

# Computers in Human Behavior

## A Self-Compassion Experience in Immersive Video: Opportunities and Pitfalls

--Manuscript Draft--

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**Cover letter**

Doron Friedman  
IDC, Herzliya, Israel

January 24, 2022

Dear editor/s,

We wish to submit an original research article entitled " **Meeting Yourself (in Immersive Video): Opportunities and Pitfalls**" for consideration in *Computers in Human Behavior*.

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

In this paper, we report on a novel technique for individuals to have a meeting with themselves using immersive video – 180 stereoscopic video experienced in virtual reality headsets. In addition to the novel technique we report intriguing findings: while the participants in the Self condition found the experience significantly more meaningful than those in the control condition, and reported higher active positive affect, the experience negatively affected self esteem, self kindness and self isolation (reverse coded) as compared to the control group. Interaction effects that may explain these findings were found to be related with age and BMI, but not gender.

We have no conflicts of interest to disclose.

Please address all correspondence concerning this manuscript to me at [doronf@idc.ac.il](mailto:doronf@idc.ac.il).

Thank you for your consideration of this manuscript.

Sincerely,

Doron Friedman

### **Meeting Yourself (in Immersive Video): Opportunities and Pitfalls: Paper Highlights**

- We report on a novel technique for individuals to have a meeting with themselves using immersive video – 180 stereoscopic video experienced in virtual reality headsets.
- As expected, the participants in the Self condition found the experience significantly more meaningful than those in the control condition, and reported higher active positive affect
- Contrary to our expectations and to previous research, the experience negatively affected self esteem, self kindness and self isolation (reverse coded) as compared to the control group.
- Interaction effects that may explain these findings were found to be related with age and BMI, but not gender.
- Overall, we suggest a novel technique that is likely to become more popular with the progress in VR, and suggest much care is needed before this can be assumed to be a positive experience.

## **A Self-Compassion Experience in Immersive Video: Opportunities and Pitfalls**

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## **Meeting Yourself (in Immersive Video): Opportunities and Pitfalls**

### **Abstract**

We have designed an immersive video experience providing participants with the experience of an intimate encounter with themselves using immersive video. Seventy-three participants (35 men, 38 women) ages 22-65 ( $M = 37.82$ ,  $SD = 8.1$ ) were randomly assigned to one of two conditions: meeting Self ( $n=38$ ) and meeting Stranger ( $n=35$ ), and the experience was carefully designed to increase self-compassion. The participants in the Self condition found the experience significantly more meaningful than those in the control condition ( $t(72)=-3.923$ ,  $p<0.001$ ) and reported higher active positive affect ( $t(72)=-2.353$ ,  $p=0.021$ ). However, our results indicate that the experience (interacting with self) negatively affected self-esteem, self-kindness and self-isolation (reverse coded) as compared to the control group (interacting with a stranger). Furthermore, the results indicate that older individuals may benefit more from the experience than younger individuals, and suggest that BMI is also an important moderating variable. Overall, our conclusion is that meeting yourself in VR can be a very powerful experience, but further studies are necessary in order to understand the contribution of experience design decisions and moderating variables, if this is intended as a positive experience.

### **Introduction**

Social interactions with others can be infinitely rich experiences, eliciting a wide range of human subjective experiences and emotions, with both immediate and long-term impact on the individuals involved. What would it be like to have a social encounter with yourself? Virtual reality (VR) allows for experiences that are not possible otherwise (Gonzalez-Franco & Lanier, 2017), and sometimes these experiences may even have a transformative impact (Gaggioli et al., 2016); one such example is interacting with a virtual representation of yourself.

Vinai et al. (2015) developed the self-mirroring technique, which was mainly aimed at helping patients better recognize their own emotions, and further studies found this to be an effective therapeutic intervention (Frau et al., 2018). Meeting yourself in VR is qualitatively different than looking at the mirror, because the virtual self can be

interactive, and is not limited to mirroring you. Solomon's paradox, named after the biblical King Solomon, states that people are wiser when reflecting on other people's problem compared with their own (Grossmann & Kross, 2014). While some degree of self-criticism may be constructive, severe forms of self-criticism have been related to most forms of psychopathology (Petrocchi et al., 2017). Self-compassion has been suggested as an antidote to self-criticism, and it has been consistently correlated with positive mental health (Bluth & Neff, 2018). Neff characterized self-compassion by increased kindness and reduced self-judgment, increased feelings of common humanity and decreased isolation, and greater mindfulness and less over-identification with difficult thoughts and feelings (Neff, 2003a), and this was operationalized into a self-compassion scale (SCS) (Neff, 2003b). Compassion focused therapy (CFT) (Gilbert, 2009, 2014) is intended to elicit specific positive affect that is soothing, which is different from energizing positive affect states. These soothing emotions have been specifically linked to less depression, anxiety, and self-criticism (Petrocchi et al., 2017).

Petrocchi et al. (2017) also demonstrated that 'compassionate self-talk' during exposure to a mirror increases self-compassion as measured by soothing positive affect as well as heart rate variability. Furthermore, they found that the increase in soothing positive affect was mediated by the awareness of a common humanity, one component of the self-compassion scale (SCS). Participants in their study were asked to come up with four phrases they would use to soothe and comfort their friend, and their study compared three conditions: 'self-talk' in front of a mirror, mirror only, and 'self-talk' only.

Our goal in this study was to take this direction one step further and ask whether performing a 'compassionate self-talk' with yourself in VR, may have similar effects. We adapted the procedure in (Petrocchi et al., 2017) to VR, including the instructions for self-talk as well as most of the measurements. In our study the dependent variable was different, however, and the main question addressed how a compassionate talk with yourself in VR is different than a similar session with a stranger.

According to the objective self-awareness theory, when individuals are self-aware they compare themselves to their standards, which is often unfavorable (Duval &

Wicklund, 1972). Nevertheless, mirror exposure has been found beneficial under some conditions. A technique called 'self-mirroring' asks individuals to watch a video of their face while recalling a significant life event (Vergallito et al., 2020; Vinai et al., 2015). The question we wanted to ask is whether 'compassionate talk' to yourself would have the beneficial effects observed by (Petrocchi et al., 2017), or whether this setup would 'backfire', as predicted by the self-awareness theory.

Vergallito et al. (2020) compared muscle mimicry when viewing videos of yourself or others expressing several basic emotions. Participants were significantly less accurate in recognizing their own vs others' neutral expressions, one's own expressions were rated to have higher arousal overall as compared to other expressions, and there were also differences in facial muscle activations between the self and other conditions. Among other things, this indicated that individuals interpret very slight muscle activations in their own face as emotional responses, more so than in others.

