )		Control Group (N = 113)		Diff.	VRDS Group (N = 59 <sup>b</sup> )		Control Group (N = 48 <sup>b</sup> )		Diff.
	<i>M (SD)</i>	<i>95% CI Lower - Upper</i>	<i>M (SD)</i>	<i>95% CI Lower - Upper</i>	<i>M</i>	<i>M (SD)</i>	<i>95% CI Lower - Upper</i>	<i>M (SD)</i>	<i>95% CI Lower - Upper</i>	<i>M</i>
<i>DWS</i>	.05 (.70)	-.10 - .20	-.04 (.78)	-.18 - .12	.09	.17 (.63)	.01 - .34	-.02 (.78)	-.25 - .21	.19
<i>AAS</i>	51.63 (10.10)	49.46 - 53.79	50.81 (10.88)	48.78 – 52.83	.82	52.08 (9.40)	49.64 – 54.53	50.15 (11.40)	46.84 – 53.46	1.93
<i>FOP</i>	9.29 (4.08)	8.42 – 10.16	9.46 (3.83)	8.75 – 9.46	-.17	8.89 (3.93)	7.87 – 9.91	9.31 (3.86)	8.19 – 10.44	-.42
<i>PC</i>	12.43 (4.05)	11.56 – 13.30	12.10 (3.96)	11.36 – 12.84	.33	12.83 (3.79)	11.84 – 13.82	12.10 (3.89)	10.97 – 13.23	.73
<i>PA</i>	13.93 (4.63)	12.94 – 14.92	12.86 (4.25)	12.07 – 13.65	1.07	14.10 (4.52)	12.92 – 15.28	13.00 (4.56)	11.68 – 14.32	1.1
<i>FOL</i>	15.98 (3.65)	15.19 – 16.76	16.39 (4.07)	15.63 – 17.15	-.41	16.27 (3.28)	15.42 – 17.13	15.65 (3.90)	14.51 – 16.78	.62
<i>GAD-7</i>	4.56 (4.55)	3.58 – 5.53	4.70 (4.45)	3.87 – 5.53	-.14	5.14 (4.35)	4.00 – 6.27	5.21 (4.91)	3.78 – 6.63	-.07
<i>Ageing Anxiety, Dementia Worry and Generalised Anxiety in VRDS and Control Participants</i>										

*Note.* <sup>a</sup>Excluding 8 participants who did not receive the immersive VR simulation as intended. <sup>b</sup>Excluding participants who related most to the son (carer) during the VR dementia simulation. DWS = Dementia Worry Scale. AAS = Anxiety about Ageing Scale; AAS subscale: FOP = Fear of Old People AAS, PC = Psychological Concerns, PA= Physical appearance concerns, FOL = Fear of Losses. GAD-7 = Generalised Anxiety Disorder Scale.

observing data from only those participants relating to the mother during simulation. Conversely, mean scores on the AAS subscales of fear of losses and fear of old people indicated lower anxiety in VRDS participants compared to controls. When considering only those relating to the mother however, fear of losses became higher in VRDS participants compared to controls. However, after adjustment for GAD, there was no statistically significant difference in AA or DW between the VRDS and Control groups (AAS:  $F(2, 196) = .518, p = .472$ , partial  $\eta^2 = .003$ ; DWS:  $F(2, 196) = 1.030, p = .331$ , partial  $\eta^2 = .005$ ). Comparison of the AAS subscales did not reveal any significant differences between the groups for fear of old people ( $U = 5,063.00, z = .512, p = .609$ ), psychological concerns ( $t(197) = .581, p = .562$ ), physical appearance ( $t(197) = 1.694, p = .092$ ) or fear of losses ( $U = 5,118.00, z = .646, p = .518$ ). The Bonferroni corrected significance level was  $p = .0125$ .

Accounting for likely self-other merging, by excluding participants who related to the son rather than the mother during simulation, did not lead to any significant difference between groups in AA ( $F(2, 104) = .874, p = .352$ , partial  $\eta^2 = .008$ ), or DW ( $F(2, 196) = 1.030, p = .331$ , partial  $\eta^2 = .005$ ), controlling for GAD-7. There was also no significant difference in fear of old people ( $U = 1,542.00, z = .799, p = .424$ ), psychological concerns ( $t(105) = .974, p = .332$ ), physical appearance concerns ( $t(105) = 1.248, p = .215$ ) or fear of losses ( $U = 1,259.50, z = -.986, p = .324$ ) between these VRDS and control participants. The Bonferroni corrected significance level was  $p = .0125$ .

### **Question 3: Predicting WTC**

As seen in the correlation matrix (Table 8), ATC was significantly positively associated with WTC, with a medium effect. Overall AAS, fear of old people and psychological concerns were significantly negatively associated with WTC. The largest effect was fear of old people. Having previous experience of caring for

Table 8.

*Correlation Matrix of Possible Predictor Variables of Willingness to Care (WTC) for People with Dementia*

	WTCS	ATC	DWS	AAS	FOP	PC	PA	FOL	GAD-7	PED 1	PED 2	PED 3
WTCS	1	-	-	-	-	-	-	-	-	-	-	-
ATC	<sup>b</sup> .409** (.000)	1	-	-	-	-	-	-	-	-	-	-
DWS	<sup>a</sup> -.034 (.623)	<sup>b</sup> .034 (.628)	1	-	-	-	-	-	-	-	-	-
AAS	<sup>a</sup> .348** (.000)	<sup>b</sup> .142* (.041)	<sup>a</sup> .269** (.000)	1	-	-	-	-	-	-	-	-
FOP	.457 ** (.000)	<sup>b</sup> .114 (.103)	<sup>b</sup> .057 (.419)	<sup>b</sup> .558** (.000)	1	-	-	-	-	-	-	-
PC	<sup>a</sup> .268** (.000)	<sup>b</sup> .113 (.104)	<sup>a</sup> .177* (.011)	<sup>a</sup> .705** (.000)	<sup>b</sup> .204** (.003)	1	-	-	-	-	-	-
PA	<sup>a</sup> .102 (.057)	<sup>b</sup> .052 (.459)	<sup>a</sup> .178* (.010)	<sup>a</sup> .703** (.000)	<sup>b</sup> .236** (.001)	<sup>a</sup> .318** (.000)	1	-	-	-	-	-

*Note.* Cells show correlation coefficients with *p* values in parenthesis below. Due to the reflections performed in the transformation of WTC and ATC variables, reducing scores are representative of increasing WTC and ATC. <sup>a</sup>= Pearson's correlation (*r*); <sup>b</sup>= Spearman's Rho (*r<sub>s</sub>*); <sup>c</sup> = Kendall's tau-b (*τ<sub>b</sub>*); <sup>d</sup>= point-biserial correlation (*r<sub>pb</sub>*). \*significant at *p* = .05; \*\* significant at Bonferroni corrected level of *p* = .004. WTC = willingness to care scale; ATC = ability to care; DWS = dementia worry scale; AAS = ageing anxiety scale; FOP = AAS subscale fear of old people; PC = AAS subscale psychological concerns; PA = AAS subscale physical appearance; FOL = AAS subscale fear of losses; GAD-7 = generalised anxiety scale; PED1 = relative/close friend with dementia; PED2 = formal or informal caring experience for People with dementia; PED3 = previous dementia training.

Table 8. (continued)

*Correlation Matrix of Possible Predictor Variables of Willingness to Care (WTC) for People with Dementia*

	WTCS	ATC	DWS	AAS	FOP	PC	PA	FOL	GAD-7	PED 1	PED 2	PED 3
FOL	<sup>b</sup> .069 (.323)	<sup>b</sup> .134 (.055)	<sup>b</sup> .366** (.000)	<sup>b</sup> .572** (.000)	<sup>b</sup> .081 (.247)	<sup>b</sup> .318** (.000)	<sup>b</sup> .154* (.027)	1	-	-	-	-
GAD-7	<sup>b</sup> -.099 (.155)	<sup>b</sup> .094 (.177)	<sup>b</sup> .326** (.000)	<sup>b</sup> .348** (.000)	<sup>b</sup> .039 (.574)	<sup>b</sup> .349** (.000)	<sup>b</sup> .166* (.017)	<sup>b</sup> .349** (.000)	1	-	-	-
PED1	<sup>c</sup> -.150* (.009)	<sup>c</sup> -.066 (.294)	<sup>d</sup> .255** (.000)	<sup>d</sup> -.022 (.752)	<sup>c</sup> -.149* (.013)	<sup>d</sup> .061 (.386)	<sup>d</sup> .018 (.802)	<sup>c</sup> .009 (.878)	<sup>c</sup> -.004 (.944)	1	-	-
PED2	<sup>d</sup> -.233** (.001)	<sup>c</sup> -.104 (.096)	<sup>d</sup> .090 (.197)	<sup>d</sup> -.073 (.299)	<sup>c</sup> -.217** (.001)	<sup>d</sup> .002 (.983)	<sup>d</sup> .007 (.917)	<sup>c</sup> .015 (.806)	<sup>c</sup> -.092 (.121)	<sup>c</sup> .139* (.046)	1	-
PED3	<sup>d</sup> -.133 (.055)	<sup>c</sup> -.014 (.826)	<sup>d</sup> .065 (.354)	<sup>d</sup> -.088 (.208)	<sup>c</sup> -.264** (.000)	<sup>d</sup> .021 (.762)	<sup>d</sup> -.004 (.956)	<sup>c</sup> .007 (.907)	<sup>c</sup> -.012 (.835)	<sup>c</sup> .182* (.009)	<sup>d</sup> .448** (.000)	1

*Note.* Cells show correlation coefficients with *p* values in parenthesis below. Due to the reflections performed in the transformation of WTC and ATC variables, reducing scores are representative of increasing WTC and ATC. <sup>a</sup>= Pearson's correlation (*r*); <sup>b</sup>= Spearman's Rho (*r<sub>s</sub>*); <sup>c</sup>= Kendall's tau-b (*τ<sub>b</sub>*); <sup>d</sup>= point-biserial correlation (*r<sub>pb</sub>*). \*significant at *p* = .05; \*\* significant at Bonferroni corrected level of *p* = .004. WTC = willingness to care scale; ATC = ability to care; DWS = dementia worry scale; AAS = ageing anxiety scale; FOP = AAS subscale fear of old people; PC = AAS subscale psychological concerns; PA = AAS subscale physical appearance; FOL = AAS subscale fear of losses; GAD-7 = generalised anxiety scale; PED1 = relative/close friend with dementia; PED2 = formal or informal caring experience for People with dementia; PED3 = previous dementia training.

someone with dementia (paid or family) was significantly associated with higher WTC. There were significant associations identified between some of the possible WTC predictor variables, however most of these were not correlated highly enough to be excluded from the regression model. The only exception was overall AA which was highly significantly correlated with its own AAS subscales. Overall AA was excluded from the model and the two AAS subscales correlating significantly with WTC (fear of old people and psychological concerns) were retained.

