An Investigation Into Anxiety In Virtual Reality Following A Self-Compassion Induction

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22nd April 2016

Word Count: 7300

Thesis submitted as a requirement for the degree of MSc in Cyberpsychology, Dun Laoghaire Institute of Art, Design and Technology, 2016.

Declaration

This Thesis is entirely my own work, and has not been previously submitted to this or any other third level institution.

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Date: _____

Acknowledgements

I would like to express my sincere gratitude to my supervisor Rob Griffin who has been of great assistance and encouragement throughout this project.

I would also like to thank Cliona Flood, Grainne Kirwan, Hannah Barton and Nicola Porter who kindly allowed me to come to their classes to inform their students about my experiment with a view to finding volunteers. I would also like to thank Pat Moffat and Marion Palmer for their assistance.

This project could not have happened if I had not had the love and support over the years of my mother Rose, and my late father Gerard. Thank you both, from the bottom of my heart. A big thank you too to my old friend David Hevey whose assistance was very valuable. Last but not least I would like to thank my partner Eithne who is both kind and wise and from whom I learn so much every day.

Table Of Contents

Abstract

Self-compassion practices may enhance virtual reality (VR) exposure therapy's effectiveness for social anxiety disorder. This study investigated if a self-compassion induction (i.e. compassionate letter writing) influenced self-reported anxiety in VR. 27 third level students were randomly assigned to one of two induction conditions (compassion or control) and verbalised their VR experiences. As hypothesised the VR experience increased state anxiety. However the compassion induction did not influence state anxiety. Thematic analysis of qualitative data revealed that participants had strong emotional responses to the main VR avatar and that this was related to mental states that were attributed to it. These results contribute to research suggesting that certain VR environments can be effective as social exposures for VR exposure therapy.

Introduction And Literature Review

> To date, there is no clear evidence that compassion cultivation and compassionate mind training will help socially anxious people, but there is a lot of indirect evidence that it might. (Gilbert, 2014, p. 45)

Social anxiety disorder (SAD), also known as social phobia, is a common and persistent mental health problem (American Psychiatric Association, 2013; Pilling et al., 2013). It is most notably characterised by an intense fear or anxiety regarding social situations. Individuals with SAD perceive themselves to be subject to scrutiny and judgement by others and tend to avoid social situations that are perceived to be threatening, or to endure such situations with significant discomfort (Clark & Wells, 1995; Rapee & Heimberg, 1997). SAD is estimated to be one of the most common mental health disorders, with a lifetime prevalence rate in Europe of 6.7% (range 3.9-13.7%; Fehm, Pelissolo, Furmark & Wittchen, 2005) and has a high comorbidity rate with other mental health problems, notably depression and substance abuse (Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992; Szafranski, Talkovsky, Farris & Norton, 2014). Estimates are that only about one in three people affected will seek professional help (Ruscio et al., 2007) and symptoms tend to not improve without treatment (Bruce et al., 2008). SAD is recognised to have two sub-types, namely a generalised form manifesting as widespread fear of social situations, and a non-generalised form where the phobia is focused on specific social situations, such as public speaking (Blackmore & Heimberg, 2008*)*.

The most well-researched psychological treatment for social anxiety disorder is

cognitive behavioural therapy (CBT; Rodebaugh, Holaway, & Heimberg, 2004). According to NICE (2013), individual CBT is the first choice of treatment for SAD and is recommended ahead of drug therapy. CBT typically combines a number of aspects, two of the most central being cognitive restructuring and graduated exposure. Graduated exposure is traditionally offered by getting the client to imagine or recall the feared situations (sometimes referred to as "imagination-based" exposure) or by using real-world situations or physical props (known as "*in vivo*" exposure). In reviewing CBT it has been found that it is the combination of cognitive restructuring and graduated exposure rather than exposure alone that brings about the most effective and lasting gains from therapy (Blackmore & Heimberg, 2008).

Another approach to treating SAD is virtual reality exposure therapy (VRET), also referred to as virtual reality graduated exposure therapy (VRGET) or experiential cognitive therapy (ECT). Research into using immersive virtual reality (VR) to deliver the exposure aspect of CBT in a range of phobias including SAD has been ongoing since the 1990's (Wiederhold & Wiederhold, 2005). VRET is typically some blend of the following: graduated exposure using VR, cognitive restructuring, relaxation training and biofeedback (Wiederhold & Wiederhold, 2005). Three meta-analyses of VRET have been published to date (Opris et al., 2012; Parsons & Rizzo 2008; Powers & Emmelkamp, 2008*)*. These meta-analyses taken together indicate that VRET is as effective in treating anxiety disorders as conventional CBT (Morina, Ijntema, Meyerbröker & Emmelkamp, 2015). However, it has also been pointed out that a majority of published VRET trials have used small sample sizes and heterogeneous outcome measures making it difficult to accurately assess its effectiveness (Parsons, 2015). Therefore given that many of the existing studies have methodological limitations some caution needs to be exercised in judging VRET's

efficaciousness at present (McCann et al., 2014).

According to Wiederhold and Bouchard (2014) VRET has certain advantages over *in vivo* or imagination-based exposure, including the following: clients typically report that they "enjoy" VR; therapists find it cost effective to use when compared to *in vivo* exposure; it can be especially good for clients who find imagining difficult; and it allows for a flexible and controlled exposure to the phobic situation. Some disadvantages of VRET have also been cited. One has been that it may be costly for therapists to acquire VR equipment and relevant software (Rowa, Milosevic & Antony, 2014). Given that the cost of VR equipment is dropping with the advent new headsets such as the Oculus Rift (Oculus VR, 2015) this may be less a barrier to entry. Another factor is that in cases of co-morbidy of conditions caution needs to be exercised (Eichenberg & Wolters, 2012). In addition imagination-based exposure currently adds no additional cost or technical requirements to therapy and is more familiar to therapists. A possible barrier to the wider adoption of VRET within clinical settings is the need for therapist awareness and training on how to integrate VR technologies into existing practice (Wiederhold & Bouchard, 2014).

A relatively new model for SAD, based on evolutionary psychology, with an accompanying treatment approach, is Compassion Focused Therapy (CFT; Gilbert, 2014). Compassion and self-compassion as defined by Gilbert involves a sensitivity to the suffering in oneself or others combined with a commitment to doing something about it (Empathy and Compassion in Society, 2012). In this way self-compassion is viewed as a form of motivation that can help organise a person's overall perspective. A recent systematic review has found that CFT is beneficial for mood disorders especially where high self-criticism is present (Leaviss & Uttley, 2014). In their review of loving kindness meditation and compassion meditation Hoffman, Grossman and Hinton (2011) concluded that such

practices offer potential therapeutic benefits when combined with CBT.

Other definitions of compassion have also been proposed. According to the prominent compassion researcher Kristin Neff (2003) self-compassion can be thought of has having three components: kindness, a sense of common humanity and mindfulness. Compassionate Mind Training (CMT) is an example of a therapy program that provides guidance on using self-compassion in supporting mental well being (Gilbert & Procter, 2006). The goal of CMT is to help clients in therapy to develop an ability to self-soothe and develop a warmer kinder attitude towards themselves and their imperfections. Neff has also developed a set of self-compassion exercises that includes compassionate letter writing (Neff, 2015). Compassionate letter writing is also promoted by Gilbert (2010); there is evidence that expressive writing can grant an outlet for exploring and gaining perspective on difficult situations and emotions (Pennebaker, 1997). Leary, Tate, Adams, Batts and Hancock (2007) reported that across five studies self-compassion was an important factor in moderating distressing events and that it had certain distinct advantages over raised self-esteem that make it an attractive avenue for therapeutic intervention. Neff, Kirkpatrick and Rude (2007) found that self-compassion helped protect against self-evaluative anxiety in a mock job interview. They found that in terms of personality traits higher scores in self-compassion were associated with positive affect, curiosity, and exploration while those with lower scores tended to have more negative affect and neuroticism. Lincoln, Hohenhaus and Hartmann (2013) employed a self-compassion induction before exposure to a mildly distressing experience in order to see how it might influence paranoid anxiety. They found that the self-compassion induction reduced the negative impact of the distressing experience.

A number of studies have examined how self-compassion and self-esteem can be combined with VR to investigate therapy-targeted psychological processes such as anxiety.

Falconer et al. (2014) looked at how embodiment in VR assisted with enhanced self-compassion. Atherton et al. (2014) performed a study on how self-esteem might influence paranoid anxiety in VR. They found that an induction that momentarily increased self-esteem had a significant effect on lowering paranoid reactions in VR as compared to an induction that momentarily reduced self-esteem. Their study was based on a sample made up exclusively of males who were identified as being vulnerable to paranoia.

Experiments using a variety of challenging social exposures in VR have been conducted that demonstrate that such environments can increase state levels of anxiety or discomfort. This was examined in the case of public speaking in VR (Owens & Beidel, 2015); a party scene in VR (Parrish, Oxhandler, Duron, Swank & Bordnick, 2015); conversing one on one with an avatar (Powers et al., 2013); a mock blind date and a mock job interview in VR (Hartanto, Kampmann, Morina, Emmelkamp, Neerincx & Brinkman, 2014; Morina, Brinkman, Hartanto & Emmelkamp, 2014). According to Foa and Kozak (1986) the fear response to a situation driving a phobia needs to be activated and worked with in order for exposure therapy to be effective. In some cases semi-structured interviews have been used to gain insight into participants' subjective reactions to avatars in VR (Freeman et al., 2003; Fornells-Ambrojo et al., 2013). According to Blascovich et al. (2002) VR environments populated with avatars offers a powerful tool for primary research in social psychology.

