

**Speaking to one's younger self - A Virtual Reality Assisted Intervention for
Self- Compassion: A Quantitative Study**

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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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Date: 14.06.2024

Overview

Part 1: Systematic review. A systematic review exploring the efficacy of the integration of virtual reality technology in mental health and specifically for the improvement of self-esteem. A search of multiple scientific databases was conducted based on inclusion and exclusion criteria set prior to the search. The results were screened for their appropriateness for this systematic review. The eleven papers that met the inclusion criteria and were deemed relevant were assessed for their quality. The findings of the included studies are detailed, and conclusions based on those results are drawn regarding the effectiveness of virtual reality assisted interventions on the amelioration of self-esteem. The systematic review found that virtual reality assisted interventions can be beneficial in improving self-esteem.

Part 2: Empirical paper. A research study exploring the effectiveness of a virtual reality paradigm based on embodiment of personalised digital avatars (adult and child) on the enhancement of self-compassion and the reduction of self-criticism. The findings of this study show that following the virtual reality assisted intervention participants experienced improvements in self-compassion and positive affect, as well as a decrease in their self-criticism. This was a joint project with George Grigorakis, who interviewed participants following the virtual reality assisted intervention to explore their experience for his qualitative research project, *Nurturing Self-Compassion: Exploring Interactions with One's Child-Self in Virtual Reality*.

Part 3: Critical appraisal. A critical appraisal and reflection on the process of conducting the study described in the empirical paper. The considerations made for methodological decisions are discussed. The experience of participants is considered as well as the theoretical concepts that might aid the understanding of this experience. Lastly, the limitations of the study are expanded on.

Impact statement

Academic. This study contributes to the growing evidence on the efficacy of incorporating virtual reality technology in interventions aiming to improve self-compassion. The findings of this study confirm previously observed effects of improved self-compassion and reduced self-criticism for a non-clinical sample of participants following a virtual reality assisted intervention. Further, this study shows that this virtual reality protocol can induce positive changes in mood and reduce self-criticism.

This study investigated whether a virtual reality paradigm of speaking to one's younger self could produce positive changes in self-compassion and reductions in self-criticism. Further, it explored whether the use of personalised avatars (created to resemble the participants at a younger age) would affect the observed effects experienced by participants following the virtual reality assisted intervention compared to avatars that were generic-looking. The findings of this study did not find a significant difference between engaging with an individualized child avatar and a generic-looking child avatar. These results could be helpful in informing future research, which could focus on either adapting this study's protocol or developing avatars that participants would perceive as resembling them more than those created for the purposes of this study.

Lastly, this study attempted to explain the effects observed following the virtual reality assisted intervention. This study discussed the potential effect that systems theorised in Compassion Focused Therapy, such as the soothing system, might have had in explaining the results of this study. Moreover, phenomena such as the proteus effect, uncanny valley, and the avatar's perceived qualities were explored to provide possible explanations for the non-significant differences found between the two participant groups.

Clinical. Evidence exists which suggests that self-compassion is associated with positive affect and well-being, while self-criticism is associated with depression and anxiety. Thus, the promising findings of this study relating to increased self-compassion and reduced self-criticism have clinical implications regarding the use of the virtual reality paradigm to improve mental health. Further, considering the challenges in using imagery techniques therapeutically, the virtual reality assisted intervention investigated in this study provides a promising alternative for those individuals who struggle with creating images in their minds. Moreover, some individuals from clinical populations might struggle with accessing self-compassion due to increased self-criticism and distressing memories that might be evoked during the process. Therefore, adapted virtual reality assisted interventions can be employed as a tool to facilitate scaffolding towards engaging with interventions aimed at improving self-compassion.”.

Public health. This study’s sample consisted of individuals from the general public, who were not experiencing mental health difficulties. The findings of this study showed that healthy individuals may also struggle with self-compassion and self-criticism. Encouragingly, this virtual reality assisted intervention was found to be beneficial in increasing self-compassion and reducing self-criticism. This is important as there is a growing interest in self-help as well as in the use of new technologies to improve well-being. As virtual reality technology is becoming more accessible findings such as these of this study can provide the public with alternative ways to engage with self-care using available technology.

Table of Contents

Thesis declaration.....	2
Overview	3
Impact statement	4
Acknowledgements	11
Part One: Systematic Review and Meta-Synthesis	12
Abstract	13
1. Introduction.....	14
1.1 Virtual reality technology	14
1.2 Virtual reality applications for mental health	15
1.3 Self-esteem.....	16
1.4 Psychometric tools for self-esteem	17
1.5 Development of trait self-esteem	18
1.6 Virtual reality applications for improved self-esteem	19
2. Methods.....	20
2.1 Information sources	20
2.2 Search strategy	20
2.3 Eligibility criteria:	21
2.4 Selection Procedure	21
2.5 Data collection and analysis.....	22
2.6 Quality Assessment and Risk of Bias	24

3.	Results.....	25
3.1	Study design and risk of bias	42
3.2	Participants and VR type	46
3.3	Description of reviewed studies	46
3.4	Self-esteem targeted VR studies	48
3.5	VR studies not specifically targeting self-esteem.....	51
4.	Discussion.....	55
4.1	Effectiveness of VR-assisted interventions on improving self-esteem.....	56
4.2	Effect of type of VR and intervention.....	58
4.3	Effect of sample size	59
5.	Conclusions.....	60
6.	Limitations	61
	References	62
	Part 2: Empirical Paper	71
	Abstract	72
1.	Introduction.....	74
1.1	Self-compassion and self-criticism	74
1.2	Theoretical underpinnings	75
1.3	Psychological interventions for increased self-compassion	77
1.4	Virtual reality integration with mental health support.....	78
1.5	Study's objectives and hypotheses.....	80

2.	Methods.....	82
2.1	Participants and experimental design.....	82
2.2	Outcome Measures.....	84
2.3	Virtual Reality Equipment and Environment	86
2.4	Ethics Statement.....	87
2.5	Procedure and materials	87
2.6	Planned analyses	92
3.	Results.....	92
3.1	Baseline differences between groups.....	92
3.2	Analyses of outcome measures	93
3.3	Self-compassion.....	95
3.4	Self-criticism.....	96
3.5	Fear of self-compassion	97
3.6	Positive affect.....	97
3.7	Negative affect	98
4.	Discussion.....	99
4.1	Key Findings	99
4.2	Contributions to existing research	100
4.3	Exploration of the observed effects	101
4.4	Conclusions and implications for future research.....	105
4.5	Limitations	107

References	108
Part 3: Critical Appraisal	118
1. Introduction.....	119
2. Virtual reality protocol and study design development	119
3. Avatar creation software and process.....	122
4. Participant recruitment and personalising avatars	123
5. Experimental process	125
6. Participants' Experience.....	126
7. Conclusions.....	128
References	130
Appendices:.....	132
Appendix A: Ethical Approval	132
Appendix B: Participant information sheet	134
Appendix C: Study Registration & Consent Form	137
Appendix D: Study recruitment poster	141
Appendix E: Post-Intervention Support and information Sheet.....	142
Appendix F: Outcome measures Qualtrics form	143
Appendix G: Joint project acknowledgement	160

Part 1:

Table 1. Search records breakdown	26
Figure 1. PRISMA flow diagram... ..	27
Table 2. Summary of variables extracted from reviewed studies and risk of bias rating	28
Table 3. Risk of bias for random controlled trials (ROB-2)	43
Table 4. Risk of bias for non-randomised controlled trials (ROBINS-I).....	45
Table 5. Summary of studies utilising VR-assisted therapeutic interventions & non- therapeutic VR interventions.....	47

Part 2:

Table 1. Demographic characteristics	84
Figure 1. Virtual environment and embodying adult avatar	91
Table 2. Mean and standard deviation of dependent variables pre VR-intervention and post VR-intervention for participants in each condition	94

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Part One: Systematic Review and Meta-Synthesis

“Exploring the effect of Virtual Reality Assisted interventions on Self-Esteem”

Abstract

Background: In recent years Virtual reality (VR) has been utilised in the treatment of mental health difficulties, which is a novel application of this technology and has been shown to have positive results. Self-esteem is a psychological construct that has been explored in research as it has been found to be a predictive factor in the development of mental health difficulties such as depression and anxiety. This systematic review set out to explore the evidence base on the use of VR in scientific protocols developed to improve self-esteem.

Methods: A search of titles and abstracts was conducted on several databases (Psycinfo, Medline, Embase) on the 26th of July 2023. results of this search were reviewed against pre-set inclusion criteria: empirical study, quantitative study, completed study, written in English, access to full text, including a VR-assisted intervention, outcome measure of Self-esteem, pre-post intervention findings on self-esteem measure reported, adult participants.

Results: 11 studies met the inclusion criteria (6 randomised control trials, 2 quasi-experimental studies, 3 within-subjects studies) with a total of 418 participants. Results suggested that VR could be a beneficial intervention type in increasing self-esteem.

Discussion: This systematic review supports the effectiveness of VR in improving self-esteem in part. Some of the studies reviewed were deemed to have increased risk of bias introduced. Further, due to small sample sizes, varied protocols and the use of different types of VR, it is difficult to ascertain which aspects of VR were beneficial. More research is needed in order to draw generalisable conclusions that would apply to both clinical and non-clinical populations.

1. Introduction

1.1 Virtual reality technology

Virtual reality (VR) is an umbrella term that refers to the use of various technologies in creating computer-generated, realistic, digital environments which users can interact with and manipulate (Zheng et al., 1998). One of the key characteristics of VR is that it allows immersion into virtual worlds that respond to users' actions in real time. As VR can be achieved with the use of different technologies, there are various types of VR (Anthes et al., 2016).

More specifically, there are immersive and non-immersive types of VR based on the type of equipment used to create and display digital environments (Li et al., 2017). For instance, immersive VR can be more easily achieved when using technologies that block out stimuli from the outside world (i.e. head-mounted displays). Alternately, more traditional equipment, such as a computer display, and a mouse and keyboard can also be used. This type of VR is often referred to as non-immersive. Although more difficult, immersion can also occur when using such technologies as users can still become absorbed in the virtual environment (Zheng et al., 1998). Further evidence from neuroscientific studies using brain neuroimaging technologies exists that suggests that many of the same brain regions that are active during engagement in immersive VR are also active during non-immersive (flat screen) VR (Doeller, King, Burgess, 2008).

Due to its ability to create virtual worlds that can resemble the real world, VR's applications, over the years, have become particularly wide (Wexelblat, 2014). VR's qualities render it useful in creating safe, non-stressful environments (Amado et al., 2016). Further, scenarios

developed in VR can be personalised and repeated as needed. These virtual environments can then be used to provide individuals with a space to learn, train and build new skills while monitoring progress (Huang et al., 2021). Another advantage of VR is that can eliminate some of the barriers to accessing an intervention/treatment (Rus-Calafell et al., 2018). More specifically, individuals can access environments and scenarios that might be otherwise inaccessible to them, without the need to physically be in a specific location. Moreover, these situations being virtual means that individuals can disengage from them at any point and actions performed in VR are less likely to be consequential in the real world.

As VR simulations can be designed and controlled to fit certain desirable standards with high ecological validity, which can be valuable both therapeutically and scientifically, this indicates a broad spectrum of clinical implications for VR technologies (Žilinský & Halamová, 2023). VR is currently being used in a plethora of industries, including education, architecture, medicine etc. (Javaid & Haleem, 2020). Notably, VR has shown promising results in the assessment and treatment of mental health difficulties (Freeman et al., 2017).

1.2 Virtual reality applications for mental health

There is evidence in the literature regarding VR being used to treat several mental health disorders. For instance, VR has been utilised as a means of providing exposure therapy and has been found to be effective for specific anxiety disorders, including social anxiety (Horigome et al., 2020), panic disorder and agoraphobia (Botella et al., 2007), as well as post-traumatic stress disorder (Gonçalves, 2012; Rizzo, 2009). Similarly, VR has been identified to be an effective treatment (or treatment enhancer) for depression and generalised anxiety disorder (Baghaei et al., 2021).

This is significant as depression and anxiety are among the most commonly diagnosed mental health difficulties around the world (WHO, 2017). Comorbidity between the two disorders is also particularly common as depressed individuals often experience anxiety symptoms (e.g. excessive worrying) and vice versa, anxious individuals can experience depressive symptoms such as anhedonia (Aina & Susman, 2006). One psychological characteristic that has been closely associated with and can be considered both a risk and a protective factor for depression and anxiety is self-esteem (Sowislo & Orth, 2013). Evidence shows that self-esteem, or rather low self-esteem, can act as a vulnerability trait for developing depression (Orth et al., 2009).

1.3 Self-esteem

Self-esteem is a psychological construct that can be defined as an individual's subjective view and evaluation of themselves in terms of their personal worth (Donnellan, Trzesniewski & Robins, 2011). Individuals who have positive evaluations of themselves as being worthy are classified as having high self-esteem and those who have negative views of their personal worth as having low self-esteem. Rosenberg et al. (1989) further extended this understanding of self-esteem by considering high self-esteem to also incorporate self-respect and self-acceptance, while low self-esteem indicates feelings of self-rejection and self-dissatisfaction.

Self-esteem can be categorised as global or domain-specific. Global self-esteem is conceptualised as an individual's view of their overall self-worth. Conversely, domain-specific self-esteem refers to the evaluation of self-worth in specific areas, such as career and academic achievements etc. (Donnellan et al., 2011).

1.4 Psychometric tools for self-esteem

Many attempts have been made to measure self-esteem over the years resulting in a diverse set of measures that aim to quantify self-esteem, including self-report and informant report measures, measures based on reaction times, puppet-based and picture measures for children etc. (Donnellan et al., 2011). The most widely used tool to measure self-esteem is the one developed by Rosenberg (1989), The Rosenberg Self-esteem scale.

The Rosenberg Self-esteem scale (RSE) is a self-report psychometric measure which comprises of ten different statements relating to self-esteem, some worded in a positive manner and others with negative wording (e.g., I feel that I'm a person of worth, at least on an equal plane with others; All in all, I am inclined to feel that I am a failure). Individuals are asked to rate each statement on the measure on a Likert scale based on how much they identify with the statements. High scores on the scale are indicative of high self-esteem and oppositely low scores indicate low self-esteem. As RSE has been used widely, much research has been undertaken to produce evidence of its psychometric qualities. Evidence shows that RSE has high levels of internal consistency, with the alpha coefficient exceeding .80 (Hagborg, 1993).

Other outcome measures that exist in the literature and have been used in research relevant to this review are the Self-Esteem Rating Scale (SERS), the Visual Analogue Self-Esteem Scale (VASES) and the Hudson Index of Self-Esteem (ISE). SERS is a measure with good validity and reliability that was developed as a more accessible tool to investigate global self-esteem in individuals experiencing severe mental health difficulties (Lecomte et al., 2006). Most of the existing measures of self-esteem relied on the individuals' ability to comprehend complex linguistic constructs. VASES, a valid and reliable non-verbal tool, was developed to fill the

gap in the measurement of self-esteem for individuals who might struggle with sophisticated use of language, both expressive and receptive (e.g. aphasic patients) (Brumfitt & Sheeran, 1999). Lastly, the ISE is a valid self-report measure, with high internal consistency. It has a high positive correlation to RSE (Nosek et al., 2016).

1.5 Development of trait self-esteem

Research on differences in self-esteem based on demographic characteristics has been conducted producing surprising evidence. It has been theorised that there would be gender differences in self-esteem (Hyde, 2005) with women and girls scoring lower on measures of self-esteem. However, empirical evidence does not support this idea, as only small differences have been found in favour of men (McCartney & Rosenthal, 2000). These small differences are more prominent in adolescence and have been shown to disappear as individuals get older.

Similarly, differences in self-esteem based on race are not as pronounced as had been previously theorised (Gray-Little & Hafdahl, 2000). More specifically, it had been suggested that race could have an impact on self-esteem with individuals from racially minoritized groups experiencing lower self-esteem compared to their white peers due to internalising stigma against minorities existing in society. However, research has only found small effect differences amongst races with Black individuals scoring highest on self-esteem measures followed by White, Latino and Asian individuals respectively (Twenge & Crocker, 2002).

Although the process of building one's self-esteem over their life can be supported or hindered by external factors (e.g. attachment to parental figures), self-esteem or the evaluation of one's worth is considered to be subjective as it is often not influenced or validated by external criteria (Orth & Robins, 2014). This is of interest as it suggests that interventions intending to improve self-esteem could focus on self-improvement (e.g. skills building), which can then have a positive effect on individuals' subjective view of themselves and their self-worth.

1.6 Virtual reality applications for improved self-esteem

Reviewing the evidence provided above around self-esteem and its connection to mental health, the potential for improvement of self-esteem through interventions, as well as the increasing evidence for the use of VR-assisted interventions aimed at ameliorating mental health outcomes, this review focused on investigating the relationship between VR and self-esteem. More specifically, this systematic review set out to explore the existing evidence base on the effect that interventions utilising VR have on self-esteem and whether self-esteem improves following VR-assisted interventions. Analysing the results of this systematic review could lead to improvements in our understanding of the mechanisms of change for VR-assisted interventions targeting self-esteem.

Further, to my knowledge, this is the first systematic review focusing on the effect of VR-assisted interventions on self-esteem. Considering the promising evidence on the effectiveness of VR-assisted interventions in mental health alongside the important role that self-esteem plays in the development and maintenance of mental wellbeing, I am interested in exploring the relationship between VR and self-esteem.

2. Methods

The present systematic review was undertaken following the 2020 updated version of Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA).

2.1 Information sources

This systematic review includes all literature that was published up until the 26th of July 2023 and was written in English. This literature was accessed through OVID, an interface that provides access to different scientific databases. The specific databases that were searched were Psycinfo, Medline and Embase. The search focused on literature investigating the use of VR paradigms in increasing self-esteem in adult subjects.