In addition to WTC, ATC fear of old people, psychological concerns and previous caring experience of dementia were entered into a regression model in that order (Table 9). All assumptions of linearity, independence of residuals, homoscedasticity, no multicollinearity, no significant outliers and normality were met.

Table 9.

*Summary of Hierarchical Multiple Regression Predicting Willingness to Care (WTC)*

Variable	WTC							
	Model 1		Model 2		Model 3		Model 4	
	B	$\beta$	B	$\beta$	B	$\beta$	B	$\beta$
Constant	1.209**	-	1.009**	-	.938**	-	.968**	-
ATC	.124**	.438	.104**	.368	.009**	.351	.096**	.341
FOP (AAS)	-	-	.025**	.406	.023**	.381	.022**	.356
PC (AAS)	-	-	-	-	.008*	.130	.008*	.137
Carer exp.	-	-	-	-	-	-	-.056	-.110
$R^2$	.192		.352		.368		.379	
$F$	48.657**		55.371**		39.357**		30.820**	
$\Delta R^2$	.188		.160		.016		.011	
$\Delta F$	48.657**		50.366**		5.104*		3.660	

*Note.* N = 207. ATC = Ability to Care; FOP = Fear of Old People; PC = Psychological Concerns, AAS = Anxiety about Ageing Scale, Carer exp. = Previous experience of caring (family or professional) for PwD \* $p < .05$ , \*\* $p < .001$ .

As indicated in Table 9, ATC accounted for 19.2% of the variance in WTC. Fear of old people accounted for a further significant 16% of the variance and psychological concerns, a further significant 1.6%. Having carer experience



provided an additional non-significant 1.1%. The full model was statistically significant,  $R^2 = .379$ ,  $F(4, 202) = 30.820$ ,  $p = .000$ ; adjusted  $R^2 = .367$ , and accounted for 37.9% of the variance in WTC.

## **Discussion**

This exploratory study was conducted to investigate the feasibility and, primarily, the impact of delivering a brief VR dementia simulation to healthy adults. To determine whether simulation had any beneficial or problematic consequences, participants' caring towards PwD (WTC and Emotional WTC) and anxieties about ageing and dementia (AA and DW) were measured. Possible predictors of WTC for PwD were also explored. Despite the growing popularity of dementia simulation in healthcare trainings and increasing accessibility to the public, no previous research has considered these variables, or used a general population sample.

### **Impact of the VR Dementia Simulation**

This study demonstrated that it is feasible to deliver an immersive first-person VR dementia simulation to the adult population, via their own internet-connected devices, during which a high level of compassion is felt towards the PwD. Indeed, post-simulation compassion scores in this study were higher than post-simulation compassion scores reported by Adefila and colleagues in a similar study with health students (2016). Overall, however, this study found experience of a brief VR dementia simulation had no positive or negative impact on healthy adult participants. Simulation did not influence healthy adults' self-reported WTC or Emotional WTC, when controlling for perceived ability to care and previous experience of dementia. Similarly, simulation led to no significant difference in DW, or any aspects of AA, when controlling for generalised anxiety and previous experience of dementia.

Previous studies have shown that an immersive first-person perspective during VR provides an embodied experience and self-other merging, and these processes underpin improved attitudes, empathy and helping behaviours towards the identified 'other' (Ahn et al., 2013). In this study, a significant minority of individuals indicated they related more to the family carer (son), rather than the person with dementia (mother), during simulation. The possibility that this reduced the extent to which participants experienced self-other merging and resulted in a less impactful experience was explored, however, this hypothesis was not substantiated. When looking at data only from individuals most likely to have experienced self-other merging during simulation, the non-significant findings remained. Interestingly, analysis revealed that men and those aged under 45 years were more than twice as likely to relate to the family carer/son, rather than the mother during simulation. This suggests that gender and age may play an important role in enabling self-other merging during VR simulation.

**Consistency with previous research findings.** No existing dementia VR research has measured WTC, DW or AA in response to simulation, therefore, direct comparisons to previous findings are not possible. However, links are made to some previously measured constructs that overlap and relate to the variables measured in this study. 'Empathy' towards PwD, has been investigated in prior VR dementia simulation research and it can be argued that there are some overlapping themes with WTC, particularly the Emotional WTC factor. On the basis of face validity, Emotional WTC is measured with items that incorporate empathy (e.g. listening to someone who is sad, helping someone deal with anxiety about the future, comforting someone who is upset). As described, the current study found no significant difference in WTC or Emotional WTC between participants exposed to VR dementia simulation and those who were not. This is therefore somewhat unsupportive of existing literature in which VR dementia simulation has been

demonstrated to lead to significantly improved empathy towards PwD, in family carers (Wijma et al., 2017).

The other variable that has been investigated in response to VR dementia simulation previously is attitude towards PwD. Whilst, attitude was not directly measured in this study, the AAS incorporates items that reference attitudes towards old people (e.g. I enjoy talking to old people, I feel very comfortable around older people) and is known to be negatively influenced by poor attitudes towards older people. The previous literature is mixed when it comes to attitude findings and this current study is in line with the Wijma et al. study (2017) which found no change in attitude towards PwD in family carers. On the other hand, this current study is inconsistent with the larger study by Gilmartin-Thomas et al. (2018a) which reported significantly improved attitudes towards PwD, in health students following VR dementia simulation.

No other VR dementia simulation studies have previously measured AA or DW, thus direct comparison to previous research is not possible for these variables either. However, some comparison to other forms of simulation can be made. Inconsistent with findings in this study, an IMSE dementia simulation has previously been shown to lead to heightened anxiety (non-specific), and an ageing simulation has inadvertently negatively impacted on AA (Henry et al., 2007). However, consistent with the non-significant anxiety findings of this current study, Henry et al., (2011) reported no change in AA following an ageing simulation.

**Explanations for non-significant findings.** Several possible explanations for the non-significant findings and the discrepancies with existing findings are discussed.

**Sample size considerations.** The study was slightly underpowered with a smaller than required sample size. This may have resulted in a type-two error,

whereby true differences between the groups may have remained undetected. This possibility is particularly important to consider in reference to the analyses excluding those who were unlikely to have a first-person experience, at which point the sample became further depleted. Taking this into consideration, small non-significant differences were observed between the groups in the following directions. WTC, Emotional WTC, AA and DW were all slightly higher in those exposed to the simulation, particularly in those who had a first-person experience, compared to controls. However, reported level of DW in both groups of the study was, on average, lower than that found in populations of adults expected to have high DW; individuals who have sought memory screens but are not found to have any memory difficulties (Kessler et al., 2014; Kinzer & Suhr, 2016). Similarly, mean levels of AA reported by both control and VRDS participants were comparable to baseline levels previously reported in healthy adult and student populations (Allan & Johnson, 2008; Lasher & Faulkender, 1993).

***Simulation length and content.*** Another factor contributing to the non-significant finding may be the short length of simulation. Taking participant burden and the exploratory nature of this study into account, a brief dementia simulation of under four minutes was selected. However, this is around a third of the length of those identified in previous literature (Gilmartin-Thomas et al., 2018a; Wijma et al., 2017). Longer exposure may be necessary for a measurable effect to be observed. Furthermore, the brief nature of the VR dementia simulation may have been particularly diluted given the high level of prior dementia experience found in the sample. For individuals with dementia-related experience, it is possible that the brief simulation used did not provide much new information or a novel enough experience to lead to any significant impact.

The VR dementia simulation selected for this study, unlike others identified in the systematic review in Part One of this thesis, did not solely focus on negative

aspects of ageing and dementia. For example, other characters in the simulation were shown to offer care and compassion and the individual with dementia had a level of independence. It is possible that this image of PwD did not feed into prevailing negative stereotypes which usually tends to raise peoples' anxieties about dementia and ageing (Sun, Gao, & Coon, 2015).

***Terror Management Theory and hidden anxiety.*** With TMT in mind, the simulation used in this study could arguably be acting as a 'mortality salience': a primer for thoughts of our inevitable death (Chonody & Teater, 2016; Greenberg et al., 1986). Therefore, as the theory states, the sense of terror or dread this results in, is necessarily managed with distal death defences, such as denial of one's own ageing, 'othering' of PwD, or adherence to worldviews such as the afterlife (Greenberg et al., 1986; O'Connor & McFadden, 2012). Based on TMT, it is therefore possible to argue that the VR dementia simulation may well have significantly raised anxieties, but that this would go undetected due to the defences used. Furthermore, this hidden anxiety and use of distal death defences could result in negative consequences, such as wanting to avoid older PwD (Chonody & Teater, 2016). However, if this were the case, whilst all other AA factors might be comparable between VRDS and Controls, a discrepancy would be expected on the fear of old people scale. According to Lasher and Faulkender (1993), the fear of old people scale captures AA in individuals who present as 'defensive' about ageing (p.257). As previously stated however, there were no significant differences between VRDS and control participants on any of the AAS subscales, and in fact, observable non-significant differences were in the opposite direction, with fear of old people found to be lower in VRDS participants.

***Participant characteristics.*** It is possible that the outcomes of this study were influenced by biases in the sample. Participants were well informed of the research aims prior to taking part, due to the need for informed consent, which may

have affected their desire to answer in a favourable manner. In line with this hypothesis, the entire sample reported relatively high levels of WTC and Emotional WTC towards PwD which may reflect a social desirability bias. Alternatively, this may just be a true reflection of their attitudes given their prior personal and professional experience of dementia. In line with previous findings, having a relative or close friend with dementia and higher generalised anxiety were both significantly associated with higher DW in this study (Kessler et al., 2012; Kinzer & Suhr, 2016; Page, 2013). Higher DW was also significantly associated with higher AA. It is possible then that individuals with high previous experience of dementia are accustomed to experiences such as those in the simulation, buffering them from any harmful consequences such as raised anxiety. Furthermore, it may be much harder to reduce the existing anxiety, or improve the existing WTC, in this population.

Whilst randomised allocation to groups and stratification were used to balance prior experience of dementia, observable, non-significant, differences discussed previously may be a result of subtly non-equivalent groups, rather than type-two error. For example, the largest, but still non-significant, difference between the groups was for age-related physical appearance concerns. This AA factor was greater for participants in the VRDS group, despite the simulation not having any content related to physical appearance. There were a non-significantly greater proportion of females in the VRDS group, and age-related physical appearance concerns tend to be higher in females than males (Lasher & Faulkender, 1993).

### **Predicting Willingness to Care**

This study established that a model of perceived ability to care, fear of old people, psychological concerns and previous caring experience of dementia was significantly predictive of individuals' WTC for PwD. Higher perceived ability to care,

lower fear of old people and lower psychological concerns were each, independently, significantly predictive of higher WTC for PwD. Whilst having prior caring experience of dementia alone, contributed only non-significantly to an increased level of WTC.