### **1.1 Body Ownership in Virtual Reality**

VR can offer experiences beyond exposure to mirror or videos. A central tool that has been studied extensively in recent years in VR is body-ownership illusions. A growing number of studies reveal that when participants are controlling a virtual body that is different than their own they adapt their behavior or beliefs in ways that are consistent with this alternate body's characteristics (for reviews see: Kilteni et al., 2012; Maister et al., 2015; Slater & Sanchez-Vives, 2014). For example, placing adults in child-like bodies can alter their perception of space (Banakou et al., 2013) and time (Landau et al., 2020), and body ownership illusions have been suggested as a potential intervention to combat stereotypes and racism (Hasler et al., 2017; Peck et al., 2013) or gender violence (Seinfeld et al., 2018).

Falconer (2014) suggested a method, utilizing body ownership illusions, for reducing self-criticism. In the first stage of their experiment participants interacted compassionately with a crying virtual child, when being 'embodied' in a virtual adult. In the second stage an experimental group later embodied the crying child, thereby establishing a self-to-self situation enabling the participants to deliver compassionate statements to their selves. This condition resulted in a significantly greater increase in self-compassion as opposed to a third-person non-embodied control group. Self-



criticism significantly decreased in both conditions. In a follow-up study (Falconer et al., 2016), this procedure was repeated with 15 participants with major depressive disorder, in three weekly repetitions. Of the 15 patients, 5 showed reliable improvement 4 weeks later and an additional 4 patients showed a clinically significant improvement. They reported an increase in self-compassion scales, and repeating sessions seemed to deepen some aspects of the experience.

## **1.2 Meeting yourself in VR**

The studies mentioned above establish 'self-talk' in VR indirectly; in VR it is also possible for a participant to meet a virtual clone of him/herself. Recognizing yourself in pictures has consistent neural traces in the components of event related responses (ERP) of electroencephalogram (EEG) of seeing yourself (specifically, P200), and this neural trace is found even with caricatures with up to 30% distortion (Kaufmann & Schweinberger, 2008). This has also been validated with avatars generated from images (Gonzalez-Franco et al., 2016), where the results were not photorealistic, and there were clear visual differences between pictures and the avatar pictures.

Fox & Bailenson (2009) report on a series of studies demonstrating that confronting an avatar that looks like you and gains or loses weight according to your physical exercise can make you exercise more. They suggest a theoretical framework for this effect, based on the social cognitive theory (Bandura, 1977, 2001) that highlights the power of a model demonstrating behavior on the observer, and the fact that one of the factors in Bandura's theory is the similarity of the model to the observer. (Hershfield et al., 2011) showed that individuals reported saving more for retirement after being confronted with their elder selves, and suggested that the effect was based on increased connection with the future self. More recently, Wolf et al. (2021) demonstrated the importance of the 'embodiment' factor when encountering yourself: participants estimated the body weight of the virtual human, as their embodied self-avatars, significantly lower compared to participants rating the virtual human as other's avatar. Furthermore, the estimations of body weight were significantly predicted by the participant's BMI with embodiment, but not without. These studies confronted participants with a look-alike avatar, but there was no interaction between the participants and the virtual clone.

Friedman et al. (2014) demonstrated that you can indeed have a meaningful interactive experience with your virtual clone in the context of virtual time travel. If a VR session was recorded, and if the participants had a virtual body in that session, then they could later on experience the same VR session again, this time inhabiting another virtual body, which was identical to the original body in appearance. This allowed the individuals to take part in an interactive scenario whereby they saw their virtual clone take part in the scene, just like another virtual human. Moreover, using a knowledge-based algorithm for reasoning about causality (Friedman, 2016; Pizarro et al., 2015), participants could also 'undo' actions previously carried out by their past selves.

Neyret et al. (2020) let people experience their own body from either 1<sup>st</sup> or 3<sup>rd</sup> person perspective, in three options: an avatar based on their real body, an avatar based on their body image (based on their estimation of their body sizes), and their ideal body. The avatar was static, but the participants could go around it and inspect it in VR for several minutes, including in 3<sup>rd</sup> perspective, so this constituted as a limited interaction with yourself, or your body (gender matched, not 'look alike'). The main finding was that female participants evaluated their real body as more attractive when they saw it from a third-person perspective, and that their level of body dissatisfaction was lower after the experimental procedure.

Osimo et al. (2015) were the first to suggest externalizing inner speech using VR. Participants were first 'embodied' in a look-alike avatar in front of another virtual person, in this case a look-alike of Sigmund Freud. The participants were asked to tell Freud about a personal problem, and were then immediately transferred to be 'embodied' as Freud, now seeing their virtual clone repeat the sentence, but this time from a 2<sup>nd</sup>-person perspective. They were then expected to provide themselves advice, as Freud would have, and switch bodies again, this time seeing Freud providing them with the advice. The participants were asked to respond, and this back-and-forth process repeated iteratively as long as the participants wished. The hypothesis was that if participants were embodied as a counsellor it would be easier for them to solve the personal problem. They reported two studies: one within group (n=12) included two sessions – either Freud or themselves as counselor. Additional 10 participants

experienced asynchronous embodiment, as a control condition. Overall, self-counseling tended to increase mood and happiness ratings, and specifically the increase was larger when counseling was done by Freud as opposed to a look-alike avatar of the participant, and larger in the synchronous condition as compared to the asynchronous control condition.

### **1.3 Age, Positivity Effect, and Wisdom**

Experimental research has found ample evidence for an age-related positivity effect (for a meta-analysis see Reed et al., 2014), concluding that older adults show a significant information processing bias toward positive versus negative information, whereas younger adults show the opposite pattern. One of the major theories supported by evidence is the socio-emotional selectivity theory (SST, Carstensen, 2006), according to which the effect rises from goals shifting across the adult life span: whereas younger people tend to pursue goals concerning knowledge acquisition and expanding horizons, older people prioritize goals related to emotional meaning and satisfaction. Indeed, our pilot studies indicated that the experience may have a different effect on different age groups. Such effects are often not revealed in typical laboratory studies where the target population is young students; however, our pilot studies took place in a science-art setting, which allowed for a wide range of ages. Thus, our main hypothesis was that there would be significant differences between the responses to the experience of compassionate talking to yourself, as compared to the experience of having the same immersive experience with a stranger. Additionally, we hypothesized that age, gender and BMI may be important mediating variables.