2.2 Search strategy

The search was completed three separate times, one for each of the databases. However, as the databases were accessed through the same interface, OVID, the search terms for all searches were the same. The search syntax used was as follows: ((Virtual reality OR avatar OR virtual world* OR virtual environment OR VR) AND self-esteem).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word].

2.3 Eligibility criteria:

This systematic review focused on literature that meets certain eligibility criteria. Below is a list of those criteria:

- Studies to be written in English
- The full text of studies to be accessible online
- Studies to be of an empirical and quantitative
- Studies to include a VR component in their design
- Studies to include at least one outcome measure of Self-esteem that is administered prior to and following the intervention
- Participants to be over 18

As the relationship between VR and self-esteem is novel combining research exploring this relationship in both adults and young people could pose the risk of rendering the results of this review less meaningful. This would be due to the two populations exhibiting known differences in needs and capabilities, namely developmental, cognitive, and psychological (Weisman et al., 2021). Hence the decision was made to focus this review on exploring the effectiveness of VR-assisted interventions on improving self-esteem only in adults.

2.4 Selection Procedure

Once the inclusion criteria had been decided, the database searches were conducted. Search results were then screened in three different stages, judging each result against the pre-set

eligibility criteria. Firstly, I looked at the titles of all search results eliminating the ones that did not match the inclusion criteria. Following this, the same process took place this time focusing on abstracts. Finally, for the remainder of the results, I read the full text of each study to consider their eligibility, leading to the final set of studies that were included in this study.

The studies included in this systematic review were undertaken between 2003 and 2023. However, with the exception of one study, most of the selected studies were conducted on or after 2016.

2.5 Data collection and analysis

Having gained an understanding of the type of studies and variables that existed in the results of the database search through reading the full articles, I decided which variables would be of interest for this systematic review. In many of the studies included multiple outcome measures were administered, and some explored the effects of multiple interventions. However, for the purposes of this systematic review, only variables that were deemed of interest were focused on and extracted. In total, data relating to eight variables were extracted. Below is a description of these variables:

1. Study type. This variable was used to identify the type of methodologies used in exploring the use of VR for self-esteem in the included studies and was also relevant in the quality assessment process, as different methodologies carry different levels of risk of bias that can be assessed using various tools.
2. The description of the VR protocol. This variable was used to consider the kinds of interventions used in the selected studies.

3. Type of VR-assisted intervention. This variable refers to the specific manner in which VR was used in the studies. There are various ways in which VR can be used (e.g. immersive VR using head mounts or VR using big displays).
4. The duration of the intervention. This was of interest as exposure to VR differed in all the studies and it is measured both in terms of time spent in VR but also looking at the overall duration of the intervention in weeks or months.
5. Information about the sample. Although samples of all included studies consisted of adults only, this variable refers to other characteristics of participants, including mental and physical health conditions, living in the community or inpatient units, alongside age and life stage.
6. Sample sizes. This variable focused on sample size in both the experimental conditions as well as the control groups for those studies that used control groups in their methods.
7. Outcome measure. As various tools have been developed to measure self-esteem, this variable explored the outcome measures that were used in the included studies to ascertain the effect of VR on self-esteem.
8. Results of intervention. This variable focused on the results showing the effect of VR-assisted interventions on self-esteem by collecting numerical data deriving from statistical testing performed on outcome measures.

Some of the studies did not report on all the variables collected for the purposes of this systematic review. Where possible, I contacted the authors of these studies via email to query whether these data could be shared with me. This was successful on some occasions. For instance, some of the researchers (e.g. Dr Umm Eman Syed) shared additional data with me

that was not included in their published research. However, attempts to reach out to other researchers were unsuccessful.

In terms of analysing the data collected for this review, it was decided that a descriptive statistics methodology should be used. The rationale for this decision was based on the small number of eligible papers included in this review. Further, the included studies utilised heterogeneous methodologies in terms of type of VR and length of VR exposure, as well as various self-esteem measures. Using a meta-analysis methodology could lead to results providing a potentially misleading picture on the effect of VR on self-esteem.

2.6 Quality Assessment and Risk of Bias

In the quality assessment and risk of bias process, I was supported by my colleague, George Grigorakis. Grigorakis and I reviewed the included studies in relation to their quality and bias separately. Once the process was completed, we compared our findings and discussed any differences in our ratings. Where there were differences, we presented our rationales for our individual ratings and came to a consensus about the final rating for those studies.

As studies included in this systematic review utilized different methodologies, namely some were randomized control trials and others were quasi-experimental or single group studies, two separate tools were used to guide the review process. The Cochrane risk of bias for randomized trials framework, which was revised in 2019, was used to assess the studies that employed randomized control trial methodology (RoB-2). This framework allowed us to consider various domains of the studies that could affect the risk of bias. More specifically, the tool prompted us to consider the risk of bias arising from the randomization process, deviation from the intended interventions, missing outcome data, the measurement of the

outcome variable and the selection of the reported result. Lastly, the tool provided an algorithm for making decisions for each of these domains and the overall risk of bias.

For those studies in which participants were not randomly assigned to different conditions or which did not have more than one group of participants, the Risk of Bias In Non-randomized Studies – of Interventions tool (ROBINS-I) was used. Similar to RoB-2, ROBINS-I provides a framework for assessing risk of bias arising from various domains. For this tool, the domains are bias due to confounding, selection of participants into the study, classification of interventions, deviations from intended interventions, missing data, measurement of outcomes, selection of the reported result and the overall risk of bias. An algorithm is provided in order to decide on judgments of the level of risk of bias for each domain and overall.

3. Results

In this results section, I will be presenting the findings of the literature search as well as descriptions of each included study in relation to the variables of interest for this review as described in the methodology section above.

The database searches conducted for this systematic review yielded a total of 288 records.

The detailed search breakdown can be seen in Table 1.

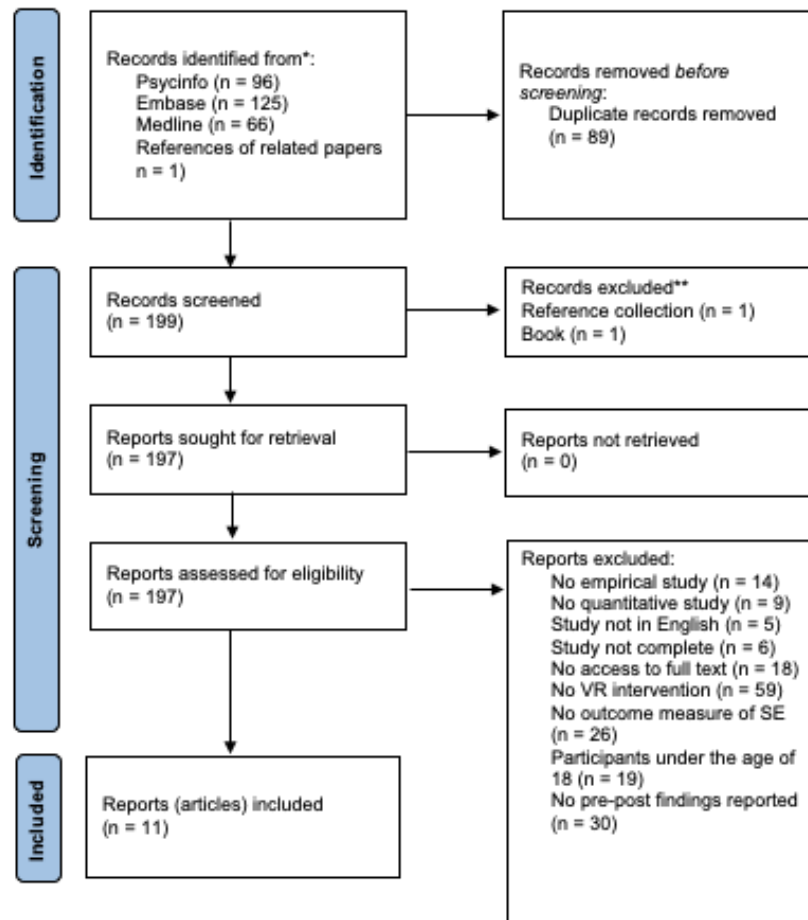
Table 1*Search records breakdown.*

Virtual reality + Self-esteem	
Psychinfo	96
Embase	125
Medline	66
Related references from search records	1
Total before removing duplicates	288
Σ	197

The most common reasons for excluding a study from this systematic review were: VR not being used in the protocol of the study, no outcome measure of self-esteem, no pre-post data/discussion of self-esteem findings, participants under the age of 18, not having access to the full paper, no empirical paper, no quantitative methodology. For further details see Figure 1.

Figure 1

PRISMA flow diagram.



The selection criteria were met by 11 studies. A complete list of the studies that were included in this review alongside structured summaries of each of the variables of interest can be found in Table 2.

Table 2

Summary of variables extracted from reviewed studies and risk of bias rating.

References	Study Type	VR-assisted intervention description	Type of VR	Intervention duration (VR exposure)	Sample description (age)	Sample size (experimental/ control group)	Outcome measures	Results of intervention	RoB rating
Amado et al. (2016)	Pilot single group within subjects study	Navigating VR town engaging in daily activities (i.e. shopping, bank, hobbies)	Non- immersive	Twelve 1-h- and-a-half weekly sessions during a 3- month program	Outpatients with diagnosis of schizophrenia (18+)	7/-	The self- esteem rating scale (SERS)	No significant difference was found either between baseline and post- treatment (pre: $\mu =$ 84.1, $\sigma =$	

								14.7; post: μ = 87.2, σ = 10.8; p = 0.26)	
									
Fan et al. (2022)	quasi- experimental, non- randomised design with a control group	Engaging in activities, such as gardening and flower arrangement, in VR + hand-on horticultural activities. Control	Immersive	Eight 2 hour sessions offered for 8 consecutive weeks	Older adults living in the community	32/30	Rosenberg self-esteem scale (RES)	GEE analysis showed that Self-esteem improved significantly for the experimental group post- intervention compared to the control	

group
participants
received
scheduled
activities,
such as
physical
exercise.

group ($\beta =$
2.18, $P =$
.005)



Felnhofer et al. (2019)	Randomised control trial with two experimental conditions	Participants prepared for a job interview in a VR waiting room while supported by	Immersive	Total VR exposure was 10 minutes (5' of immersion; 5' of interview	Healthy young adults (18-33 years old)	16/16/16	Rosenberg self-esteem scale (RES)	Avatar supported participants showed a lower drop in self-esteem following the
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either an
avatar of a
person
whom they
met briefly
or a random
agent avatar.
Control
group
participants
prepared
without
support.

prep with
avatar)

interview task
(M=15.125,
SD=5.353, p
= 0.10) than
agent
supported
participants
(M=11.75,
SD=3.786) or
the control
group
(M=13.00,
SD=5.808),
 $F(2,$
45)=2.395,

								p=.103, par. $\eta^2=0.096$	
									
Giachero et al. (2020)	Randomised control trial with one experimental and one control group	Engaging in daily life activities, such as grocery shopping, traveling, in VR with the support of a therapist. Control group participants	Non-immersive	Twice weekly 2 hours sessions for the duration of 6 months	Adults attending hospital neurological department	18/18	Visual Analogue Self-Esteem Scale (VASES)	Significant improvement in Self-esteem from pre to post ((F(1, 34) = 14.848, p < 0.001, partial η^2 = 0.304), but this was equal to both the experimental	

engaged in
the same
training but
without the
VR
component.

and control
group;

Within group
comparisons
of the
experimental
groups
showed a
significant
effect of time
((F(1, 12) =
12.598, p =
0.004, partial
 $\eta^2 = 0.512$;
mean = 37.00

								(DS: 5.46)
								pretreatment
								vs. 42.50
								(DS: 6.31)
								posttreatment.
								
Kim et al. (2022)	Randomised control trial with one experimental condition and one control group.	Self-training in VR which entailed participants to complete speech tasks in different scenarios (e.g. daily life, school	Immersive	8 weekly sessions – no information about duration of each session	Adults with social anxiety disorder	24/28	Rosenberg self-esteem scale (RES)	Significant effect of time and group interaction in increasing Self-esteem (F= 8.55, p= 0.006)



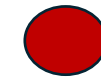
life, business
life). Control
group
participants
did not
receive any
treatment
until the end
of the trial.

Nijman et al. (2023)	Randomised control trial with one experimental condition and an active	Social cognition training and skills building in VR (e.g.	Immersive	Twice weekly 5 -35 minutes sessions over a sixteen- week period	Adults with psychosis	41/40	The Self- Esteem Rating Scale (SERS)	No significant effect of time in the experimental condition (b = 4.15, p= 0.60)

control	facial affect						or the control
group.	recognition).						condition (b=
	Control						-1.7, p= .59,
	group						d= -0.13)
	participants						
	received a						
	VR						
	relaxation						
	program.						

								
Nijman et al.	Single-group	Social	Immersive	Twice	Adults with	22/-	The Self-	A small effect
(2020)	within	cognition		weekly 45-60	psychosis		Esteem	statistically
	subjects	training and		minutes			Rating	non-
	feasibility	skills		sessions over			Scale	significant
	pilot study	building in					(SERS)	improvement

		VR (e.g. emotional recognition, social perception, social interactions)		a sixteen-week period				in Self-esteem was shown ($t = -1.79$, $p = 0.9$, $d = -0.25$)	
Nosek et al. (2016)	Single-group within subjects feasibility pilot study	Self-esteem enhancement group in VR	Non-immersive	Seven weekly two-hour long sessions	Adult women with physical disabilities (22 – 61)	19/-	Rosenberg self-esteem scale (RES)	RSE: A significant improvement was shown between pre and post VR exposure with a moderate	
							Hudson Index of Self-		



							Esteem	effect size (t=
							(ISE)	2.62(18), p=
								.02, d = 0.6)
								ISE: A non-
								significant,
								small effect
								increase was
								shown (t=
								1.59(18), p=
								.13, d= .36)
								
Riva et al.	Randomised	Experimental	Non-	Ten twice	Adult women	No information	Rosenberg	Self-esteem
(2003)	control trial	Cognitive	immerive	weekly 50	with binge	about specific	self-esteem	improved
	comparing	therapy with		minutes	eating	group sizes;	scale	significantly
	three	VR exposure		sessions over	disorder	total number of	(RES)	for all

interventions or engaged
and a control with
group treatment as
usual
(nutrition
group or
CBT).
Control
group
participants
were placed
on a waiting-
list.

a 6-week
period

participants =
36.

intervention
groups; no
numerical
data
provided.



Robinson-Whelen et al. (2020)	Randomized controlled feasibility study	Self-esteem group offered in VR with the use of avatars.	Non-immersive	Seven weekly 2-hours long sessions	Adult women with spinal cord injury	10/11	Rosenberg self-esteem scale (RES)	Slight non-significant, small effect increase in self-esteem (t= -1.00, df = 9, p= .34, d = .32)
Syed & Kamal (2021)	Quasi-experimental study with one experimental condition	Physical rehabilitation therapy with the support of VR technology.	Non-immersive	Twice weekly sessions lasting 34-40 minutes over a period of 1.5 months.	Young people and adults with neurological conditions	17/17	Rosenberg self-esteem scale (RES)	Self-esteem showed significant large effect improvement in the VR condition



and a control
group

Control
group
participants
received a
conventional
therapy
group.

compared to
the control
group ($t=$
 2.41 , $p= .05$,
 $d= .83$)



Key: Low risk:  Moderate risk:  Serious risk:  Critical risk: 

Significant results:  Ambivalent results:  Non-significant results: 

3.1 Study design and risk of bias

For the study design of the included studies, this was looked at from the perspective of the outcome variable of interest, in this case, self-esteem. Of the 11 selected studies, 6 were randomised control trials, with one or more experimental groups and one control group. 2 studies had a control group but were deemed quasi-experimental as participants were not able to be randomly assigned, the control group participants engaged in some activity that was not VR-related, and/or researchers and participants could not be blinded to different conditions. Finally, 3 studies were single group within-subjects studies (see Table 2 for details).

Overall, in terms of bias, 4 studies were deemed to have a low rating for risk of bias, 5 studies raised some concerns for risk of bias and 2 studies were deemed to carry serious risk of bias. None of the studies raised high/critical risk of bias concerns. These results indicate that some caution should be taken when interpreting the data extracted from the selected study and synthesising them to come to generalisable conclusions. More details regarding risk of bias rating can be found in Table 3 and Table 4.

Table 3

Risk of bias for randomised control trials (RoB-2).