The Present Study

The present study investigates how a self-compassion induction might influence state anxiety in a VR environment populated by one potentially anxiety-provoking prominent avatar and three background avatars. A mixed methods approach was chosen that

incorporated both quantitative and qualitative data. The first hypothesis was that there would be a statistically significant increase in state anxiety globally post-VR exposure compared to pre-VR exposure. This would indicate that this VR environment might be a valid social exposure for treating social anxiety. The second hypothesis was that the increase in state anxiety would be less for participants in the compassion group compared to the control group. This would indicate that a self-compassion induction might have potential to be incorporated into existing VRET protocols in order to assist clients with emotional regulation during graduated exposure. A thematic analysis examines the most commonly occurring experiences during VR exposure.

Method

Design

A between-subjects experimental design investigated the influence of self-compassion on self-reported anxiety in VR. State anxiety was measured across three time points: after a sample VR experience, after an induction and after VR exposure. Participants were randomised into two groups: a compassion-induction group and a control group.

Ethics Statement

The Ethics Committee of the Dun Laoghaire Institute of Art, Design and Technology approved this project. Written informed consent was obtained from all participants.

Participants

27 third level students were recruited by convenience sampling. Participants were not informed of the subject matter of the study until completion of testing. Testing took place during February and March 2016.

Self-Compassion And Control Inductions

Two inductions were used in this experiment, a self-compassion induction and a similarly-structured control induction. The self-compassion induction was based on a self-compassion exercise devised by Neff and Lamb (2009) entitled “Exploring self-compassion through writing”. To begin participants were instructed to watch a short video entitled “2-Minute Tips: How to Practice Self-Compassion”, (UMNCSH, 2013). Then they worked through an instruction sheet with four steps. First they recalled a recent difficult time in their lives where they may have benefitted from more self-compassion. Second they were

instructed to try to think of themselves from the perspective of an unconditionally loving imaginary friend who is offering compassionate support in the difficult situation. Third they completed a writing task that involved writing a brief supportive letter to themselves from the point of view of the compassionate friend. Finally participants were invited to reflect on the letter's content and to allow its sentiments to sink in.

The control induction was similarly structured but had different content. Participants began by watching a short video entitled “Recipe: simple 2 egg omelette" (Tannah Food, 2011). Following this participants worked through an instruction sheet with four steps. First they were asked to recall a recent time when they wanted to prepare a simple meal. Next they were told to try to think about themselves from the perspective of a skillful cook who is available for coaching on how to cook well. This was followed by a writing task that took the form of writing a supportive letter to themselves from the point of view of the skillful cook. Finally they were invited to reflect on the letter's content and to allow its sentiments to sink in. Complete induction scripts are available in the Appendix G.

Measures

Self-compassion Scale - Short Form (SCS-SF). The 12 item SCS-SF measures levels of self-reported self-compassion attitudes and behaviours using a 5-point Likert-scale (Raes, Pommier, Neff & Van Gucht, 2010). Total scores range from 1 to 5 with higher scores indicting higher self-compassion. The SCS–SF demonstrated internal consistency (Cronbach’s alpha $\geq .86$) and a strong correlation with Neff's (2003) long form SCS ($r \geq .97$ all samples) and therefore represents a reliable and valid alternative to the widely used SCS (Raes et al. , 2010).

Liebowitz Social Anxiety Scale – Self Report (LSAS-SR). This measure reliably

measures trait social anxiety (Fresco et al., 2001; Rytwinski et al., 2009). It is derived from the clinically-administered Liebowitz Social Anxiety Scale (LSAS; Heimberg et al., 1999; Liebowitz, 1987). Total scores range from 0 to 144 with higher scores indicating higher social anxiety. A score between 30 and 60 is indicative of non-generalised social anxiety while a score of greater than 60 is indicative of generalised social anxiety (Mennin et al., 2002; Rytwinski et al., 2009). The self-report measure performs similarly to the clinician-administered version and reliability estimates range from .88 to .95 (Fresco, was et al above 2001; Oakman, Amerigen, Mancini & Favolden, 2003).

Six-item State-Trait Anxiety Inventory (STAI-6). This measure was developed by Marteau & Bekker (1992) as an efficient and reliable way to measure state anxiety. It is derived from the 20-item Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch & Lushene, 1970). The STAI-6 has correlation coefficients greater than .90 and it was deemed to have reliability and validity for assessing state anxiety comparable to the original STAI (Marteau & Bekker, 1992; Tluczek, Henriques & Brown, 2009). Scores range from 20 to 80 with higher scores indicating higher state anxiety.

Presence measures. A single-item measure of presence in VR was used based on Bouchard et al. (2004), who reported high levels of test-retest reliability (.81-.83) in two separate samples. Single item measures of presence have been used in a number of studies in VR (e.g. Bouchard et al., 2012; Bouchard, St-Jacques, Robillard & Renaud, 2008; Grinberg, Careaga, Mehl, & O'Connor, 2014). While the person was in VR they were asked: "To what extent do you feel present in the VR environment, as if you are really there, on a scale of 0 to 10, where 0 would indicate that you feel no presence and 10 would indicate that you feel totally present?"

Since the existence of social presence or copresence was also deemed important for

this environment to be a valid manipulation a second question asked at the interview stage: "Did you feel like you were present with someone else in virtual reality? Can you score this on a scale of 0-5, where 0 equates to not feeling like being with someone and 5 equates to really feeling like you were with someone."

Experience using VR. Participants rated their experience using VR on a 4 point scale: 0 = Never that I am aware; 1 = Once or twice; 2 = A few times (3-9); 3= Quite a bit (10+ times).

Cybersickness. One question was asked at the end of the semi-structured interview to assess the intensity of VR-induced symptoms and effects. This was based on the single item measure used by Hoffman, Garcia-Palacios, Carlin, Furness and Botella-Arbona, 2003. The question was worded as follows: "Did you feel any nausea or discomfort in virtual reality? Can you score this on a scale of 0-5, where 0 equates to not feeling any nausea or discomfort and 5 really maximum nausea or discomfort."

Virtual Reality

The VR technology used was the Oculus Rift Developer Kit 2 running on a PC with the following specification: 64-bit Microsoft Windows 7 Professional operating system, Intel Xeon CPU running at 2.30GHz (2 processors), 16GB internal RAM, NVIDIA Quadro K4000 graphics card. In regard to software two VR environments were used which will be described in the following sections.

The first VR environment was entitled Ambient Occlusion Room (Knabe, 2015). It comprised a room containing inanimate objects and furniture (see Figure 1). The participant could look around the room but not move. The participant had no representation of their body in VR. There was no audio in this environment. The purpose of the first VR experience

was the habituate the participant to VR in order to control for novelty.

Figure 1. Ambient Occlusion Room

The second VR environment was entitled Coffee Without Words (Knabe, 2015). It involved the participant sitting in a cafe (see Figure 2). At the beginning of the experience the title “Coffee Without Words” appeared briefly and then the screen faded to the cafe. The participant was seated at a small table opposite a female computer-controlled digital character, i.e. an avatar who appeared to be approximately one metre away. The avatar's range of behaviour was to move her head and eyes in a pattern to approximate natural human gaze behaviour, occasionally looking at the participant in the eyes and occasionally looking around the room (Knabe, 2014). The avatar did not speak. In addition three other avatars appeared in the background as greyed-out figures. The greyed-out avatars did not look in the direction of the participant and did not move around or move closer to the participant at any time. Additional screen shots of the VR environment can be found in Appendix H. The participant had a simple representation of a body in VR that they would see when they

looked down (see Figure 3). The participant's virtual body was fixed and static and didn't respond to the participant's movement. The virtual body always appeared masculine and this did not vary between male and female participants. The audio in the VR experience was comprised of background cafe noises rendered in stereo and played at a medium volume setting using the built in PC speakers.