## **Methods**

### **Participants and Design**

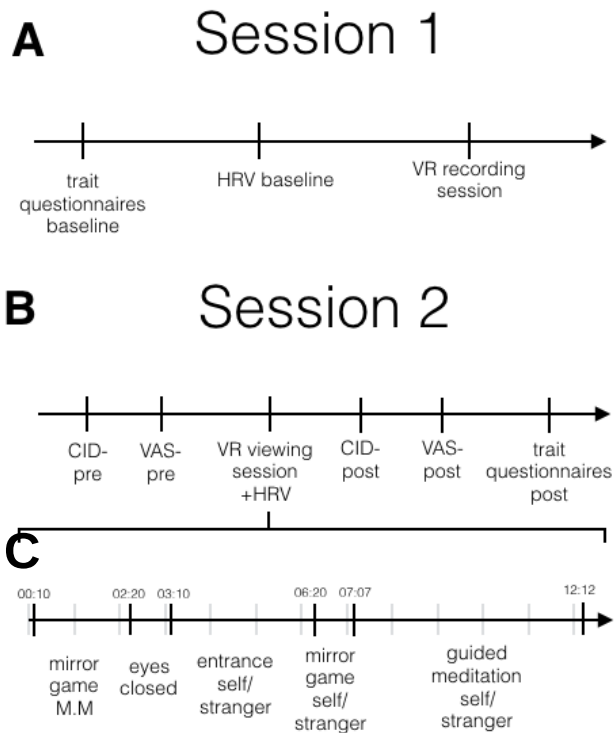
Eighty two participants took part in the study; after removing 9 participants with a significant portion of missing data the rest of the paper is based on 73 volunteers (35 men, 38 women) between the age of 22 to 65 years ( $M = 37.82$ ,  $SD = 8.1$ ). Participants were randomly assigned to one of two conditions: Self ( $n=38$ ) and Stranger ( $n=35$ ). The experiment took part in a contemporary art centre, as part of a science-art project. The experiment was held in an isolated location within the art centre

compound. Recruitment from the general population was conducted through websites and social networks, and participants were invited to attend the experiment separately, such as in typical controlled laboratory conditions. All participants had normal or correct-to-normal vision and hearing. The study was approved by the (removed for anonymity) institutional review board.

## **Procedure**

Each participant took part in two sessions conducted 2-5 weeks apart: a video production and trait-baseline session (S1), and an experience session (S2) (Figure 1). In S1 (Figure 1A), after providing their informed consent, participants were asked to fill in demographic information and questionnaires measuring self-compassion, self-esteem and body-image. Participants then moved to the VR room for the production of the 180° stereoscopic video (see Materials).

In the experience session (S2, Figure 1B), participants completed a comfortable interpersonal distance (CID) test and rated their momentary affect using visual analogue scales (VAS). Participants were then fitted with a custom-designed jacket (see below) and transferred to the VR room for the VR experience. The viewing session started identically for all participants and then differed according to the participant's experimental condition – they either 'met themselves' (Self condition) or a stranger (Stranger condition) (Figure 1C). Following the VR session, participants repeated the CID and VAS measurements, and answered the three self-rating questionnaires from S1, followed by a question regarding the meaningfulness of the experience. Subsequently, all participants took part in a semi-structured interview on the quality of the experience.



**Figure 1: Experimental steps. A) Demographic and trait questionnaires, heart rate variability baseline. B) Experience session: measuring comfortable interpersonal distance (CID), visual analogue scale of emotions (VAS) before and after the VR experience, as well as post-experience trait questionnaires. C) The detailed steps of the VR experience, as described in the text and in Figure 3.**

## Video production and setup

### Recording session

Production of the immersive video was done on S1. First, the experimenter handed the participant a custom-designed jacket with extendable sleeves. The recording began with the participant entering the room and being greeted by the experimenter. A confederate wearing the same jacket, with the sleeves extended so they cover the hands, is seated on a mat behind an immersive 180° stereoscopic video camera (ZCam E1 180° camera rig with a 220° iZugar fisheye lens). The camera captures the action in the room from the first-person perspective (1PP) of the confederate, such that the confederate will later on play the role of the participant's body. The experimenter

asked the participant to take a deep breath and then invited her to play a version of the 'mirror-game' Noy et al. 2011 – a technique in which one person (the experimenter) performs a movement sequence and a person positioned in front of them (the participant) mimics them, producing coherent dance-like motion (Figure 2A); this is intended to establish a connection with the interaction partner. The sequence ended with the experimenter and the participant touching hands.

Next, the participant was instructed to sit in front of the confederate and look into the lens of the camera (Figure 2B). The confederate asked the participant to take a deep breath (again) and then invited her to play the exact same sequence of the mirror game performed earlier while standing. At the end of the sequence the confederate asked the participant to lay her hands on his hands and look into the lens (to later on result in 'self-gaze'). There was a 3-minute audio playback of guided meditation, after which the participant was instructed to hold hands with the confederate (Figure 2C). Finally, the participant was requested to take a seat behind the 180° stereoscopic camera while the experimenter is seated in front of them (Figure 2D). The experimenter asked the participant to take a deep breath and then places her hands on the exposed hands of the participant with the aim to establish a 1PP for the participant. Capturing the 1PP exposed hands of the participants will later be instrumental in convincing the participants that the body and hands they see in VR are theirs. They will later not suspect that after the hands are covered, that the body is not theirs, creating an illusion of seeing themselves in 3PP while they are still in 1PP, including their own body seen in the VR. The experience session (in session S2) continues from this stage. Parts B-D establish the intimate part of the interaction, with the participant playing one role in parts B and C and another role in part D. Part 2A is intended as an introduction, as well as for training the participant to carry out the mirror game.

### **Main Experience Session**

The experience session on S2 was based on an edited version of the recording session; editing (using MistikaVR and Adobe Premier) consisted of re-ordering segments and adding a voice over of guided meditation (as in Hofmann et al., 2011). Two participant recordings (one for each gender) were randomly selected to be used as 'stranger-

videos' for the Stranger (control) condition. The length of the different viewing segments was identical in both conditions and across participants. An Oculus Rift VR headset was used and the viewing order was as follows (Figure 3):