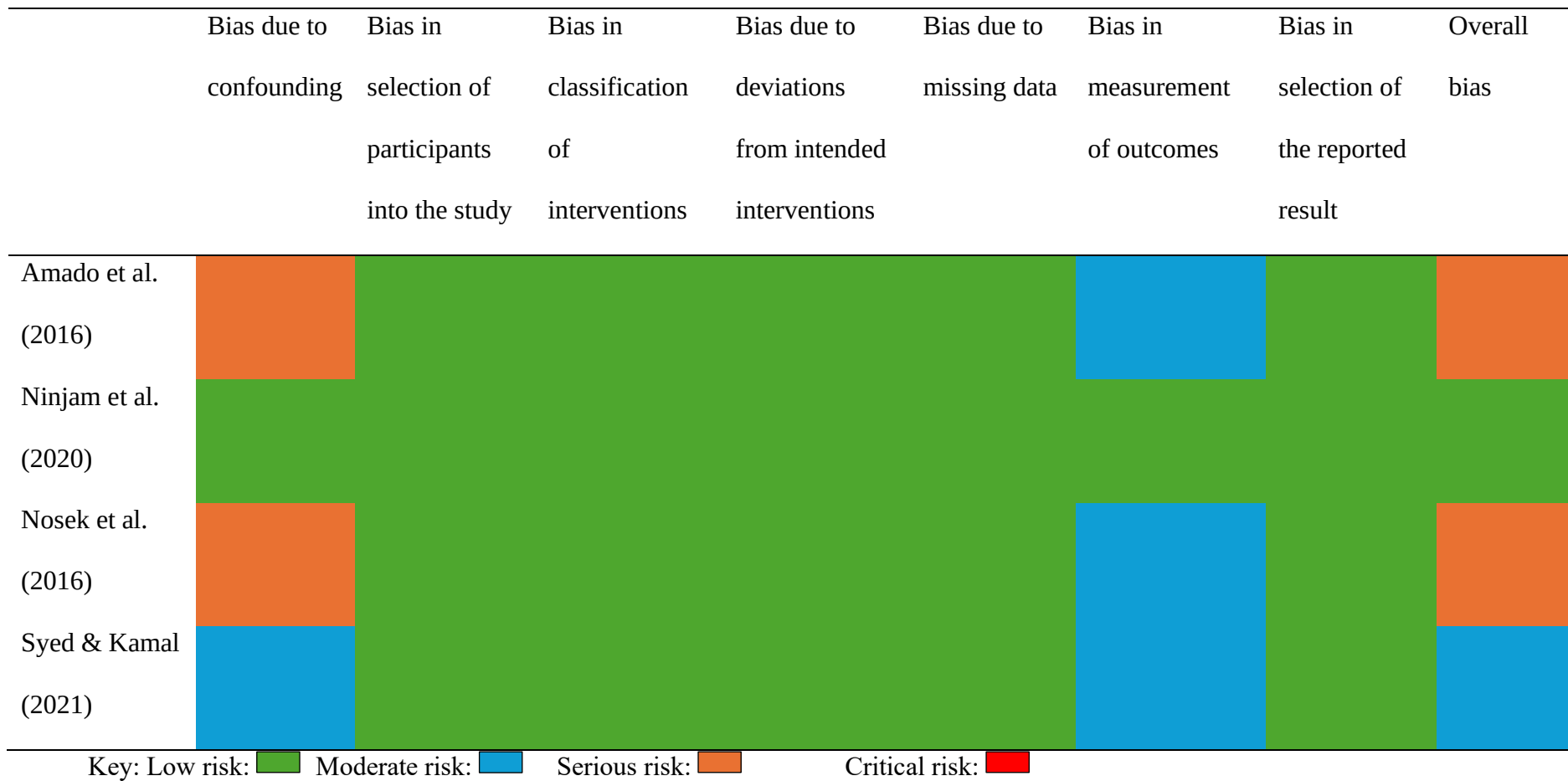
	Risk of bias arising from the randomization process	Risk of bias due to deviations from the intended interventions	Missing outcome data	Risk of bias in measurement of the outcome	Risk of bias in selection of the reported result	Overall risk of bias
Fan et al. (2022)	Low	Low	Low	Low	Low	Low
Felnhofer et al. (2019)	Low	Low	Low	Low	Low	Low
Giachero et al. (2020)	Low	Low	Low	Low	Low	Low
Kim et al. (2022)	Low	Low	Low	Low	Low	Low
Nijman et al. (2023)	Low	Low	Low	Low	Low	Low



Key: Low Risk: ■ Some concern: ■ High Risk: ■

Table 4

Risk of bias for non-randomised control trials (ROBINS-I).



3.2 Participants and VR type

The number of participants included across all of the selected studies amounted to 418. Of these, 240 participants were in the intervention/experimental groups while 178 were in control groups. These numbers are only estimates of the actual numerical breakdown of participants in different conditions as some of the studies did not have control groups and there was one study that did not provide the exact breakdown for how participants were split in groups, instead only the total number of participants was provided. See Table 2 for more details.

In terms of the VR type utilised in the selected studies, 6 used non-immersive VR, with the use of traditional computer displays to display the virtual worlds the participants were engaged in. The remaining 5 studies used immersive VR technologies with head-mounted displays being used.

3.3 Description of reviewed studies

Below are descriptions of each of the included studies with information regarding the variables of interest of this review, including findings on the effectiveness of VR-assisted interventions on improving self-esteem. Based on the various study designs and methodological differences of the reviewed studies, the studies have been separated between those that were designed to target self-esteem specifically and those that measured changes in self-esteem as secondary outcome date.

Further, some of the studies utilised protocols including psychological therapeutic interventions which were assisted by VR, whereas others employed interventions from different scientific disciplines with the addition of VR. The majority of the reviewed studies (7) undertook VR-assisted therapeutic interventions. Table 5 summarises which of the reviewed studies utilised VR-assisted psychological therapeutic interventions, and which did not.

Table 5

Summary of reviewed studies utilising VR-assisted therapeutic interventions & non-therapeutic VR interventions.

VR-assisted psychological therapeutic interventions
Amado et al. (2016)
Kim et al. (2022)
Nijman et al. (2023)
Nijman et al. (2020)
Nosek et al. (2016)
Riva et al. (2003)
Robinson-Whelen et al. (2020)
Non-psychological therapeutic VR interventions
Fan et al. (2022)
Felnhofer et al. (2019)
Gianchero et al. (2020)
Syed & Kamal (2021)

3.4 Self-esteem targeted VR studies

Nosek et al. (2016) were interested in exploring the feasibility and effectiveness of an internet-based intervention aimed at enhancing self-esteem amongst women with disabilities ($n = 19$). To do this, they employed a non-immersive VR protocol. Participants were given access to a 3-D virtual environment online platform, which they could connect to from their homes, and were instructed to create virtual avatars of themselves. They then used these avatars to take part in weekly therapy groups, where other participants and the facilitators also used virtual avatars. These groups lasted for two hours each time for seven weeks. The outcome measures used in this study to investigate changes in self-esteem following the intervention were RES and ISE. The statistical analysis of the data gathered showed that on the RES participants' self-esteem has significantly improved post-intervention. This improvement was of a medium effect size. For the ISE a non-significant small effect change was found.

Another study focusing specifically on improving self-esteem is the Robinson-Whelen et al. (2020) study. In this study, the researchers utilised the self-esteem group intervention protocol for women with disabilities from the Nosek et al. (2016) study and adapted it to contain modules that would fit the experience of women with spinal cord injury specifically. Participants in the study were randomised in one of two conditions. The experimental condition participants ($n = 10$) took part in the group self-esteem intervention, while the control group participants ($n = 11$) did not engage with the intervention throughout the duration of the study and were only given the program materials at the end of the study. All participants completed the same self-esteem measure, the RES. The participants in the

experimental group engaged with the intervention via a non-immersive, 3-D VR, online platform in which they could engage with the virtual environment and join the self-esteem intervention as virtual avatars of themselves. The intervention lasted seven weeks and groups took place once per week for the duration of two hours. At the end of the intervention the intervention group had a small effect non-significant improvement on the self-esteem outcome measure. There was no difference between the experimental and the control groups.

Fan et al. (2022) also designed a VR-assisted intervention aiming to improve self-esteem alongside other psychological states such as mastery, achievement and depression. To do this, they combined immersive VR with hands-on horticultural activities for elderly participants recruited from community centres. These participants were split in two groups, one experimental group ($n = 32$) and one comparison group ($n = 30$). The experimental group participants were exposed to VR via a head-mounted display and joystick, where they could engage in activities such as gardening and treasure hunting. This was followed by hands-on horticultural real-world activities, including gardening seeds and bouquet arranging.

Following the completion of each VR task, the experimental group participants received two gold coins as positive feedback. Each session lasted for two hours and all participants received eight sessions over eight consecutive weeks. The control group participants engaged in scheduled activities including physical fitness and paper cutting for the duration of the study. At the end of the intervention, an improvement in self-esteem, measured by the RSE, was found for experimental control group participants, which was statistically significant compared to the comparison group.

In their 2020 study, Giachero et al. recruited participants who were experiencing aphasia following suffering a stroke. They wanted to explore the effect of a VR-assisted intervention on the psychological well-being, including self-esteem, and language recovery of aphasic patients. They utilised a randomised control methodology with one experimental group ($n =$

18) and a control group (n = 18). The experimental group engaged in conversational therapy supported by non-immersive VR. During exposure to VR, participants were assisted by therapists to engaged with everyday settings (e.g. supermarket) and were asked to make choices including where to explore, what to do etc. They communicated these choices with their therapist who then used the keyboard to facilitate moving around the virtual environment. Each exposure to VR lasted for two hours. Sessions were offered twice per week for the duration of six months. The control group participants only engaged in conversational therapy without the VR component. To measure changes in self-esteem, participants were administered the VASES before and after the intervention. The results of the study showed significant improvement in self-esteem for both groups. However, the effect of the improvement was greater and more significant for participants in the VR group.

Syed and Kamal (2021) were interested in comparing a VR-assisted intervention, designed to improve physical health/rehabilitation and, by extension, mental health, self-esteem and engagement in overcoming illness in patients with neurological deficits, against conventional physical therapy. In this quasi-experimental study, participants were assigned to either the experimental group (n = 17) or the control group (n = 17). All participants in the study received at least two exercise sessions per week for six weeks. Experimental group participants engaged in exercising with the aid of non-immersive VR. VR supported them to maintain an exercise routine through kinetic sensors meaning that they did not need a joystick to move around. Instead, cameras would capture their movement and display it on the screen. Control group participants partook in conventional exercise groups utilizing gym equipment. Self-esteem was measured by administering the RSE. The data analysis revealed that self-esteem improved significantly at the end of the study for participants who engaged in the VR-assisted intervention compared to those who were involved in the conventional exercise group.

3.5 VR studies not specifically targeting self-esteem

The rest of the studies included in this systematic review utilised VR in their interventions but these were not specifically designed to improve self-esteem. However, changes in self-esteem were measured as secondary outcome data. For instance, in their study, Amando et al. (2016) designed a non-immersive VR-assisted intervention aiming to target cognitive deficits in individuals with schizophrenia that impacted their daily living functionality. This was a within-subjects study ($n = 7$) and the intervention entailed participants exploring a 3-D virtual town displayed on a computer screen, where they could engage in activities that they found difficult or stressful in the real world. The intervention took place weekly for twelve weeks and in each session, participants were exposed to VR for ninety minutes. As part of the evaluation of the intervention, the researchers used various psychological measures, including SERS, for self-esteem. The statistical analysis conducted did not find any significant differences in self-esteem following the intervention.

Felinhofer et al. (2019) were interested in exploring whether providing support to individuals in the form of a digital avatar in VR, would have an effect on stress while they anticipate taking part in a real-world stressful event. In this experiment, participants were asked to engage in a five-minute interview. Prior to this, participants were placed in three different groups: one experimental group with an avatar ($n = 16$), one experimental group with an agent ($n = 16$) and one control group ($n = 16$). The experimental group participants were immersed in a virtual environment via a head-mounted display and were supported to prepare for the interview task for five minutes. The difference between the experimental groups was that the participants in the avatar group were informed that the avatar is controlled by a

researcher they briefly met before entering the VR space. Participants in the agent group were told that the agent was controlled by a computer program. Unbeknownst to the participants, all avatars were controlled by computer software. The control group participants did not receive any support. Exposure to the stressful event (interview) led to a decrease in self-esteem for all participants. However, participants in the avatar group experienced a significantly lower decrease in their self-esteem compared to the agent group and the control group.

Kim et al. (2022) designed an immersive VR-assisted intervention for individuals with social anxiety, which they evaluated in their randomised controlled study. Their intervention entailed participants in the intervention group ($n = 24$) engaging in speech tasks in virtual environments resembling daily life situations. This intervention was meant to function as training to improve social skills and reduce symptoms of social anxiety. Participants completed eight weekly sessions covering social scenarios in different environments with increasing difficulty. The control group participants ($n = 28$) did not engage in any treatment during the trial. To measure self-esteem, the researchers used the RSE. The results showed that participants in the intervention group had significantly improved outcomes in regards to their self-esteem compared to the control group.

Nijman et al. (2020) were interested in exploring whether utilising VR technology would enhance social cognition training (SCT) in adults with psychosis. Traditional SCT has been shown to improve social functioning in individuals with psychosis but perhaps lacks in simulating real-life interactions and environments. In this single-group feasibility study, Nijman et al. recruited participants ($n = 22$) with a psychotic condition and offered them twice weekly sessions lasting between forty-five and sixty minutes over a period of sixteen weeks. During these sessions, participants explored virtual environments and completed tasks that were aimed at enhancing skills such as emotional recognition, social perception, social

interactions etc. Although this study looked at social cognition skills, the researchers were also interested in measuring other psychological states, including self-esteem. Self-esteem was measured via administering the RSE. The analysis of RSE did not show a statistically significant improvement in self-esteem. Only a small effect, non-significant improvement was found.

In a related study, Nijman et al. (2023), designed a protocol to explore the efficacy of the immersive VR-assisted intervention, DISCoVR, developed in the study above (Ninjam et al., 2020) aiming to improve social cognition skills in individuals with psychosis. In this randomised control trial, Nijman et al., recruited participants who were either placed in the experimental intervention group ($n = 41$) and engaged in DISCoVR or in the active control group ($n = 40$) and engaged in relaxation in immersive VR. Although the study focused on investigating the effects of DISCoVR on social functioning, both interventions in this study are of interest for this systematic review as VR was utilised in both. Participants engaging with DISCoVR in this study, were offered twice weekly sessions lasting for up to thirty-five minutes over a sixteen-week period. During the sessions, they navigated virtual scenarios and partook in tasks such as interacting with avatars and identifying emotions based on their expression, body language etc. Participants in the control group, engaged in relaxation in VR. During these sessions, participants were immersed in various environments simulating nature and were guided to complete relaxation exercises, such as breathing. Self-esteem was measured in this study as part of secondary outcomes using the RSE. The results showed that neither VR-assisted intervention produced any significant improvements in self-esteem.

Finally, in their study Riva et al. (2003), investigated whether experimental cognitive therapy (ECT) intervention utilising VR would yield improved results for women diagnosed with binge eating disorder compared to traditional approaches such as Cognitive Behavioural Therapy (CBT) and nutrition groups (NG). Participants ($n = 36$) were randomised into one of

the different conditions (ECT, CBT, NG) or the waiting list control group. A specific breakdown of the group numbers was not provided in the article. All participants completed the nutrition group for 5 weeks. Following this, ECT and CBT participants were also offered additional sessions.

More specifically, those who engaged in ECT were offered fifteen additional sessions (five weekly group sessions and ten biweekly VR sessions). ECT sessions lasted fifty minutes each time and involved immersion in virtual environments exploring triggers for bingeing behaviours and participants' concerns around food, eating, shape etc. Further, the VR technology was utilised to support participants in engaging with guided imagery but instead of this being imaginal, it was achieved digitally in VR. Alongside binge eating behaviours, self-esteem was also measured in this study using the RSE. The results showed that self-esteem improved significantly for all treatment groups compared to the control group. However, as the numerical results for self-esteem are not report in the article, it is difficult to ascertain whether ECT with VR was superior to the other treatments in terms of improvements to self-esteem.

Summary of results:

- Included studies utilized immersive (6) and non-immersive (5) VR methodologies
- Study design varied [i.e. randomized controlled trials (6), quasi-experimental studies (2), single group studies (3)]
- Participants were all adults but with various characteristics (e.g. mental health difficulties, physical health difficulties, neurological conditions, living in the community or inpatient setting)

- Some studies were designed to focus on self-esteem specifically (5) while others were not (6)
- 7 of the reviewed studies utilized protocols including psychological therapeutic interventions whereas the other 4 did not
- Exposure duration to VR varied from 5 minutes to 2 hours
- Intervention duration varied from a single session to weekly & bi-weekly sessions over six months
- Sample sizes varied between 7 participants and 81 participants
- Participants were engaged in VR in various ways (e.g. exploring virtual towns, completing daily life tasks, exploring feelings/facial expressions on avatars, embodying avatars in virtual groups)
- 5 of the included studies found the VR had a significant positive effect on self-esteem, 4 studies did not find an effect and 2 studies produced equivocal results
- 3 of the studies that found significant results were designed to improve self-esteem whereas 2 measured self-esteem as secondary data

4. Discussion

In this discussion section, I will critically synthesise the information presented in the result section above, discuss themes that have been identified and draw conclusions regarding the topic of this review. This systematic review looked at the effectiveness of VR-assisted interventions on improving self-esteem. The results of this review have identified that VR-assisted interventions can have a positive effect on self-esteem and that VR technology can

be employed to improve outcomes of psychological therapeutic and other interventions, which is an encouraging outcome. However, it is important to hold in mind that the included studies are heterogeneous in their methodologies as well as other aspects of their approach such as their specific use of VR, VR type, the time of exposure in VR, their sample size etc.

Further, although this systematic review focused on the effectiveness of VR-assisted interventions on self-esteem, the literature search on the databases showed that this was the primary focus of most but not all of the studies. More specifically, some studies utilised VR-assisted interventions that were specifically designed to improve self-esteem or more generally psychological factors, including self-esteem. At the same time, in some of the reviewed studies, self-esteem was only explored as a secondary outcome variable and the interventions discussed did not have improvement of self-esteem as their primary aim.

Moreover, some of the reviewed studies employed protocols that included VR-assisted psychological therapeutic interventions whereas others utilised interventions from other scientific disciplines enhanced with VR. Lastly, some of the studies included in this systematic review were found to contain considerable risk of bias. Bias introduced in research can lead to misleading results, which in turn can lead to conclusions that are false or even harmful (Higgins et al., 2019). Therefore, due to all the above, careful considerations should be made when interpreting the results of this review and forming conclusions.

4.1 Effectiveness of VR-assisted interventions on improving self-esteem

In terms of improving self-esteem with the use of VR-assisted interventions, the results of the reviewed studies are in their majority positive. However, due to the limited pool of studies that were identified to be exploring this topic (only eleven studies were reviewed), it would

be difficult to make broad and generalisable conclusions on the effectiveness of VR-assisted interventions on self-esteem. In summary, five of the reviewed studies showed significant positive results in the increase of self-esteem following the VR-assisted intervention. On the other hand, four other studies did not find any significant changes in self-esteem. Finally, two of the included studies produced ambivalent results.