Figure 2. Coffee Without Words

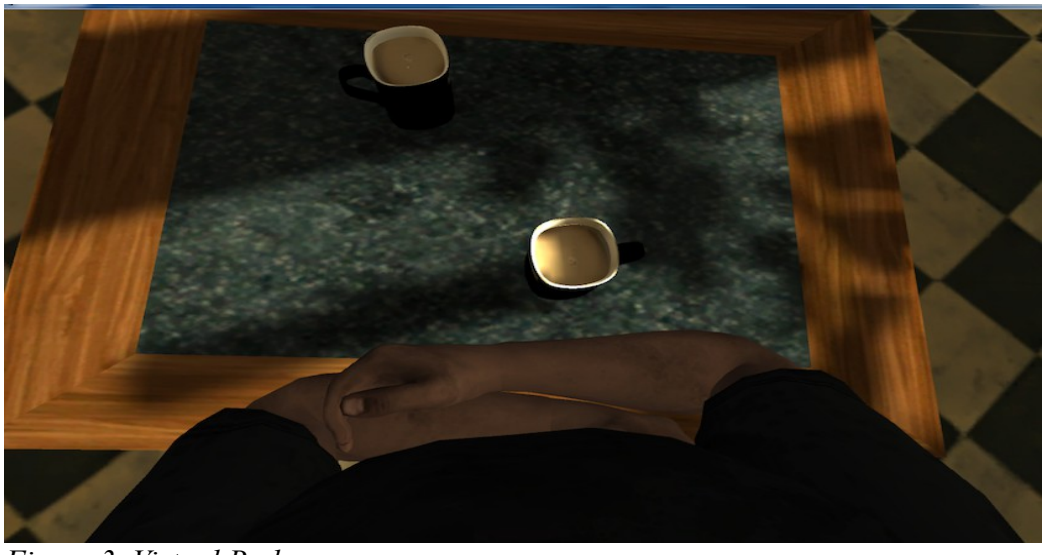

Figure 3. Virtual Body

Procedure

Participants were randomly assigned (blocked by gender) to either the self-compassion induction or the control induction using a pre-generated randomisation schema derived from the web site https://www.random.org (Haahr, n.d.). Participants completed a demographics survey followed by the SCS-SF and LSAS-SR. The participant then entered the first VR experience for approximately one minute. Following this the STAI-6 questionnaire was completed to measure baseline state anxiety (referred to in the Results section as "Time point 1" or "T1"). Participants then completed one of the two inductions. The STAI-6 questionnaire was then retaken so as to track anxiety levels after the induction and just before entering VR (T2). The participant then entered the second VR experience. Before entering this VR experience the participant was instructed on the think aloud protocol (TAP; see Table 1 for details of the instruction). Think aloud protocols have been widely used in cognitive science in order to gather data on thinking processes as it occurs for a participant in real time (Hevey, 2010). The participant spent approximately five minutes in this VR environment. While in VR sense of presence was checked for. Upon leaving VR the STAI-6 questionnaire measure was taken a third time (T3). Following this a brief semi-structured interview (SSI) was conducted that took approximately five minutes (see Table 2 for details of the questions asked). The experiment was brought to a conclusion by debriefing the participant. A flow chart of the procedure can be see in Figure 4.

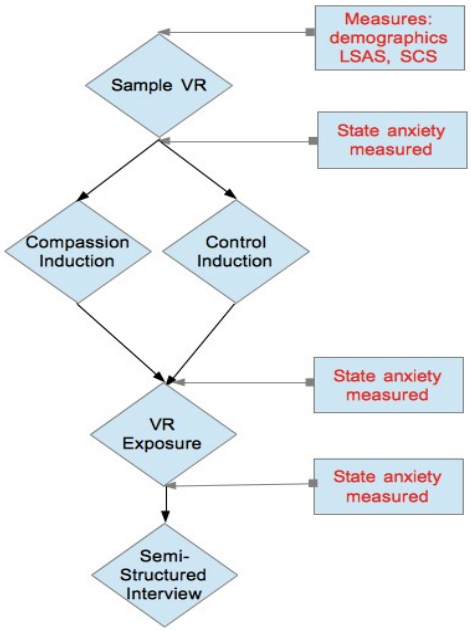

Figure 4: Flowchart of the experimental procedure

Table 1: Think Aloud Protocol (TAP) Instruction

TAP instruction	"*So just before putting the virtual reality headset on I need to go over something first. So you'll be in virtual reality for about 5 minutes. Can I suggest that while you are in virtual reality that you feel free to say aloud whatever thoughts and feelings you are experiencing there, insofar as this is comfortable for you. Does that make sense?*"

Table 2: Semi-Structured Interview (SSI) Questions

Q1	First of all can you tell me what impression you had of the virtual reality experience overall?
Q2	What thoughts and feelings did you notice yourself having during the experience?
Q3	What thoughts and feelings did you find yourself having towards the main character in virtual reality, who was sitting opposite you in the cafe?
Q4	What thoughts and feelings did you notice yourself having towards yourself in virtual reality?
Q5	Do you think that the video clip you watched earlier and the exercise you did after that influenced you in any way in how you responded in virtual reality?
Q6	Did you feel like you were present with someone else in virtual reality? Can you score this on a scale of 0-5, where 0 equates to not feeling like being with someone and 5 equates to really feeling like you were with someone.
Q7	Did you feel any nausea or discomfort in virtual reality? Can you score this on a scale of 0-5, where 0 equates to not feeling any nausea or discomfort and 5 really maximum nausea or discomfort.

Thematic Analysis

In order to undertake the qualitative analysis the audio recorded TAPs and SSIs were transcribed and any personal identifying information was deleted. Digital recordings were destroyed once accuracy of the transcripts was confirmed by sampling by an independent reviewer. The author reviewed all transcripts to develop an initial coding scheme based on primary themes identified through an iterative review process. Once this phase was complete the author coded five transcripts randomly selected. Next these were coded by the independent reviewer as a comparison in order to assess understanding of codes, discuss disagreements, and modify the coding scheme. An additional three transcripts were independently coded and checked by the author and reviewer. Any discrepancies in coding were reviewed until satisfactory consensus was agreed. The author also recorded all coding

and thematic decisions to provide an audit trail of the analytic process.

Statistical Approach

In order to test if there was an effect from the self-compassion induction on state anxiety a mixed ANOVA was used employing SPSS version 22. This incorporated a between groups factor with 2 levels (compassion versus control induction) combined with a repeated measure (time) with 3 levels: T1 (baseline), T2 (post induction) and T3 (post VR exposure). Post hoc comparisons used the Fisher LSD test. Independent samples t-tests compared the two groups on trait self-compassion, trait social anxiety, experience using VR, level of presence experienced, sense of copresence and cybersickness. Pearson correlations assessed relationships between the measures. Statistical significance was set at .05, two-tailed. Where appropriate, partial η^2 and Cohen's d statistic provide an index of effect size.

Results

Demographic Information

27 participants were recruited: 13 in the compassion group (9 females, 4 males) and 14 in the control group (10 females; 4 males) The age profile of the compassion group (M = 27.08 years; SD =10.92) was similar to that of the control group (M = 27.07 years; SD =9.31).

Participants Profile

Participants typically had limited experience with VR (M = 1.04, SD = 0.81) with only two participants (7.4%) answering that they had used VR ten times or more. Trait self-compassion scores were in the mid-range (SD = 3.18, SD = 0.72). The mean score on social anxiety (M = 42.37, SD = 18.51) was over the threshold indicating possible non-generalised social anxiety (i.e. >30), a result that was not anticipated. Four participants (14.8%) had a LSAS SR score greater than 60, with two happening to be in each experimental condition. Participants scored in the higher range on sense of presence (M = 7.74, SD = 1.48) and co-presence (M = 4.04, SD = 1.02) while scores on the cybersickness measure were in the lower range (M = 0.3, SD = 0.76).

Independent Samples T-Test

No significant differences between the two groups were found (see Table 3).

Table 3. Independent samples t-test results by condition

Measure	Compassion Group	Control Group	Statistics
	***M* (*SD*)**	***M* (*SD*)**	***t* (df), *p***
VR Experience	1.00 (0.82)	1.07 (0.83)	$t(25) = -0.23$, p = .82
SCS	3.11 (0.91)	3.24 (0.51)	$t(25) = -0.46$, p = .65
LSAS	45.69 (20.30)	39.29 (16.85)	$t(25) = -0.90$, p = .38
Presence	8.15 (1.14)	7.36 (1.69)	$t(25) = 1.42$, p = .17
Copresence	4.15 (0.69)	3.93 (1.27)	$t(25) = -0.57$, p = .58
Cybersickness	0.15 (0.56)	0.43 (0.94)	$t(25) = -0.92$, p = .37

Effect Of Manipulation

The condition by time interaction was not statistically significant: $F(2,50) = 0.825$, $p = .444$, partial $\eta^2 = .032$. However, the main effect of time was found to be statistically significant: $F(2, 50) = 3.510$, $p < .05$, partial $\eta^2 = .123$. The average anxiety level at the three time points can be seen in Table 4. Figure 5 plots the mean change in anxiety for the two groups. The trend was for state anxiety to increase more for the control group than the compassion group; however, this was not statistically significant. The results of a post-hoc LSD test indicated that there was a statistically significant ($p < .05$) rise in state anxiety levels between T2 and T3, i.e. before entering the VR exposure and after the VR exposure. Effect size (d) was calculated at .6, which indicates a medium effect size (Cohen, 1988). State anxiety levels between time points T1 and T2 did not significantly differ.