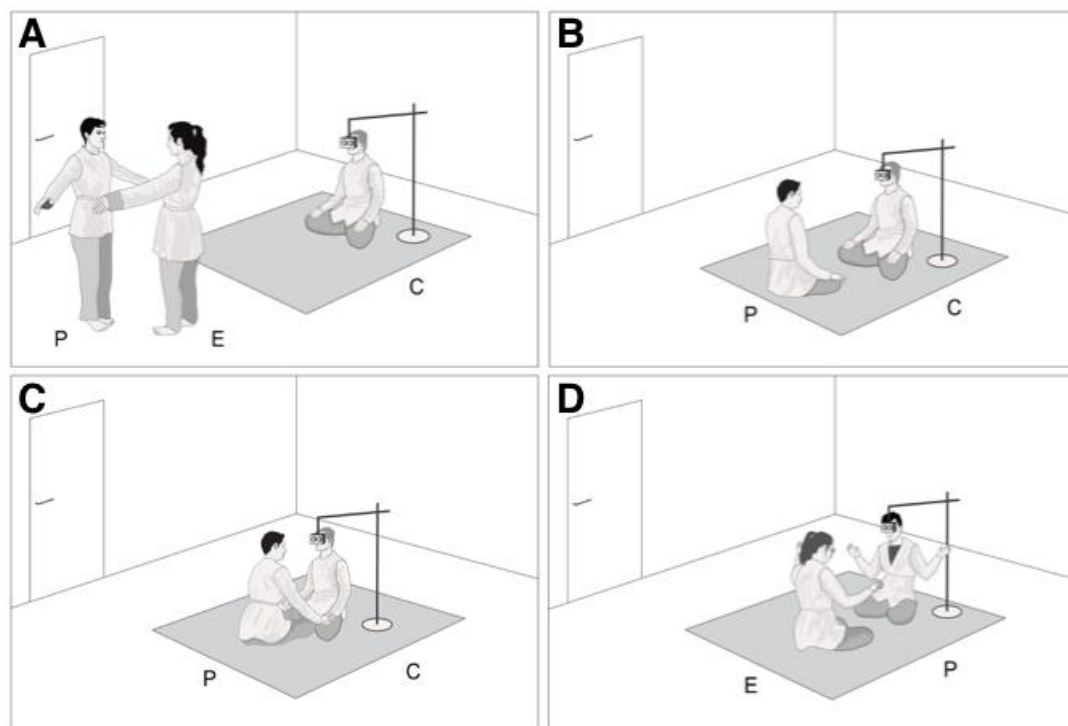
[A] After a short free scanning of the virtual room, the participant sees the virtual-experimenter enter, sit across and put her hands on the participant's hands. This part (Figure 3A) corresponds to the 4th part of the recording session (Figure 2D). In this stage the participants see their own hands and the sleeves are not covered. Subsequently, the participants are guided to close their eyes.

[B] The participants are guided to open their eyes, and see an immersive video corresponding to the first part of the recording session (Figure 2A). During the time when participants are expected to close their eyes the 'body swap' takes place; after they open their eyes the participants are 'embodied' by the confederate, but they are not expected to notice this because they are wearing the custom jacket and the sleeves are now covered. From now on, participants in the Self condition view their own recorded videos, while participants in the Stranger condition view the 'stranger-video' of their matching gender. In this part the participants see their virtual-self/stranger enter the room with the experimenter and watch them play the 'mirror-game' (Figure 3B). This part lasts 3:10 minutes and ends with the virtual-self/stranger sitting in front of the participant.

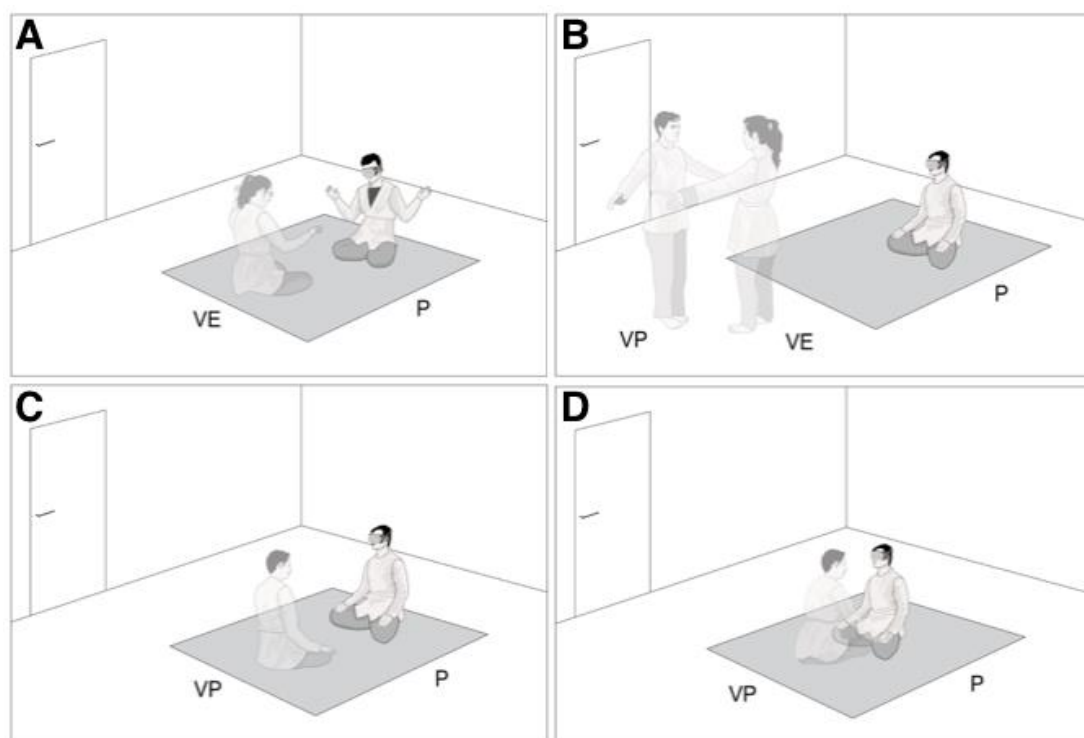
[C] The participant plays the 'mirror-game' sequence with the virtual-self/stranger (Figure 3C, corresponding to the recording displayed on Figure 2B). This part lasts approximately 50 seconds and ends with the virtual self/stranger placing their hands on the participant's hands. In reality a gender-matching experimenter places their hands on the participant synchronously with the video (Figure 4).

[D] The participant is instructed to look into the virtual-self/stranger's eyes while listening to a voice-over of a guided self-compassion meditation (Figure 3D, corresponding to the recording during the stage displayed in Figure 2C). This part lasts approximately five minutes. The viewing session ends with an instruction to the participant to close their eyes. The guided meditation was inspired by Christin Neff's Mindful Self-Compassion program (Neff & Germer, 2013). Specifically, we used a variant of the loving-kindness meditation (Hofmann et al., 2011), which is focused on

developing self-compassion following a personal experience of suffering.