More specifically, one study (Nosek et al., 2016) found significant results in one of the self-esteem outcome measures (RSE) but not another (ISE). Further, the second equivocal study (Felnhofer et al., 2019) found that between two VR-assisted interventions, only one succeeded in reducing the decrease in self-esteem following a stressful event. The one that was successful was the one where participants believed they were supported by a real person's avatar in VR, as opposed to other participants who believed they were supported by a computer. This difference could be attributed to cognitive appraisals of others, in this case, avatars, that do not have an immediate effect in the way individuals respond to them (Felnhofer et al., 2018).

Humans are social beings and have evolutionarily developed a sense of safety when in groups with other humans. This effect has been found to be present in real life as well as in VR (Kothgassner et al., 2016). It is, therefore, plausible that once participants have had enough time interacting with virtual avatars, those avatars perceived to be controlled by humans, activated this feeling of safety response in participants. It would be beneficial to understand more about the perceived important elements of avatars and their interaction with humans that could produce a similar sense of safety for individuals and consider how to develop technologies that would be able to accomplish that.

4.2 Effect of type of VR and intervention

Amongst the studies that found significant improvements in self-esteem, the type of VR did not seem to play an important role, as they are almost split in half in terms of using immersive and non-immersive VR (three non-immersive; two immersive). One could hypothesise that the type of VR would be a central factor in the effectiveness of VR-assisted interventions, with immersive VR being the one that would produce more significant results due to its ability to fully immerse individuals in digital environments and minimise distractions from the outside world (Slater & Sanchez-Vives, 2016). However, this does not seem to be the case based on the results of this systematic review. It would, therefore, be interesting to explore the commonalities of the two VR types and consider which are the most influential in increasing the effectiveness of a VR-assisted intervention, (e.g. control of virtual environments etc.).

A common factor that all the studies which found significant results for self-esteem improvement was that the protocols they used for their VR-assisted interventions all included prolonged and repeated exposures to VR. VR sessions in the included studies lasted between thirty-four minutes to up to two hours. Further, VR sessions occurred at least once per week and in some case twice weekly for a duration of between six weeks to six months. Based on this information, one could conclude that an important aspect of VR-assisted interventions is that individuals might need long and repeated exposures to the virtual environments for the intervention to be supportive of their self-esteem improvements. It is worth mentioning, however, that the studies that did not report significant increases in self-esteem, also utilised prolonged and repeated VR exposure protocols. What is not clear from the reviewed studies

is what would be the shortest overall exposure that would yield significant positive results for individuals. This is important as it would help develop interventions that are both effective yet cost-efficient.

Another aspect of the VR-assisted interventions that was particularly varied, and thus complicating the interpretation of the results, were the different virtual worlds and scenarios that participants engaged with. There are some similarities (e.g. participants exploring situations from daily life) but overall, the environments and tasks completed within them differ across the reviewed studies. Further, in some instances, VR was accompanied by real world activities as part of the intervention either taking place prior to or following the VR exposure (e.g. participants engaging in gardening in the real world following VR exposure to gardening in Fan et al., 2022). Taking this into account, it is difficult to decipher which elements of the virtual environments were most beneficial and thus led to improvements in self-esteem. Similar observations have been made by other researchers in the field of VR and mental health (e.g. Rizzo & Koenig, 2017; Žilinský & Halamová, 2023).

4.3 Effect of sample size

Sample sizes of the included studies could also present as a concern when interpreting the results of this review. The sample sizes of the review studies range between seven to forty-one. Research suggests that for statistical testing to have sufficient power to detect potential intervention effects a sample size of thirty and above is required (Brunnström & Barkowsky, 2018). Most of the reviewed studies did not meet this threshold and therefore might have either missed existing effects, leading to Type II error, or detected effects that would be difficult to generalise. Further, most samples consisted of clinical populations, which is

advantageous when thinking about clinical interventions, however, results might not be as applicable to the general population.

Moreover, the results of the included studies were mostly based on self-report measures, which can introduce bias and lead to errors (Giromini et al., 2022). Gathering information through various sources and utilising different formats of measures could prove beneficial in improving the robustness of future results in this field. Information regarding the long-term effects of the VR-assisted interventions would also be of interest. This information is not available in this review, as all the studies included only explored the immediate effects of VR-assisted interventions and did not gather data at a follow-up time point.

5. Conclusions

This systematic review, guided by PRISMA 2020 principles, focused on the effect of VR-assisted intervention on self-esteem. The results, although limited, showed that VR-assisted interventions can be beneficial in improving self-esteem for individuals. This is a promising area of research in which developments could be particularly advantageous so that VR technologies could be integrated with day-to-day psychological practice aiming to ameliorate self-esteem and, by extension, mental health. However, generalising these results should be done with caution due to, as mentioned above, the varying limitations that the reviewed studies presented with. As is evident from the low number of studies included in this review, more research is needed to explore the full potential of VR-assisted interventions for psychological traits, including self-esteem. Future research should focus on improving on the areas that current research is lacking, including recruiting larger samples, exploring the effect

of VR-assisted interventions on self-esteem on both clinical and non-clinical populations, employing more diverse manners of collecting data etc.

6. Limitations

The main limitation of this systematic review is that it was conducted by only one researcher. It might be that due to this some relevant results might have been missed. This review only looked at research conducted in English and studies to which I could not gain full access were also not included. This means that potentially relevant studies might have been left out of this review. Best efforts were made to contact authors to collect information that was missing from some of the studies or to gain access to the text of studies that were not available online, however, not all authors approached responded to my enquires. Further, although my colleague, George Grigorakis, aided me in conducting the quality and risk of bias assessments as the second rater, it is possible that some bias existing in the reviewed studies was not identified.

Lastly, this systematic review was not pre-registered with Prospero, which could introduce bias and raise doubt in terms of the results of this review. Doubts regarding the interpretation of the results of this review could also be raised due to the variations and differences in methodology, sample size and VR protocols of the reviewed studies.

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Part 2: Empirical Paper

**“Speaking to one’s younger self - A Virtual Reality Assisted Intervention for
Self- Compassion: A Quantitative Study”**

Abstract

Background: This study aimed to explore the effect of utilising a Virtual Reality (VR) assisted intervention on increasing self-compassion in healthy individuals. More specifically, the intervention paradigm involved participants speaking to their younger selves while embodying digital avatars. It was hypothesised that following the intervention all participants would experience an increase in self-compassion and positive affect and a reduction in self-criticism, fear of compassion and negative affect and that these effects would be greater for participants with personalised avatars.

Methods: Fifty-four participants were randomly allocated to either speak to a child avatar that resembled them when they were younger (based on pictures provided by participants) or a generic-looking child avatar, while embodying personalised adult avatars. Participants were immersed in VR via headsets and offered compassion to their younger selves. Once participants completed this task, they switched their perspective by embodying the child avatars and then they experienced the compassion back by watching the recording of their adult avatar.

Results: The results of this study showed that participants experienced an increase in self-compassion and positive affect as well as a decrease in self-criticism following the VR-assisted intervention. No significant effects were found for fear of self-compassion or negative affect. Contrary to the initial hypotheses, the child avatar that participants engaged with (individualised or generic) did not seem to affect the observed effect of this study.

Discussion: This study produced promising results for the use of a novel virtual reality assisted intervention and its efficacy on improving self-compassion and reducing self-criticism. Possible explanations of the findings regarding the type of childhood avatar not

having an effect on the observed changes, including avatar-user closeness and the proteus effect, are discussed.

1. Introduction

1.1 Self-compassion and self-criticism

Self-compassion refers to the psychological trait of relating to oneself in a manner which is supportive and caring, especially when distressed and experiencing psychic pain (Neff, 2011). Self-compassion can be understood as the ability to treat oneself with kindness and experience loving feelings towards the self while actively attempting to self-soothe and comfort at times of adversity. Moreover, self-compassion encompasses the understanding that there is a common human experience within which imperfections exist in some form for everyone, leading to taking a non-judgmental and accepting stance towards the self without ruminating on and emphasising negative feelings (Allen & Leary, 2010; Neff, 2003b).

Self-compassion has been linked in the literature with being a beneficial trait in maintaining positive health both physically and mentally (Allen & Leahy, 2014). In terms of physical health, self-compassion helps promote positive health-related behaviours, including seeking medical advice and exercising. Further, individuals with high self-compassion were found to exhibit better responses of their sympathetic and parasympathetic nervous systems in the face of stressors leading to a reduced likelihood of experiencing harmful physical symptoms such as high blood pressure (Arch et al., 2014). Psychological well-being can also be positively affected by self-compassion, as it increases the experience of positive mind states, life satisfaction, optimism, and happiness (Zessin, Dickhauser & Garbade, 2015). Lastly, self-compassion can enhance self-esteem and motivation through emotional stability when faced with setbacks and an increased drive to fulfil one's aspirations (Breines & Chen, 2012).

A psychological trait that is often considered to be located on the opposite end of the spectrum from self-compassion is self-criticism. Self-criticism can be described as the negative and harsh evaluation of oneself (Thompson & Zuroff, 2004). These negative appraisals of the self can relate to various aspects of one's characteristics (e.g. personality traits, physical attributes etc.) as well as behaviours, skills, and achievements. Self-criticism can give rise to negative affect, such as contempt and disgust, towards the self and it has been shown to act as a vulnerability factor for mental health difficulties, including depressive disorders (Ehret, Joormann & Berking, 2015). One mechanism through which self-criticism might contribute to the development of depressive symptoms could be related to the strength of negative emotions towards the self for self-critical individuals, which can be experienced as intolerable and difficult to cope with (Gilbert et al., 2004).

1.2 Theoretical underpinnings

The concepts of self-compassion and self-criticism have been explored extensively in relation to their implications and potential usefulness when incorporated into psychological therapy. More specifically, Compassion Focused Therapy (CFT) developed by Paul Gilbert has placed a lot of its focus on moving away from self-critical and blaming stances towards the self and towards a more open stance of taking responsibility and learning how to cope with difficult situations (Gilbert, 2009). CFT bases its ideas on evolution and neuroscientific research and theorises that three emotion regulation systems exist, namely the threat and protection system, the drive and excitement system and the contentment, soothing and social safeness system.

These systems are developed based on individual experiences starting in early life (Gilbert, Lee & Matos, 2024). Gilbert's model posits that the activation of these systems is connected to different coping strategies employed by individuals to manage and overcome adversity. Occasionally, these systems are out of balance, and one might dominate over the others. For self-critical individuals, research suggests that the threat system is more active, while self-compassionate individuals tend to rely more on the soothing and social safeness system (Kim et al., 2020). CFT focuses on ameliorating this imbalance and, through various compassionate techniques, allows the soothing system to become more easily accessible (Gilbert, 2009).

Similarly to CFT's emotional regulation systems, research suggests that self-compassion and self-criticism also start to develop throughout childhood and into adolescence (Gilbert & Irons, 2009). During this time, young adolescents are beginning to develop their identities outside of the family context. Therefore, interpersonal relationships with peers or other significant adults become important in the development of a positive sense of the self or the experience of shame and self-criticism (Whittle et al., 2016). Experiencing shame in the context of peer relationships can stem from the view of the self as unattractive in the minds of others and has been linked with a reduced capacity for self-compassion (Gilbert & Miles, 2002). Similarly, the experience of shame can lead to what Gilbert described as fear of compassion (Gildert et al., 2011). This term refers to an individual's resistance to self-compassion due to concerns that being self-compassionate might bring about negative consequences, such as becoming weak.

Considering the mechanisms through which these traits, that develop early in life, can persist into adulthood, it would be beneficial to draw on the research on the effect of memories on self-criticism and shame. Research suggests that memories of situations that were perceived as shameful and embarrassing, or as confirming of the individual's negative beliefs about themselves developed in childhood and adolescence, can continue to affect the individual in

their adulthood by increasing the experiences of self-criticism and reducing their capacity for self-compassion (Pinto-Gouveia & Matos, 2011). It has also been suggested that such memories can act as “ghosts from the past” due to their encapsulated negative outcomes and meanings for the individual (Wild & Clark, 2011).

1.3 Psychological interventions for increased self-compassion

In psychological therapy, many techniques have been utilised to work on such memories as well as on their effect on limiting one’s access to self-compassion, self-reassurance and self-soothing. In CFT, one such technique is compassionate imagery (CFI) (Gilbert, 2009). Using this technique, individuals are encouraged to bring to mind their “ideal” compassionate self and create a rich image of the self in their mind’s eye, including facial expressions, posture, voice tones etc. Then individuals are encouraged to consider the emotional reactions attached to their imagined compassionate self (Lee, 2005). Imagery rescripting is another technique that focuses on memories that trigger feelings of shame and self-criticism. This technique is used to update the content of shameful memories in order to reduce the distress that recalling them produces and to help disconfirm potentially outdated negative beliefs about the self (Nilsson, Lundh, & Viborg, 2012).

Other techniques that work on distressing memories are based on perspective-taking, which refers to the ability of an individual to step outside of themselves and appraise situations from another’s point of view (Marvin, Greenberg and Mossler, 1976). For instance, techniques such as “chair work”, encourage individuals to imagine conversing with another person or themselves (or part of themselves) so to generate a different perspective that might provide

further insight or relief for the individual and cultivate self-compassion (Kolts, 2016; Pugh, 2017).

Research on perspective-taking techniques has shown promising outcomes in aiding individuals to experience self-compassion. More specifically, Boland et al. (2021) found that when participants were put in a condition where they were asked to imagine speaking to their younger selves, they experienced an increase in self-compassion and a decrease in emotional distress and self-criticism following the intervention. Additionally, the results were more significant compared to a condition where participants were instructed to imagine speaking to a “trusted other”.

A common characteristic that connects all the above therapeutic techniques is that they require individuals to use their imagination and create detailed images and scenarios in their minds. However, the literature on mental imagery suggests that there can be noticeable differences across individuals in their ability to produce and maintain mental images, as well as the quality and vividness of those images (Abraham, 2006). Further, experiencing mental health difficulties, including post-traumatic stress disorder and depression, can impede one’s ability to use their imagination at the level that is required in order to make use of mental imagery therapeutic techniques (Pattel et al., 2007).

1.4 Virtual reality integration with mental health support

It would therefore be important to consider alternatives that could lift the barriers to accessing and benefiting from such imagery techniques. Utilising technology could present a novel solution to this problem. Technological advancements in recent years have led to the development of technologies such as Virtual Reality (VR) (Wohlgenannt, Simons, Stieglitz,

2020). Virtual reality is a broad term encompassing different types of technologies that facilitate the creation of virtual environments that can be explored, interacted with, and manipulated by the user (Zheng et al., 1998). These interactions between the digital environments and the users can produce a strong sense of immersion as the virtual environments respond to the users' actions in real-time altering their perception and creating the illusion that the user is in fact inside the digital environment (Bailenson, 2018).

Existing research on the use of VR in mental health has shown that VR-assisted interventions can be beneficial in the treatment of various mental health difficulties including anxiety disorders, and depression (Freedman et al., 2017). There is evidence to suggest that virtual environments can trigger physiological and psychological responses in users which are comparable to those reactions that would be expected to be observed in the real world (Gregg & Tarrier, 2007). More specifically, using VR, safe, personalised, digital environments can be developed to support individuals struggling with mental health difficulties in building and enhancing skills as well as learning new ways of coping, including cultivating self-compassion.

In their research, Falconer et al (2014; 2016) explored the efficacy of a VR-assisted intervention in increasing experiences of self-compassion and reducing self-criticism. This study utilised embodiment, which refers to the illusion of ownership of the body of a digital avatar's body (Pecks & Gonzalez-Franco, 2021), to create a virtual reality condition during which participants had the opportunity to embody a generic adult avatar and comfort a distressed child following developing and learning a compassionate script. Later, participants switched perspectives and embodied the child avatar while listening to themselves providing self-compassionate statements. The results of these studies showed that participants from both clinical and non-clinical populations experienced a reduction in self-criticism and an increase in self-compassion. Furthermore, depressive symptoms also reduced following the

VR-assisted intervention. These results suggest that VR could become an alternative means to accessing imaginal techniques for those individuals who might struggle with creating and maintaining mental images in their minds for prolonged periods of time.

The present experimental randomised controlled study is an adaptation to the Falconer's et al (2014, 2016) VR protocol and hopes to provide further support for the findings that demonstrated the efficacy of VR in increasing self-compassion and decreasing self-criticism. Based on the literature detailed throughout this introduction, regarding the early development of self-criticism and self-compassion in childhood and adolescence as well as considering that various therapeutic techniques that encourage individuals to imagine communicating with their younger selves (e.g. chairwork) (Kolts, 2016) alongside the evidence provided above regarding the effectiveness of such imagery techniques (Boland et al., 2021), this study will invite participants to speak to their younger selves in VR. Participants will be randomly allocated into two groups. All participants will be provided with individualised adult avatars, the participants of the experimental group will be provided with avatars of their younger selves and the participants of the control group with generic child avatars.

1.5 Study's objectives and hypotheses

This study will investigate the efficacy of this adapted VR protocol and hopes to find that following the intervention participants across both conditions will experience improvements in their self-compassion and positive affect as well as a reduction in self-criticism, fear of compassion and negative affect. Further, it is hypothesised that participants from the experimental group will experience a greater increase in their self-compassion and positive

affect and a greater decrease in self-criticism, fear of compassion and negative affect compared to the participants in the control group.

In summary, the following study outcomes are predicted:

Hypothesis 1: Following the VR-assisted intervention, all participants will experience an increase in self-compassion. Participants in the experimental group will experience an increase in self-compassion that is higher compared to those in the control group.

Hypothesis 2: Following the VR-assisted intervention, all participants will experience a reduction in self-criticism. Participants in the experimental group will experience a decrease in self-criticism that is higher compared to those in the control group.

Hypothesis 3: Following the VR-assisted intervention, all participants will experience a reduction in fear of self-compassion. Participants in the experimental group will experience a reduction in fear of self-compassion that is higher compared to those in the control group.

Hypothesis 4: Following the VR-assisted intervention, all participants in the experimental group will experience an increase in positive affect. Participants in the experimental group will experience an increase in positive affect that is higher compared to those in the control group.