Table 4: Mean change in state anxiety

Time point	All Participants *M* (*SD*)	Compassion *M* (*SD*)	Control *M* (*SD*)
T1	29.85 (9.26)	31.00 (11.67)	28.79 (6.59)
T2	28.52 (11.35)	29.77 (14.56)	27.36 (7.68)
T3	35.52 (10.37)	33.54 (8.21)	37.37 (12.05)

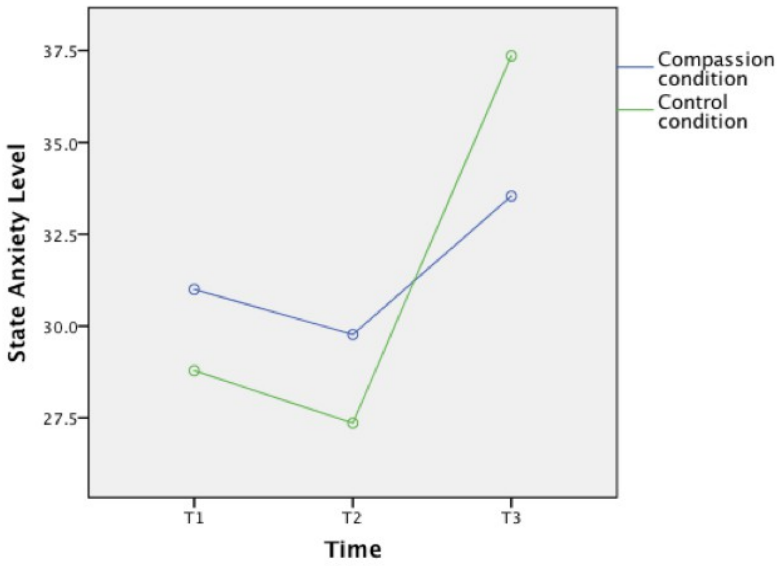

Figure 5: Plot graph of mean change in state anxiety for each induction group

Relationships Between Variables

Pearson correlations examined the relationships between variables (see Appendix A). There was a statistically significant correlation between reported presence during time in VR and copresence (r (27)= .516, p = .006) indicating a strong positive correlation (Cohen, 1988). There was also a strong negative correlation (r(27) = -.474, p = .012) between self-

reported trait self-compassion and self reported trait social anxiety. No other correlations were statistically significant.

Thematic Analysis

Table 5: Primary Themes Identified

Theme 1	**An interesting, stimulating environment** "The detail is actually really impressive. I feel like I am in a real cafe" (TAP) "I thought it was brilliant. It was really life like and I really felt like I was a part of it " (SSI) "So intense" (TAP)
Theme 2	**A range of emotional responses, tending towards discomfort** "Yeah I feel really ashamed" (TAP) "Very anxious. It made me really uncomfortable" (SSI) "I kind of felt like I was kind of like the villain like I had said something really offensive" (SSI)
Theme 3	**Attributing mental states to the avatar** "She is kind of upset" (TAP) "I was wondering why she was feeling like that, almost like what did I do?" (SSI) "My feeling developed the more I looked at the person in front of me and the way she was looking, was she looking at me, I started to think that she was fed up or annoyed or didn't want to be there". (SSI)
Theme 4	**Feeling it is real but knowing it is not real** "She is looking around her. Looking at me in the eyes. Its really intense. Its really strange that it feels kinda real" (TAP) "It's very life like but not life-like if you know what I mean its kind of like you'd know it's not real but you'd feel like you're kinda immersed in it" (SSI)

Four primary themes were identified through an iterative analysis of the transcripts of the TAP and SSI. These are presented in Table 5. The first of the themes centred around participants' positive evaluations of the VR environment overall. Participants generally found it visually impressive, stimulating and immersive. Some commented on the sound effects adding to a sense of immersion. Remarks on the detail and realism of the digital rendering of the cafe scene and the avatar in front of them were frequent and the contrary was uncommon.

The second most apparent theme was the strength and range of emotional responses that participants had in VR. The most common emotive word used in the combined transcripts was “uncomfortable”; it appearing 65 times in total. The majority of participants expressed mild to moderate discomfort in the TAP and SSI, (e.g. “The way she is looking around and looking at me makes me feel uneasy”). The striking proximity of the avatar was remarked upon by about 25% of participants, (e.g. “goodness me I'm shocked. It's very intimate to find myself suddenly so close”). Three people (11%) expressed more severe discomfort, finding the experience scary and in two cases comparing it to a horror film (e.g. “it really reminded me of that film The Ring. It could be the stuff of nightmares”). In addition some participants seemed to experience some affective empathy for the avatar, which will also be returned to in the third theme.

The first and second themes might seem somewhat contradictory. However what seemed to come across in the comments was two layers, namely an appreciation and even liking of the VR setting on the one hand coupled with discomfort related to the avatar sitting opposite them on the other. Some participants commented on their sense of uncertainty about what to do in the situation and in some cases a desire to get up and explore the cafe was expressed. There was also a tendency for some participants to express less anxiety in the TAP towards the end of the 5 minutes in VR.

The third theme, connected to the previous one regarding emotional responses, was the attribution of mental states to the avatar. This could be broadly divided into two categories: attribution of mental states to the avatar independent of the participant (independent mental states: IMS) and attribution of mental states in the avatar related to the participant (relational mental states: RMS). In the case of attributing IMS participants typically remarked how the avatar looked unwell or sad or defensive (e.g. “she seems really sad. She’s all closed off and doing the sad eyes its weird”). In some cases this came across as possibly being emotional empathy, i.e. feeling the avatar's pain or distress. In the case of attributing RMS this was most commonly expressed around feeling that the avatar was judging them or annoyed with them (e.g. “I feel like she is angry with me or I have done something wrong”). In the case of both IMS and RMS there appeared to be a range of degrees of certainty regarding the mental states attributed to the avatar. For instance some participants appeared certain about the avatar's negative feelings for them (e.g. “I feel like she's angry at me now I don't know what I did”). On the other hand other participants were uncertain, saying that the avatar was behaving in certain ways and were aware of the visceral impact this was had on them, however also indicating that they were not certain as to the meaning and intent of the avatar's behaviour (e.g. “her body language makes me feel that she is annoyed with me.”).

The fourth theme was to do with participants finding the environment realistic and immersive yet at the same time pointing out that they realised it was not actually real. Phrases like “as if” and “feels like” were common (e.g. “It feels really real though, it feels like I am in a café. It feels weird. The sound as well makes it feel like I'm actually there.”).

Discussion

This study hypothesised that state anxiety would increase following time spent in a VR environment populated with a potentially anxiety-provoking avatar. Furthermore it was hypothesised that a self-compassion induction would lead to a smaller increase in state anxiety as compared to a control induction. In line with the first hypothesis state anxiety did increase significantly between the start and end of time spent in the VR exposure. However the self-compassion induction did not influence the level of the anxiety response.

The result that state anxiety increased after VR was in line with other experiments that have used challenging VR social exposures. Examples of this include a conversation with an avatar (Powers et al., 2013) and a mock blind date and mock job interview with an avatar (Hartanto, Kampmann, Morina, Emmelkamp, Neerincx & Brinkman, 2014; Morina, Brinkman, Hartanto & Emmelkamp, 2014). A novel aspect of the present study was that the social exposure does not involve any performance on the part of the participant other than sitting opposite, i.e “being with” an avatar. In examining what may have lead to the anxiety response a study by Fornells-Ambrojo et al. (2013) may be relevant. In their study they investigated participant responses to neutral acting avatars in an underground train in VR. They found that there was no increase in anxiety between pre and post VR exposure. In their study participants were informed in advance that they would be on a VR underground train populated by avatars and that they would be able to move around freely to explore it. One theme that emerged from their thematic analysis was that participants found themselves falling back on social scripts that helped guide them in how to typically behave in that kind of situation (i.e. when taking an underground train). In addition, some participants moved away from avatars they didn't wish to be near. In the present study, participants were not

informed on what to expect, i.e. they were not told about the cafe or the avatar that would be sitting opposite them. Once participants entered VR the avatar was sitting opposite them, appearing to be about one metre away, and was not communicating. According to Hall (1969) the boundary of personal space is about one and half meters. These factors combined potentially created an ambiguous situation where there may have been the lack of social scripts available to guide behaviour. Furthermore participants were unable to get up and move around the cafe, effectively having limited personal agency. In the TAP and SSI transcripts some participant comments reflected these points, i.e. noting the closeness of the avatar, the uncertainly about what to do in the unconventional situation, and the desire to get up and walk around the cafe but realising that this was not an option. These factors may be possible reasons for why anxiety levels increased for participants in the present study.

The self-compassion induction had no significant effect on state anxiety. As this study had a small sample size it may not have been sufficiently powered to find a significant effect. Previous research does not provide an estimate of the effect size to expect from a brief compassion on anxiety in VR like the one used. A different kind of self-compassion induction, or one done in more depth, or one that incorporated additional elements, might have been effective. One participant at the end of their interview made an interesting suggestion, namely that repeating the self-compassion induction after the VR exposure might have been beneficial in reducing anxiety. Another factor was that no manipulation check was made to see how participants responded to the self-compassion induction in terms of its perceived effectiveness or ease of use.

The sample was characterised by moderate levels of non-generalised social anxiety on average. Werner et al. (2012) found that people with SAD tend to be less self-compassionate than those without SAD, and that people with SAD had a greater fear of both

negative and positive evaluation than those without SAD. Consequently as some people can find it hard to be self-compassionate, it was possible that the more anxious participants in the self compassion induction may not have derived the anticipated benefit from the intervention .

In the thematic analysis the overall impression was that participants found the VR experience engaging and stimulating, while at the same time discomforting due to the emotional responses they found themselves having to the avatar who sat opposite them, whom they tended to attribute mental states to as if she was a real person. The fact that participants found the VR environment engaging, stimulating and immersive is important given that a stated advantage of VR exposure is that clients tend to like VR over *in vivo* or imagination-based exposure (Wiederhold & Bouchard, 2014). Sense of presence and copresence were both on the high end of their respective scales and had a statistically significant positive correlation. A common definition of presence in VR is the phenomena of a person behaving and feeling as if they were in the virtual world (Sanchez-vives & Slater, 2005). The sense of realism, immersion and emotional responsiveness that emerged in the first two themes seem to parallel the presence scales' results. Higher presence in VR has been linked to higher anxiety levels; however, higher presence has not been linked to better treatment outcomes (Ling, Nefs, Morina, Heynderickx & Brinkman, 2014). It has been suggested by Bouchard, Bossé, Loranger and Klinger (2014) that once a certain threshold of both presence and anxiety is reached in VRET then this may be sufficient for treatment to progress.