**Figure 2: Recording session. A) The participant (P) and the experimenter (E) play a mirror game. B) The participant sits in front of the camera and confederate (C) and play a mirror game. C) The participant looks into the camera. D) Participant seated behind 180° 3D camera, experimenter places hands on the participant.**





**Figure 3: Experience session: the participant is wearing the VR headset. A) The participant (P) sees his body in 1PP and feels the touch of the (virtual) experimenter (VE). B) The participant observes a recording of themselves (virtual participant – VP) playing a mirror game with the experimenter, C) The participant experiences playing a mirror game with herself. D) The participant is holding hands with her virtual self.**



**Figure 4: A snapshot of the experience session; the participant is holding hands with the experimenter, while viewing himself touching hands with the confederate's hands inside the VR.**

### **Measurements**

**Demographic information:** Participants were asked to complete a short demographic form, which included items regarding height and weight for body mass index (BMI) calculation, gender and age.

**Self-compassion:** The Self-compassion scale short form (SCS-SF; Raes et al., 2011) was employed. The scale consists of 12 items that assess the way people 'treat themselves' when things go wrong. This measure is composed by assessing the positive and negative aspects of the three main components of self-compassion: Self-Kindness (e.g., "When I'm going through a very hard time, I give myself the caring and tenderness I need. ") versus Self-Judgment (reverse-coded; e.g., "I'm intolerant and impatient towards those aspects of my personality I don't like. "); Common Humanity (e.g., "I try to see my failings as part of the human condition.") versus Isolation (reverse-coded; e.g., "When I fail at something that's important to me, I tend to feel alone in my failure."); and Mindfulness (e.g., "When something upsets me I try to keep my emotions in balance.") versus Over-

Identification (reverse-coded; e.g., “When I’m feeling down I tend to obsess and fixate on everything that’s wrong.” (Neff, 2003b). Responses are given on a 5-point scale ranging from 1 (almost never) to 5 (almost always) with higher scores indicating higher self-compassion. A mean score of self-compassion is then calculated, as research indicates that a single higher order factor of “self-compassion” explains the strong inter-correlations among the sub-scales (Neff, 2003b). Each of the variables includes two items, and we take their mean as the value of that variable.

**Self-esteem:** The Rosenberg Self-esteem scale (RSE; Petersen, 1965) is a measure of overall self-esteem and consists of 10 items that assess global self-worth by measuring both positive and negative (reverse-coded) feelings about the self (e.g., “On the whole, I am satisfied with myself”). The scale is believed to be unidimensional. All items are answered using a 4-point Likert scale format ranging from 1 (strongly disagree) to 4 (strongly agree), with higher scores indicating higher self-esteem. Internal consistency reliability was  $\alpha = 0.849$ .

**Body-image:** The Multidimensional Body-Self Relations Questionnaire Appearance Scales (MBSRQ-AS; Cash, 2000) is a 34-item self-report inventory for the assessment of body image, measuring one’s attitudinal dispositions toward the physical self, using 5 subscales. A shorter version of this questionnaire consisting of 19 items and two subscales - appearance evaluation (AE) (7 items) and appearance orientation (AO) (12 items) - was employed. All items are measured on 5-point scale ranging from 1 (definitely disagree) to 5 (definitely agree), and each subscale score is the mean of its constituent items. Cronbach’s alpha was 0.858 for AE and 0.816 for AO, in this study.

All questionnaires were translated to Hebrew, validated by a professional translator, and implemented in Qualtrics.

**Visual analogue scales:** Before and after the intervention (S2-pre and S2-post), participants were asked to rate their current levels of negative and positive affect on several visual analogue (VAS) 100-point scales. The VAS is a measure of affect intensity that is valid for registering short-term changes in affect (Albersnagel, 1988) . Negative

affect (NA) was assessed by four emotions related to the self-criticism induction (ashamed, disgusted with themselves, guilty, angry at themselves). The activated and the soothing positive affect were assessed by two sub-scales of the Activation and Safe/ Content Affect Scale (Gilbert et al., 2008). Four items with the highest factorial loading of the activated positive affect (activated PA; lively, energetic, excited, enthusiastic) and the soothing positive affect (soothing PA; safe, secure, content, warm) were chosen. Given their high internal consistency (Cronbach's  $\alpha$  for negative affect = 0.843; activated positive affect:  $\alpha$  = 0.829; soothing positive affect:  $\alpha$  = 0.826), responses to items belonging to the same affect system were aggregated to compute the mean.

**Comfortable interpersonal distance test:** The stimuli used were a modified version of a paper-and-pencil validated measure of comfortable interpersonal distance (CID; (M. P. Duke & Nowicki, 1972; Marshall P. Duke & Kiebach, 1974). There were no significant results; please refer to Appendix A for more details.

**VR-related questions:** We also assessed the meaningfulness of the experience using a single item (rated on a 7-point scale), perceived self- presence in the VR (1 item, rated on a 7-point scale), perceived presence of the actor in the VR (1 item, rated on a 7-point scale), and willingness to participate in future experiments (1 item, yes/no).

**Physiological measures:** All participants were fitted with a strap ECG recording device, in order to measure heart rate and its derivatives. No significant results were found in this data; see Appendix B.

**Follow up Questionnaire:** Three months after the experiment a short online survey was sent to all participants, including the following questions: how much would you willing to pay for the VR experience if it was a paid event? The answers were 10, 20, 50 or 70 Euros, or "I would not pay for such a meeting". A second question said: "All of us had experiences with transformative effect, i.e., experiences that significantly changed the way we experience our lives. As compared to such experiences, how would you rate the VR experience?" (1-5 Likert scale). Finally, participants were asked to write three words that describe the experience.

## **Qualitative Analysis**

Forty-eight participants went through semi-structured interviews after the experience; 24 from each condition. Applied thematic analysis (ATA) was conducted on 24 interviews (50%), 12 from each condition, based on full transcriptions of the interviews. ATA (Guest et al., 2014) identifies and describes implicit and explicit ideas within the data, consequently linking them into the theoretical framework of the study. That is, the analysis was conducted through a bottom-up approach in which the answers provided by the participants determined the main themes, rather than the questions asked. Additionally, at the start of the interview, participants were asked to provide five words describing their experience.

## **Results**

### **Main Effects**

The participants in the Self condition found the experience significantly more meaningful than those in the control condition ( $t(72)=-3.923$ ,  $p<0.001$ ) and reported higher active positive affect ( $t(72)=-2.353$ ,  $p=0.021$ ).

The participants in the Stranger condition reported a higher awareness to the presence of the confederate (inside the VR) than the participants in the control condition ( $t=2.043$ ,  $df=72$ ,  $p=0.045$ ).