Hypothesis 5: Following the VR-assisted intervention, all participants in the experimental group will experience a reduction in negative affect. Participants in the experimental group will experience a reduction in negative affect that is higher compared to those in the control group.

2. Methods

2.1 Participants and experimental design

The current project was undertaken jointly with Georgios Grigorakis. Grigorakis explored the experience of participants following the VR-assisted intervention for his qualitative study, *Nurturing Self-Compassion: Exploring Interactions with One's Child-Self in Virtual Reality*. I investigated the changes in self-compassion following the VR-assisted intervention for this quantitative study as described below.

An experimental randomised controlled design was used in this study, in which variables of interest (e.g. self-compassion) were compared in two separate conditions and over time (pre & post intervention). The type of child avatar that participants were provided with constituted the between-subjects condition. More specifically, participants in the experimental condition were provided with personalised child avatars (i.e. avatars that were created to look like them when they were children) and control group participants were provided with child avatars that were generic looking. All participants were provided with personalised adult avatars. The dependent variables were measures of self-compassion, self-criticism, fear of self-compassion, positive and negative affect. Following the effects observed in Falconer's (2014 & 2016) studies and VR paradigm, it was calculated that a sample of 18 participants per

group should detect a large effect size (Cohen's $f = 0.35$, $\alpha = 0.025$, $\beta = 0.2$) and the aim became to recruit up to 24 participants for each group.

In order to recruit participants, this study was advertised on the UCL Psychology subject pool portal as well as more widely on social media and psychology network mailing lists.

Therefore, participants recruited were both psychology students and individuals from the general public. Once participants expressed interest in the study, they were instructed to complete a consent form in which they declared that they met the inclusion criteria for taking part in this study. The inclusion criteria were being over eighteen years of age, being fluent in the English language, having no history of epilepsy, not experiencing motion sickness, being available to travel to central London, and being able to provide current and childhood photos.

Sixty-seven participants signed up for the study initially. However, twelve of those participants (17.9%) did not end up taking part in the study. Of those participants, nine did not respond to correspondence regarding booking a slot for the VR-assisted intervention, and three cancelled their booked slots and were unable to reschedule. The remaining fifty-five engaged with all the different parts of the study. The responses of one of those participants were not able to be taken into consideration due to missing values on their pre-intervention questionnaires, therefore the data from fifty-four participants who completed the study were considered for statistical analysis. The mean age of the fifty-four participants was 25.7 ($SD = 5.6$). The detailed demographic characteristics of this study's sample can be found in Table 2 below. Participants were randomly assigned to one of two groups – twenty-eight (51.8%) completed the condition with the personalised child avatar and twenty-six (48.1%) completed the condition with the generic child avatar.

Table 1*Demographic characteristics.*

Gender	n (%)
Female	42 (77.8%)
Male	11 (20.4%)
Prefer not to say	1 (1.8%)
Racial identity	
Asian	17 (31.5%)
Black	3 (5.5%)
Mixed race	5 (9.2%)
White	28 (51.8%)
Other	1 (1.8%)
Education level	
Secondary school	2 (3.6%)
Vocational training	1 (1.8%)
Attended university but did not obtain degree	13 (23.6%)
Bachelor's degree	10 (18.2%)
Graduate degree	28 (51.8%)
Employment status	
Full-time employment	23 (42.6%)
Part-time employment	5 (9.2%)
Unemployed	2 (3.7%)
Student	20 (37%)
Other	4 (7.4%)
Disability status	
Disabled	6 (11%)
No perceived disability	48 (88.9%)

2.2 Outcome Measures

Forms of Self-Criticizing/Attacking & Self-Reassuring Scale (FSCRS) (Gilbert, Clark, Hempel, Miles, & Irons, 2004): the FSCRS was used to measure traits of self-criticism and

self-reassurance for participants. Participants were asked to rate how much each of the 22 items applies to themselves on a 5-point Likert scale ranging from 0 = not at all like me to 4 = extremely like me. The scale comprised of three subscales: inadequate self (IS), hated self (HS) and reassured self (RS). The scale has high internal reliability, with Cronbach's alphas of .90 for IS, and .86 for HS and RS scales. The scale has been validated in both clinical and non-clinical populations.

Self-compassion and Self-Criticism Scale (SCCS) (see Falconer et al., 2013, Manuscript S1): This self-report questionnaire was used to measure state self-compassion and self-criticism. When completing this questionnaire participants were instructed to imagine five different scenarios (e.g. "You arrive home to find that you have left your keys at work") that can be perceived as threatening to the self and might trigger either self-criticism or self-compassion. Participants were provided with a 7-point Likert scale (1 = not at all to 7 = highly) used to indicate whether, in each scenario, they would react to themselves in a Harsh, Contemptuous, Critical, Soothing, Reassuring, and Compassionate manner. The scale consists of two separated subscales – one with the sum of the positive items generating the Self-compassion scale and another with the sum of the negative items, which generates the Self-criticism scale. The authors reported the scale as having high internal reliability with Cronbach's alphas of .91 for the Self-compassionate subscale and .87 for the Self-criticism subscale.

International Positive and Negative Affect Schedule, Short Form (I-PANAS-SF) (Karim, Weisz, & Rehman, 2011): This measure was used to identify the extent to which participants were experiencing certain positive and negative emotions on a 5-point Likert scale (1 = not at all to 5 = very much so). I-PANAS-SF is a reliable measure with Cronbach's alphas for the Positive affect scale being .78 and for the Negative affect scale .76. The scale has been tested across cultures.

Types of Positive Affect Scale (TFPAS) (Gilbert et al., 2008): TFPAS was used to measure participants' positive affect. This self-report questionnaire instructed participants to use a 5-point Likert scale (0= 'not characteristic of me' to 4 = 'very characteristic of me') to indicate how characteristic it is of them to experience a range of eighteen positive emotions. The scale consists of three subscales (Active positive affect, Relaxed positive affect and Safe/Warm positive affect). The measure demonstrated good psychometric properties with Cronbach's alpha of .83 for Active positive affect and Relaxed positive affect subscales and .73 for Safe/Warm positive affect subscale.

Fears of Compassion Scale (FCS) (Gilbert, McEwan, Catarino, & Baião, 2014): FCS was used to measure the extent to which participants were experiencing fears of compassion towards themselves. Although the complete scale consists of three subscales, for the purposes of this study, only the fear of self-compassion was used. This subscale looked to identify traits of fear of allowing oneself to engage in self-compassion (15 items: i.e. "I feel that I don't deserve to be kind and forgiving to myself"). The scale has good psychometric properties with Cronbach's alpha 0.85 for fear of compassion for the self.

2.3 Virtual Reality Equipment and Environment

The avatars for this study were created using the software Character Creator 3 with the headshot plugin (Reallusion), which converted participants' photographs into digital avatars in FBX format. These were then passed through a bespoke pipeline built for the headset app. For the delivery of the virtual environment, an Oculus Quest 2 (Meta Platforms inc.) headset

was utilised. On the headset, software that was designed by Virtual Bodyworks S.L., Barcelona specifically for this virtual reality task was used.

2.4 Ethics Statement

The University College London Psychology and Language Sciences ethics committee approved all the processes and materials that were utilised in this study (CEHP/2021/587). Participants were provided with an information sheet that included information regarding the procedures for the study, iterated their voluntary participation and ability to withdraw at any point and described the manner in which data was managed, which was based on the Data Protection Act of 2018 as well as UCL policies. Lastly, informed consent was obtained by all participants in the form of an online form that was signed prior to booking a slot for the VR-assisted intervention.

2.5 Procedure and materials

Participants who expressed interest in the study had access to an electronic information sheet that was shared with them online. This online form included information regarding self-compassion and its beneficial effect on well-being and mental health. Further, information was shared regarding the nature of the study, the inclusion criteria, the different stages of the intervention, the randomisation process and the existence of two different conditions, the compensation for taking part in the study and a statement relating to the voluntary nature of the study as well as the ability for participants to withdraw at any time. At the end of the

information sheet, those participants who, following reading the information, decided to take part in the study were instructed to complete an online consent form. Once the consent form was completed, participants were randomly assigned to one of the two conditions of the study – speaking to an individualised child avatar in VR (experimental condition) or speaking to a generic child avatar in VR.

Following the randomisation process, participants were contacted via email to complete the pre-intervention questionnaires (FSCRS, SCCS, I-PANAS-SF, TFPAS, FCS). Further, in this email, the researchers requested participants to share two pictures of themselves – one of their current selves and one of themselves when they were between the ages of six and fourteen. It was explained that these pictures would be used to create the participants' individualised avatars. However, although the childhood pictures of control group participants would not be used to create avatars, this was not mentioned in the email as not to alert participants to their assigned condition prior to the intervention. Lastly, participants were requested to choose a time slot to complete the intervention.

On the day of the intervention, participants were greeted by researchers and information about the study was reiterated. Participants were provided with explanations regarding the various steps of the intervention and what to expect during each of them. More specifically, participants were shown the VR headset, and it was explained that this would be used to facilitate the VR experience. It was also explained that once in the VR participants would be embodying the avatar of their current selves and would be sat opposite a child avatar. At this point, participants were reminded that depending on the group they were randomly allocated to, they would either see their younger self in the VR or a generic child avatar. However, all participants were instructed to imagine that they were speaking to their younger selves regardless of whether the child avatar was individualised or generic-looking.

The researchers described that the child avatar would appear to become distressed and at this point, participants would be expected to provide the child avatar with compassion, which would be recorded by the headset. As they would be doing so, the child would react and become increasingly more settled. The decreasing level of emotional distress shown by the child avatar was controlled by the researchers. Once this part of the intervention was completed, it was explained that the participants would switch their perspective by embodying the child avatar. During this time, the recording of them expressing compassion would be played back to them and they would be able to experience this from the perspective of their child avatar. Following experiencing this, the VR-assisted intervention would be completed, and they would be supported to remove the headset.

Prior to engaging with the intervention, the concept of compassion was explained, and, with the help of the researchers, participants were guided through developing a compassionate script that they would later use to provide compassion to their child avatars. This script was an adaptation of Falconer et al.'s (2014) script and was developed in collaboration with Chase and Zeniou (Song-Chase et al., 2024; Zeniou et al., 2024). The following basic steps for providing a compassionate response to someone in distress were discussed:

- *Validation*: The aim of the step is to acknowledge that the other person is feeling upset and to show openness to this feeling by expressing that it is totally acceptable for them to feel this way.
- *Redirection of attention*: The aim of this step is to draw the other person's attention away from the negative emotions/situation to something more positive and soothing.

- *Memory activation*: This last step aims to remind the person of other people in their lives that can provide comfort as to instil more positive and comforting feelings in them.

Participants were instructed to keep these steps in mind while considering what they would personally like to have the opportunity to express to their younger selves. For participants who struggled to formulate such ideas, suggestions were made, and example sentences were provided (e.g. to think about negative experiences that they have overcome and what positive aspects of themselves they discovered through those). Once participants had finished writing their compassionate scripts, they were encouraged to take some time to memorise it and then they were supported to wear the VR headset – figure 1 shows the virtual environment participants were placed in and an example of the first phase of the VR-assisted intervention where participants embodied their adult avatar and faced their child avatar.

Figure 1

Virtual environment and embodying adult avatar.



At the beginning of each embodiment stage in the VR environments, participants engaged in embodiment exercises aiming to facilitate the experience of being in and controlling the body of the avatars. These exercises entailed participants being guided to perform certain movements with their physical bodies, which were mirrored by the avatars' digital bodies. Following the end of the VR experience, participants were asked to complete the post-intervention questionnaires (FSCRS, SCCS, I-PANAS-SF, TFPAS, FCS). Participants were reminded of their compensation, and this marked the end of the experiment.

2.6 Planned analyses

To test this study's hypotheses, separate 2x2 mixed analyses of variance (ANOVA) are planned to be used for each hypothesis. These will explore the changes in all the dependent variables (FSCRS, SCCS, I-PANAS-SF, TFPAS, FCS). Time (pre and post-VR-assisted intervention) will be the within-subjects factor and condition allocation (personalised or non-personalised child avatar) will be the between-subjects factor for each of the separate ANOVAs.

3. Results

3.1 Baseline differences between groups

Independent sample t-tests were used to capture potential differences between the two conditions (experimental group and control group). The analyses showed that there were no significant differences between the groups at baseline on all measures (FSCRS, SCCS, I-PANAS-SF, TFPAS, FCS).

3.2 Analyses of outcome measures

As it can often be the case with small sample sizes, the data obtained from this study's sample deviated slightly from the normal distribution (Krithikadatta, 2014). This was initially gauged by examining the descriptive statistics and histograms for all variables. It was further confirmed by statistical tests of normality, namely the Shapiro-Wilks test. The sample's deviation from the normal distribution was taken into account when considering the type of analysis that would best suit the testing of the hypotheses of this study. After some deliberation, it was decided to move forward with a parametric statistical analysis. More specifically, mixed analysis of variance (ANOVA) was deemed to be the most appropriate statistical test. The rationale behind this decision was based on the robustness of ANOVA, which renders it possible for it to tolerate violations of the normality of distribution assumption (Blanca-Mena et al., 2017). Further, no alternative non-parametric test exists for mixed ANOVAs.

Separate 2x2 mixed analyses of variance (ANOVA) were used to analyse all the pre and post-intervention dependent variables (FSCRS, SCCS, I-PANAS-SF, TFPAS, FCS) with Time (pre and post-VR-assisted intervention) as the within-subjects factor and condition allocation (personalised or non-personalised child avatar) as the between-subjects factor. The mean scores and standard deviation on all measures in each condition at baseline and following the VR-assisted intervention can be seen in Table 2.

Table 2

Mean and standard deviations of dependent variables pre-VR-assisted intervention and post-VR-assisted intervention for participants in each condition.

	Condition:	Baseline (pre-VR-	Post-VR-assisted
	Personalised	assisted	Intervention
	child avatar (1)	intervention)	
	Non-		
	personalised		
	child avatar (0)		
Self-compassion	0	44.38 (15.72)	54.07 (18.65)
	1	46.57 (15.59)	58.89 (15.27)
Reassuring self	0	29.23 (5.87)	29.84 (5.38)
	1	29.07 (6.23)	30.21 (6.11)
Self-criticism	0	66.73 (8.95)	62.11 (13.00)
	1	64.82 (18.52)	57.82 (17.95)
Inadequate self	0	24.46 (7.35)	24.88 (7.61)
	1	26.60 (8.52)	24.78 (7.64)
Hated Self	0	7.73 (3.19)	7.69 (2.63)
	1	8.32 (3.57)	7.85 (3.59)
Fear of self-compassion	0	31.03 (11.61)	32.76 (11.64)
	1	32.96 (12.26)	32.96 (11.77)
Positive Affect	0	16.23 (3.12)	16.61 (3.20)
	1	15.46 (3.85)	16.50 (3.37)

Active Positive Affect	0	28.07 (6.29)	28.84 (5.96)
	1	25.25 (6.68)	26.78 (6.68)
Relaxed Positive Affect	0	17.73 (5.91)	18.34 (5.29)
	1	17.03 (4.24)	17.10 (4.61)
Safe/Warm Positive Affect	0	13.15 (2.76)	13.88 (2.87)
	1	13.64 (2.72)	14.01 (3.32)
Negative Affect	0	11.38 (3.17)	10.69 (3.05)
	1	10.57 (2.84)	10.50 (2.28)

3.3 Self-compassion

Self-compassion was measured by two of the outcome measures used in this study. The self-compassion scale from SCCS was used to measure state self-compassion, while the reassuring-self scale from FSCRS was used to measure trait self-compassion. The analysis showed that for state self-compassion (SCCS) time had a significant large effect on self-compassion, $F(1, 52) = 25.43$, $p = .001$, $\eta_p^2 = .33$. Self-compassion scores increased for all participants following the VR-assisted intervention. No significant effect was found for either the condition (personalised or non-personalised child avatar), $F(1, 52) = .82$, $p = .37$, $\eta_p^2 = .01$, or the interaction between time and condition, $F(1, 52) = .36$, $p = .55$, $\eta_p^2 = .007$.

For trait self-compassion, the reassuring-self scale (FSCRS) data presented an upward trend following the intervention, however, no significant effects were found for time, $F(1, 52) =$

2.06, $p = .16$, $\eta_p^2 = .04$, condition, $F(1, 52) = .00$, $p = .94$, $\eta_p^2 = .09$, or their interaction $F(1, 52) = .19$, $p = .66$, $\eta_p^2 = .004$.

The data suggests that participants experienced a significant improvement in their state self-compassion following the compassionate VR-assisted intervention irrespective of whether they spoke to a younger self avatar that looked like them or was generic looking.

3.4 Self-criticism

Self-criticism was also measured using two outcome measures. The self-criticism scale from SCCS was used to measure state self-criticism as well as the inadequate-self scale and hated-self scale from FSCRS, which were used to measure trait self-criticism. A significant large effect of time was found for state self-criticism (SCSC), $F(1, 52) = 8.07$, $p = .006$, $\eta_p^2 = .13$. However, neither the condition, $F(1, 52) = .73$, $p = .39$, $\eta_p^2 = .01$, nor the interaction of time and condition, $F(1, 52) = .34$, $p = .56$, $\eta_p^2 = .007$, seemed to have a significant effect. Further, although there was a downward trend from pre-VR to post-VR for the inadequate-self scale, no significant effects were found (time, $F(1, 52) = 1.21$, $p = .27$, $\eta_p^2 = .02$; condition, $F(1, 52) = .25$, $p = .61$, $\eta_p^2 = .005$; interaction or time and condition, $F(1, 52) = 3.11$, $p = .08$, $\eta_p^2 = .05$). Similarly, despite the downward trend of the data, the analysis did not show any significant effect for the hated-self scale (time, $F(1, 52) = .99$, $p = .32$, $\eta_p^2 = .01$; condition, $F(1, 52) = .19$, $p = .66$, $\eta_p^2 = .004$, interaction or time and condition, $F(1, 52) = .71$, $p = .40$, $\eta_p^2 = .01$).