As well as finding the environment engaging participants also expressed an emotional response centred around discomfort that was mainly linked to the avatar sitting opposite them, whose presence and behaviour simulated a kind of awkward or ambiguous

social situation. In order for exposure therapy to be effective the fear response linked to the phobic situation needs to be activated and worked with (Foa & Kozak, 1986). Bouchard, Wiederhold & Bossé (2014) promote a more recent understanding of how exposure therapy works, namely, "[T]he psychological mechanism behind exposure is therefore conceptualized as the active development and learning of safe associations with the feared stimuli rather than a passive weakening, or unlearning, of previous associations of threat" (p. 91). The VR environment that was used in this study seemed to display the coupling of these two aspects, i.e. a challenging stimuli (in this case the avatar) in an otherwise pleasant setting (the cafe). Having VR environments that combine very pleasant settings with phobic elements might prove useful in therapy.

The thematic analysis also identified the attribution of mental states to the avatar was commonplace. The mental states attributed varied in how they related to the participant and the degree of certainly that participants felt they could infer the avatar's intent. In some cases emotional empathy seemed to be expressed for the avatar. In an investigation of empathy towards an distressed avatar in VR Gillath, McCall, Shaver and Blascovich (2008) found that participants responded emphatically to avatars. A number of studies into how paranoia expresses itself in VR have also been conducted (for a review see Broome, Zányi, Hamborg, Selmanovic, Czanner, Chalmers, Birchwood and Singh, 2013). In a study mentioned earlier, Fornells-Ambrojo et al. (2013) found that in response to neutral-acting avatars on an underground train in VR there was a tendency for some participants to jump to conclusions regarding the intentions of the avatars. In the present study there were instances of participants displaying a range of levels of certainty as to the avatar's attitudes and intentions based on her body language. This varied from more rigid certainty about the avatar's thoughts and intentions to a more flexible curiosity regarding what might be going on in the

avatar's mind. In addition there was a range of attitudes regarding how the avatar's intentions related to them. In some cases participants reported how the avatar appeared sad or defensive or unwell, independent of them. In other cases participants reported how the avatar's mental states were directed at them, in the form of judging them or being dismissive of them. It could be suggested that a VR environment such as this could help bring to the fore certain cognitive tendencies such as distorted or rigid thinking styles in clients who present for therapy. Constructs such as psychological flexibility as developed in Acceptance and Commitment Therapy (ACT; Hayes, Luoma, Bond, Masuda & Lillis, 2006) as well as failure to mentalise leading to psychic equilivance as described in Mentalisation Based Therapy (Gergely, Fonagy, Jurist & Target, 2002) offer further potential frameworks for working with clients around such reactions. Cognitive restructuring, as well as learning meta-cognitive strategies, is an important aspect of current treatment for SAD. Furthermore, aside from distorted thinking, sometimes social situations can be genuinely difficult and can bring up strong emotional responses. A VR environment such as the one used might be helpful with exploring “being in your own skin” and simply “being with” others, potentially helping build awareness and tolerance for strong emotional responses.

In regard to the forth theme, namely that many participants noticed how real-seeming the experience was while at the same time remarking that they knew it wasn't real, further indicates how a VR experience like the one used could be a valid exposure to a challenging social situation while at the same time building in some distance and safety for someone with social anxiety. In a recent TEDx talk Brendan Rooney describes how film, especially more immersive forms like 3-D films, can serve as a “sandbox for our emotions”, giving us a place where we can engage with emotive scenarios at a certain remove and perhaps learn from this experience (Rooney B. [TEDxUCD Talks], 2015). This is all the more true for VR

given its highly immersive quality. In that talk he also cautions that more immersive technologies can provide powerful experiences that might be overwhelming for some people and how care around its uses needs to be exercised.

This study had some limitations. The sample was a small one limited to third level students. Furthermore, the main explanation for the rise in state anxiety was that the VR environment acted as a kind of exposure to an ambiguous social situation, however it is also possible that some participants experienced the so called “uncanny valley” response (UV). The UV has been posited as being an emotional response of repulsion that some people experience when presented with an animated (or robotic) person who looks extremely human-like but at the same not quite human-like, thereby possessing an “eerie” quality (Mori, MacDorman & Kageki, 2012). It has been recognised that the UV is an important factor for VRET research (Bouchard, Bossé, Loranger & Klinger, 2014). A few participants' reactions were such that it would have been interesting to investigate to see if the UV response was active in the present study. Three participants reported that the experience had some horror movie qualities to it. Another participant reported in the TAP that the avatar looked like “a moving blinking corpse”. However, since UV was not assessed it is uncertain from the qualitative data if it was present or not. It would be important to ensure that when it comes to the treatment of SAD that a VR experience does simulate a social exposure and not something else such as the UV. Assessing the UV response is recommended for related research. Another limitation, as already discussed earlier, was that the self-compassion induction may have been too short and limited to be effective.

This study had a number of strengths. It examined a novel social exposure in VR in the form of participants simply sitting opposite an avatar for approximately five minutes. It demonstrated that a VR exposure such as the one used can increase state anxiety

significantly and lead to the attribution of a wide variety of mental states to an avatar. Importantly an effort to control for the experience of VR itself was included at the beginning of the experiment by way of the initial sample VR experience. Finally the use of mixed methods, notably the combination of the TAP and SSI, was effective in providing rich data for interpreting what was happening for participant's subjectively while in VR.

There are a number of ways that related future research could be informed by this study. First a clinical population diagnosed with SAD could be used instead of a student population as was used in the present study. Second consideration could be given to offering a longer and more involved self-compassion induction when investigating self-compassion and VR exposure, and perhaps combine this with repeating the self-compassion induction after leaving VR. Third a check could be made following a self-compassion induction on how participants responded to it, i.e. did they find it difficult or easy; ineffective or effective. Fourth the UV response could be operationalised and measured after VR exposure to examine if this is a factor in anxiety responses.

In conclusion this study demonstrated how a novel social exposure in VR involving simply being with an avatar can be anxiety-provoking. A brief self-compassion induction was used; however it did not have any effect on state anxiety. Participants exhibited a range of emotional responses and readily attributed mental states to the avatar they encountered as if they were in the presence of a real person. Clinical implications are that a VR exposure such as the one used could provide rich material for clients to explore with a therapist, in terms of working with cognitive distortions, enhancing metacognitive ability, enhancing metalisation, as well as developing better emotional regulation.

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Appendix A: SPSS Results

Descriptive Statistics

Between-Subjects Factors

		Value Label	N
Experimental (1) or control (2) condition	1	Experimental condition	13
	2	Control condition	14

Descriptive Statistics

	Experimental (1) or control (2) condition	Mean	Std. Deviation	N
STAI6 score (baseline) T1	Experimental condition	31.00	11.669	13
	Control condition	28.79	6.589	14
	Total	29.85	9.264	27
STAI time total score (after induction) T2	Experimental condition	29.77	14.561	13
	Control condition	27.36	7.682	14
	Total	28.52	11.352	27
STAI time total score (after VR) T3	Experimental condition	33.54	8.212	13
	Control condition	37.36	12.049	14
	Total	35.52	10.368	27

Descriptive Statistics

Descriptive Statistics

	Mean	Std. Deviation	N
Participant age	27.07	9.919	27
Participant gender: male (1) or female (2)	1.70	.465	27
Experience using VR	1.04	.808	27
Presence score (0-10)	7.74	1.483	27
SCS SF - Self compassion total score	3.18	.720	27
LSAS SR Total score	42.37	18.512	27
STAI6 score (baseline) T1	29.85	9.264	27
STAI time total score (after induction) T2	28.52	11.352	27
STAI time total score (after VR) T3	35.52	10.368	27
Social Presence - copresence	4.04	1.018	27
CyberSickness - Nausea	.30	.775	27

Independent Samples T-Test

Group Statistics

	Experimental (1) or control (2) condition	N	Mean	Std. Deviation	Std. Error Mean
Participant age	Experimental condition	13	27.08	10.920	3.029
	Control condition	14	27.07	9.311	2.488
Experience using VR	Experimental condition	13	1.00	.816	.226
	Control condition	14	1.07	.829	.221
Presence score (0-10)	Experimental condition	13	8.15	1.144	.317
	Control condition	14	7.36	1.692	.452
SCS SF - Self compassion total score	Experimental condition	13	3.11	.914	.254
	Control condition	14	3.24	.507	.136
LSAS SR Total score	Experimental condition	13	45.69	20.295	5.629
	Control condition	14	39.29	16.850	4.503
Social Presence - copresence	Experimental condition	13	4.15	.689	.191
	Control condition	14	3.93	1.269	.339
CyberSickness - Nausea	Experimental condition	13	.15	.555	.154
	Control condition	14	.43	.938	.251