The major dependent variables were measured by questionnaires that were administered both before and after the experience. We verified there were no significant differences between the groups before the experience, and below we report findings measured as after-before; i.e., we report differences between the conditions reflected in the change in the self-compassion measurements.

There were significant differences between the two conditions in the difference (after-before experience) in reported self-esteem (SES\_D;  $t=2.303$ ,  $df=71$ ,  $p=0.024$ ), self-kindness (SCS\_SK\_D;  $t=2.034$ ,  $df=71$ ,  $p=0.046$ ), and self-isolation (SCS\_IS\_D;  $t=2.41$ ,  $df=71$ ,  $p=0.019$ ); in all measurements the reported values increased in the Stranger condition and decreased in the Self condition.

### **Interaction Effects**

Further, we ran a multivariate general linear model (GLM) analysis with condition as a fixed factor and age, BMI, and gender as covariates, using the median values to split the participants into two groups (age = 37, BMI =26.5). We report significant or nearly significant interaction effects. In order to display these interaction effects, we split both age and BMI in their median values. A two-way ANOVA with these binary categorical variables yields almost identical results to the GLM results. Interestingly, there were no significant gender effects. For completeness we also report near significant effects.

### **Age**

There was a significant interaction between the difference in body image appearance (MBSRQ\_AE\_D, post-experience – pre-experience) and age ( $F(df)=8.116$ ,  $p=0.001$ ), and between the difference in reported self-kindness before and after the experience (SCS\_SK\_D) and age ( $F(df)=3.156$ ,  $p=0.049$ ); Figures 5 and 6 indicate that both measures decreased in the Self condition for the younger group and increased in the Self condition in the older group.

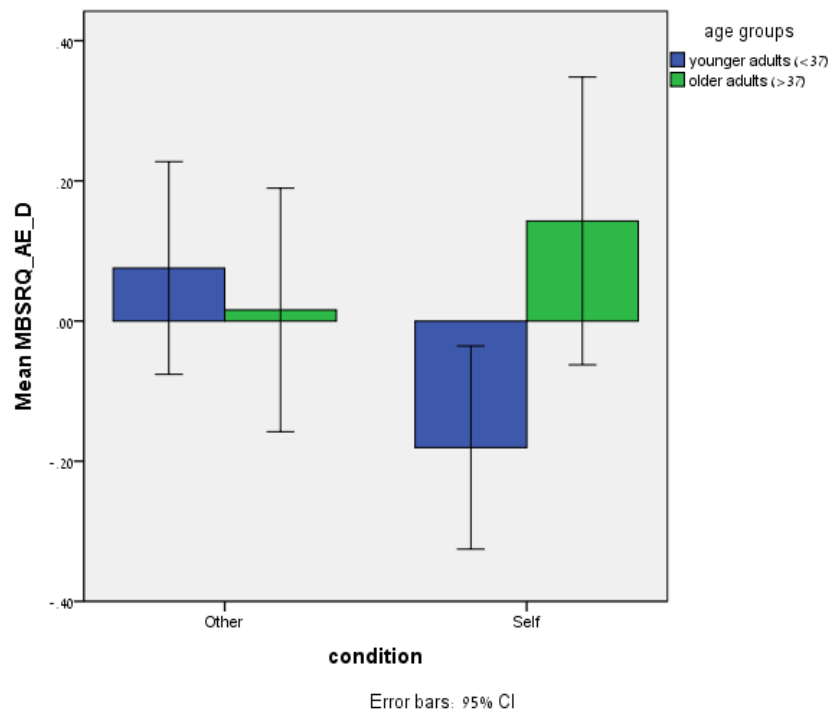
The interaction between the extent to which the participants found the experience meaningful and age was approaching significance ( $F=2.806$ ,  $p=0.068$ ). As indicated in Fig. 7, older participants found the experience more meaningful in the Self condition, but there was no difference in the Stranger condition.

### **BMI**

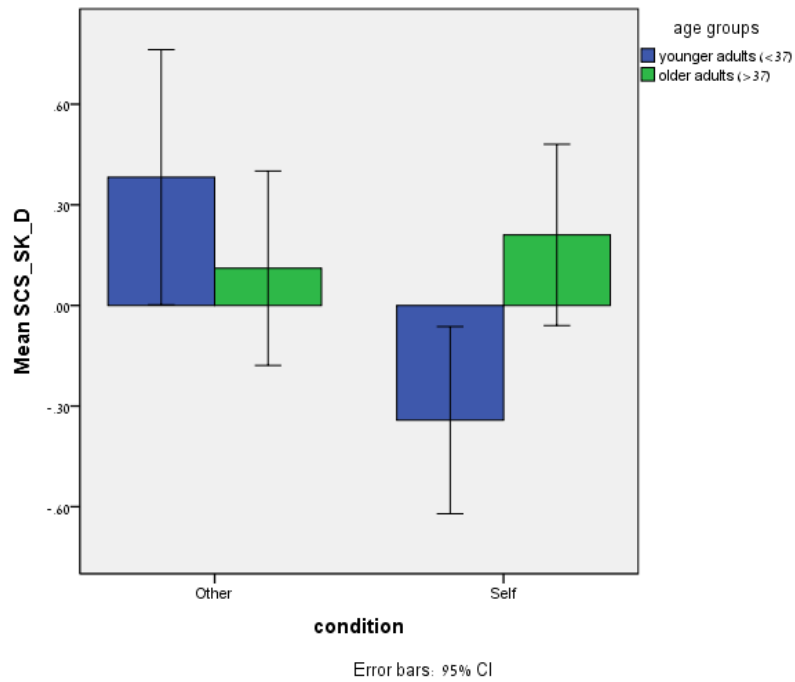
There was a significant interaction between the difference in reported isolation before and after the experience (SCS\_IS\_D) and BMI ( $F(df1, df2) =3.624$ ,  $p=0.032$ ); Figure 8 indicates that individuals with low BMI felt more isolated than individuals with high BMI in the Stranger condition but not in the Self condition.

There was also an interaction approaching significance between the difference in reported self-compassion in general before and after the experience (SCS\_D) and BMI ( $F=3.067$ ,  $p=0.053$ ); Figure 9 indicates that self-compassion increased for individuals with high BMI and decreased for individuals with low BMI; this was true in both conditions, but the gap was larger in the Stranger condition than in the Self condition.