The data shows that the compassionate VR-assisted intervention was beneficial in reducing participants' critical stance towards themselves. This effect was not affected by the type of child avatar participants were provided with.

3.5 Fear of self-compassion

The fear of self-compassion subscale of the FSCRS was used to measure Fear of self-compassion. Statistical analysis did not find any significant differences following the VR-assisted intervention. More specifically, time, $F(1, 52) = .42, p = .51, \eta_p^2 = .008$ was not shown to have a significant effect. Similarly, condition, $F(1, 52) = .13, p = .71, \eta_p^2 = .003$ was not found to have a significant effect. Lastly, the interaction between time and condition did not produce a significant effect, $F(1, 52) = .42, p = .51, \eta_p^2 = .008$.

3.6 Positive affect

Two outcome measures were used to consider changes in positive affect following the VR-assisted intervention - the positive affect subscale of the I-PANAS-SF and the TFPAS. For the I-PANAS-SF the analysis showed that there were no significant changes in positive affect (time, $F(1, 52) = 3.29, p = .07, \eta_p^2 = .06$; condition, $F(1, 52) = .27, p = .60, \eta_p^2 = .005$; interaction of time and condition, $F(1, 52) = .69, p = .40, \eta_p^2 = .013$). Similarly, the relaxed-self subscale of the TFPAS did not seem to significantly change (time, $F(1, 52) = .46, p = .49, \eta_p^2 = .009$; condition, $F(1, 52) = .57, p = .45, \eta_p^2 = .01$; interaction of time and condition, $F(1, 52) = .29, p = .59, \eta_p^2 = .006$).

However, the analyses showed statistically significant improvements in the other two subscales of the TFPAS. More specifically, there was a large significant effect of time, $F(1,$

52) = 6.44, $p = .01$, $\eta_p^2 = .11$, for the active positive affect subscale, but the effects of the condition, $F(1, 52) = 2.09$, $p = .15$, $\eta_p^2 = .03$, and the interaction between time and condition, $F(1, 52) = .71$, $p = .40$, $\eta_p^2 = .01$, were not statistically significant. Lastly, the analysis of the safe/warm positive affect subscale of the TFPAS, showed that time had a positive medium statistically significant effect, $F(1, 52) = 3.89$, $p = .05$, $\eta_p^2 = .07$, but no other significant effects were found (condition, $F(1, 52) = .20$, $p = .65$, $\eta_p^2 = .004$; interaction of time and condition, $F(1, 52) = .26$, $p = .60$, $\eta_p^2 = .005$).

3.7 Negative affect

The impact of the VR-assisted intervention on negative affect was measured by the negative affect subscale of the I-PANAS-SF. The statistical analysis showed that negative affect decreased following the VR-assisted intervention, however, this was not found to be statistically significant. More specifically, time did not have a significant effect on negative affect, $F(1, 52) = 2.01$, $p = .16$, $\eta_p^2 = .03$. Similarly, the condition, $F(1, 52) = .47$, $p = .49$, $\eta_p^2 = .009$, and the interaction between time and condition, $F(1, 52) = 1.32$, $p = .25$, $\eta_p^2 = .02$, did not produce a statistically significant effect on negative affect.

Results summary table:

- The two groups did not differ in the observed changes following the VR intervention.

Following the VR intervention:

- State self-compassion significantly increased
- Trait self-compassion did not significantly improve
- State self-criticism significantly reduced
- Trait self-compassion did not significantly decrease
- Fear of compassion did not significantly reduce
- Positive affect significantly increased
- Negative affect did not significantly decrease

4. Discussion

4.1 Key Findings

This study's most important finding is that this VR-assisted intervention during which healthy individuals were invited to embody digital avatars and speak to their younger self can produce a significant increase in self-compassion and positive mood as well as a decrease in self-criticism. These effects were observed in all participants of this study, regardless of whether they spoke to their personalised child avatar or a generic child avatar.

4.2 Contributions to existing research

This study was an adaptation of Falconer et al. (2014, 2016) studies and as such it produced comparable results. More specifically, state self-compassion increased, and state self-criticism decreased following the VR-assisted intervention. However, the result of this study did not show a significant change in trait self-compassion and trait self-criticism. The state level of emotions involves affects that are relatively temporary and are dependent on the varying circumstances surrounding the individual. The trait level, on the other hand, involves more stable personality characteristics, which indicate the frequency with which certain emotions are experienced (Wood et al., 2008). It is plausible that state self-compassion and self-criticism were affected by the VR-assisted intervention due to the nature of the task at hand, which included participants providing compassion to their younger selves. However, due to the more stable nature of trait self-compassion and self-criticism, this type of short-term, one-off, VR-assisted intervention might not have been sufficient to trigger significant changes.

Further, fear of self-compassion did not change significantly following the VR exposure. Fear of self-compassion has been linked to individuals' attachment organization and is therefore developed from early on in life, meaning that it can become entrenched within individuals' value systems and personality structure (Bowlby, 1980; Gilbert, 2010). As such, fear of self-compassion might be more resistant to change and therefore, longer-term interventions might be needed for positive changes to occur.

In terms of negative affect, this variable decreased post-VR, but similarly to Falconer et al (2014) this was not statistically significant. Considering that participants of this study were from a non-clinical population, one could attribute this non-significant change to the fact that

participants might not have been experiencing high levels of negative mood at the time of the study. Therefore, it would be less likely that a significant reduction in the participants' already low levels of negative mood would occur.

Lastly, this study found that participating in the VR-assisted intervention seemed to have the beneficial significant effect of increasing positive affect, which is a result that is different to the Falconer et al. study (2014). More specifically, this study found a significant increase in active positive affect and safe/warm positive affect, but not relaxed affect. Research suggests that these positive feelings might derive from separate neurological systems (Depue & Morrone-Strupinsky, 2005). Active positive affect is associated with seeking achievement and reward, while safe/warm positive affect is linked with contentment and social connectedness (Gilbert et al, 2008). Although these are two distinct systems, it is not unlikely that the task of this study's VR-assisted intervention could have activated them both. Participants engaged in soothing their younger selves, which could have activated their safe/warm positive affect through a sense of social connection and providing comfort to another. In addition, one could imagine that participants might have gained a sense of reward and achievement by participating in this study and contributing to research. The adaptation of the VR protocol to include speaking to one's younger self might have increased these feelings of reward and warmth as the task might have felt more meaningful and personal to participants.

4.3 Exploration of the observed effects

The findings of this study showed that participants experienced an increase in their self-compassion and positive affect and a decrease in their self-criticism following the VR-assisted intervention, which were not related to the child avatar (personalised or generic) they

engaged with in VR (experimental manipulation). These findings contradict some of the hypotheses of this study, which predicted that participants who spoke to a child avatar that resembled them in their younger age (experimental group) would have significantly greater gains compared to participants who spoke to a generic child avatar (control group). There might be multiple reasons for these results.

Firstly, it was observed that the direction of change for most of the variables, including state and trait self-compassion and self-criticism and positive and negative affect was as expected and it seemed to be greater for the experimental group (personalised child avatar) compared to the control group (generic child avatar). However, these differences between groups did not reach statistical significance. It is thus possible that the study did not have sufficient power to detect statistically significant differences between the two groups.

Another explanation could be that these results might be related to the perceived qualities of the avatars. Research suggests that avatars perceived to possess characteristics which are closely related to the user, can increase the effectiveness of avatar use and strengthen the effect of VR-assisted interventions (Ratan & Dawson, 2016). Moreover, avatars which are perceived to be similar in some respect to individuals can trigger the Proteus Effect. The proteus effect refers to the phenomenon during which individuals modify their behaviour and attitudes based on the avatars they are embodying or engaging within VR (Yee & Bailenson, 2007). In the case of this study, participants in the experimental group experiencing the proteus effect could mean that they would exhibit greater compassion in their engagement with the child avatar, who they would perceive as similar to themselves at a younger age, as well as experience more significant self-compassion and positive mood following embodying the child avatar.

However, anecdotally during the study participants in both groups occasionally expressed that they could not observe a resemblance between themselves and their avatars, both adult and child. As the two groups did not differ significantly following the VR-assisted intervention and participants in both groups experienced comparable changes, this could mean that the avatars might have not been perceived as personal enough to induce the proteus effect which in turn could have triggered a greater compassionate response in participants with individualised child avatars. Further, not experiencing the avatars, especially the child avatars, as close to the participants' memories of themselves at a younger age, might have made facilitating feelings of compassion and warmth in response to speaking to them less likely and thus minimising the initially hypothesised effect that personalised child avatars would have on participants' self-compassion.

Moreover, research shows that individuals might experience a sense of unease when engaging with digital avatars in virtual reality (Kätsyri et al., 2015). This phenomenon is referred to as the 'Uncanny Valley' effect. This term was first coined by a Japanese robotics scientist, Dr Mori (Mori, MacDorman & Kageki, 2012), who observed that on occasion engaging with avatars or robots that appear to be human-like but possess some imperfection that distinguishes them from being human (e.g. restricted or unusual movements or speech) would create cognitive dissonance, which could lead to individuals experiencing feelings of aversion towards the avatars. It is plausible that participants in this study might have experienced the uncanny valley effect in relation to their avatars, which could have precluded them from feeling a greater sense of self-compassion following the intervention.

Conversely, the intervention protocol, which provided participants with space to consider what sentiments they would like to convey to their younger selves and to be able to do so in VR, might have been a more important factor in inducing changes in self-compassion, self-criticism and positive mood. This possible explanation for the mechanism behind the

observed effects of this study fits with existing literature on CFT. More specifically, as mentioned in the introduction section, Gilbert (2014) theorized that a soothing system exists, which is present from early on in life and can aid in emotional regulation and reducing negative emotions such as anxiety. The soothing system is often activated when experiencing comfort through meaningfully feeling close and connected to others (Lopes & Silva, 2020).

The soothing system is important in the development of compassion for oneself and others. In order to increase access to the soothing system, various imaginal therapeutic techniques have been utilized, including compassionate imagery (CFI). As described in previous sections of this study, CFI is used to increase positive feelings through the process of imagining one's compassionate self. Research suggests that this process stimulates the activation of the parasympathetic nervous system providing a sense of calmness (Gilbert 2014). Further, CFI can contribute to the reduction in maladaptive behaviours, such as negative self-talk and can lead to positive behavioural changes that are associated with greater mental and physical well-being (Kelly et al., 2010).

In a similar manner, participants in this study were instructed to consider what they might say to their younger selves, develop a compassionate script based on this and express compassion to their child avatars. It is possible that in this process the participants' soothing system was activated as they were conjuring this compassionate image and dialogue. Additionally, providing compassion in VR and experiencing it back while embodying the child avatar, could have triggered a similar activation of the soothing system leading to an increased sense of self-compassion and a decrease in self-criticism.

Research conducted on the effectiveness of CFI and other imaginal techniques has found that some individuals might not experience the benefits of this type of technique due to low imagery vividness (Naismith et al., 2019). Imagery vividness refers to the quality of mental

images being conjured by individuals. In cases of low imagery vividness, the mental images appear to lack details that would make them realistic (Andrade et al., 2014). In their research, Naismith et al. (2018) found that individuals reporting low imagery vividness during CFI practice did not experience positive changes in their compassionate affect following the exercise. Further, there is evidence to suggest that some individuals might struggle with maintaining mental images for prolonged periods of time (Blackwell, 2019). The benefit of using VR technology is that it circumvents the need for individuals to create mental images and sustain them, as VR environments and avatars are already developed in advance and remain in place even if individuals become distracted. In this way, VR could enhance the experience of imagery techniques and thus contribute to the observed effects of this study.

4.4 Conclusions and implications for future research

The findings of this study contribute to the growing literature on the efficacy of the combination of VR with imagery techniques in improving self-compassion and reducing self-criticism. This is significant as both these psychological states have been found to impact mental health and therapeutic outcomes. More specifically, research suggests that self-compassion can have a beneficial effect on mental health through an increase in positive affect and engagement in adaptive coping behaviours (Inwood & Ferrari, 2018). Further, it has been linked to greater positive outcomes following therapeutic interventions (MacBeth & Gumley, 2012). On the contrary, self-criticism has been associated with poor mental health as well as hindering the effect of therapy leading to poorer outcomes (Löw et al., 2020).

These findings have significant clinical implications. As discussed previously in this paper, imagery techniques rely heavily on individuals' abilities to create and maintain vivid mental

images, which can be difficult for some. Therefore, employing VR technologies in assisting imaginal techniques can circumvent the need to use one's imagination, which can act as a barrier, and thus render imaginal techniques more accessible in clinical practice. Further, VR-assisted imaginal technique protocols could be utilized to support individuals from clinical populations, who might struggle with accessing self-compassion altogether (Pauley & McPherson, 2010). VR technologies can be employed as part of protocols aiming to scaffold the process of engaging with self-compassion.

For instance, support could be provided prior to engaging with the VR-assisted imaginal techniques in exploring and updating the meaning of painful memories that might be acting as “ghosts from the past” for individuals whose attempt to engage with self-compassion might trigger distressing memories leading to heightened self-criticism. This type of support has been shown to be effective in improving the impact of distressing memories (Segal, Kessler & Anholt, 2015). Following this process, individuals could be supported in providing compassion to others (similarly to Falconer et al., 2014 & 2016 protocols) and slowly build this up to providing self-compassion (e.g. to their younger selves).

The current study adds to the evidence base which shows that VR protocols can have a beneficial effect on self-compassion. However, the results of this study did not find a link between personalised avatars and greater outcomes on self-compassion and self-criticism. It would therefore be important to explore which aspects of VR might have contributed to the observed effects and the mechanisms of change behind these effects. Further, participants occasionally commented on the quality of the avatars as a factor that hindered the immersiveness of the experience. It would be of interest to explore whether avatars that participants find to be closer to how they perceive themselves in terms of appearance, would improve gains in self-compassion and decrease in self-criticism.

Moreover, investigating protocols that offer multiple exposures to VR could be an interesting way forward. As some of the variables measured in this study might be resistant to change, namely fear of compassion and trait self-compassion and self-criticism, protocols entailing repeated sessions might be beneficial. Lastly, this study sample consisted of individuals from a non-clinical population. It would be interesting to consider whether effects reported in this study could also be observed when participants are recruited from a clinical population.

4.5 Limitations

One limitation of this study was its relatively small sample size. Although the minimum sample size based on the power calculation was met, this study might have benefitted from a larger sample size to detect potentially statistically significant changes following the VR-assisted intervention and between groups. Another limitation was that participants were not screened for self-criticism prior to taking part in the study. This might have meant that participants could already be low in self-criticism and as such might not have experienced the intervention's effects to be as great as individuals who are highly self-critical.

Furthermore, participants were from a non-clinical population, which meant that the researchers were not aware of information related to participants' current and past mental health. This data was not collected from participants, however, in hindsight, it would have been of interest to know more regarding the mental health status of participants as this might have provided further insight into the findings of this study. Lastly, participants were mostly recruited from the student population, which meant that they were demographically quite similar, namely young, educated, and female. This would make generalising the result of this study to the general population difficult.

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Part 3: Critical Appraisal

1. Introduction

In this critical appraisal, I am writing about my reflections on the process of conducting the research project described in Chapter 2. I am focusing on the dilemmas regarding the research protocol and study design as well as the rationale that influenced the decision-making process. For instance, details around the use of avatars, their characteristics and the experimental manipulations are provided in this chapter. I am also expanding on some of the limitations that were mentioned in the previous chapter and what their possible consequences on the observed effects might have been. Moreover, I am attempting to understand the potential reasons behind the anecdotal qualitative feedback some participants provided in regard to their perception of their personalised avatars. Finally, throughout this critical appraisal, I am describing my reflections on the challenges of conducting this study and the learning that has been developed through overcoming them.

2. Virtual reality protocol and study design development

The virtual reality assisted intervention, that I undertook as part of the empirical paper, aimed at improving participants' self-compassion by providing them with the opportunity to speak to their younger selves. As it was discussed in the introduction chapter of the empirical paper, there is plenty of evidence to suggest that imaginal therapeutic techniques can be beneficial in triggering positive changes in self-compassion (e.g. Lee, 2005). Moreover, protocols that involve individuals imagining speaking to their younger selves have also been found to induce positive changes in self-compassion (e.g. Boland et al. 2021). However, these techniques tend to rely heavily on individuals' skills in terms of conjuring images in their

minds and maintaining their attention and concentration for prolonged periods of time. As someone who is interested in technological advancements, I found the concept of integrating virtual reality and mental health to be fascinating. Coming from this position as a researcher, I became interested in exploring whether virtual reality could provide a solution to potential barriers to positively engaging with imaginal techniques and in contributing to the growing literature in this field of research.

Virtual reality has been used in novel ways in research and has been shown to produce positive effects in self-compassion (e.g. Falconer et al., 2014; 2016). This was done, however, using avatars that were not personalised for each participant. In designing the protocol for this study's virtual reality assisted intervention, it was decided to go one step further and explore whether personalization of the digital avatars would potentially allow us to observe greater improvement in self-compassion and reduction in self-criticism. Further, the study protocol was adapted to involve participants considering what compassionate words they would like to be able to share with their younger selves, further enforcing the personalised nature of this adapted intervention. Therefore, avatar creation became an integral part of this project and it felt that "getting it right" would be of great importance.

The protocol for the virtual reality assisted intervention posed a methodological dilemma, and thus various different iterations of it were considered. For instance, we considered offering the "speaking to your younger self" intervention with both adult and child personalised avatars the experimental group, while having a control group in which participants would engage in the intervention the way it had previously been offered in the original work by Falconer et al. (2014; 2016).

Although this would still be of interest, the results would only provide evidence for whether the adapted intervention protocol (speaking to your younger self) can produce improvements in self-compassion. My research partner, George Grigorakis, and I were keen to explore the role of virtual reality as well as that of digital avatars and how personalised avatars might affect the variables measured in this study versus non-personalised avatars. Therefore, it was decided to adapt the protocol as follows:

To offer the same intervention to all participants (i.e. opportunity to speak to one's younger self) and use the personalised versus non-personalised avatars as the experimental manipulation separating the two groups.