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Participant age	Equal variances assumed	.069	.795	.001	25	.999	.005	3.896	-8.018	8.029
	Equal variances not assumed			.001	23.700	.999	.005	3.920	-8.090	8.101
Experience using VR	Equal variances assumed	.105	.748	-.225	25	.824	-.071	.317	-.724	.581
	Equal variances not assumed			-.225	24.904	.823	-.071	.317	-.724	.581
Presence score (0-10)	Equal variances assumed	3.288	.082	1.422	25	.167	.797	.560	-.357	1.951
	Equal variances not assumed			1.442	22.926	.163	.797	.552	-.346	1.939
SCS SF - Self compassion total score	Equal variances assumed	4.245	.050	-.457	25	.652	-.129	.282	-.709	.452
	Equal variances not assumed			-.447	18.453	.660	-.129	.288	-.732	.474
LSAS SR Total score	Equal variances assumed	.063	.804	.895	25	.379	6.407	7.158	-8.335	21.148
	Equal variances not assumed			.889	23.421	.383	6.407	7.209	-8.491	21.304
Social Presence - copresence	Equal variances assumed	3.172	.087	.567	25	.576	.225	.397	-.593	1.044
	Equal variances not assumed			.579	20.340	.569	.225	.389	-.586	1.036
CyberSickness - Nausea	Equal variances assumed	3.310	.081	-.917	25	.368	-.275	.300	-.892	.342
	Equal variances not assumed			-.934	21.359	.361	-.275	.294	-.886	.336

Mixed ANOVA Results

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
factor1	Sphericity Assumed	719.222	2	359.611	3.510	.037	.123
	Greenhouse-Geisser	719.222	1.654	434.874	3.510	.047	.123
	Huynh-Feldt	719.222	1.827	393.655	3.510	.042	.123
	Lower-bound	719.222	1.000	719.222	3.510	.073	.123
factor1 * Condition	Sphericity Assumed	169.099	2	84.549	.825	.444	.032
	Greenhouse-Geisser	169.099	1.654	102.245	.825	.425	.032
	Huynh-Feldt	169.099	1.827	92.554	.825	.435	.032
	Lower-bound	169.099	1.000	169.099	.825	.372	.032
Error(factor1)	Sphericity Assumed	5122.901	50	102.458			
	Greenhouse-Geisser	5122.901	41.347	123.901			
	Huynh-Feldt	5122.901	45.676	112.157			
	Lower-bound	5122.901	25.000	204.916			

Pairwise Comparisons

Measure: MEASURE_1

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	1.330	2.150	.542	-3.098	5.758
	3	-5.555	2.745	.054	-11.208	.098
2	1	-1.330	2.150	.542	-5.758	3.098
	3	-6.885*	3.262	.045	-13.604	-.166
3	1	5.555	2.745	.054	-.098	11.208
	2	6.885*	3.262	.045	.166	13.604

Based on estimated marginal means

*. The mean difference is significant at the

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Correlations

		Age	Participant gender: male (1) or female (2)	Exp. using VR	Presence score	SCS SF	LSAS SR Total score	STAI6 T1	STAI6 T2	STAI6 T3	Copresence	Cyber Sickness
Participant age	Pearson Correlation	1	-0.212	0.019	-0.195	0.245	-0.235	-0.276	-0.087	0.171	-0.172	-0.053
	Sig. (2-tailed)		0.289	0.926	0.33	0.218	0.237	0.163	0.667	0.393	0.392	0.793
	N	27	27	27	27	27	27	27	27	27	27	27
Participant gender: male (1) or female (2)	Pearson Correlation	-0.212	1	-0.174	-0.06	-0.088	0.152	0.079	0.008	0.009	0.024	-0.174
	Sig. (2-tailed)	0.289		0.384	0.767	0.664	0.45	0.697	0.967	0.964	0.905	0.386
	N	27	27	27	27	27	27	27	27	27	27	27
Experience using VR	Pearson Correlation	0.019	-0.174	1	0.04	-0.083	-0.06	-0.004	0.233	0.232	0.045	0.227
	Sig. (2-tailed)	0.926	0.384		0.841	0.679	0.766	0.983	0.243	0.245	0.824	0.254
	N	27	27	27	27	27	27	27	27	27	27	27
Presence score (0-10)	Pearson Correlation	-0.195	-0.06	0.04	1	-0.319	0.354	-0.33	-0.111	0.109	.516**	0.203
	Sig. (2-tailed)	0.33	0.767	0.841		0.105	0.07	0.092	0.583	0.588	0.006	0.309
	N	27	27	27	27	27	27	27	27	27	27	27
SCS SF - Self compassion total score	Pearson Correlation	0.245	-0.088	-0.083	-0.319	1	-.474*	0.234	-0.29	0.049	-0.197	-0.275
	Sig. (2-tailed)	0.218	0.664	0.679	0.105		0.012	0.241	0.143	0.808	0.324	0.165
	N	27	27	27	27	27	27	27	27	27	27	27
LSAS SR Total score	Pearson Correlation	-0.235	0.152	-0.06	0.354	-.474*	1	-0.017	0.104	-0.185	-0.044	0.3
	Sig. (2-tailed)	0.237	0.45	0.766	0.07	0.012		0.933	0.606	0.355	0.829	0.128
	N	27	27	27	27	27	27	27	27	27	27	27
STAI6 score (baseline) T1	Pearson Correlation	-0.276	0.079	-0.004	-0.33	0.234	-0.017	1	.451*	-0.06	-0.366	-0.015
	Sig. (2-tailed)	0.163	0.697	0.983	0.092	0.241	0.933		0.018	0.768	0.06	0.941
	N	27	27	27	27	27	27	27	27	27	27	27
STAI time total score (after induction) T2	Pearson Correlation	-0.087	0.008	0.233	-0.111	-0.29	0.104	.451*	1	-0.211	-0.188	0.034
	Sig. (2-tailed)	0.667	0.967	0.243	0.583	0.143	0.606	0.018		0.291	0.348	0.865
	N	27	27	27	27	27	27	27	27	27	27	27
STAI time total score (after VR) T3	Pearson Correlation	0.171	0.009	0.232	0.109	0.049	-0.185	-0.06	-0.211	1	0.147	0.339
	Sig. (2-tailed)	0.393	0.964	0.245	0.588	0.808	0.355	0.768	0.291		0.463	0.084
	N	27	27	27	27	27	27	27	27	27	27	27
Social Presence - copresence	Pearson Correlation	-0.172	0.024	0.045	.516**	-0.197	-0.044	-0.366	-0.188	0.147	1	-0.209
	Sig. (2-tailed)	0.392	0.905	0.824	0.006	0.324	0.829	0.06	0.348	0.463		0.295
	N	27	27	27	27	27	27	27	27	27	27	27
CyberSickness - Nausea	Pearson Correlation	-0.053	-0.174	0.227	0.203	-0.275	0.3	-0.015	0.034	0.339	-0.209	1
	Sig. (2-tailed)	0.793	0.386	0.254	0.309	0.165	0.128	0.941	0.865	0.084	0.295	
	N	27	27	27	27	27	27	27	27	27	27	27

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix B: Thematic Analysis Samples

TAP: Original Transcripts	Reviewer 1	Independent Reviewer
This is really life like And you can see that the person you are with is uncomfortable like you're in a fight or something She is kind of upset It seems like it's a bit of an uncomfortable atmosphere In the café it's really quiet really calm And people behind her just seems like it's not a comfortable atmosphere for anybody	This is really life like (immersive) And you can see that the person you are with is uncomfortable like you're in a fight or something She is kind of upset (mental states) It seems like it's a bit of an uncomfortable atmosphere (emotional response) In the café it's really quiet really calm (pleasant environment) And people behind her just seems like it's not a comfortable atmosphere for anybody	This is really life like (realistic) And you can see that the person you are with is uncomfortable like you're in a fight or something (attributing mental states) She is kind of upset (attributing mental states) It seems like it's a bit of an uncomfortable atmosphere (emot. Responses) In the café it's really quiet really calm (nice environment) And people behind her just seems like it's not a comfortable atmosphere for anybody (unpleasant environment)
Ok so I am obviously in a café, I am being ignored or she is distracted I am not sure, maybe she doesn't know I am here, its a nice café, there are a couple in the background who are also not really looking at each other. Oh she is looking at me now.	Ok so I am obviously in a café, I am being ignored or she is distracted (Mental states) I am not sure, maybe she doesn't know I am here, its a nice café, (pleasant environment) there are a couple in the background who are also not really looking at each other. Oh she is looking at me now.	Ok so I am obviously in a café, I am being ignored or she is distracted (attributing mental states) I am not sure, maybe she doesn't know I am here, its a nice café, (liking the environment) there are a couple in the background who are also not really looking at each other. Oh she is looking at me now.
I'm wondering why she's sad Oh I don't like the way she's looking at me I feel a bit scared	I'm wondering why she's sad (Mental states) Oh I don't like the way she's looking at me (emotional reactions) I feel a bit scared (emotional reactions)	I'm wondering why she's sad (empathy? Attributing mental states) Oh I don't like the way she's looking at me I feel a bit scared (emotional reactions)
The way she glances back between both eyes left and right the blinking is very realistic I'm getting an emotional response of sadness and now kinda i don't know she hasn't looked over that way before what you looking what's over there. she seems sad now	The way she glances back between both eyes left and right the blinking is very realistic (realism) I'm getting an emotional response of sadness and now kinda i don't know (emotional response) she hasn't looked over that way before what you looking what's over there. she seems sad now (empathy?)	The way she glances back between both eyes left and right the blinking is very realistic (immersive) I'm getting an emotional response of sadness and now kinda i don't know (emotional responses) she hasn't looked over that way before what you looking what's over there. she seems sad now (attributing mental states)