**Fear of old people and WTC.** Fear of old people, which captures some aspects of attitudes towards old people (Lasher & Faulkender, 1993), was the most strongly predictive factor of WTC for PwD. This suggests that PwD subject to ageism are likely to receive worse care which corroborates previous research findings (Herrmann et al., 2018; Milne, 2010; Mukadam & Livingston, 2012). Taking TMT into account, it could be argued low WTC in individuals with high fear of old people, particularly in the context of lower anxiety on other AAS factors, may be a result of a distal death defences. To expand, when encountering dementia these individuals may be reminded of their inevitable death, and to manage the fear this would otherwise present, they employ defences such as avoidance of PwD resulting in a low desire to provide care.

### **Strengths and Limitations**

As previously mentioned, this study had a slightly smaller than required sample size and is therefore likely to be somewhat under-powered. The possibility of a type two error must be considered with regards to the non-significant findings for WTC, DW and AA. Despite this, the sample size was not dissimilar to that utilised in Gilmartin-Thomas et al. (2018a) study and is much larger than the samples used in the other two existing studies on VR dementia simulation. Additionally, unlike the other existing controlled study on this topic (Gilmartin-Thomas et al., 2018a) a robust randomisation method was used to allocate participants to either group of the study, strengthening the likelihood of equivalent groups, and therefore, the control of confounding variables. Given the number of

analyses conducted, type-one errors are also a possibility. Conservative significance values (Bonferroni corrected) have been used throughout to reduce the likelihood of over-estimating significance of the findings.

Control of important confounding variables, such as previous experience of dementia, was built into both the design of the study, with stratification, and through the analyses, with use of ANCOVAs, strengthening the conclusions drawn. An exception to this is demographics. Random sampling, as desired, led to no significant-differences in age, gender and ethnicity between groups. However, there were missing demographic data from over ten percent of participants completing the study, and none collected from those who withdrew. Therefore, the influence that gender, ethnicity and age had on withdrawal status and overall outcome was not explored. This must be considered in relation to the findings, particularly given gender was found to influence the perspective taken and is known to differentially influence factors of AA. It would be important to address this in future studies of a similar nature and may help to ask demographics as a first step in the participation process.

There are several characteristics of the sample in this study that limit the generalisability of the findings and it should be noted that the sample is not reflective of the general population from which it was drawn. Participants were mostly female, white British, and most had previous experience of dementia. This may be a result of inadvertent sampling biases such as relying on online recruitment methods and social media platforms. It is also possible that individuals may have been more motivated to take part if dementia had some personal significance to them, particularly given the financial incentive was a donation to ARUK. On the other hand, as previously stated, dementia is increasing in prevalence and given the pivotal role that family carers play in the UK, perhaps it is not unusual to find such a high level of exposure to dementia in the general population.



Given cost and time constraints, VR headsets were not used as standard to experience the simulation and only used by those few participants that happened to own one. Instead, 360-degree film technology was used and whilst this was highly accessible for participants, it is possible that it limited the extent to which the experience was immersive and this should be considered when reading the findings of this study. However, the delivery method used, without headsets and via participants' own internet-connected devices, is true to the way in which members of the public will be accessing the ARUK film. This strengthens the ecological validity of the study. Given that the simulation used in this study is freely available to the public, this research has necessarily addressed an important gap in the literature by conducting research on a general adult population, where all other research has focused on healthcare workers or carers.

The study relied on self-report measures to obtain data about the impact of the simulation. This method is subject to social desirability bias and it may therefore have been useful to include a measure that monitors for this. However, the online anonymous nature of the study and absence of any face to face contact with a researcher is likely to have reduced social desirability biases occurring. All the primary outcome measures used in the research were validated tools with published psychometric properties and were demonstrated to have good internal consistency within this study. This is a strength considering other ageing and dementia simulation literature has sometimes suffered from the use of weak measurement tools.

Online research comes with several limitations. Whilst considerable measures were taken to standardise participants' simulation experience, there will undoubtedly have been some variation. For example, participants were instructed to launch the simulation in a quiet private environment and to use headphones. Whilst these instructions and recommendations were given on several occasions

there is no way to guarantee that every individual followed them. It is possible that some individuals were therefore exposed to unknown confounding variables which influenced their experience.

## **Future Research**

For VR dementia simulation to be most effective, WTC would increase and AA and DW would remain stable, or most favourably, reduce. To date there is no evidence of any inadvertent harm from dementia VR simulation. However, the findings regarding benefits remain inconclusive and given the increasing accessibility to this type of technology, more research is warranted to provide clarity on this matter. It would be informative to replicate this study, because it is the only one so far to have measured WTC, AA and DW, but would benefit from a larger sample size to address the possibility that a type two error occurred. Given the non-significant findings, another appropriate future direction would be to conduct a qualitative investigation. The level of detail gathered via this approach could provide evidence of subtle responses to the simulation that were not captured by reductionist quantitative measures.

Any further studies using VR dementia simulation may benefit from including a measure that taps into self-other merging, and exploring what factors influence this. For example, does using a VR headset make it more likely that participants will have an embodied experience? The controlled studies conducted so far have not incorporated active comparison groups and little is known about how VR dementia simulation compares to alternative activities. Future studies could, for example, compare VR dementia simulation to an alternative, such as IMSE, and determine which is most effective at producing desired outcomes. Resources could then be focused on advancing the most useful technology.

Future research that wishes to consider the impact of an intervention, simulation or otherwise, on WTC for PwD, should consider the model of prediction produced in this research. For example, studies might aim to control for two key aspects of AA, fear of old people and psychological concerns, given their significant influence. Furthermore, where baseline perceived ATC is low, perhaps addressing this prior to a WTC intervention may improve desired outcomes.

Whilst previous experience of dementia was controlled for within this study, there was high overall experience which may have impacted on the findings. Further research is needed to understand how different types of previous experience influence the way in which people may or may not benefit from VR dementia simulation and other interventions designed to improve WTC. Future research may therefore benefit from comparing groups of participants with and without prior experience of dementia to investigate whether simulation leads to different outcomes.

### **Clinical Implications of the Findings**

Continued use of VR dementia simulation both as a training tool and a public awareness tool, must be considered carefully, weighing up the effort and resource expended and the likelihood of a beneficial outcome as these are not guaranteed. Where VR dementia simulation is used in training, collecting data with validated measures and conducting practice-based evaluation is recommended to continue building the literature base.

When using or developing VR dementia simulation experiences to improve caring behaviours and emotional caring towards PwD, consideration should be given to the model predicting WTC. For example, the two aspects of AA which can negatively influence WTC, fear of old people and psychological concerns could be addressed both within the content of the simulation but also during post-simulation

reflective discussion. Attending to these important aspects of AA may well lead to greater improvements in WTC.

Gender and age were both significant predictors of which perspective was taken during the simulation. This study therefore provides evidence to recommend an approach used in some previous VR dementia simulation, that matches the first-person voice and identity of the VR character to the sex of the participant (Wijma et al., 2017). Perhaps it may also be important to provide instruction prior to simulation which reminds the user that despite the similarities they may notice between themselves and other characters, the aim is to try take the perspective of the person with dementia only. Taking these measures may improve the likelihood that participants have an embodied experience leading to self-other merging.

Feasibility and usability of the simulation delivery method used in this study was high. The simulation was accessed easily on any internet-connected device. This is worth bearing in mind for the design and delivery of any future VR dementia simulation as it is a relatively resource-light approach.

## **Conclusion**

Despite some limitations, this research has addressed important gaps in the literature by conducting research with the healthy general adult population, and by attending to both the possible benefits and subtle unintended problematic consequences of VR dementia simulation. Whilst no significant beneficial impact was found following a brief VR dementia simulation, research should continue to explore this possibility with larger sample sizes, continued use of psychometrically strong measures, and with longer exposure to VR. This research has reassuringly provided new evidence that a simulation already currently available to the public does not lead to increased AA or DW and that individuals feel high levels of compassion towards PwD immediately following exposure. Furthermore, this study

has provided a predictive model which can be consulted to inform the design and delivery of interventions that aim to improve WTC for PwD.

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### **Part three: Critical Appraisal**

## **Introduction**

This critical appraisal reflects on some of the personal interests, lessons and challenges that arose during my systematic literature review and empirical research. I discuss first the importance of effective stigma-reduction interventions in dementia and reflect on how my own perceptions have been influenced throughout the review and research process. Second, I highlight the opportunity for the field of psychology to widen its reach through the use of accessible VR technologies. Finally, I describe some of the unique challenges stemming from conducting a piece of internet mediate research (IMR), and my attempts to address them.

## **Attitudes Towards Dementia**

My knowledge and understanding of attitudes to dementia has become grown during the process of conducting a literature review and a piece of empirical research within this field. I have gained insight into the factors that can influence perceptions of dementia, and, in turn, how perceptions influence behaviour towards people with dementia (PwD). With a rapidly ageing global population and the current absence of an effective cure for dementia, the number of people living with a form of the syndrome is rising steadily. Rightly, it has gained status as world health priority (World Health Organisation [WHO], 2017). Current UK and international dementia priorities include taking action to reduce the widespread stigma associated with dementia, as this stigma has problematic consequences that ultimately worsen quality of life for PwD (Department of Health, 2016; WHO, 2017). Older PwD are particularly vulnerable to a double form of discrimination whereby dementia stigma and ageism combine and can, problematically, come to define an individual's experience of living with dementia (Milne, 2010). I have come to appreciate the current importance of conducting research into the effectiveness of interventions addressing negative beliefs about dementia and ageing held by both healthcare workers and the public.

## **Fear of Dementia and Ageing**

Throughout my research, I have developed a particular interest in how fear of dementia and ageing perpetuates stigmatising beliefs. I have been able to contribute to the literature on this subject. For example, within my study, fear of old people was found to play an important predictive role in willingness to care for PwD, perhaps indicating this is an important target to address in future interventions. Fears of dementia and ageing are widespread and persistent across time, culture, gender and age (Brunton & Scott, 2015; Page, 2013; Sargent-Cox, Rippon, & Burns, 2013). I have been struck by the reports and statistics I have come across in my research, which confirm dementia as one of the most feared health conditions amongst adults, a trend I am interested in better understanding. One theory that shed light on this idea relates to how dementia seems to threaten our sense of self and our subjective experience of reality (Kessler, Bowen, Baer, Froelich, & Wahl, 2012; Page, 2013). Kessler and colleagues (2012) argued that the thought of living with the unique symptoms of dementia (e.g. memory loss, communication difficulties, personality changes) may lead us to assume that we would be less able to connect with others and therefore less able to lead a meaningful life.

It has been enlightening for me to reflect on my own perceptions and fears around dementia and ageing during the process of this research. I felt saddened at times to read about the significant negative impact on older PwD that exposure to negative attitudes can have, particularly in the areas of care, quality of life and psychological wellbeing. I also noticed feelings of fear and anxiety within myself whilst reading the literature throughout the review and for my research, especially when considering the idea of supporting a close relative or partner with dementia or living with dementia myself. This has felt frustrating to me when considering the unhelpful ways in which such fears can feed into negative stereotypes of, and behaviour towards, older PwD.



