Paint with Me: Stimulating Creativity and Empathy While Painting with a Painter in Virtual Reality

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Fig. 1: Picture of author demoing the experimental setup.

Abstract—While nothing can be more vivid, immediate and real than our own sensorial experiences, emerging virtual reality technologies are playing with the possibility of being able to share someone else's sensory reality. The Painter Project is a virtual environment where users see a video from a painter's point of view in tandem with a tracked rendering of their own hand while they paint on a physical canvas. The end result is an experiment in superimposition of one experiential reality on top of another, hopefully opening a new window into an artist's creative process. This explorative study tested this virtual environment on stimulating empathy and creativity. The findings indicate potential for this technology as a new expert-novice mentorship simulation.

Index Terms—Embodied simulations, Virtual Environments, Mixed Reality, Creativity, Empathy, Painting

INTRODUCTION

> "Think about it: there is no experience you have had that you are not the absolute center of. The world as you experience it is there in front of YOU or behind YOU, to the left or right of YOU, on YOUR TV or YOUR monitor. And so on. Other people's thoughts and feelings have to be communicated to you somehow, but your own are so immediate, urgent, real."
>
> – David Foster Wallace, This is Water (2005 Kenyon Commencement Speech)

On March 25, 2014, Facebook CEO and Founder Mark Zuckerberg announced that Facebook had purchased Oculus VR, the leader in virtual reality technology. In his announcement, Zuckerberg suggests that virtual reality will be the new platform for social media, enabling a more personal and immersive exchange of experiences. Marc Andreessen, an Oculus VR angel investor, proclaims that the Oculus will "redefine fundamental human experiences." (Oculus Blog, December 13, 2013) While virtual reality technology is not new, recent advances in the technology allow it to be more suited as a communication medium rather than just trying to render an "ideal copy" or perfect simulacra of an experience that is indistinguishable from that which could be had in the physical world (Biocca and Levy, 1995). Termed "embodied experiences" (Ahn, Le, & Bailenson, 2015) or "embodied simulations (Bertrand, Franco, Pointeau, & Cherene, 2014), immersive virtual environment technology (IVET) can allow users to embody the first-person point-of-view of another person while seeing and hearing sounds from the experiential locus of another person, as though the viewer can wear another person's sensory apparatus. This simulation allows for the illusion of being in another person's shoes and embodying their perspective, a situation perhaps best represented by Spike Jonze's 2006 film *Being John Malkovich*, wherein characters enter a portal that allows them to see, feel, and hear through John Malkovich's body. Because this new communication medium allows people to share a new mode of access one another's experiences, this study hypothesizes that it can facilitate greater intimacy, understanding, and empathy.

The Machine to Be Another (by BeAnother Lab) is an artistic project based out of the Massachusetts Institute of Technology (MIT) Media Lab whereby two people wear an Oculus with a camera on it that is live streamed into the other person's Oculus screen, such that they see from one another's point-of-view in real time. This study is

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motivated by BeAnother Lab's claim that these embodied simulations in IVET can "stimulate empathy through embodied interaction between individuals." (Bertrand et al., 2014, p. 1) The interview questions were motivated by Zuckerberg's statement that immersive virtual environments offer the most "most social platform" to ever exist (Farr, 2014). Thus, the aim of this inductive study is to pinpoint the specific affordances of this new media and explore possible implications for kinesthetic empathy, social perspective taking, learning, and communication about the creative process of being a painter. These factors are hypothesized to be facilitated by visuomotor body resonance and sensorimotor contingencies based on the shared kinesthetic experience between the performer and the user. This study specifically addresses the communication issue of relaying the creative process of artistic expression to a novice, or inexperienced artist. The hypothesis is that moving together (in this case, drawing) during an embodied experience in IVET can enhance empathic accuracy and stimulate creativity.

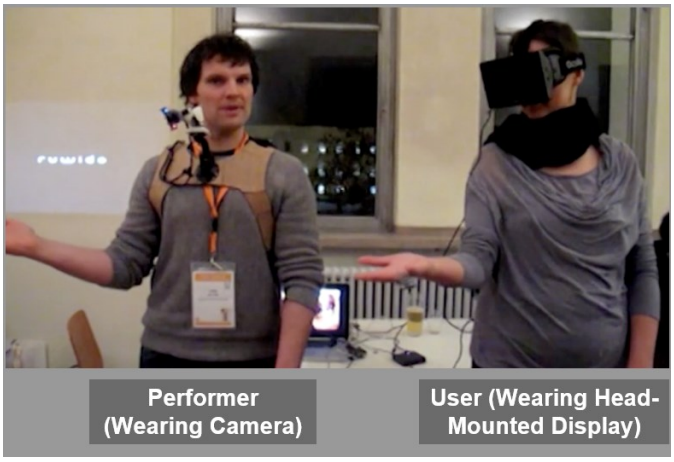


Fig. 1: The MachineToBeAnother Perspective Sharing setup, where the Performer (Left) wears front-facing camera that is live streamed into the Head Mounted Display (HMD) of the User (Right). Photo reproduced with permission from BeAnother Lab. In this setup, the Performer follows the movements of the User while they move synchronously.