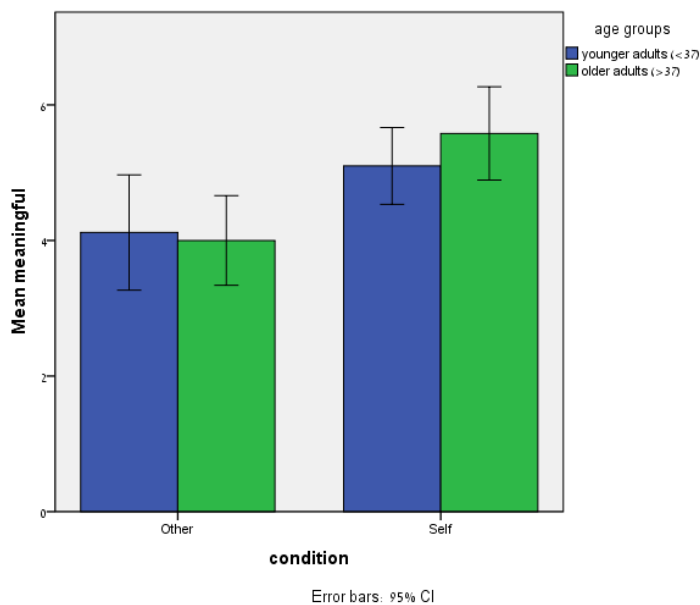
There was an interaction approaching significance between the difference in appearance body image before and after the experience (MBSRQ\_AE\_D) and BMI ( $F=2.775$ ,  $p=0.07$ ); Figure 10 indicates that individuals with higher BMI had higher decrease in body image than individuals with low BMI in the Stranger condition but not in the Self condition.



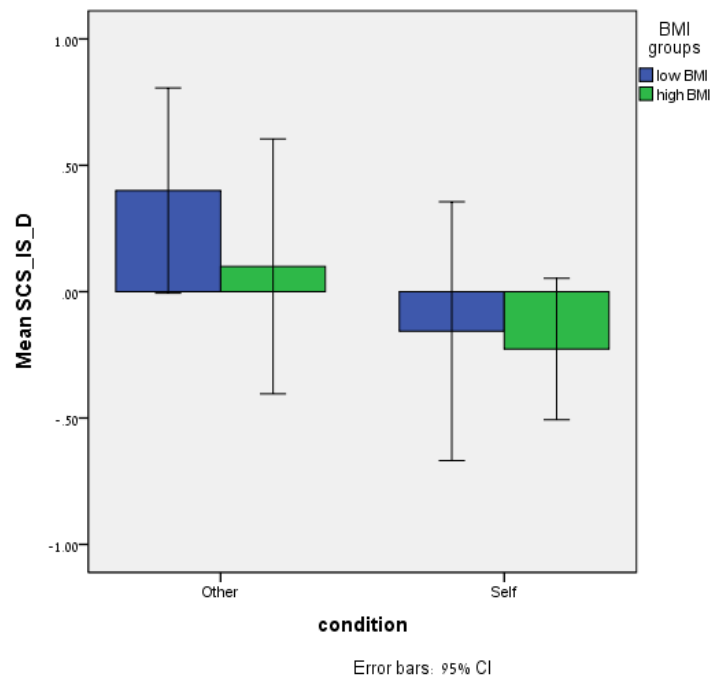
**Figure 5: Interaction effect of age and body image appearance: 'meeting themselves' resulted in lower body image appearance for younger participants as compared to the control condition, whereas it was higher in the Self condition for older participants.**



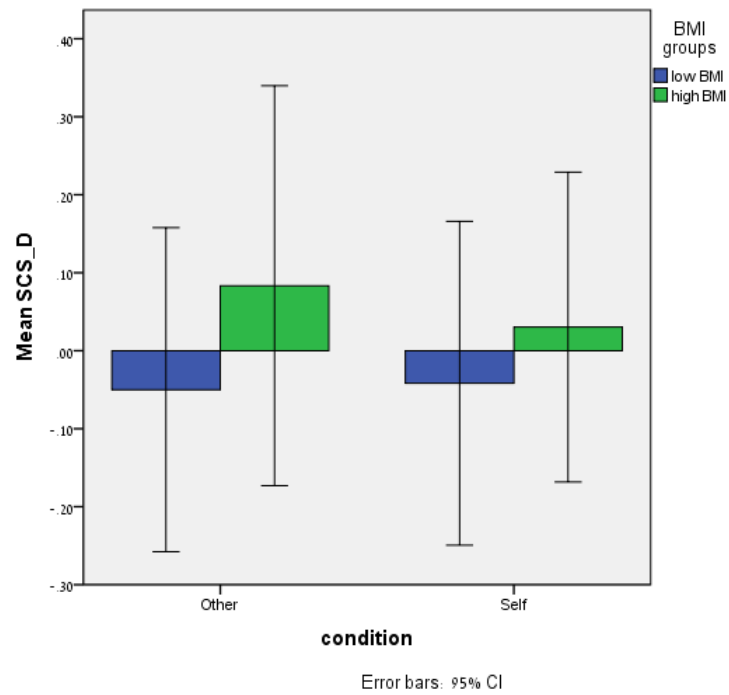
**Figure 6: Interaction effect of age and self-kindness: 'meeting themselves' resulted in lower self-kindness in younger participants as compared to the control group, whereas it was higher in the Self condition for older participants.**



**Figure 7: Interaction effect of age and the extent to which the participants found the experience meaningful.**

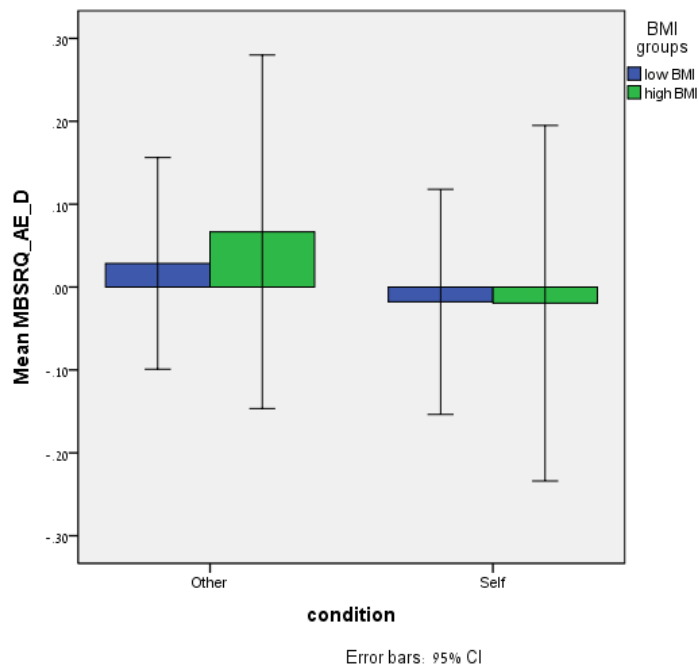


**Figure 8: Interaction effect of the self-isolation component of self-compassion and BMI.**



**Figure 9: Interaction effect of general self-compassion and BMI.**





**Figure 10: Interaction effect of body image appearance and BMI.**

## Gender

The GLM analysis did not find any interaction effects related to gender.