Further, for the quantitative part of the study, which I undertook, it was important to consider which outcome instruments to use to measure potential changes in the variables of interest, namely self-compassion, self-criticism, fear of compassion, positive and negative affect. As research with similar protocols has been conducted previously (Falconer et al., 2014; 2016), I reviewed the outcome measures used in those studies to consider their suitability for the present one. The advantage of this was that it was an efficient way of choosing the outcome measures and it removed the need to "reinvent the wheel". Moreover, the outcome measures used in previous research were all tools that had been shown to have good psychometric properties, thus providing increased confidence that the variables of interest would be sufficiently captured by these tools. However, choosing the outcome measures of this study in this manner, meant that my curiosity was potentially dimmed, and I did not explore alternative options for outcome measures that might have been available.

Lastly, there were the various steps that participants would need to complete as part of this study, namely completing questionnaires before and after the intervention, finding and sharing pictures of themselves that met the specified criteria, and travelling to central London

to engage with the intervention. Thus, I worried that this study could potentially be perceived as too demanding, and therefore discourage individuals from expressing their interest in taking part. To mitigate this, I decided to attempt to reduce the demands on participants' resources by using shorter versions of the outcome measures.

More specifically, to measure fear of compassion, I used the Fear of Compassion Scale. This measure comprises of three subscales, the fear of compassion for the self, for others and from others. As this study focused on self-compassion, I decided to only use the fear of self-compassion subscale. In doing so, I wonder whether potential benefits in terms of behavioural and attitude changes in the experience of compassion to and from others have been missed in this study. Similarly, to measure negative affect, I only used the short version of the Positive and Negative affect scale, which only enquired about the experience of five negative emotions. Although this meant that the time required to complete the questionnaires was significantly shorter, in hindsight, I ponder whether utilising a more comprehensive measure for negative mood would have shown significant results.

3. Avatar creation software and process

Considering that neither myself nor Grigorakis had prior experience in virtual reality or digital character creation, the prospect of creating multiple personalised avatars was simultaneously exciting and stress-inducing. This meant that we were required to allocate sufficient time to learn how to use the specific software that was available to us, Character Creator, in order to create avatars for our participants. The help of our supervisor, Professor John King was invaluable in the process. However, the multiple, at first seemingly complicated, steps that one needs to follow to create avatars from beginning to end seemed

quite daunting. This was not helped by the realization that manipulating one seemingly small parameter of the avatars' appearance could lead to a plethora of error messages or could lead to the end product looking far different to what was initially envisioned. For a project that was exploring the efficacy of personalised avatars, this felt like an area of the project in which improvement was paramount adding to the pressure of completing this research project.

4. Participant recruitment and personalising avatars

While deciding on the process through which to recruit participants and the inclusion/exclusion criteria, the methods used in previous similar studies were considered. More specifically, Falconer et al. (2014) screened participants for self-criticism and set a cut-off point. Individuals scoring below this cut-off on a measure of self-criticism did not qualify to take part in their study. However, the protocols of our studies were different in terms of what was expected of participants. In our study, participants had to be able and willing to provide good-quality pictures of themselves when they were younger.

Further, there were time constraints, such as academic deadlines and completing clinical placements while conducting this study, which meant that recruitment had to be completed within a strict timeframe and without delays. For these reasons, due to highly specific inclusion criteria and competing time demands, it was decided that for the purposes of this study, participants would not be screened for self-criticism. Although this meant that we were able to complete the experiment portion of the study within the allocated time, I wonder whether our results would be more significant were we to offer the intervention to individuals who presented as highly critical of themselves and thus could possibly experience greater

gains following the virtual reality assisted intervention compared to others who might not be as self-critical.

Moreover, the process of creating personalised avatars for participants became more complicated once advertising the study began and potential participants started expressing their interest. One of the main criteria for taking part in this study was being able to provide a good-quality childhood picture of oneself, which would be used to create a personalised child avatar. I realised quickly that this could be a potential barrier for participants as many of those individuals who expressed interest in our study were not able to provide pictures that met the specified criteria, namely that the pictures were of good quality, well and evenly lit, with the whole face of participants visible and with a neutral facial expression.

These criteria were not arbitrarily chosen. They were put in place as the software used for avatar creation struggled to create avatars from pictures which did not meet said criteria. Alongside our eagerness to provide participants with good-quality avatars that they could relate to, it was important for us to do this well as there is research that links avatar-user closeness to the efficacy of virtual reality assisted interventions (Ratan & Dawson, 2016). However, engaging in the process of utilizing the software to create avatars from “imperfect” pictures led to avatars occasionally not coming close to the likeness of participants. Further, to my frustration, there were instances during which avatars seemed to be close to the picture used to create them, but then looked completely different when inputted to a different software, Unity, that configured them in a format that could be read by the virtual reality headset.

One specific aspect of creating avatars that seemed to hinder avatar-user closeness was our inability to occasionally match the avatar’s hair to that of the participants. The reason for this was due to a limited selection of hairstyles that were available to us via Character Creator.

This lack of diversity in hairstyles was more prominent for avatars of participant of colour and male participants. As much as I would have liked to create avatars that looked identical to our participants, due to our limited resources, mainly time during a busy clinical training course and the limitations of the resources available to me, there were occasions that I had to accept that “good enough” would have to suffice.

5. Experimental process

Once recruitment was underway and some participants had signed up for the study, the process of offering the virtual reality assisted intervention commenced. Prior to this, both Grigorakis and I had spent some time learning the various steps of undertaking the intervention. This involved using the virtual reality headset, transferring virtual avatars onto it and programming it recognise which avatars we wanted to use each time. Further, we familiarised ourselves with the smartphone application that was used to run the intervention as well as the different stages of the interventions that participants would go through (e.g. switching embodiment from adult to child). Even though the whole process was rehearsed multiple times, once we started seeing participants, we stumbled upon technical issues that we had not foreseen.

For instance, on occasion, the application would not load on the headset. At other times, the avatars would appear facing the wrong way (i.e. sitting on the virtual chair facing the wall). These instances were particularly stressful as it was often not clear to us at the time how to resolve these issues. Moreover, I worried that these technical issues might colour the participants' experience in a negative light and/or that they might perceive us as the researchers as unprepared or unprofessional. Luckily, participants seemed to always be

understanding and the process of providing the intervention became smoother as time went on.

6. Participants' Experience

As I have discussed in the empirical paper, there were some instances where participants expressed that they did not think the avatars looked like them or wondered which group they were allocated to as they were not sure whether their child avatar was personalised or not. This was disappointing to hear for many reasons.

Firstly, ensuring a positive participant experience was a paramount consideration when designing this study's intervention. I, therefore, perceived this feedback as evidence that participants did not find their experience to be as meaningful as they might have predicted or hoped. Further, it was worrisome in terms of the results of the study and the potential consequences of these expressed sentiments on the observed effects, if participants struggled to relate to their personalised avatars due to issues in the avatars appearance. Lastly, on a more personal level it was disheartening to hear that despite the hard work being put into creating these avatars, participants did not experience their avatars in the way I had hoped. However, this was often balanced by participants expressing that the intervention was nevertheless meaningful to them even if they did not think their avatars resembled them.

Upon reflection, it is understandable why participants might not have been able to see themselves in the avatars. One's own image is extremely personal and their relationship or attachment to this image can be complex. Childhood images might have been affected by the participants' memories, including events that might have occurred around the time that the childhood picture they provided was captured (Cassidy, Zebrowitz & Gutchess, 2012).

Further, the way one perceives oneself might differ from how others perceive them due to sensory differences and differences in perspective (Godina & Zadorozhnyay, 2016). It is therefore plausible that participants might have had a certain image of themselves at a younger age, which did not match that of the child avatar they were provided with, even when, in some cases, the avatars resembled the pictures of participants quite closely.

Furthermore, as mentioned in the empirical paper, participants might have been experiencing the effects of a concept called “Uncanny Valley”. This is a concept that was first described by Dr Mori, a Japanese researcher of robotics (Mori, MacDorman & Kageki, 2012). The uncanny valley phenomenon refers to the aversion that some individuals might experience in response to interacting with robots or digital avatars. Perceptions of robots and avatars has been suggested to exist on a spectrum – one side of which is avatars looking cartoonish and on the other side avatars looking extremely human-like.

Uncanny valley effects occur when avatars are perceived to be in the middle of this spectrum, which often happens due to subtle discrepancies in areas such as the avatar’s movements or facial expressions. These discrepancies can be experienced as imperfections which make the avatars appear unrealistic. Moreover, in this study, child avatars were only programmed to react by appearing to be distressed or calm. Participants often wondered whether their childhood avatars would respond back to them. It is possible that uncanny valley effects occurred, even for participants who perceived their avatars as human-like, due to the lack of the conversational aspect of the child avatars.

Lastly, I have reflected on the cultural differences that could have shaped the experience of different participants. Although this was not necessarily within the scope of this research project to analyse, participants were requested to provide demographic information, including their racial identity. The demographic questions used were automatically generated using one

of Qualtrix's templates. At the time, this seemed to be appropriate in providing the researchers with sufficient basic demographic information on our sample. However, I wonder whether this data set was too broad and placed participants in categories that might miss the nuance of their experience.

For instance, although there was a question around race, there were no questions about ethnicity, which would be of interest in acknowledging the diverse backgrounds of participants. This would be valuable as research exists which suggests that cultural differences can affect one's relationship with compassion and their fear of compassion (Steindl et al., 2020). Therefore, understanding the sample's cultural backgrounds could have provided some insights into the impact of this on their engagement with and experience of the virtual reality assisted intervention.

7. Conclusions

In this critical appraisal, I have considered the different aspects of conducting academic research as part of my thesis for the doctorate in clinical psychology course, including the rationale for decisions on the study's methods, challenges which I encountered and the learning that I developed through this process. This critical appraisal has allowed me to reflect, with the benefit of hindsight, on the important insights that the results of this study provided as well as the effects and potential consequences of some of the decisions that were made as described above.

One of the main takeaways of this critical appraisal is the significance of the appearance and functionality of avatars and how this can impact the experience of virtual reality assisted interventions for individuals. More specifically, creating avatars that closely resemble

individuals as well as exploring and furthering the integration of innovative technologies that could render the avatars more personable (e.g. able to hold simple conversations) would be an interesting opportunity for future research.

Whilst this study had some limitations, as discussed above, it provided important insights into the beneficial effects of utilising technology, namely virtual reality, in improving psychological states such as self-compassion and self-criticism. Despite the challenges encountered throughout the research process and the ambiguity that still exists in terms of the use of personalised avatars, I feel encouraged that participants experienced positive effects of increased self-compassion and reduced self-criticism following the intervention. This study adds to the growing evidence base on the novel ways that technology can be integrated in mental health support. Further research could build upon the findings of this study and expand our understanding of the efficacy of technology-assisted mental health interventions.

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Appendices:

Appendix A: Ethical Approval

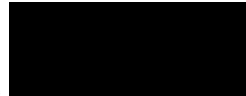
Amendment Approval Request Form

1	Project ID Number: CEHP/2021/587	Name and e-mail address of Principal Investigator: Prof John King, john.king@ucl.ac.uk
2	Project Title: Avatar embodiment within virtual reality	
3	Type of Amendment/s (tick as appropriate) Research procedure/protocol (including research instruments) ☒ Participant group ☐ Sponsorship/collaborators ☐ Extension to approval needed ☐ Information Sheet/s ☒ Consent form/s ☒ Other recruitment documents ☐ Other ☐ Please specify:	

Details of Amendments (provide full details of each amendment requested, state where the changes have been made and attach all amended and new documentation) <u>Section A3 – Contact details</u> Additional applicant 2 Full name: Spyridon Tsolakidis Position held: Trainee Clinical Psychologist (second year on Doctorate in Clinical Psychology course) Research Department: Clinical, education and health psychology Email: Spyridon.tsolakidis.18@ucl.ac.uk Telephone: 07403556233 Additional applicant 3 Full name: Georgios Grigorakis Position held: Trainee Clinical Psychologist (second year on Doctorate in Clinical Psychology course) Research Department: Clinical, education and health psychology Email: Georgios.grigorakis.15@ucl.ac.uk Telephone: 07857149484
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Declaration (to be signed by the Principal Researcher)

- I confirm that the information in this form is accurate to the best of my knowledge and I take full responsibility for it.
- I consider that it would be reasonable for the proposed amendments to be implemented.



Signature:

Date: 18/01/23.....

Appendix B: Participant information sheet

Participant information

Research project title:

Speaking to your younger self: Experiencing self-compassion in Virtual Reality.

Department:

Department of Clinical Psychology

Research team contacts details:

This study is being run by Georgios Grigorakis (georgios.grigorakis.15@ucl.ac.uk) and Spyros Tsolakidis (spyros.tsolakidis.18@ucl.ac.uk).

Principal Investigator: Professor John King (john.king@ucl.ac.uk).

Invitation

We would like to invite you to participate in this research project. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, it is important for you to read the following information carefully and discuss it with others if you wish. Please contact the researchers by email if anything is not clear, if you have questions, or if you would like more information about the study. You can also contact the researchers with any feedback, queries or concerns related to this study both during and after completion. Thank you for reading this.

Project information

What is the purpose of the project?

This project aims to explore whether engaging in self-compassion while being presented with an avatar of one's younger self in virtual reality is related to greater self-compassion following the intervention. Further, this study is interested in exploring the experience of engaging in this intervention. These findings will help improve our understanding of virtual reality-based interventions for individuals who might be struggling with self-criticism.

Previous research suggests that compassion-based virtual reality interventions can be very effective in reducing self-criticism and increasing self-compassion.

Who can participate in this research?

- Aged over 18 years old
- Able to provide 2 pictures:
 - 1 recent picture of yourself
 - and 1 picture of yourself as a child between approximately 6-14 years old (e.g. a yearbook picture)
 - Ideally these pictures will be well-lit, with neutral background and expression (e.g. passport style photo). However, they do not have to be perfect, we can use editing tools to make them easier to use to create the virtual reality avatars (e.g. remove background).
- Speak English
- No history of epilepsy and seizures
- No experiences of motion sickness
- Wanting to participate, with availability to travel into central London to complete the intervention

Taking part in this study

Do I have to take part?

Participation in this study is voluntary. It is up to you to decide if you want to take part and there are no disadvantages if you decide not to. If you do decide to take part, you will be asked to sign a consent form. You can drop out of this study at any time, even after you have signed the consent form, by simply contacting the researchers. You will not be asked to provide a reason for withdrawing.

What will happen if I decide to take part?

You will be invited to sign a consent form and complete some online questionnaires (the questionnaires will take about 15-20 minutes). Once registration is complete, you will be contacted to provide a recent picture of you and one of you when you were a child (between approximately 6-14 years old). These will be used to create your personalised avatars (one of your current self and one of your younger self). You will then be contacted to book your in-person virtual reality intervention.

At this point, there will be a randomisation process during which you will enter in one of the two groups. People in the first group (control) will have a personalised avatar of their current self and a generic avatar of their younger self. People in the second group (experimental) will have a personalised avatar of their current self as well as a personalised avatar of their younger self. Unfortunately, we cannot guarantee which group you will be placed in once you register. However, every participant will have the opportunity to engage with the virtual reality experience and have at least a personalised avatar of their current self.

Randomisation is a commonplace practice in research as it limits selection bias and helps balance the different groups in terms of known and unknown variables (e.g. demographics). The reason for the existence of the two groups is that so we can determine whether any potential changes that occur following the intervention might have been due to chance or due to the intervention in question.

After the session, you will be asked to repeat the questionnaires you completed initially. We will also ask you to participate in a further conversation about your experience with the virtual reality intervention. This conversation will be held either online or in person.

The virtual reality task will take about 45-60 minutes and another 15-20 minutes to repeat the questionnaires.

The follow-up conversation about your experience will take about 1 hour.

The whole process will take between 1-2 hours of your time.

Benefits and disadvantages of taking part

What are the benefits of taking part?

You will receive either academic credit (if you are a UCL undergrad student) or one £10 voucher (if you are not a UCL undergrad student).

All participants (students and non-students) who complete the follow-up conversation will also get an additional £10 voucher.

You might learn of new ways to be compassionate towards yourself.

Your participation in this study will help improve our understanding of virtual reality based interventions for self-compassion, which can hopefully in the future become more widely available as a form of therapeutic treatment.

What are the possible disadvantages of taking part?

The virtual reality-based intervention you will participate in is new and therefore does not have an extensive evidence base. However, we do not expect any risks to you. It is possible that taking part could bring up strong feelings. If this is the case for you, we can signpost you to appropriate services for mental health support.

We do not recommend taking part if you are currently struggling with severe low mood/depression, or are thinking about ending your life.

As the study involves using Virtual Reality technology, this might cause dizziness, nausea or sickness. The research team has ensured the intervention is safe, and you will be offered breaks, and the option to stop if you feel uncomfortable. If you have a history of epilepsy and seizures, you will not be able to take part in this study for your own safety.

Confidentiality

What if something goes wrong?

If you have any concerns at any point in the study you can raise feedback or concerns with the Principal Researcher, Professor John King (john.king@ucl.ac.uk).

If you feel your concerns have not been dealt with as you wanted, you can also contact the Chair of the UCL Research Ethics Committee at ethics@ucl.ac.uk.

Will my taking part in this project be kept confidential?

All the information we collect about you during the project will be kept confidential and will not be identifiable in any reporting or publication. Your data will be pseudonymised. A voice recording might be used for the follow-up conversation. These recordings will be securely stored on UCL servers and will be deleted as soon as the data has been analysed.

Are there any limitations to confidentiality?

Confidentiality will be maintained and respected. If there are any legal or safety concerns, e.g. regarding harm to participants or the public, relevant agencies may need to be informed. Please contact us if you have any further questions regarding confidentiality.