The methods design for this study was inspired by the Machine to Be Another's performance "la noia de les lagrimes vermelles" ("the girl with the red tears"), wherein a 12-year old girl named Sarah wore two small cameras on a hat to share her embodied creative process of drawing while her mother Anna followed her movements. It is important to note that within this framework, the user becomes visually blind to their own body, which is replaced by the virtual simulation of the sensory apparatus of the performer. BeAnother Lab emphasizes shared movements, similar physical environments, and using real physical objects to enhance the sensorimotor contingencies between a user and a performer and to increase "the illusion of being in the place depicted by the virtual reality" (p. 3, Bertrand et al., 2014). However, Be Another Lab instructs the "performer" (the person wearing the cameras) to copy the movements of the "user" (the person wearing the Oculus), and the present study does the opposite. The present study involves handing the user, who is the experimental subject, a real paintbrush, palette, and seating them in front of a real canvas so that the physical reality of the user will match that of the performer and mirror what the user sees in the virtual simulation. The performer, who is a professional artist recruited from the Copenhagen community, paints while the subject (the user) will be instructed to "move with" and copy the painter's movements with their own paintbrush and canvas that the subject can feel, but cannot directly see.

In the opening quote, David Foster Wallace summarizes one of the greatest obstacles of human communication: the attempt to translate the felt immediacy of first-person experience to someone else, and to moreover understand someone else's experience. Wallace states that all of our experiences are rendered through an embodied point of view, and that this orientation places the subject at the center of his or her experiences. However, recent advances in filmed, streamed, and simulated virtual reality environments allow subjects to see first-personally from the point-of-view of another person, character, or avatar. Thus, in this sense, it could be argued that through this technology it is now possible to have exactly the type of experience that Wallace suggests our day-to-day mode of being occludes: an experience in which a person is not the absolute center of their own experience. Instead, through this technology the individual is placed in the center of someone else's experience. This inductive study explores how this virtual simulation can transform our ability to relate to and learn from one another.

1 Theoretical Framework

Psychologists have demonstrated the cognitive process of perspective taking through imagining oneself in the shoes of another to be very effective in stereotype reduction (Batson et al., 1997), learning (Siegler, 1995), and improved interpersonal communication (Fussell & Krauss, 1989). Batson et al. (1997) argue that empathy involves the cognitive ability and resources to engage in taking the perspective of another person. Thus, the high cognitive demand of mentally transposing oneself into another's perspective is a severely limiting factor in the generalizability and applicability of these results. Moreover, Davis and Kraus (1997) have shown that individuals differ in their ability and motivation to engage in and hence benefit from this form of cognitive perspective taking. The media affordances of virtual reality technology include multisensory inputs to layer perceptual information in a virtual environment in ways that can concretely allow one to see, hear, and feel as if they were having the sensations in the physical world, and thus users can literally be placed within the point-of-view of another. Ahn, Tran Le, and Bailenson (2015) used this technology to facilitate easy and effective perspective taking, and found that IVET were more effective than cognitive perspective taking and that IVET experiences led to greater self-other merging, attitude change, and helping behavior towards persons with disability. The Virtual Human Interaction Lab (VHL) at Stanford, led by Jeremy Bailenson, recently launched the "Empathy at Scale" project, aiming to create and develop applied research protocols for teaching empathy, specifically in anti-discrimination training.

Numerous studies have examined the impacts of Body Ownership Illusions (BOIs), originating with the rubber hand illusion (RHI; Botvinick & Cohen, 1998). The rubber hand illusion works by having a subject's real hand hidden from view behind a panel while a rubber hand is placed on a table next to their real hand. By delivering synchronous tactile stimulation to a subject's hand and the rubber hand, subjects experience the rubber hand as if it is their real hand, which is termed the body ownership illusion (BOI). Ehrsson et al. (2007) extended the RHI to full-body ownership illusions by filming from a mannequin body while subjects wore an IVET head-mounted display (HMD) and had their stomach stroked synchronously with the mannequin stomach. The effect occurs through what is termed "visuotactile triggers" for body ownership illusions. Kilteni, Maselli, Kording, and Slater (2015) describe how the RHI extends to BOI in avatar bodies in virtual reality by using vision and motor (visuomotor) synchronously to create a sense of ownership over avatar body. This is accomplished with motion tracking that renders the user's physical movements onto an avatar body in a virtual environment (see Figure 2). Instead of using an avatar body in a simulated environment to induce body ownership, the present study uses a stereoscopic video captured environment with binaural audio to explore empathy for another real person, as opposed to empathy through BOI with an avatar body. Thus, the present study explores the effects of synchronous visual and motor presentation while the subject moves together with the painter. The dependent measures for this study were adapted from Ahn and colleagues's (2015) study on empathy towards