## Qualitative Results

In the 48 post-experiment interviews, twelve of the participants in the Self condition expressed an intense emotional experience; four female participants aged 40-45 could not stop crying during the interview and expressed the desire to "let their emotions go". They stated that the encounter with their self "was the most intense experience they had ever had"; "one they would take with them for a long time"; and "one that was difficult to contain, therefore inducing the need to cry". This emotional intensity was not expressed by those participants in the Stranger condition. When asked to state five words to describe the experiment, participants in the Self condition used mostly positive words such as: deep (multiple participants), intimate, addictive, strong, forgiving, total, empowering, dream come true, whole, and exciting. Some neutral words were used such as: surprising (multiple participants) or exposed. However, there were also quite a few negative words: intimidating (multiple participants), hard, sad, uncomfortable, and disturbing. Interestingly. Only in the

Stranger condition people mentioned 'too intimate' or 'invasion of private space'. Importantly, the positive words used by participants in the Stranger conditions were, in general, more moderate, such as: nice or cool.

The recurring themes that emerged were categorized into five broader themes, as follows: (1) “Meditative” experience – participants reported having gone through a calming, relaxing, pleasant, Buddhist type experience, in which they felt a connection to their “self”; (2) Innovation – participants expressed a new, different, curious, fascinating, interesting, unknown, “cool”, and technological experience; (3) High valence emotions – Participants conveyed the experience as surprising, exciting, disappointing (whether they met their self or not) deterring, and empathetic; (4) Compassion – self-acceptance, self-forgiveness, self judgement (of self and others) were articulated; and (5) Age – the older adults described a process of maturation or higher self-acceptance over the years. Furthermore, this acceptance was apparent when compared to the younger adults who described more negative self-perceptions (within the self-encounter), specifically a lower sense of self-acceptance. The older adults indicated more self-love, acknowledging reality, maturation, acceptance of failure, empathy and self-forgiveness.

### **Long term effects**

Significantly more participants from the Self condition opted to fill in the follow up questionnaire (35 vs 22, 57 in total)( $\chi^2=9.72$ ,  $p=0.02$ ), taking place 3 months after the main study. Participants in the Self condition rated the experience to be significantly more transformative (mean=2.62 on a 1-5 scale) ( $t(55)=2.242$ ,  $p=0.027$ ); there were no statistical differences in other measures discussed here.

### **Discussion**

"Meeting yourself in VR" was reported as significantly more meaningful, induced significantly more active positive affect. However, our results also indicate that in some cases an interaction with yourself can "backfire"; contrary to the conclusions of previous studies involving encounters with self, we found that in our context 'meeting

yourself' resulted in significantly reduced self-esteem and self-kindness, and reported self-isolation increased, as compared with an equivalent interaction with a stranger.

Further analysis of all measures, including the interviews, revealed that these effects may be at least partially explained by individual differences in age, and possibly also BMI. Specifically, the 'interacting with yourself' experience resulted in opposite effects on different age groups; the younger participants were more critical towards themselves after meeting themselves (lower body image, less self-kindness) as opposed to the older participants. This is consistent with socio-emotional selectivity theory (SST) (Carstensen, 2006).

In a comprehensive review of 28 studies (Braun et al., 2016) self-compassion and body image were implicated as protective factors regarding poor body image and eating pathology, with a few exceptions. Our findings indicate that 'interacting with yourself' had a larger positive impact on participants with high BMI as compared to participants with low BMI; this was reflected in reported body appearance and overall self-compassion (both cases nearly significant). While these findings could be attributed to floor effects in individuals with low BMI, they are nevertheless very encouraging when considering such interactions as a treatment for obesity or body image. Interestingly, we did not find significant gender effects, and this was also the case in the original self-talk in front of the mirror study (Petrocchi et al., 2017).

Overall, 'interacting with yourself' in the form that we have explored resulted in a very meaningful experience, but a complex one; the individual outcome most likely depending on multiple factors, and in our study, we show that age and BMI are important factors. Our study was based on immersive video, whereas most other studies looking at 'meeting yourself' in VR adopt computer graphics imagery (CGI) due to the differences between these experiences, mostly the much higher photorealism of our approach, we also anticipated that these may have very different consequences. In fact, in the main previous study investigating self-talk in VR (Osimo et al., 2015), self-talk with another (virtual) person had a more positive outcome than self-talk with a virtual clone of yourself. Thus, it could be that self-talk is useful in VR, but less so when you see yourself, especially in a photo-realistic like setup such as stereoscopic video.

More generally, we can compare four studies with different types of 'self-talk' – explicit in front of the mirror (Petrocchi et al., 2017), implicit in VR (Falconer et al., 2014), explicit, in VR, in front of either yourself or Freud (Osimo et al., 2015), and explicit in front of yourself, in video 360 (current study). We try to generalize the conclusions, although each study measured different dependent outcome variables. VR body ownership plays an important role in the (Osimo et al., 2015) and (Falconer et al., 2014) studies, but not in our study and in the (Petrocchi et al., 2017). We suggest that in the special case of interacting with yourself, a critical aspect is perspective taking – rather than "who you are", it is about "who you are confronted with" (see Hasler et al., 2021 for somewhat similar conclusions).

Our method was deliberately selected to duplicate the self-talk mirror study (Petrocchi et al., 2017), but our results indicate that the effects of the intervention are less favorable. Moreover, our participant sample is much older than the (Petrocchi et al., 2017) study (mean age = 37.8 years vs 26.3 years), and the non-favorable results are especially relevant for the younger participants. A possible explanation is that interacting with yourself in front of the mirror is a common experience, whereas interacting with yourself in immersive video is a very different experience.

To conclude, these four studies suggest four different methods of intervention or therapy for well-being. Our study is different in the technique used, which is highly photorealistic. Importantly, this is the first to suggest caution – under certain conditions meeting yourself can 'backfire'. As VR is being increasingly applied for psychological and wellness interventions, it is crucial to further understand what elements of the experience are desired and for which specific participant group.

## **Acknowledgements**

Removed for anonymity

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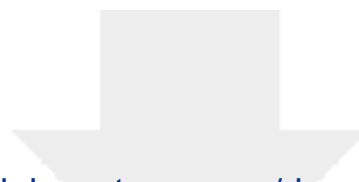
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