However, reflecting on how I feel now at the end of this process, I have noticed a shift from this original position of fear and frustration. It has been exciting to work on a project that centres on the ways in which clinical psychology can positively influence the narrative on dementia. I have seen how systematic literature reviews and empirical research can provide evidence and understanding to support the creation of effective interventions, designed to improve attitudes towards PwD. I hope to be able to continue contributing to this field as a scientist-practitioner. Whilst my findings regarding willingness to care for PwD after a brief VR dementia simulation were non-significant, I have been able to draw out potential areas for future work to maximise and build on the potential benefits that these kinds of interventions could provide. Most of all, I have been particularly struck and encouraged by the genuine positive response I have received when telling people about my research topic. It has been especially heart-warming to receive positive feedback from some people who took part in the research and to notice a theme of determination and enthusiasm to keep improving perceptions of dementia.

### **Rising Accessibility of VR Technology**

One of the factors piquing my interest in this research project was the use of innovative digital technology. I'm interested in how clinical psychology can widen its reach with engaging digital approaches. Evidence-based digital approaches are relatively common within psychology now and have, amongst other things, improved access to psychological support (Fairburn & Patel, 2017). VR is one digital technology that has gathered a great deal of interest in recent years. A recent meta-analysis of systematic reviews provided evidence that VR can be effective in the treatment of anxiety disorders, eating disorders and pain management (Riva, Baños, Botella, Mantovani, & Gaggioli, 2016).

Recently, VR technology has become far more accessible. VR and 360-degree film are essentially available to anyone with a portable internet-connected

device, such a smartphone or tablet. Affordable VR headsets, such as Google Cardboard, can be used in conjunction with apps for accessible immersive experiences. Whilst this technology has mostly been a platform for games, there is an emerging collection of health-care apps, some related to psychological wellbeing, available to the public, that use this approach. The app used within my research, A Walk Through Dementia (AWTD) (Alzheimer's Research UK [ARUK], 2016), is one example. I have since discovered more examples through my clinical work and personal interest in this area. For example, working in the field of paediatric psychology I have encountered the development of VR apps designed to reduce procedural anxiety by enabling children to acclimatise to the anaesthetic room prior to surgery (<https://littlesparkshospital.com/>).

The popularity and excitement surrounding novel VR approaches must not be taken as indicators of their usefulness. This is a theme I have tried to address both within my literature review and my empirical research. It has been apparent, from conducting my own research, that we have a responsibility to ask questions about the psychological impact of these technologies given their increasing uptake amongst both adults and children. As it stands, there is very limited published research around the use of VR health apps, nor are clinical psychologists noticeably involved in the design and public discussion of their use. Research into the psychological impact of VR health apps may provide important guidance to developers. Additionally, it is an opportunity for clinical psychology to make effective psychological support available and engaging to more people, outside of the therapy room. I am keen to continue exploring the use of such accessible technology, for this purpose, in my post-qualified life.

### **Recruitment and Sample**

To participate in my research, individuals required access to an internet-connected device. Participation was conducted entirely online via Qualtrics, an

online survey-building platform. A sample size of 265 was required to provide appropriate power and find a small effect size. With these factors in mind, it seemed appropriate to focus the majority of my recruitment efforts to online mediums. I used social media platforms, such as Facebook and Twitter, email contacts, and a participation recruitment website ([www.callforparticipants.com](http://www.callforparticipants.com)), to advertise my study. Pre-empting biases that can occur from internet based recruitment and IMR (Whitehead, 2007), I also made paper posters and placed them in various university locations to increase my recruitment reach. To make it easy for participants to reach the website I provided tear off strips at the bottom of the poster which contained both a link to the website and a QR code. The QR code could be scanned by a smartphone to automatically launch the Qualtrics site. However, Qualtrics monitoring indicated only a small number of people accessed the study in this way.

### **Sample Representativeness**

The achieved sample was neither reflective of the general population from which it was recruited or quite large enough to provide sufficient power. That said, the demographics of participants recruited may well be similar to the type of people that would ordinarily access the VR app used in the research. Nonetheless, it has limited the generalisability of the results and the strength of the conclusions that can be drawn from the findings. Possible influences this sample may have had on the findings were discussed in my empirical paper. Here, I have considered in detail, what factors may have influenced both the size and characteristics of the sample that was ultimately achieved. The most striking characteristics of the sample were the large majority of females (over 80%) and the high levels of prior exposure to dementia, either personally or professionally. Whilst there was a good spread of ages between 18 and 65, there was a disproportionately small number of individuals in the older adult age bracket (66 – 80 years).

**IMR sampling biases.** Different social media sites tend to attract different numbers of men and women. For example, there are more female users of Facebook but more male users of Twitter (Statista, 2018). However, having used both sites, it is perhaps more likely that the high number of females reflects my personal network. I initially posted adverts on my own Facebook and Twitter sites and sent emails to my contacts. Whilst these were re-posted or forwarded by others, an initial affiliation to me was required. I know more females, young adults and people in health-related professions which may have been reflected in the sample. It is possible that using additional social sites such as Reddit, which has more male engagement, may have boosted numbers of men (Statista, 2018). Furthermore, although it was not measured, there may have been a bias in the sample with regards to a higher than average level of education. Again, in my personal network I am connected with more people who have been through the higher education system or are in professional training. If I were to replicate this study, it might be worthwhile adding an additional question about education to monitor the representativeness of the sample.

In general, younger people make up the majority of people using social media (Statista, 2018) and they are also more likely to participate in IMR (Whitehead, 2007). Despite this, a relatively good spread of ages was achieved and young people were not over-represented. There was however only a small number of individuals from the older adult age bracket and this is perhaps reflective of their lower use of the internet (Whitehead, 2007). Whilst this research did not specifically target older adults, it aimed to be inclusive of them. Further steps could have been taken to promote the study more widely via non-internet mediums. For example, posters were only placed in university premises, but using community settings such as local libraries may be helpful in future. However, aside from recruitment methods, it is possible that the online nature of participation and lack of face-to-face

contact may have presented as a barrier to older adults in the research (Whitehead, 2007). Given the large number of participants needed, time and resource constraints, it was not possible to carry out the study face-to-face.

**Participants' personal motivations for taking part.** One final factor that is likely to have influenced the sample characteristics is personal motivations for participating. The study topic was dementia, which will have attracted more attention from people with a special interest in the area. ARUK posted my study advertisement on their Twitter account late on in my recruitment process. Whilst this led to a boost in numbers, it is highly likely to have been viewed by people who have more personal and professional dementia experience than average. Owing to the large sample size and limited availability of funding, it was not possible to provide participants with individual financial compensation for their time. Instead, I decided to offer a small donation, on behalf of each participant, to ARUK. I picked ARUK as their VR app formed the basis of my research product. This donation will likely have motivated individuals for whom dementia has personal significance. Together, these motivating factors make it likely that my sample had higher interest in, experience of, and perhaps positive association to dementia than the general population which it was aiming to represent.

Clearly this sample composition must be considered when interpreting my findings, and a detailed discussion on this matter was presented in my empirical paper. Particular points to highlight are the likelihood of a more favourable baseline attitude towards dementia but also higher anxiety about it (Kessler et al., 2012). Given these were key outcomes in the research, steps were taken to try and maximise the control of this variable e.g. with stratification to equalise dementia experience across the study groups. I also explored whether previous experience of dementia was a factor in withdrawal from the study but did not find any evidence to support this. However, these steps do not address the problem of an overall high

level of dementia experience within the sample. An interesting way to address this problem in future research could be to group participants according to their dementia experience (e.g. none vs. a relative with dementia) and investigate whether this interacts significantly with the impact of a dementia simulation intervention.

## **Sample Size**

Data collection for this project was not able to start until February 2018. Given there were still new individuals participating up until the last day of data collection, it is likely that a slightly longer window of time would have led to the necessary sample size of 265 being achieved. However, to ensure no data protection breaches inadvertently took place, data collection was ceased in advance of the new General Data Protection Regulation (GDPR) enforced in May 2018 (European Commission, 2018). Compliance with GDPR took precedence. Whilst the overall number of consenting individuals (263) was very close to the required participant number, exclusion criteria and withdrawals led to a smaller number completing the entire study, leaving it somewhat underpowered. Having conducted a literature review on current similar research, however, I was reassured by the fact that my sample size was towards the larger end of the previous studies into this area.

The process of monitoring survey data collection via Qualtrics was an anxiety-provoking one. Qualtrics indicates each time a person has visited the site and the progress made through the study. In the initial days of data collection, it was tempting to monitor numbers regularly throughout the day, however this ultimately perpetuated my worry about not recruiting enough people. Instead, I adopted an approach of checking the numbers once a week and using the graphical display (frequency of new participants per day) to inform decisions about further

recruitment. For example, I could see that people were much more likely to participate at the weekend rather than a weekday, so when re-posting my adverts online I would do so over the weekend.

A further challenge with IMR and online recruitment is that you can never tell how many individuals your advert is reaching and thus do not get much sense of a response rate. However, Qualtrics does allow you to monitor the number of new visits to the page. Interestingly, the number of individuals viewing the first page of the site was relatively high (530). Approximately 50 percent of these individuals moved beyond the first page to read all the information pages and complete a consent form. Having an indication of the reasons the other 50 percent did not move beyond the first page of the site would both inform knowledge of any bias in the sample and future decisions about how to engage people in IMR. However, the practicalities around doing this make it very difficult, particularly given these individuals have not provided consent for their data to be used. One cannot, therefore, easily ask them to provide details of why they do not wish to continue. One possible improvement in the study with regard to this, could be to ask individuals who completed, for feedback about ways in which the engagement experience could be improved.

### **Further Methodological and Ethical Challenges of IMR**

The British Psychological Society's (BPS) 'Ethics Guidelines for Internet-mediated Research' (2017) encourages researchers to consider the ways in which IMR and absence of face-to-face presence with participants alters the way in which the principles of the Code of Human Research Ethics are applied.

### **Privacy and Confidentiality**

Overall, participants' anonymity and privacy were well protected during this study. No personal details (e.g. email) were required, there was no fact-to-face

contact with a researcher, and all data were held confidentially and securely at all times. However, Qualtrics automatically collects and records GPS location information, unless disabled by participants. This information was not required by the researcher and raised a privacy concern. Therefore, to address this, all participants were explicitly informed that Qualtrics would collect GPS data but that this would not be used within the research at any point. Details were also given of the secure storage format. As an additional precautionary step, the consent form required further tick box confirmation from participants that they had read and understood the data protection information and they were given the option to re-read this information if they felt it necessary.

**Withdrawal.** Due consideration must also be given to withdrawal in IMR. Qualtrics allows participants to exit mid-way through a survey by simply closing the browser window, however it automatically saves all data up until that point. Without further information, it is therefore unknown to the researcher whether an individual has withdrawn wanting their data to be removed, whether they have left accidentally, or whether they are happy for their data to be used but do not wish to continue. The problem was addressed as far as possible with the provision of clear and detailed information from the outset about the storage of data and the right to withdraw, and the provision of researcher contact details for clarification on these matters.