Illustration 1: Think Aloud Protocol Samples

SSI: Original Transcripts	Reviewer 1	Independent Reviewer
yeah its very good. its very life like but not life-like if you know what i mean its kind of like you'd know its not real but you'd feel like you're kinda immersed In it if you know what I mean if that makes sense	yeah its very good. (enjoyable) its very life like but not life-like (real but not real) if you know what i mean its kind of like you'd know its not real but you'd feel like you're kinda immersed (immersed) In it if you know what I mean if that makes sense	yeah its very good. (liked it) its very life like but not life-like if you know what i mean its kind of like you'd know its not real (real but not real) but you'd feel like you're kinda immersed (immersed) In it if you know what I mean if that makes sense
sort of fear i was sort of afraid of the girl but then i felt a bit sorry for her because i didn't know why she was looking like that maybe as the film went on maybe that something is wrong with her and that is why She is looking so intently at me	sort of fear (emotional reactions) i was sort of afraid of the girl (emotional reactions) but then i felt a bit sorry for her (emotional reactions) because i didn't know why she was looking like that maybe as the film went on maybe that something is wrong with her and that is why She is looking so intently at me	sort of fear (emotional reactions) i was sort of afraid of the girl (emotional reactions) but then i felt a bit sorry for her (emotional reactions) Because i didn't know why she was looking like that maybe as the film went on maybe that something is wrong with her and that is why She is looking so intently at me
I felt like she knew me personally and i felt like she was angry at me or just she didn't like me	I felt like she knew me personally (attributing mental states) and i felt like she was angry at me (attributing mental states) or just she didn't like me (attributing mental states)	I felt like she knew me personally and i felt like she was angry at me or just she didn't like me (attributing mental states)
I just couldn't get over how it sort of affected my moo it was really surprising that it was able to change how i was feeling so I found it really engaging	I just couldn't get over how it sort of affected my mood (emotional reactions) it was really surprising that it was able to change how i was feeling (emotional reactions) so I found it really engaging (immersive)	I just couldn't get over how it sort of affected my mood (emotional reactions) it was really surprising that it was able to change how i was feeling (emotional reactions) so I found it really engaging (immersive)

Illustration 2: Semi-Structured Interview Samples

Appendix C: Measures

LSAS-SR

Liebowitz Social Anxiety Scale Liebowitz MR. Social Phobia. Mod Probl Pharmacopsychiatry 1987;22:141-173

Pt Name:		Pt ID #:
Date:	Clinic #:	Assessment point:

Fear or Anxiety:	Avoidance:
0 = None	0 = Never (0%)
1 = Mild	1 = Occasionally (1—33%)
2 = Moderate	2 = Often (33—67%)
3 = Severe	3 = Usually (67—100%)

	Fear or Anxiety	Avoidance	
1. Telephoning in public. (P)			1.
2. Participating in small groups. (P)			2.
3. Eating in public places. (P)			3.
4. Drinking with others in public places. (P)			4.
5. Talking to people in authority. (S)			5.
6. Acting, performing or giving a talk in front of an audience. (P)			6.
7. Going to a party. (S)			7.
8. Working while being observed. (P)			8.
9. Writing while being observed. (P)			9.
10. Calling someone you don't know very well. (S)			10.
11. Talking with people you don't know very well. (S)			11.
12. Meeting strangers. (S)			12.
13. Urinating in a public bathroom. (P)			13.
14. Entering a room when others are already seated. (P)			14.
15. Being the center of attention. (S)			*15.*
16. Speaking up at a meeting. (P)			16.
17. Taking a test. (P)			17.
18. Expressing a disagreement or disapproval to people you don't know very well. (S)			18.
19. Looking at people you don't know very well in the eyes. (S)			19.
20. Giving a report to a group. (P)			20.
21. Trying to pick up someone. (P)			21.
22. Returning goods to a store. (S)			22.
23. Giving a party. (S)			23.
24. Resisting a high pressure salesperson. (S)			24.

STAI-6

Theresa M. Marteau and Hilary Bekker

Appendix A: Self-evaluation questionnaire (Y-6 item)

Name ..... Date .....

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the most appropriate number to the right of the statement to indicate how you feel right now, at this moment. *There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.*

	Not at all	Somewhat	Moderately	Very much
1. I feel calm	1	2	3	4
2. I am tense	1	2	3	4
3. I feel upset	1	2	3	4
4. I am relaxed	1	2	3	4
5. I feel content	1	2	3	4
6. I am worried	1	2	3	4

Please make sure that you have answered *all* the questions.

SCS-SR

HOW I TYPICALLY ACT TOWARDS MYSELF IN DIFFICULT TIMES

Please read each statement carefully before answering. To the left of each item, indicate how often you behave in the stated manner, using the following scale:

Almost never				Almost always
1	2	3	4	5

_____ 1. I'm disapproving and judgmental about my own flaws and inadequacies.
_____ 2. When I'm feeling down I tend to obsess and fixate on everything that's wrong.
_____ 3. When things are going badly for me, I see the difficulties as part of life that everyone goes through.
_____ 4. When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world.
_____ 5. I try to be loving towards myself when I'm feeling emotional pain.
_____ 6. When I fail at something important to me I become consumed by feelings of inadequacy.
_____ 7. When I'm down and out, I remind myself that there are lots of other people in the world feeling like I am.
_____ 8. When times are really difficult, I tend to be tough on myself.
_____ 9. When something upsets me I try to keep my emotions in balance.
_____ 10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.
_____ 11. I'm intolerant and impatient towards those aspects of my personality I don't like.
_____ 12. When I'm going through a very hard time, I give myself the caring and tenderness I need.
_____ 13. When I'm feeling down, I tend to feel like most other people are probably happier than I am.
_____ 14. When something painful happens I try to take a balanced view of the situation.
_____ 15. I try to see my failings as part of the human condition.
_____ 16. When I see aspects of myself that I don't like, I get down on myself.
_____ 17. When I fail at something important to me I try to keep things in perspective.
_____ 18. When I'm really struggling, I tend to feel like other people must be having an easier time of it.
_____ 19. I'm kind to myself when I'm experiencing suffering.
_____ 20. When something upsets me I get carried away with my feelings.
_____ 21. I can be a bit cold-hearted towards myself when I'm experiencing suffering.
_____ 22. When I'm feeling down I try to approach my feelings with curiosity and openness.
_____ 23. I'm tolerant of my own flaws and inadequacies.
_____ 24. When something painful happens I tend to blow the incident out of proportion.
_____ 25. When I fail at something that's important to me, I tend to feel alone in my failure.
_____ 26. I try to be understanding and patient towards those aspects of my personality I don't like.

Appendix D: Information Sheet

Information Sheet

Study Title: **Factors affecting people's emotional responses to virtual reality.**

Name of Researcher: Vincent Ryan. Version: 15th Febuary 2016

Institution: Institute of Art Design and Technology, Dublin

Purpose of the Research

This is a psychological study to investigate people's emotional responses to virtual reality. Research to date has shown that peoples' reactions to various virtual reality settings can vary depending on a host of factors. These factors include such things as the kinds of experiences the virtual reality environment provides, personality traits and habits and the kinds of activities the person was doing before he or she entered virtual reality. This study is looking at these factors using brief visits to two virtual reality environments.

Invitation

You are invited to consider taking part in the research study, which is being undertaken by Vincent Ryan (researcher) and Rob Griffin (research supervisor). To be able to participate you need to be a student at IADT and be 18 years or older. Before you decide whether or not you wish to take part, it is important for you to understand what it will involve. Please take time to read this information carefully. Ask if there is anything that is unclear or if you would like more information.

Do I have to take part?

You are free to decide whether you wish to take part or not. If you decide to take part you will be asked to complete two consent forms, one form is for you and the other is for our records. You will be free to withdraw from the experiment at any point during it without giving specific reason.

What will happen if I take part?

To begin you will complete three psychological questionnaires based around personality and mood. You will then enter the first virtual reality experience. Following this you will watch a short instruction video and do a simple exercise. Next will then be asked to fill in one of the original questionnaires again. Then you will enter a second virtual reality experience. During this time you are invited to say aloud what you are experiencing while you are in virtual reality. Following this you will be asked to fill in the original questionnaire a third time. Once complete there is a brief five minute interview about your experience. At the end of the experiment there is debriefing and an opportunity for questions. The whole process takes about thirty minutes.

What are the benefits (if any) of taking part?

Taking part means that you get to try some novel virtual reality experiences using the Oculus Rift virtual reality headset. You will also have contributed in a small way to psychological science.

What are the disadvantages or risks (if any) of taking part?

Participating in the research is not anticipated to cause any disadvantages or major discomfort. It is reported that some sufferers of vertigo, migraine, motion sickness and claustrophobia can find virtual reality hard to tolerate. There is a small risk that some aspects of the study might bring up emotional upset for some participants. This should be taken into account when deciding on whether or not to participate. The researcher must remind you that your participation is completely voluntary and you will have the liberty to participate and withdraw at any point during the experiment.

What if there is a problem?