persons with achromatopsia (color blindness), where a virtual simulation of a task space from the colorblind colleague's point of view increased prosocial attitude and behaviour. Ahn et al. report an increase in self-other merging and feelings of oneness measured by the Inclusion of Other in the Self Scale originally developed by Aron et al. (1992). Rather than measuring BOI exclusively, this study explored the effects of visumotor synchrony (moving together) on oneness, adapting Ahn et al.'s methodology.



Fig. 2: Image from Peck et al. (2013) study, "Putting yourself in the skin of a black avatar reduces implicit racial bias" by researchers at EVENT Lab at University of Barcelona. The user wears a full body-tracking suit (Top Left) and HMD while seeing from the embodied first-person perspective of an avatar body with motion-tracking. The user can see the avatar hands and body in a mirror in the virtual environment (Bottom).

Virtual environments have been shown to significantly alter sense of self through transformed self-representations (Yee & Bailenson, 2007), disoriented spatial localization of one's own the body (Leggenhager, Tadi, Metzinger, & Blanke, 2007), and modified form, shape, and morphology of the body, termed "homuncular flexibility" (Won, Bailenson, Lee, & Lanier, 2015). Further, virtual environments impact social interactions and social awareness, specifically implicit racial bias (Groom, Bailenson, & Clifford, 2009), social perspective taking (Gehlbach et al., 2015), and helping behavior towards persons with disabilities (Ahn, Le, & Bailenson, 2015). Despite that Bertrand et al. (2014) make the important distinction that embodied experiences under the BeAnother Lab paradigm involve real people instead of avatars, it is still useful to extend the findings of avatar studies to the plausible cognitive and behavioral effects when sharing experiences with real people. Yee and Bailenson (2007) coined the term "Proteus Effect" to describe the experience of transformed self-representation when users identify with the physical appearance of an avatar such that the avatar's appearance affects the user's behavior in the virtual world, or even in the real world. For example, embodying an attractive avatar increases intimacy with a confederate, as demonstrated by greater self-disclosure and proximity to confederate during a conversation. It is interesting that this effect occurs even though the subject's avatar was presented with a neutral or blank face to a confederate, meaning that the effect can be attributed to self-perception and not social feedback. Moreover, Yee, Bailenson, and Ducheneaut (2008) showed that this effect extended to subsequent face-to-face interactions. Freeman et al. (2013) conducted a study on decreased avatar height in a virtual simulation of riding on a subway train, and found that decreased height contributed to greater anxiety and paranoia. Rather than identifying with the physical appearance of the painter (which the subjects cannot see), the present study explores whether subjects identify with the painter's thoughts and feelings while they paint along with her.

Individuals often coordinate their movements either intentionally or unintentionally in rhythmic behavior with other individuals (Richardson, Marsh, Isenhower, Goodman, & Schmidt, 2007). This interpersonal coordination can occur overtly through physical contact or by detecting visual movement information, and coordination can occur even when the goal does not explicitly define the coordination itself (Richardson, Marsh, & Schmidt, 2005). Thus, visually mediated interpersonal communication can entrain movement coordination. This study uses visually perceived movements and synchronized movements during a communication task, and explores the effects on communication efficacy. In everyday social interactions, people tend to mimic one another's movements and gestures, termed the chameleon effect (Chartrand & Bargh, 1999), and this mimicking behavior has been linked to greater likeability and social influence, even by non-human digital avatars (Bailenson & Yee, 2005). This study explores whether this type of "mimicry" can enhance empathic understanding. Goodwin, McCloskey, and Matthews (1972) mechanically stimulated the muscle tendon of a physically constrained joint as a method to induce illusory body distortions, and blindfolded subjects experienced the illusion of movement. Thus, it seems plausible that based on the conclusions from these studies, subjects might experience a merging with someone else while moving together and seeing the other person's body move from a first-person perspective. Further, Patel et al. (2006) conducted an experiment whereby they compared learning outcomes from traditional 2-dimensional film media of a teacher instructing Tai Chi movements, with a significant effect of the 3-dimensional immersive virtual reality projection on learning. Thus, learning of movement patterns can be enhanced through training in virtual reality.