Qualtrics did not have the functionality to allow a 'withdraw' button on every page which would help to address this issue more fully. However, if I were to replicate the research using the same platform, I might add a tick box question to each page, without forced response, that asked participants if they wished to withdraw at this point. This could then direct them to a debrief page. Alternatively, I would explore use of another survey software that allowed for a neater integration of withdrawal options.



## **Scientific Integrity**

One of the main concerns I had in relation to conducting my study as IMR was the lack of control over conditions under which participants completed the tasks and how this may have impacted the scientific integrity of the study (British Psychological Society, 2017). Several key steps were taken to address this. Firstly, the inbuilt function on Qualtrics that disallows multiple survey entries from the same IP address was used to prevent repeat participation, and this function was successfully tested prior to launching the site. However, this does not prevent individuals attempting to re-take the survey from different devices. An additional step for future research might be to explicitly state the importance of not taking the survey more than once on the debrief page.

Secondly, from the outset, participants were given explicit information about the environmental conditions to use when launching the simulation (e.g. in a quiet private setting, with headphones). This information was emphasised by inclusion on the advertisements, the study information pages and within the simulation launch instructions. Whilst these conditions were clearly communicated, the possibility remains that some participants did not follow the guidelines.

An additional consideration is the variation in experience created by the provision of options for viewing the simulation (e.g. smart-phone, tablet, VR headset, or computer device). A possible issue anticipated from these hardware options was a non-immersive experience for some participations due to poor graphics. Possible ways of maximising control in the IMR context were explored. On balance, with the large sample size needed, considerable pilot functionality testing of the app, and difficulty in preventing individuals accessing the survey from certain devices, I considered it appropriate to allow the different viewing options. To address hardware variance problems as far as possible, I made strong recommendations

about which hardware to use (smartphone or tablet). This approach had a relative degree of success with only 21% of individuals accessing the simulation from a computer or laptop. I also provided tailored instructions which should have resulted in the most immersive experience possible, depending on the way in which participants decided to view the simulation. A further check regarding any technical problems was also built into the survey and allowed for identification and exclusion of a small number of individuals who did not receive an immersive experience.

Given the limits to control in IMR, if I were to conduct further research improving on this study, I would be interested in trying to conduct some sessions face-to-face and provide participants with VR headsets. Possible ways to manage the enhanced resource needed to do this would be to use cardboard viewer headsets, which are relatively cheap, and to run sessions in groups. Using groups would potentially fit well with some of the suggestions made in my empirical paper discussion. Namely, to include post-simulation reflective discussions addressing fear of old people. This would also fit well with a qualitative design which I believe would be a useful next step for the continuation of this research.

### **Maximising Benefits and Minimising Harm**

Given the IMR nature of the study, the ability to verify participant identity and assure their eligibility for the research was somewhat reduced. Steps I took to address this included citing eligibility criteria on the initial advertisements, ensuring adverts were shared only in line with ethical approval and being very clear with anyone who offered to share my advertisement what the eligibility criteria were. In the event of individuals accessing the Qualtrics website, despite not meeting these criteria, participants were also asked to complete an eligibility checklist prior to taking part as recommended in the BPS IMR ethics guidance (2017). It was felt that these steps significantly reduced the likelihood of this happening, maximising the

generalisability of the results and minimising any harm to participants. The possibility remains that individuals who ought to have been excluded, may have taken part in the research. Weighing this up with the knowledge that the simulation app used in the research was already available in the public domain without any viewer restrictions, I did not consider there to be any harm caused if individuals unintended to be included in the research did access the study.

## **Conclusions**

The opportunity to reflect on my research journey has helped me to identify areas of budding interest, to consolidate key learnings and ultimately gain confidence as a scientist-practitioner. I have seen how, despite non-significant findings, research can contribute to the literature in a helpful way by proposing future alterations to research methods and interventions. I have learned a lot about the current dementia context and have thoroughly enjoyed being able to contribute to a topic that feels relevant and important today. I have also highlighted the opportunity that clinical psychology has to widen its audience by engaging with accessible VR technology.

Conducting IMR has allowed me to become much more familiar with the specific challenges associated with this approach. I would be able to more confidently address these challenges in the future and better weigh up the pros and cons of an IMR approach versus laboratory or face-to-face based research. Reflecting on these challenges, I have presented several suggestions as to how my study could be improved if replicated as well as providing direction to further research in the area.

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## Appendices

### Appendix A.

Table of Systematic Search Terms

	PsycINFO	Embase	CINAHL
<i>Simulation</i>	Simulat*.mp OR exp Computer Simulation/ OR exp Simulation Games/ OR exp Simulation/ OR "Virtual Reality".mp. OR exp Virtual Reality/ OR Game .mp. OR Virtual .mp.	Simulat*.mp. OR Simulation/ OR Virtual Reality/ OR Virtual Reality.mp. OR Game.mp. OR Virtual. mp.	(MH "Computer Simulation+") OR (MH "Simulations+") OR TX simulation OR TX simulation OR (MH "Virtual Reality+")
	AND	AND	AND
<i>Dementia/ Ageing</i>	"Cognitive impairment".mp OR Dementia.mp. OR exp Dementia/ OR Alzheimer's.mp. OR exp Alzheimer's Disease/ OR Ag?ing.mp. OR exp Aging/ OR	Dementia.mp. OR Dementia/ OR Alzheimer's.mp. OR Alzheimer Disease/ OR exp Aging/ OR Aging.mp	TX Ag?ing game OR TX ag?ing (MH "Aging") OR (MH "Cognitive Aging") OR TX dementia OR Alzheimer's OR Cognitive Impairment OR Memory Loss OR (MH "Delirium, Dementia, Amnesic, Cognitive Disorders+")
	AND	AND	AND
<i>Outcome</i>	Empath*.mp. OR exp Empathy/OR Sympath*.mp. OR exp Sympathy/OR Compassion*.mp. OR Attitude*.mp. OR exp Health Personnel attitudes/ OR exp "Aging (Attitudes toward)"/ OR exp "Mental Illness (Attitudes toward)"/ OR exp "Aged (Attitudes toward)"/ OR exp Attitudes/ OR Stigma*.mp. OR exp Stigma/ OR Anxiety.mp. OR exp Anxiety/ OR Fear.mp. OR exp Fear/ OR "Emotional reaction".mp. OR exp Emotional responses/ OR "Social distance".mp. OR exp Social behavior/ OR exp Social acceptance/ OR exp Social perception/	Exp Empathy/ OR Empath*.mp OR Sympathy.mp. OR Sympathy/ OR Exp Compassion.mp. OR Health Personnel Attitude/ OR Attitude.mp. OR Attitude/ OR Stigma.mp. OR Stigma/ OR Anxiety.mp. OR Anxiety/ OR Fear.mp. OR Fear/ OR Emotion/ OR 'Emotional reaction'.mp. OR 'Social distance'.mp. OR Social distance/ OR Distress.mp OR Harm.mp OR "Care and caring"/ OR Caring.mp.	TX Empath* OR (MH "Empathy") OR (MH "Caring") OR TX attitudes OR (MH "Attitude+") OR (MH "Social Attitudes") OR (MH "Social Behavior+") OR (MH "Attitude to Mental Illness") OR (MH "Attitude to Illness") OR (MH "Attitude to Aging") OR (MH "Attitude of Health Personnel+") OR (MH "Stigma") OR TX Stigma OR TX Compassion OR TC Fear OR (MH "Fear+") OR TX Emotional reactions or Emotional responses OR TX Understanding
<i>Additional Filters:</i>	1. English Language 2. Human 3. Published between January 2000 – January 2018	1. English Language 2. Human 3. Published between January 2000 – January 2018	1. English Language 2. Human 3. Published between January 2000 – January 2018

## Appendix B.

### Adapted Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies

#### QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES



#### COMPONENT RATINGS

##### A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

- 1 Very likely
- 2 Somewhat likely
- 3 Not likely
- 4 Can't tell

(Q2) What percentage of selected individuals agreed to participate?

- 1 80 - 100% agreement
- 2 60 - 79% agreement
- 3 less than 60% agreement
- 4 Not applicable
- 5 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

##### B) STUDY DESIGN

Indicate the study design

- 1 Randomized controlled trial
- 2 Controlled clinical trial
- 3 Cohort analytic (two group pre + post)
- 4 Case-control
- 5 Cohort (one group pre + post (before and after))
- 6 Interrupted time series
- 7 Other specify \_\_\_\_\_
- 8 Can't tell

Was the study described as randomized? If NO, go to Component C.

No Yes

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

## Appendix B. (Continued)

### C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

- 1 Yes
- 2 No
- 3 Can't tell

The following are examples of confounders:

- 1 Race
- 2 Sex
- 3 Marital status/family
- 4 Age
- 5 SES (income or class)
- 6 Education
- 7 Health status
- 8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

- 1 80 – 100% (most)
- 2 60 – 79% (some)
- 3 Less than 60% (few or none)
- 4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

### D) BLINDING

Criteria D) Blinding was removed from this tool when assessing the quality of papers in this current review.

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

- 1 Yes
- 2 No
- 3 Can't tell

(Q2) Were the study participants aware of the research question?

- 1 Yes
- 2 No
- 3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

### E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?

- 1 Yes
- 2 No
- 3 Can't tell

(Q2) Were data collection tools shown to be reliable?

- 1 Yes
- 2 No
- 3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3



## Appendix B. (Continued)

### F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?

- 1 Yes
- 2 No
- 3 Can't tell
- 4 Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

- 1 80 -100%
- 2 60 - 79%
- 3 less than 60%
- 4 Can't tell
- 5 Not Applicable (i.e. Retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK	
See dictionary	1	2	3	Not Applicable

### G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

- 1 80 -100%
- 2 60 - 79%
- 3 less than 60%
- 4 Can't tell

Criteria G) Intervention Integrity was removed from this tool when rating the quality of papers in this current review. In the original tool, this criteria did not contribute to the overall rating.

(Q2) Was the consistency of the intervention measured?

- 1 Yes
- 2 No
- 3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

- 4 Yes
- 5 No
- 6 Can't tell

Criteria H) Analyses was removed from this tool when rating the quality of papers in this current review. In the original tool, this criteria did not contribute to the overall rating.

### H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

- 1 Yes
- 2 No
- 3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

- 1 Yes
- 2 No
- 3 Can't tell

## Appendix B. (Continued)

### GLOBAL RATING

#### COMPONENT RATINGS

Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	SELECTION BIAS	STRONG	MODERATE	WEAK
		1	2	3
B	STUDY DESIGN	STRONG	MODERATE	WEAK
		1	2	3
C	CONFOUNDERS	STRONG	MODERATE	WEAK
		1	2	3
D	BLINDING	STRONG	MODERATE	WEAK
		1	2	3
E	DATA COLLECTION METHOD	STRONG	MODERATE	WEAK
		1	2	3
F	WITHDRAWALS AND DROPOUTS	STRONG	MODERATE	WEAK
		1	2	3
				Not Applicable

#### GLOBAL RATING FOR THIS PAPER (circle one):

- |   |          |                            |
|---|----------|----------------------------|
| 1 | STRONG   | (no WEAK ratings)          |
| 2 | MODERATE | (one WEAK rating)          |
| 3 | WEAK     | (two or more WEAK ratings) |

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No — Yes

If yes, indicate the reason for the discrepancy

- |   |   |
|---|---|
| 1 | Oversight                                 |
| 2 | Differences in interpretation of criteria |
| 3 | Differences in interpretation of study    |

This literature review was carried out by a single author thus quality rating was not discussed and checked with a second reviewer.