At the end of the experiment I will discuss with you how you found the experience and how you are feeling. If you subsequently feel distressed information on support services will be provided.

Will my taking part in this study be kept confidential?

All information that is collected about you during the course of the research will be anonymised and securely stored to ensure confidentiality. It will not be possible to identify you from the stored material. You are free to withdraw your data from this study during the data collection phase and without giving reasons. However, as your data will be anonymous it will be collated with other data and it will not be possible to withdraw your individual data once the study is completed.

What will happen to the results of the study?

The results of this study will go into the researcher's thesis forming part of his MSc degree in Cyberpsychology in IADT. He is hoping to get it published in an academic journal and to present at academic conferences. If you wish you can be sent a copy of the completed research.

Who has reviewed the study?

This study has been approved by the Department of Technology and Psychology Ethics Committee (DTPEC).

Contact information for questions or problems

If you have concerns about any aspect of this study you can to speak to the researcher or his supervisor who will do their best to answer your questions. Contact details are in the next section.

Contacts for further information:

Researcher's name: Vincent Ryan.	Researcher's email: n00146597@student.iadt.ie
Supervisor’s name: Robert Griffin	Supervisor’s email: robert.griffin@iadt.ie

Thank you for taking the time to read this information sheet.

Information Sheet and Consent Form adapted with permission from Keele University

15th Feb 2016, Version 3

Appendix E: Consent Forms

CONSENT FORM 1

Feb 2016

Study Title: **Factors affecting people's emotional responses to virtual reality. Vincent Ryan (researcher), Rob Griffin (Supervisor), IADT Dublin**

Please read each point carefully before ticking the box to provide consent:

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. □
2. I confirm that I am 18 years of age or older and that am a student at IADT □
3. I understand that my participation is voluntary and that I am free to withdraw at any time during the data collection process. □
4. I agree to take part in this study. □
5. I understand that data collected about me during this study will be fully anonymised □
6. I understand that since my data are anonymous and will be collated with other data it will not be possible to withdraw my data after the study is completed. □
7. I agree to the experiment and interview being audio recorded. □
8. I agree to allow the data collected to be used for future research projects. □
9. I would like a copy of the research emailed to me when it is finished (optional).

before it is submitted for publication. □

Signatures Required:

_____ Name of participant

_____Date Of Signature

_____ Researcher

_____Date Of Signature

Information Sheet and Consent Form adapted with permission from Keele University

CONSENT FORM 2: for use of quotes

Feb 2016

Study Title: **Factors that affect people's emotional responses to virtual reality. Vincent Ryan (researcher), Rob Griffin (Supervisor), IADT Dublin**

Note: All data including quotes will anonymised and participants will not be identifiable in the finished study.

Please read the following carefully. With regard to what I say during time spent in virtual reality and in the interview (circle A or B):

A. I agree for my anonymous quotes to be used in the finished research

B. I don't want any of my quotes to be used

Signatures Required:

_____ Name of participant

_____Date Of Signature

_____ Researcher

_____Date Of Signature

Information Sheet and Consent Form adapted with permission from Keele University

Appendix F: Debrief Sheet

Study Title: Factors affecting people's emotional responses to virtual reality.

Institution: Institute of Art Design and Technology, Dublin

Debriefing Form

Thank you for your co-operation in participating in this study, that looks at how people respond to various virtual reality settings and the factors that can affect people's responses. The present study examines whether watching a short video and doing a simple exercise affects a person's emotional reactions to briefly being in virtual reality where there is a digital agent present.

If you have any questions that occur later regarding your participation in this study, please don't hesitate to contact myself or my supervisor, Robert Griffin. Our contact details are at the end.

As previously mentioned, you have the right to withdraw from the study at this time; however as your data are anonymous I will not be able to withdraw you from the study at a later time. All information provided will remain confidential and anonymous in any case.

Should you feel you are upset or distressed in any way after your participation in this study you can contact the Student Counseling Service, Student Services Area, Carriglea Building, IADT, telephone 01 239 4650.

Alternatively you can call any of the numbers listed below or visit their websites.

Organisaion	Phone Number	Website
Samaritans	**1850 606 900**	**www.samaritans.org**
Aware	**1890 303 302**	**www.aware.ie**
Reachout	**01 764 5666**	**www.reachout.com**
Console	**1800 201 890**	**www.console.ie**

Researcher Contact Details:

Researcher: Vincent Ryan; email: n00146597@student.iadt.ie

Research supervisor: Robert Griffin; email: robert.griffin@iadt.ie

Kind Regards, Vincent Ryan

Appendix G: Inductions

Self Compassion Induction:

Watch a short video, then follow the 4 steps that follow, one at a time. (If you have a question just ask)

Watch a clip on self-compassion: Watch: 2-Minute Tips: How to Practice Self-Compassion: https://www.youtube.com/watch?v=Qes9HoxfkE0

Step 1
Begin by recalling a recent time when you were having a difficulty with a college friend or college task. Pause and take a moment to recall what was happening with that.

Step 2
Next try thinking about yourself from the perspective of an unconditionally kind imaginary friend who is loving, accepting, kind and compassionate to you in that difficult time.
Reflect upon what this friend feels towards you, and how you are loved and accepted exactly as you are, with all your very human imperfections.
This friend recognises the limits of human nature, and is kind and forgiving towards you. In his/her great wisdom this friend understands your life history and the millions of things that have happened in your life to create you as you are in this moment. Your particular inadequacy is connected to so many things you didn't necessarily choose: your genes, your family history, life circumstances – things that were outside of your control.

Step 3
Now take a moment to write a few lines from the perspective of this unconditionally loving imaginary friend. This is for you alone, you will keep this letter private for yourself. What would this friend say to you about your self-perceived inadequacy from the perspective of unlimited compassion? How would this friend convey the deep compassion he/she feels for you, especially for the pain you feel when you judge yourself so harshly?

Step 4
After writing these few lines, put it down for a moment then come back and read it again, really letting the words sink in. Feel the compassion as it pours into you, soothing and comforting you like a cool breeze on a hot day. Love, connection and acceptance are your birthright. To claim them you need only look within yourself.

Control Induction:

Watch a short video, then follow the 4 steps that follow, one at a time. (If you have a question just ask)

Watch a clip on: making an omelette: Recipe: Simple 2 Egg Omelette
https://www.youtube.com/watch?v=nZHdh87RJps

Step 1: Recall a recent time when you needed to make something to eat for yourself, like a simple breakfast.

Step 2: Next, try thinking about yourself from the perspective of you being a very skillful cook who is available to coach you in your cooking.
Reflect upon what this version of you would offer by way of advice in making the dish you want to make.
This version of you recognises that you can make this dish. In this version of you there is broad experience that understands what you will need by way of guidance in this cooking task.

Step 3:
Now take a moment to write a few lines from the perspective of this version of you. This is for you alone, you will keep this letter private for yourself. What would you say to yourself about your cooking task? How would this version of you coach you in the cooking task?

Step 4:
After writing these few lines to yourself, put it down for a moment then come back and read it again. Really letting the words resonate. The expertise of being a really effective cook is available to you. Let this realisation sink in.

Appendix H: Additional Screens Shots

Ambient Occlusion Room

Illustration 1: Looking Down: No Virtual Body In Sample VR

Coffee Without Words

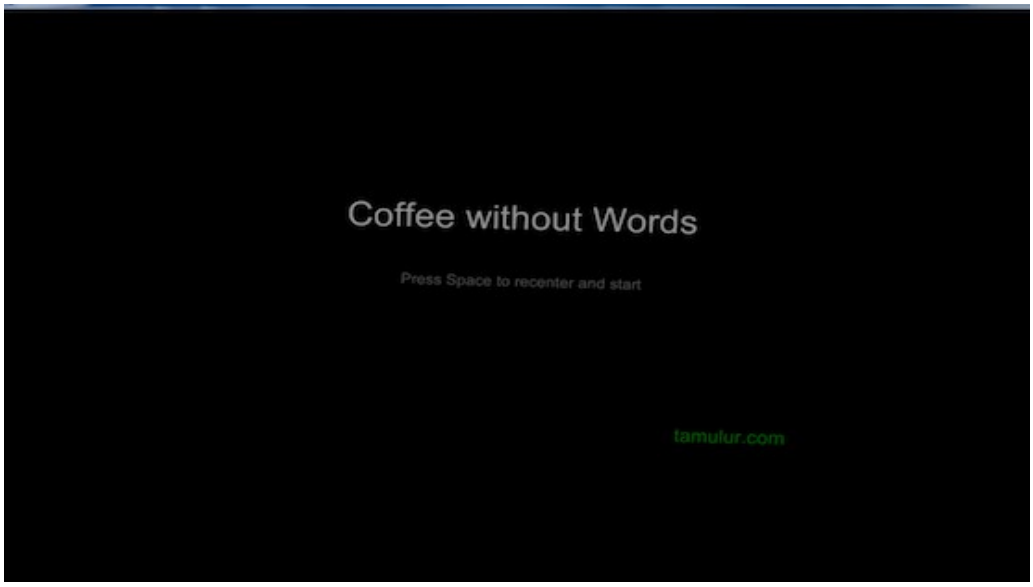

Illustration 2: Opening Caption

Illustration 3: Avatar Making Eye Contact

Illustration 4: Avatar Looking Sideways

Illustration 5: Looking Down

Illustration 6: The Cafe