2 METHODS

Background

In a recent project conducted at the Institution for Simulation and Training at University of Central Florida, Gallagher, Reinerman-Jones, Janz, Bockelman, and Trempler (2015) found that subjects in IVET simulations of space shuttle take-off experience similar states of awe and wonder as actual astronauts report when being on a space shuttle and seeing the Earth from space. Gallagher et al.'s (2015) study thus tested the stimulation of certain types of experience (which the researchers classified as "awe" and "wonder") in a virtual simulation. Based on 16 interviews with professional painters, this study similarly collected experiential categories for the creative process of painting. Painters were asked to describe their cognitive and affective experience of creativity in painting. Through content analysis, the transcripts from these interviews were coded and clustered into two major themes: as lack of judgment and the ability to watch something emerge without preconceptions. These features were analysed in the interview transcriptions with subjects after the IVET experience. The present study used a qualitative interview method inspired by Høffding and Martiny's (2015) phenomenological interview. This semi-structured interview was designed to explore the plausible stimulation of key aspects of the creative process of painting to unskilled artists undergoing a live embodied simulation with an artist in IVET.

Subjects

32 subjects (17 Male, 15 Female) ages 20-55 (M=27, SD=7.2) were recruited from the Copenhagen community for this study.

Subjects were recruited through a campus announcement on Copenhagen University's internal website, as well as a poster on campus. None of the subjects had prior painting experience.

Setup

The setup is a Mixed Reality (MR) setup that utilizes mapping the apparent location of a virtual canvas and easel onto the physical canvas and easel that the user paints upon. The experimenter calibrated the easel and canvas in proximity to the user to match and accommodate every subject such that the physical canvas mapped onto where the virtual canvas appears. Using Leap Motion integration with the Oculus DK2 virtual reality headset, the user sees a tracked rendering of their own hand, scaled to the painter's hand in the video, and was told to place their hand on top of the painter's hand while following the painter's movements and painting synchronously on their physical canvas.



Fig. 3: Still from the video shown to the User in Oculus DK2.



Fig. 4. Still of the Leap Motion hand tracking for User's hands on top of the Painter's hands.

Apparatus

2 wide-angle Go-Pro HERO 4 cameras were mounted onto a bicycle helmet with three wooden laser-printed pieces (printed at Roskilde University FabLab) to secure the cameras to the helmet just above eye level to create a stereoscopic 3D video with a view range of about 230 degrees (stitched in AutoPano with the back stitched black). The video footage was recorded at the Multisensory Experience Lab at Aalborg University Copenhagen. The painter, Ebba Chambert, was recruited based on her ability to draw realistic but abstract work from her imagination (rather than by looking at a reference object or picture). Binaural point-of-view audio was recorded using Roland CS-10EM binaural microphones, which work simultaneously as headphones. The microphones are electret and omnidirectional, and capture frequency range from 20hZ to 20khZ (average hearing range of a human). Ebba was instructed to wear the bicycle helmet camera mount and binaural microphones and talk aloud about her creative process while painting. The experiment was conducted over the span of two weeks at the Experience Lab in the Human-Computer Communication department at University of Copenhagen. The Leap Motion infrared camera was attached to the front of the DK2 with tape and positioned a downward angle to capture hand movements. The spherical stereoscopic video with Leap Motion was coded in Unity (version 6.4) and masked onto 3D models of the spherical shape of the human eyes to simulate human vision, and then was played through KolorEyes on an Oculus DK2. User wore the Oculus DK2 and binaural headphones.

- *The full video footage shown within the Oculus DK2 can be viewed on YouTube:* https://youtu.be/JLzPee7kwtQ
- *The Google Cardboard application of the video:* http://lyndajoygerry.com/painter.apk
- *YouTube video covering experimental design and setup:* https://youtu.be/7SSWd_1tg7Y



Fig. 5. Camera Apparatus Worn by Performer (Painter): 2 Go Pro Hero 4 cameras measured at inter-pupillary distance 63 mm mounted onto a bicycle helmet (fitted to painter's head) with wooden camera mounts laser printed at FabLab RUC.