Final decision of both reviewers (circle one):

- |   |          |
|---|----------|
| 1 | STRONG   |
| 2 | MODERATE |
| 3 | WEAK     |

## Quality Assessment Tool for Quantitative Studies Dictionary



The purpose of this dictionary is to describe items in the tool thereby assisting raters to score study quality. Due to under-reporting or lack of clarity in the primary study, raters will need to make judgements about the extent that bias may be present. When making judgements about each component, raters should form their opinion based upon information contained in the study rather than making inferences about what the authors intended. Mixed methods studies can be quality assessed using this tool with the quantitative component of the study.

### A) SELECTION BIAS

(Q1) Participants are more likely to be representative of the target population if they are randomly selected from a comprehensive list of individuals in the target population (score very likely). They may not be representative if they are referred from a source (e.g. clinic) in a systematic manner (score somewhat likely) or self-referred (score not likely).

(Q2) Refers to the % of subjects in the control and intervention groups that agreed to participate in the study before they were assigned to intervention or control groups.

### B) STUDY DESIGN

In this section, raters assess the likelihood of bias due to the allocation process in an experimental study. For observational studies, raters assess the extent that assessments of exposure and outcome are likely to be independent. Generally, the type of design is a good indicator of the extent of bias. In stronger designs, an equivalent control group is present and the allocation process is such that the investigators are unable to predict the sequence.

#### Randomized Controlled Trial (RCT)

An experimental design where investigators randomly allocate eligible people to an intervention or control group. A rater should describe a study as an RCT if the randomization sequence allows each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. If the investigators do not describe the allocation process and only use the words 'random' or 'randomly', the study is described as a controlled clinical trial.

See below for more details.

*Was the study described as randomized?*

Score YES, if the authors used words such as random allocation, randomly assigned, and random assignment.

Score NO, if no mention of randomization is made.

*Was the method of randomization described?*

Score YES, if the authors describe any method used to generate a random allocation sequence.

Score NO, if the authors do not describe the allocation method or describe methods of allocation such as alternation, case record numbers, dates of birth, day of the week, and any allocation procedure that is entirely transparent before assignment, such as an open list of random numbers of assignments.

If NO is scored, then the study is a controlled clinical trial.

## Appendix C. (Continued)

### *Was the method appropriate?*

Score YES, if the randomization sequence allowed each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. Examples of appropriate approaches include assignment of subjects by a central office unaware of subject characteristics, or sequentially numbered, sealed, opaque envelopes.

Score NO, if the randomization sequence is open to the individuals responsible for recruiting and allocating participants or providing the intervention, since those individuals can influence the allocation process, either knowingly or unknowingly.

If NO is scored, then the study is a controlled clinical trial.

### Controlled Clinical Trial (CCT)

An experimental study design where the method of allocating study subjects to intervention or control groups is open to individuals responsible for recruiting subjects or providing the intervention. The method of allocation is transparent before assignment, e.g. an open list of random numbers or allocation by date of birth, etc.

### Cohort analytic (two group pre and post)

An observational study design where groups are assembled according to whether or not exposure to the intervention has occurred. Exposure to the intervention is not under the control of the investigators. Study groups might be non-equivalent or not comparable on some feature that affects outcome.

### Case control study

A retrospective study design where the investigators gather 'cases' of people who already have the outcome of interest and 'controls' who do not. Both groups are then questioned or their records examined about whether they received the intervention exposure of interest.

### Cohort (one group pre + post (before and after))

The same group is pretested, given an intervention, and tested immediately after the intervention. The intervention group, by means of the pretest, act as their own control group.

### Interrupted time series

A study that uses observations at multiple time points before and after an intervention (the 'interruption'). The design attempts to detect whether the intervention has had an effect significantly greater than any underlying trend over time. Exclusion: Studies that do not have a clearly defined point in time when the intervention occurred and at least three data points before and three after the intervention

### Other:

One time surveys or interviews

## C) CONFOUNDERS

By definition, a confounder is a variable that is associated with the intervention or exposure and causally related to the outcome of interest. Even in a robust study design, groups may not be balanced with respect to important variables prior to the intervention. The authors should indicate if confounders were controlled in the design (by stratification or matching) or in the analysis. If the allocation to intervention and control groups is randomized, the authors must report that the groups were balanced at baseline with respect to confounders (either in the text or a table).

## D) BLINDING

Not applicable as this criteria was removed from the quality assessment for the current review.

~~(Q1) Assessors should be described as blinded to which participants were in the control and intervention groups. The purpose of blinding the outcome assessors (who might also be the care providers) is to protect against detection bias.~~

~~(Q2) Study participants should not be aware of (i.e. blinded to) the research question. The purpose of blinding the participants is to protect against reporting bias.~~



## Appendix C. (Continued)

### E) DATA COLLECTION METHODS

Tools for primary outcome measures must be described as reliable and valid. If 'face' validity or 'content' validity has been demonstrated, this is acceptable. Some sources from which data may be collected are described below:

Self reported data includes data that is collected from participants in the study (e.g. completing a questionnaire, survey, answering questions during an interview, etc.).

Assessment/Screening includes objective data that is retrieved by the researchers. (e.g. observations by investigators).

Medical Records/Vital Statistics refers to the types of formal records used for the extraction of the data.

**Reliability and validity can be reported in the study or in a separate study. For example, some standard assessment tools have known reliability and validity.**

### F) WITHDRAWALS AND DROP-OUTS

Score **YES** if the authors describe BOTH the numbers and reasons for withdrawals and drop-outs.

Score **NO** if either the numbers or reasons for withdrawals and drop-outs are not reported.

Score **NOT APPLICABLE** if the study was a one-time interview or survey where there was not follow-up data reported.

The percentage of participants completing the study refers to the % of subjects remaining in the study at the final data collection period in all groups (i.e. control and intervention groups).

### G) INTERVENTION INTEGRITY

Not applicable as this criteria was removed from the quality assessment for the current review.

The number of participants receiving the intended intervention should be noted (consider both frequency and intensity). For example, the authors may have reported that at least 80 percent of the participants received the complete intervention. The authors should describe a method of measuring if the intervention was provided to all participants the same way. As well, the authors should indicate if subjects received an unintended intervention that may have influenced the outcomes. For example, co-intervention occurs when the study group receives an additional intervention (other than that intended). In this case, it is possible that the effect of the intervention may be over-estimated. Contamination refers to situations where the control group accidentally receives the study intervention. This could result in an under-estimation of the impact of the intervention.

### H) ANALYSIS APPROPRIATE TO QUESTION

Not applicable as this criteria was removed from the quality assessment for the current review.

Was the quantitative analysis appropriate to the research question being asked?

An intention to treat analysis is one in which all the participants in a trial are analyzed according to the intervention to which they were allocated, whether they received it or not. Intention to treat analyses are favoured in assessments of effectiveness as they mirror the noncompliance and treatment changes that are likely to occur when the intervention is used in practice, and because of the risk of attrition bias when participants are excluded from the analysis.

## Appendix C. (Continued)

### Component Ratings of Study:

For each of the six components A – F, use the following descriptions as a roadmap.

#### A) SELECTION BIAS

**Good:** The selected individuals are very likely to be representative of the target population (Q1 is 1) and there is greater than 80% participation (Q2 is 1).

**Fair:** The selected individuals are at least somewhat likely to be representative of the target population (Q1 is 1 or 2); and there is 60 - 79% participation (Q2 is 2). 'Moderate' may also be assigned if Q1 is 1 or 2 and Q2 is 5 (can't tell).

**Poor:** The selected individuals are not likely to be representative of the target population (Q1 is 3); or there is less than 60% participation (Q2 is 3) or selection is not described (Q1 is 4); and the level of participation is not described (Q2 is 5).

#### B) DESIGN

**Good:** will be assigned to those articles that described RCTs and CCTs.

**Fair:** will be assigned to those that described a cohort analytic study, a case control study, a cohort design, or an interrupted time series.

**Weak:** will be assigned to those that used any other method or did not state the method used.

#### C) CONFOUNDERS

**Good:** will be assigned to those articles that controlled for at least 80% of relevant confounders (Q1 is 2); or (Q2 is 1).

**Fair:** will be given to those studies that controlled for 60 – 79% of relevant confounders (Q1 is 1) and (Q2 is 2).

**Poor:** will be assigned when less than 60% of relevant confounders were controlled (Q1 is 1) and (Q2 is 3) or control of confounders was not described (Q1 is 3) and (Q2 is 4).

Not applicable as this criteria was removed from the quality assessment for the current review.

#### D) BLINDING

**Good:** The outcome assessor is not aware of the intervention status of participants (Q1 is 2); and the study participants are not aware of the research question (Q2 is 2).

**Fair:** The outcome assessor is not aware of the intervention status of participants (Q1 is 2); or the study participants are not aware of the research question (Q2 is 2).

**Poor:** The outcome assessor is aware of the intervention status of participants (Q1 is 1); and the study participants are aware of the research question (Q2 is 1); or blinding is not described (Q1 is 3 and Q2 is 3).

#### E) DATA COLLECTION METHODS

**Good:** The data collection tools have been shown to be valid (Q1 is 1); and the data collection tools have been shown to be reliable (Q2 is 1).

**Fair:** The data collection tools have been shown to be valid (Q1 is 1); and the data collection tools have not been shown to be reliable (Q2 is 2) or reliability is not described (Q2 is 3).

**Poor:** The data collection tools have not been shown to be valid (Q1 is 2) or both reliability and validity are not described (Q1 is 3 and Q2 is 3).

#### F) WITHDRAWALS AND DROP-OUTS - a rating of:

**Good:** will be assigned when the follow-up rate is 80% or greater (Q1 is 1 and Q2 is 1).

**Fair:** will be assigned when the follow-up rate is 60 – 79% (Q2 is 2) OR Q1 is 4 or Q2 is 5.

**Poor:** will be assigned when a follow-up rate is less than 60% (Q2 is 3) or if the withdrawals and drop-outs were not described (Q1 is No or Q2 is 4).

**Not Applicable:** if Q1 is 4 or Q2 is 5.

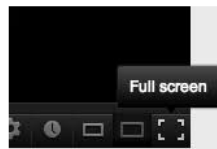
## Appendix D.