Please press next to view the Data Protection and Privacy note.

Thank you for reading this information sheet and for considering taking part in this research project.

If you would like to participate, please complete the registration form: <https://forms.office.com/e/kqCeJgXhN3>

Section

Appendix B: Data Protection Privacy Notice

The controller for this project will be University College London (UCL). The UCL Data Protection Officer provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk.

This 'local' privacy notice sets out the information that applies to this particular study. Further information on how UCL uses participant information can be found at: <https://www.ucl.ac.uk/legal-services/privacy/ucl-general-privacy-notice-participants-and-researchers-health-and-care-research-studies>

The information that is required to be provided to participants under data protection legislation (GDPR and DPA 2018) is provided across both the 'local' and 'general' privacy notices.

The lawful basis that will be used to process your personal data is: 'Public task' for personal data and 'research purposes' will be the lawful basis for processing special category data.

Your personal data will be processed so long as it is required for the research project. If we are able to anonymise or pseudonymise the personal data you provide we will undertake this and will endeavour to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at data-protection@ucl.ac.uk

You will create a pseudonymised code to complete the questionnaires, and this will be for data storage purposes. The data including completed questionnaires and follow-up recorded and transcribed conversations will be kept with the pseudonymised code by the researchers for analysis. Therefore your personal information will not be identifiable through use of a pseudonym code; the data will be stored such that your individual responses will not be traceable back to you.

Data including personal contact details will be deleted at the end of the project (September 2024). Data including pseudonymised questionnaire responses, pseudonymised interview transcripts, and pseudonymised demographic data, will be pseudonymised at the point of data analysis in September 2023, and stored indefinitely for study analysis and future research.

You can ask to withdraw from the project through their pseudonymised ID, and this would involve deletion of all of your data. The deadline for withdrawal is September 2023. After this date participants can request for their data to be deleted, however their responses will not be able to be removed from the current study analysis. It is important to note that even so, participant data will not be identifiable in the study analysis and confidentiality will be maintained as indicated above.

You can print a copy of your answer after you submit.

Study Registration

Please read the participant information sheet before completing this registration form:

<https://forms.office.com/e/cqpPZeHPyd>

* Required

Registration & Consent Form

1. I confirm that I have read and understood the participant information sheet, and have had the opportunity to consider my participation and ask any questions before deciding if I wish to participate *

☐ Yes

☐ No

2. I consent to participate in this study and be compensated by either a £10 voucher or academic credit. *

☐ Yes

☐ No

3. I confirm I understand and meet the inclusion criteria *

☐ Yes

☐ No

4. I consent to my data including completed questionnaires and follow-up conversation recordings to be stored confidentially by the research team; this includes registration data to be deleted at the end of the study (September, 2024), and pseudonymised data including questionnaire responses and follow-up conversation transcripts to be archived on password protected devices accessible by the research team

*

☐ Yes

☐ No

5. I consent to my data being pseudonymised for purposes of analysis, reporting and publication *

☐ Yes

☐ No

6. I consent to completing online questionnaires before and after the intervention

*

☐ Yes

☐ No

7. I consent to participating in the intervention, which will involve using virtual reality headsets and verbal interaction with avatars with the support of the researchers.

*

☐ Yes

☐ No

8. I understand that I may be asked to participate in a follow-up conversation about my experience with one of the researchers and receive an additional £10 voucher.

*

☐ Yes

☐ No

9. I confirm that I am aware of who to contact if I wish to raise any complaints about the study

*

☐ Yes

10. I confirm I understand confidentiality and any limitations when participating in this study

*

☐ Yes

☐ No

11. I confirm I am aware of the process to withdraw from the study if I decide so in future

*

☐ Yes

☐ No

12. I confirm I understand I will be asked to provide personal data including contact details, and special data including demographic information

*

☐ Yes

☐ No

13. I confirm I understand the legal basis for which I will be asked personal data is 'Public task', and for special data is 'research purposes' as explained under the 'Data Protection' section in the participant information sheet

*

☐ Yes

☐ No

14. Please write your name: *

15. Please generate a unique ID code, following:

First Letter of Forename, Last Letter of Surname, Month of Birth i.e. John Smith, November = JH11

Please keep note of this code as we will ask you to enter it prior to completing baseline questionnaires. *

16.

Please enter your email address so we can contact you to arrange a time for the intervention.

*

17. Please enter your phone number in case we can't get hold of you via email *



WOULD YOU LIKE TO SPEAK TO YOUR YOUNGER SELF?!

Take part in this exciting study exploring a virtual reality intervention for self-compassion!

WHO CAN PARTICIPATE?

You can take part in this study if you are:

- Over 18 years old
- You have a clear childhood photo
- You don't have a history of epilepsy/seizures
- You do not get motion sickness

WHAT DOES IT INVOLVE?

Participating in the study involves:

- Sending us one current and one childhood (6-14) photo of yourself
- Completing some brief questionnaires online
- Coming to UCL to complete a virtual reality experience (up to 60mins)
- Talking to us about your experience after engaging with the virtual reality intervention (up to 60mins)

WHY PARTICIPATE

By participating in this study:

- You can learn new ways of being more compassionate with yourself
- You will be contributing to an exciting area of new research
- You will be reimbursed for your time either via up to 2 £10 vouchers or academic credit

CONTACT US:

If you are interested in this study please contact us for more information:

georgios.grigorakis.15@ucl.ac.uk
spyridon.tsolakidis.18@ucl.ac.uk

Or scan the QR codes to read the participant information and register your interest

Registration form:
Participant information:



This is a Doctoral Research study and it funded by UCL.
Approved by the PaLS Ethics Committee (Project ID Number: CEHP/2021/587)





THANK YOU FOR TAKING PART IN THE SPEAKING TO MY YOUNGER SELF STUDY



It could be that after having had the virtual reality experience, you might be left with some strong feelings even following our debrief.

If that is the case for you, please find a list of resources that might be helpful with coping with and expressing those feelings in order to feel better.

- **My friend and family**

You can speak to your friends and family about your experience and your feelings, if you feel comfortable and safe to do so.

- **My GP**

Monday to Friday between 9am and 5pm you can contact your GP to discuss how you are feeling. They can provide advice or signpost you to other helpful services.

- **The Samaritans - 116 123**

The Samaritans is a helpline service that offer support every day at all times of the day for people struggling with their mental health.

- **SANeline - 0300 304 7000**

SANeline is a specialist mental health helpline that is open daily from 4.30pm to 10.30pm

- **My local Improving Access to Psychological Therapies Service (IAPT)**

Every council has its own IAPT service, which provides support for people struggling with depression and anxiety. You can look up IAPT and your local area and find the contact details for your local IAPT service.

- **NHS 111**

This is a helpline for urgent help, but not for threatening emergencies

- **NHS 999**

Please call 999 in an emergency if you worry that you might not be able to keep yourself safe

Please do not hesitate to contact us with any questions you might have or if you have decided to withdraw from the study.

georgios.grigorakis.15@ucl.ac.uk
spyridon.tsolakidis.18@ucl.ac.uk

You will receive your voucher(s) and/or academic credit at the end of the study

This is a Doctoral Research study and it funded by UCL.
Approved by the PaLS Ethics Committee (Project ID Number: CEHP/2021/587)



Appendix F: Outcome measures Qualtrics form

Thank you for agreeing to take part in this research study! In the next few pages you will find some questions about yourself that have to do with self-compassion, self-criticism and positive and negative emotions. Please read the instructions carefully and answer all the questions. This process should take about 15-20 minutes.

Study ID code What is your unique study ID code? (First Letter of Forename, Last Letter of Surname, Month of Birth)

Q18 How old are you?

Q21 How do you describe yourself?

- ☐ Male (1)
- ☐ Female (2)
- ☐ Non-binary / third gender (3)
- ☐ Prefer to self-describe (4)

☐ Prefer not to say (5)

Q16 What best describes your ethnic origin?

- ☐ White (1)
- ☐ Black/African/Caribbean (2)
- ☐ Asian (Indian, Pakistani, Bangladeshi, Chinese, any other Asian background) (3)
- ☐ Mixed two or more ethnic groups (4)

- ☐ Other (Arab or any others) (5)
 - ☐ Prefer not to say (6)
-

Q19 What is the highest level of education you have completed?

- ☐ Some Primary (1)
 - ☐ Completed Primary School (2)
 - ☐ Some Secondary (3)
 - ☐ Completed Secondary School (4)
 - ☐ Vocational or Similar (5)
 - ☐ Some University but no degree (6)
 - ☐ University Bachelors Degree (7)
 - ☐ Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS) (8)
 - ☐ Prefer not to say (9)
-

Q20 What best describes your employment status over the last three months?

- ☐ Working full-time (1)
 - ☐ Working part-time (2)
 - ☐ Unemployed and looking for work (3)
 - ☐ A homemaker or stay-at-home parent (4)
 - ☐ Student (5)
 - ☐ Retired (6)
 - ☐ Other (7)
-

Q23 Do you consider yourself to have a disability?

- ☐ Yes (1)
 - ☐ No (2)
 - ☐ Prefer not to say (3)
-

Q24 How would you describe your disability?

When things go wrong in our lives or don't work out as we hoped, and we feel we could have done better, we sometimes have negative and self-critical thoughts and feelings. These may take the form of feeling worthless, useless or inferior etc. However, people can also try to be supportive of themselves. Below are a series of thoughts and feelings that people sometimes have. Read each statement carefully and choose the statement that best describes how much each statement is true for you.

	Not at all like me (1)	A little like me (2)	Moderately like me (3)	Quite a bit like me (4)	Extremely like me (5)
I am easily disappointed with myself.	0	0	0	0	0
There is a part of me that puts me down.	0	0	0	0	0
I am able to remind myself of positive things about myself.	0	0	0	0	0
I find it difficult to control my anger and	0	0	0	0	0

frustration at
myself.

I find it easy
to forgive
myself.

There is a
part of me
that feels I
am not good
enough.

I feel beaten
down by my
own self-
critical
thoughts.

I still like
being me.

I have
become so
angry with
myself that I
want to hurt
or injure
myself.

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

I have a sense of disgust with myself.	0	0	0	0	0
I can still feel lovable and acceptable.	0	0	0	0	0
I stop caring about myself.	0	0	0	0	0
I find it easy to like myself.	0	0	0	0	0
I remember and dwell on my failings.	0	0	0	0	0
I call myself names.	0	0	0	0	0
I am gentle and supportive with myself.	0	0	0	0	0
I can't accept failures and setbacks without	0	0	0	0	0

feeling inadequate					
I think I deserve my self-criticism.	0	0	0	0	0
I am able to care and look after myself.	0	0	0	0	0
There is a part of me that wants to get rid of the bits I don't like.	0	0	0	0	0
I encourage myself for the future.	0	0	0	0	0
I do not like being me.	0	0	0	0	0

Different people have different views of compassion and kindness. While some people believe that it is important to show compassion and kindness in all situations and contexts, others believe we should be more cautious and can worry about showing it too much to ourselves and to others. We are interested in your thoughts and beliefs in regard to expressing kindness and compassion towards yourself.

Below are a series of statements that we would like you to think carefully about and then tick the option that best describes how each statement fits you.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I feel that I don't deserve to be kind and forgiving to myself (1)	0	0	0	0	0
If I really think about being kind and gentle with myself it makes me sad (2)	0	0	0	0	0
Getting on in life is about being tough rather than compassiona te (3)	0	0	0	0	0
I would rather not	0	0	0	0	0

know what
being 'kind
and
compassiona
te to myself'
feels like (4)

When I try
and feel kind
and warm to
myself I just
feel kind of
empty (5)

I fear that if I
start to feel
compassion
and warmth
for myself, I
will feel
overcome
with a sense
of loss/grief
(6)

I fear that if I
become
kinder and
less self-

0

0

0

0

0

0

0

0

0

0

0

0

0

0

0

critical to
myself then
my standards
will drop (7)

I fear that if I
am more self
compassiona

te I will	0	0	0	0	0
become a					
weak person					
(8)					

I have never
felt
compassion
for myself, so

I would not	0	0	0	0	0
know where					
to begin to					
develop					
these					
feelings (9)					

I worry that if
I start to
develop
compassion
for myself I

0	0	0	0	0
---	---	---	---	---

will become
dependent
on it (10)

I fear that if I
become too
compassiona
te to myself I
will lose my
self-criticism
and my flaws
will show (11)

0	0	0	0	0
---	---	---	---	---

I fear that if I
develop
compassion
for myself, I
will become
someone I
do not want
to be (12)

0	0	0	0	0
---	---	---	---	---

I fear that if I
become too
compassiona
te to myself
others will
reject me
(13)

0	0	0	0	0
---	---	---	---	---

I find it easier to be critical towards myself rather than compassiona te (14)	0	0	0	0	0
I fear that if I am too compassiona te towards myself, bad things will happen (15)	0	0	0	0	0

Below, there are several statements describing various situations. Accompanying each statement is a list of possible reactions that you may have in response to yourself during these situations. We would like you to rate on the scales the extent to which you would react to yourself in response to each statement, as if it were happening at this moment in time.

You arrive home to find that you have left your keys at work

Strongly disagree (1)	Disagree (2)	Somewh at disagree (3)	Neither agree nor disagree (4)	Somewh at agree (5)	Agree (6)	Strongly agree (7)
-----------------------------	-----------------	---------------------------------	--	---------------------------	--------------	-----------------------

Reassuring (1)	0	0	0	0	0	0	0
Soothing (2)	0	0	0	0	0	0	0
Contemptuo us (3)	0	0	0	0	0	0	0
Compassion ate (4)	0	0	0	0	0	0	0
Critical (5)	0	0	0	0	0	0	0
Harsh (6)	0	0	0	0	0	0	0

You receive a letter in the post that is an unpaid bill reminder

	Strongly disagree (1)	Disagree (2)	Somewh at disagree (3)	Neither agree nor disagree (4)	Somewh at agree (5)	Agree (6)	Strongly agree (7)
Reassuring (1)	0	0	0	0	0	0	0
Soothing (2)	0	0	0	0	0	0	0
Contemptuo us (3)	0	0	0	0	0	0	0

Compassion							
ate (4)	0	0	0	0	0	0	0
Critical (5)	0	0	0	0	0	0	0
Harsh (6)	0	0	0	0	0	0	0

You have just dropped and scratched your new Smartphone

	Strongly disagree (1)	Disagree (2)	Somewh at disagree (3)	Neither agree nor disagree (4)	Somewh at agree (5)	Agree (6)	Strongly agree (7)
Reassuring (1)	0	0	0	0	0	0	0
Soothing (2)	0	0	0	0	0	0	0
Compassio nate (3)	0	0	0	0	0	0	0
Contemptuo us (4)	0	0	0	0	0	0	0
Critical (5)	0	0	0	0	0	0	0
Harsh (6)	0	0	0	0	0	0	0

You have just opened the washing machine door to find that your white wash has turned pink

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
Reassuring (1)	0	0	0	0	0	0	0
Soothing (2)	0	0	0	0	0	0	0
Contemptuous (3)	0	0	0	0	0	0	0
Compassionate (4)	0	0	0	0	0	0	0
Critical (5)	0	0	0	0	0	0	0
Harsh (6)	0	0	0	0	0	0	0

After searching your bag, you realise that you have lost a £20 note

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)

	disagree (4)						
Reassuring (1)	0	0	0	0	0	0	0
Soothing (2)	0	0	0	0	0	0	0
Contemptuo us (3)	0	0	0	0	0	0	0
Compassion ate (4)	0	0	0	0	0	0	0
Critical (5)	0	0	0	0	0	0	0
Harsh (6)	0	0	0	0	0	0	0

I-PANAS-SF Thinking about yourself and how you normally feel, to what extent do you generally feel:

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)
Upset (1)	0	0	0	0	0
Hostile (2)	0	0	0	0	0
Alert (3)	0	0	0	0	0
Ashamed (4)	0	0	0	0	0
Inspired (5)	0	0	0	0	0
Nervous (6)	0	0	0	0	0

Determined (7)	0	0	0	0	0
Attentive (8)	0	0	0	0	0
Afraid (9)	0	0	0	0	0
Active (10)	0	0	0	0	0

Below are a series of words that describe different positive emotions. Some of these emotions relate to feeling lively, energised and excited, whereas others relate to feelings of being relaxed, calm and peaceful. We are interested in the degree to which you commonly experience these feelings.

On the right-hand side of the emotion words we would like you to rate how characteristic these feelings are of you by using the following scale:

	Does not describe me (1)	Describes me slightly well (2)	Describes me moderately well (3)	Describes me very well (4)	Describes me extremely well (5)
Secure (1)	0	0	0	0	0
Calm (2)	0	0	0	0	0
Active (3)	0	0	0	0	0
Laid back (4)	0	0	0	0	0
Lively (5)	0	0	0	0	0
Energetic (6)	0	0	0	0	0
Serene (7)	0	0	0	0	0

Eager (8)	0	0	0	0	0
Dynamic (9)	0	0	0	0	0
Safe (10)	0	0	0	0	0
Warm (11)	0	0	0	0	0
Content (12)	0	0	0	0	0
Excited (13)	0	0	0	0	0
Adventurous (14)	0	0	0	0	0
Tranquil (15)	0	0	0	0	0
Peaceful (16)	0	0	0	0	0
Enthusiastic (17)	0	0	0	0	0
Relaxed (18)	0	0	0	0	0

Appendix G: Joint project acknowledgement

This research project was conducted jointly with Georgios Grigorakis. We collaborated on developing the concept for the adaptation of the virtual reality paradigm and the methods and protocol for the intervention. Further, we undertook the recruitment of participants, and we shared the responsibility of seeing participants and providing the virtual reality assisted intervention. Following this, I focused on the quantitative part of the study by analysing the data from the outcome measures participants completed prior to and after the intervention. Grigorakis conducted separate interviews with some of the participants and utilised their feedback for the qualitative part of the study on the experience of participants engaging with the virtual reality assisted intervention.