### VR Instructions – Smartphone/Tablet

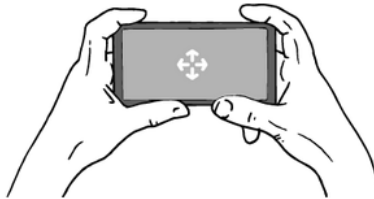
#### **VR Dementia Simulation**

Please follow these instructions to launch the video on your smart-phone/tablet device.

1. Plug your earphones in to your device and turn the volume up. Alternatively, ensure you are in a quiet environment with your volume turned up so you can hear the sound.
2. To ensure the video opens within the YouTube app, when you click on the link below hold your finger down until a menu of options pops up. Select the open in YouTube app option.
3. When the video opens, enable full screen mode. You can do this by clicking on the full screen icon in the right hand corner of the screen or by turning your device horizontally.



4. Whilst playing the VR simulation, move your device around to explore 360 degrees of the video.



**If the video does not work correctly the first time or you cannot hear it, just replay it. You are only required to watch one video ('A Walk through dementia - walking home'). Once you have finished watching it, return to this page and press to continue.**

**[6. Click and hold here to launch the VR simulation in the YouTube app.](#)**

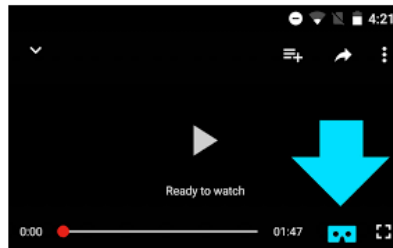
## Appendix D. (continued)

### VR instructions – Smartphone/Tablet with VR Headset

#### VR Dementia Simulation

Please follow these instructions to launch the video on your smart-phone/tablet device and use your VR headset.

1. Plug your earphones in to your device and turn the volume up. Alternatively, ensure you are in a quiet environment with your volume turned up so you can hear the sound.
2. To ensure the video opens within the YouTube app, when you click on the link below hold your finger down until a menu of options pops up. Select the **open in YouTube** app option.
3. Once the video is open, ensure you enable VR mode by clicking on the VR icon in the bottom right hand corner of the video screen and turn your phone horizontally.



4. Next, place your phone into the VR headset as per your manufacturer's instructions and play the video.



If the video does not work correctly the first time or you cannot hear it, just replay it. You are only required to watch one video ('A Walk through dementia - walking home'). Once you have finished watching it, return to this page and press to continue.

[5. Click and hold here to launch the VR simulation in the YouTube app.](#)



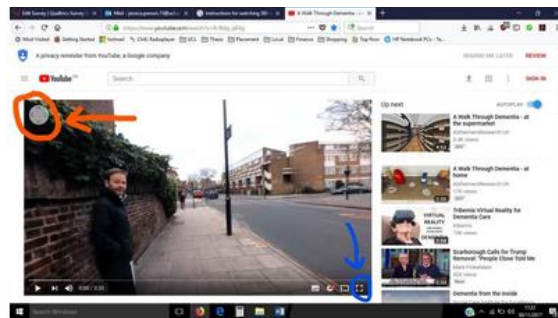
## Appendix D. (continued)

### VR instructions – Laptop/Computer

#### Dementia Simulation Video

Please follow read these instructions before playing the simulation video below.

1. Plug your headphones or earphones in to your laptop/computer. Alternatively ensure you are in a quiet environment with the volume turned up.
2. When you watch the video, enable full-screen mode by clicking on the icon in the bottom right hand corner of the video screen (marked in blue on the image below).
3. Whilst playing the video, enable 360-degree navigation by clicking on the icon in the top left-hand corner of the video screen (marked in orange in the image below). This will allow you to explore all 360 degrees of the video by clicking and dragging your mouse button around to alter your view.



4. Press play on the video below to begin.

If you have any trouble hearing the video or it does not work correctly the first time, just replay it. Once you have watched the video successfully press the escape button on your keyboard (Esc) to return to



Example Recruitment Advertisement

**PARTICIPATE IN A UCL RESEARCH STUDY:  
Simulating dementia with a virtual reality app**



**This is an online study investigating people's experience of a brief dementia simulation using a virtual reality app.**

We are interested in people's attitudes towards dementia and towards providing support for people with dementia. Participants will be asked to complete an online survey (10-15 minutes) and to experience a brief virtual reality dementia simulation (5 minutes) via their smart-phone/tablet. You do not need to know anyone with dementia to take part. We will make a small donation to Alzheimer's Research UK on behalf of every participant.

**Requirements**

- Aged 18+ years
- English speaking
- Access to the internet via a smart-phone/tablet device
- Access to the YouTube app (free to download if you don't have it installed)
- No uncorrected visual or auditory impairments
- No diagnosis of dementia, Alzheimer's disease or Mild Cognitive Impairment
- Never referred to, or attended, a memory clinic for investigation of memory or thinking problems

**Ethical approval:** This study has been approved by the UCL Clinical, Educational and Health Psychology Research Department's Ethics Chair (CEHP\_2015\_529).

**Investigators:** Jessica Parson and Dr Georgina Charlesworth. For more information please feel free to contact [Jessica.parson.15@ucl.ac.uk](mailto:Jessica.parson.15@ucl.ac.uk)

To take part, scan the QR code with your phone/tablet camera:

OR copy the link below into your phone/tablet browser:

[https://uclpsych.eu.qualtrics.com/jfe/form/SV\\_bJ8oqc2YvwZCE2p](https://uclpsych.eu.qualtrics.com/jfe/form/SV_bJ8oqc2YvwZCE2p)

Please take one:

Appendix F.  
Study Information Pages

UCL Psychology and Language Sciences



Study Information

**Title of Project: 'Simulating Dementia with a Virtual Reality App'**

**Investigators: Jessica Parson and Dr Georgina Charlesworth.**  
**UCL, Gower Street, London, WC1E 7HB +44 (0)20 7679 2000**

We would like to invite you to participate in this research project directed by researchers at UCL. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. If you decide to take part in this study, you have the right to withdraw at any point (simply close your browser) without giving a reason. Before you decide if you would like to take part, it is important for you to read the following information carefully.

Continue

UCL Psychology and Language Sciences



Study Information

In this study, we are investigating the how adults (aged 18 years and over) experience a virtual reality (VR) dementia simulation. The VR video gives you a chance to view the world from the perspective of a person living with dementia. The study is conducted entirely online and involves two tasks:

1. Completing a series of questionnaires about your experiences of and attitudes towards dementia and ageing (10- 15 minutes).
2. Watching a brief VR video that simulates some of the symptoms of dementia (5 minutes).

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Continue

Appendix F.  
Study Information Pages (continued)

UCL Psychology and Language Sciences



Study Information

**It is highly recommended that you complete the tasks on a smart-phone or tablet device.  
Please re-start this survey on a smart-phone or tablet if you have access to one and are not currently using it.**

You will need to remain connected to the internet for the duration of the tasks. This is approximately 20 minutes.



During the VR tasks you will be instructed to use the following items to enhance your VR experience:

**A smart-phone or tablet device with the YouTube app installed on it**  
(Download instructions will be provided if you do not already have the app)



**A pair of headphones/earphones**



**OPTIONAL: A VR headset**

(You can still experience 360-degree VR without a headset)



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Continue

Appendix F.  
Study Information Pages (continued)

UCL Psychology and Language Sciences



Study Information

We will not be asking you for any personal identification information or contact details. However, please be aware that the data collection platform that we use has some of its servers outside the European Economic Area, in the USA, and your mobile devices (smart-phone, tablet) may be automatically providing information such as GPS location. We do not seek, and will not be retaining or using, such 'embedded' data.

All data will be handled according to the Data Protection Act 1998 which means that the information that you give us will only be used for the purposes of the stated research. **All data will be kept confidential and anonymous.** We will not be retaining or storing embedded data. Only members of the research team will be able to access the data collected, and we will not transfer data outside of the UCL research team. The study results will be pooled data with no information traceable to any individual.

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Appendix G.  
Informed Consent Questionnaire

UCL Psychology and Language Sciences



Consent

You will now be asked some questions about your consent to take part in this research. Please read each question carefully.

I understand that my data will be held anonymously and as such, my responses cannot be traced back to me individually.

Yes

No

I understand that I am free to withdraw from the study without penalty if I so wish, simply by closing my browser.

Yes

No

Would you like to participate in this research study?

Yes

No

Appendix H.  
Eligibility Checklist

UCL Psychology and Language Sciences



**Participant eligibility criteria**

Please answer the following questions to ensure you are eligible to take part in this research.

To participate in this research you must be over the age of 18. Please confirm your age.

I am over 18 years of age

I am under 18 years of age

As this research involves briefly simulating symptoms of dementia, participants must not have a diagnosis of dementia, Alzheimer's disease (AD) or Mild Cognitive Impairment (MCI) or have been referred to a memory clinic for cognitive difficulties. Please select the response that applies to you.

I do not have a diagnosis of dementia, AD or MCI and have never been referred to a memory clinic

I have a diagnosis of dementia, AD, MCI or have been referred to a memory clinic

For the purpose of this research it is necessary that you can see and hear the VR video (the selected video does not have sufficient subtitles).

I will be able to see and hear the video

I will not be able to see or hear the video

## Appendix I.

### Debrief

**Thank you for taking part in this research. A small donation has been made on your behalf to Alzheimer's Research UK. We hope to donate up to £200 in total.**

The aim of our study is to learn about people's experience of a virtual reality (VR) dementia simulation and attitudes towards dementia. VR and simulation technologies have become increasingly popular methods of training healthcare staff to improve their care of different patient groups. There are mixed research findings about how people experience VR and simulation training. For example, some studies show positive effects such as improved empathy and compassion towards patients, others indicate potential issues such as increased anxiety about conditions. We are seeking to better understand the relationship between VR simulated dementia experiences and attitudes towards dementia.

The VR video used in this research was taken from an app created by Alzheimer's Research UK in collaboration with people living with dementia. You can find out more about the app and download it by visiting <http://www.awalkthroughdementia.org/>

The following information was created by Alzheimer's Research UK to accompany the VR film 'On the Road':

- Busy streets and noisy crowds can be overwhelming for someone with dementia, full of unfamiliar places and people.
- Getting lost is common. Sometimes people don't recognise where they are or how they got there, other times people struggle to find the right route.
- Failing to recognise people you know can be an embarrassing and heart-breaking experience for someone with dementia. Sadly, this happens more often as diseases like Alzheimer's progress.
- Was it a puddle or a hole? The brain can play tricks on us all sometimes, but these misperceptions are more common for someone with dementia. Shiny floors can look wet; puddles can be mistaken for holes.

If you would like to know more about dementia or Alzheimer's disease, information is available from family doctors, NHS Choices ([www.nhs.uk/Conditions/dementia-guide/Pages/about-dementia.aspx](http://www.nhs.uk/Conditions/dementia-guide/Pages/about-dementia.aspx)), or organisations such as the Alzheimer's Society ([www.alzheimers.org.uk](http://www.alzheimers.org.uk)) and Dementia UK ([www.dementiauk.org](http://www.dementiauk.org)). The Department of Health's 'Dementia Challenge' website (<http://dementiachallenge.dh.gov.uk/>) includes links to initiatives to help people live well with dementia.



Appendix J.  
Feasibility Questionnaire

**Your simulation experience**

Please answer the following questions about the VR video

Were you able to watch the video?

Yes

No

Did you encounter any technical difficulties?

Yes

No

Please briefly describe the technical difficulties you encountered.

Whilst watching the VR video, which person did you relate to most?

The mother

The son

Please indicate how compassionate you feel towards people with dementia by sliding the bar to the most representative place on the line below.

Not at all compassionate  
0

Very compassionate  
10

How compassionate do you feel towards people with dementia right now?



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# Appendix K.

## Battery of Self-Report Measures - Willingness to Care Scale (WTCS)

Caring for people with dementia	
As you read the statements below, think about a person with <b>dementia</b> who is in need of care.	
FIRST, tick each of the tasks <b>you feel able</b> to do for the person with dementia. Being <i>able</i> to perform a task means that you believe you <i>could do it</i> if necessary.	
SECOND, reread the items, and circle the number which best shows <b>how willing you are</b> to do each one. Being <i>willing</i> to perform a task means that you feel you <i>would do it</i> if it had to be done.	
1 = completely unwilling 2 = somewhat unwilling 3 = not sure 4 = somewhat willing 5 = completely willing.	
	ABLE?    HOW WILLING?
1. Listen to someone who is sad.	<input type="checkbox"/> 1 2 3 4 5
2. Comfort someone who is upset.	<input type="checkbox"/> 1 2 3 4 5
3. Help someone deal with anxiety about the future.	<input type="checkbox"/> 1 2 3 4 5
4. Hold hands with someone who is afraid.	<input type="checkbox"/> 1 2 3 4 5
5. Encourage someone who feels hopeless.	<input type="checkbox"/> 1 2 3 4 5
6. Listen to someone's concerns about death or dying.	<input type="checkbox"/> 1 2 3 4 5
7. Help someone keep their spirits up.	<input type="checkbox"/> 1 2 3 4 5
8. Hold someone who is crying.	<input type="checkbox"/> 1 2 3 4 5
9. Listen to someone who is angry.	<input type="checkbox"/> 1 2 3 4 5
10. Be patient with someone who is disoriented or confused.	<input type="checkbox"/> 1 2 3 4 5
11. Take someone to a medical appointment.	<input type="checkbox"/> 1 2 3 4 5
12. Bring home groceries for someone.	<input type="checkbox"/> 1 2 3 4 5
13. Help pay for someone's medicine.	<input type="checkbox"/> 1 2 3 4 5
14. Prepare meals for someone.	<input type="checkbox"/> 1 2 3 4 5
15. Clean someone's room or home.	<input type="checkbox"/> 1 2 3 4 5
16. Wash someone's dishes.	<input type="checkbox"/> 1 2 3 4 5
17. Do someone's laundry.	<input type="checkbox"/> 1 2 3 4 5
18. Help pay for someone's food or housing.	<input type="checkbox"/> 1 2 3 4 5
19. Have someone live in your home.	<input type="checkbox"/> 1 2 3 4 5
20. Negotiate someone's health care options with a doctor.	<input type="checkbox"/> 1 2 3 4 5
21. Help someone take medicine.	<input type="checkbox"/> 1 2 3 4 5
22. Change dirty bed sheets.	<input type="checkbox"/> 1 2 3 4 5

Appendix K. (Continued)

Battery of Self-Report Measures – WTCS (continued)

**1 = completely unwilling 2 = somewhat unwilling 3 = not sure 4 = somewhat willing 5 = completely willing.**

---

	ABLE?	HOW WILLING?
23. Help someone take a bath.	<input type="checkbox"/>	1 2 3 4 5
24. Clean up after someone who has lost bowel or bladder control.	<input type="checkbox"/>	1 2 3 4 5
25. Help someone eat a meal.	<input type="checkbox"/>	1 2 3 4 5
26. Clean up when someone has thrown up.	<input type="checkbox"/>	1 2 3 4 5
27. Turn someone in bed.	<input type="checkbox"/>	1 2 3 4 5
28. Change dressings on someone's sores.	<input type="checkbox"/>	1 2 3 4 5
29. Help someone in the bathroom.	<input type="checkbox"/>	1 2 3 4 5
30. Help someone move in and out of bed.	<input type="checkbox"/>	1 2 3 4 5

Dementia Worry Scale (DWS)

**How you feel about dementia**

*Please tick the box that most represents how you feel on the scale of 1 to 4*

	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
1. How concerned are you about developing dementia?	Not at all			Very much
2. How often do you worry about developing dementia?	Never concerned			Always concerned
3. Sometimes, for instance when I repeatedly forget things during the day, I am worried that I might develop dementia.	Strongly disagree			Strongly agree
4. When I notice that I have trouble remembering things, I am afraid this might be the first step toward dementia.	Strongly disagree			Strongly agree
5. I find it annoying when I forget something; it makes me afraid of becoming demented.	Strongly disagree			Strongly agree
6. When I think about developing dementia, I feel nervous.	Strongly disagree			Strongly agree

### Battery of Self-Report Measures – DWS (continued)

7. When I think about developing dementia, I feel agitated.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
	Strongly disagree			Strongly agree
8. When I think about developing dementia, I feel anxious.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
	Strongly disagree			Strongly agree
9. When I think about developing dementia, I feel tense.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
	Strongly disagree			Strongly agree
10. When I think about developing dementia, I get insecure.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4
	Strongly disagree			Strongly agree

How you feel about ageing

*How much do you agree or disagree with each statement? Please select the number between 1 and 5 that most represents how you feel about each statement.*

1. I enjoy being around old people.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
2. I like to go visit my older relatives.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
3. I enjoy talking with old people				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
4. I feel very comfortable when I am around an old person.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
5. I enjoy doing things for old people.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	

Appendix. K (Continued)

Battery of Self-Report Measures – AAS (continued)

<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
6. I fear it will be very hard for me to find contentment in old age.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
7. I will have plenty to occupy my time when I am old.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
8. I expect to feel good about life when I am old.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
9. I believe that I will still be able to do most things for myself when I am old.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
10. I expect to feel good about myself when I am old.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
11. I have never lied about my age in order to appear younger.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
12. It doesn't bother me at all to imagine myself as being old.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
13. I have never dreaded the day I would look in the mirror and see grey hairs.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
14. I have never dreaded looking old.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		
<hr/>				
15. When I look in the mirror, it bothers me to see how my looks have changed with age.				
<hr/>				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree		Strongly Disagree		

# Appendix. K (Continued)

## Battery of Self-Report Measures – AAS (continued)

16. I fear that when I am old all my friends will be gone.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
17. The older I become, the more I worry about my health.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
18. I get nervous when I think about someone else making decisions for me				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
19. I worry that people will ignore me when I am old.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	
20. I am afraid that there will be no meaning in life when I am old.				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Strongly agree			Strongly Disagree	

## Generalised Anxiety Disorder Scale (GAD-7)

Anxiety				
Over the last 2 weeks, how often have you been bothered by the following problems? Circle the number that most represents how you have felt in the past two weeks.				
	Not at all	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

Appendix L.  
Demographic Questions

<u>Demographic Questions</u>	
<b>Which gender do you identify with?</b>	
Male	
Female	
Neither	
Prefer not to say	
<b>How old are you?</b>	
Under 30 years	
31- 45 years	
46 – 65 years	
66 – 80 years	
Over 80 years	
Prefer not to say	
<b>What is your ethnicity?</b>	
White	
	British
	Irish
	Any other White background
Mixed	
	White and Black Caribbean
	White and Black African
	White and Asian
	Any other mixed background
Asian or Asian British	
	Indian
	Pakistani
	Bangladeshi
	Any other Asian background
Black or Black British	
	Caribbean
	African
	Any other Black background
Other Ethnic Groups	
	Chinese
	Any other ethnic group
Prefer not to say	





# Appendix M.

## Review of VR Technical Difficulties Experienced by Participants

Case	VR	Participant description of technical difficulty	Device	Problem*	Immersive?	RQ 1	RQ 2.
<i>Control Participants</i>							
10	Yes	Had to launch from YouTube to get VR	VR Headset	2	Yes	In	N/A
18	Yes	Not sure if it played to end	Phone	4	Yes	Ex <sup>a</sup>	N/A
27	No	Video did not play	Phone	5	No	Ex <sup>b</sup>	N/A
28	Yes	After the video I wasn't taken back to the survey	Phone	6	Yes	In	N/A
51	No	Video did not show	Phone	5	No	Ex <sup>b</sup>	N/A
111	Yes	Blurry	Phone	1	No	Ex <sup>c</sup>	N/A
156	Yes	video pixelated and froze at one point	Computer	1	No	Ex <sup>c</sup>	N/A
175	Yes	Video had to be restarted	Phone	3	Yes	In	N/A
<i>VRDS Participants</i>							
3	Yes	At points didn't load properly so was a bit stop and start	Computer	1	No	Ex <sup>c</sup>	Ex <sup>c</sup>
11	Yes	Video paused. I relaunched it	Phone	3	Yes	In	In
26	Yes	Kept going on to extra videos, how many was I meant to watch?	Phone	4	Yes	Ex <sup>a</sup>	Ex <sup>a</sup>
59	Yes	When I held down on the link it would not at first	Phone	2	Yes	In	In
61	No	Didn't open	Phone	5	No	Ex <sup>b</sup>	Ex <sup>b</sup>
76	Yes	Video stopped half way through, had to restart	Phone	3	Yes	In	In
77	No	Did not load	Phone	5	No	Ex <sup>b</sup>	Ex <sup>b</sup>
88	Yes	360 experience was not supported	Phone	1	No	Ex <sup>c</sup>	N/A
113	Yes	I found it hard to return to the questionnaire	Phone	6	Yes	In	In
130	Yes	The video was a bit shaky at first but quickly settled down	Phone	1	Yes	In	In
145	Yes	No	Phone	n/a	No	Ex <sup>c</sup>	Ex <sup>c</sup>
157	Yes	Slow image and blurry screen	Computer	1	No	Ex <sup>c</sup>	Ex <sup>c</sup>
176	Yes	difficulty exiting You Tube	Phone	6	Yes	In	In
261	No	It didn't play. Just skipped to next page	Phone	5	No	Ex <sup>b</sup>	Ex <sup>b</sup>
<b>TOTALS:</b>						<b>= 13</b>	<b>= 8</b>

Note. In = include in analysis, Ex = exclude from analysis. Exclusion reasons: <sup>a</sup>= other exposure problem; <sup>b</sup>=No VR at all, <sup>c</sup>=Not immersive VR.

*Key	Problem category	N
1	Poor quality visuals	6
2	Difficulty launching the VR	2
3	Restart required	3
4	False exposure	2
5	NO VR	5
6	Exit difficulty	4