2.1 Procedure

Pre-tests. When subjects first entered the lab, they filled out two pre-tests: The Interpersonal Reactivity Index (IRI; Davis, 1980), a psychometric test to gage empathic personality, and the Highly Sensitive Person Scale (HSP; Aron & Aron, 1997), a questionnaire to gage sensitivity to physical and emotional stimuli. HSP is a 27-item questionnaire, and the IRI is a 28-item questionnaire consisting of 7-item subscales: perspective taking, fantasy, empathic concern, and personal distress. Each item was measured on a fully labeled 5-point scale (0 = does not describe me well; 4 = describes me very well). The IRI scores ranged from 35 to 89 (M = 61.83, SD = 13.20). The HSP scores ranged from 84 to 158 (M = 115.36, SD = 21.80).

Experiment. Participants all received the same instructions about the experience. Subjects were told that they would be painting with a painter, and were instructed to move along with the painter, to follow her movements as much as possible, and to not worry about maintaining a mental representation of their actual palette or canvas. Subjects were told that the goal was not to create a work of art, but to pay attention to following the painter's experience. A palette was prepared on a paper plate using white, black, red, yellow, and blue paints arranged in a circle such that yellow was between red and blue and white and black where at the top and bottom, respectively. The palette was arranged the same for all subjects. The canvas was mounted onto an easel and the easel was positioned to match the position where it appeared to be in the virtual world (it was the same easel). This was achieved by having subjects wear the Oculus DK2, see the virtual environment (paused video), and hold out their arms to indicate where the edges of the virtual canvas appeared to be. Subjects could see their Leap-Motion tracked hands to know the relation between their hands around the physical canvas, compared to the apparent location of the virtual canvas. The experimenter then moved the easel until the subjects could feel the edges of the physical canvas. Subjects took the headset on and off a few times to check for accuracy

and slight tilt/movements of the canvas, easel, and their own chair position to best match the image presented in the virtual world. Then subjects were given the binaural headphones, the palette plate in their non-dominant hand, the brush in their dominant hand, and they put on the Oculus DK2. The experimenter guided subject's hand with the paintbrush to touch the center of the canvas. Subjects were told that if they felt eyestrain, a headache, dizziness or nausea at any time, they could just take off the headset. One subject took off the headset after 16 minutes, but his data is still included since this was sufficient time for the subject to be exposed to the virtual environment for the analysis.

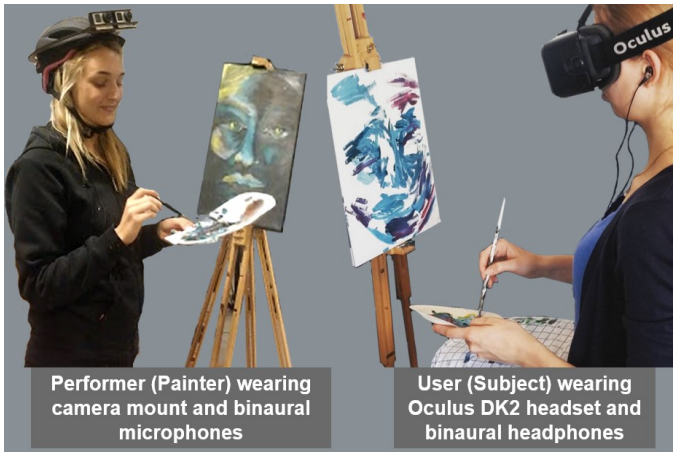


Fig. 6. Depiction of experiment setup.

The main experimental task was to move along and paint with the painter, and to refill the brush with color, mixed on the palette, also when the subjects saw the painter doing this. The one mixed reality component that was not incorporated was dipping the brush into water, but subjects were encouraged to mime this movement even though they were not dipping their brush into water.

Post-tests. When the video finished, the experimenter faded the screen to black and tapped subjects on the shoulder to take them out of the experience. Subjects were then given a Virtual Reality Survey, testing Presence, Immersion, Agency, Bodily Ownership, and Oneness. Then subjects completed the Empathic Accuracy test by watching 10 short videos from the IVET video at pre-specified time points marked by the painter when she had a unique thought or feeling. Subjects were asked to generate a sentence or phrase to describe what they thought the artist was thinking and feeling at these intervals.

Semi-Structured Interview. Experimenter conducted 15-20 minute interviews with subjects to gain more insight into what was gained from the virtual simulation and experience (media affordances), to what extent subjects felt more or less creative after the experience, and how subjects thought about the medium as a potential communication and educational platform. All subjects were asked the same 5 questions with adapted follow-up questions.

2.2 Dependent Measures

Oneness. The Inclusion of Other in the Self Scale measured how close the participants felt to the painter. Developed by Aron and colleagues (1992), this scale depicts seven drawings of increasingly overlapping circles, starting with the first picture of non-overlapping circles and the seventh picture of two almost completely overlapping circles. The participant was instructed to select the figure that best captures the extent to which they felt close to the painter.

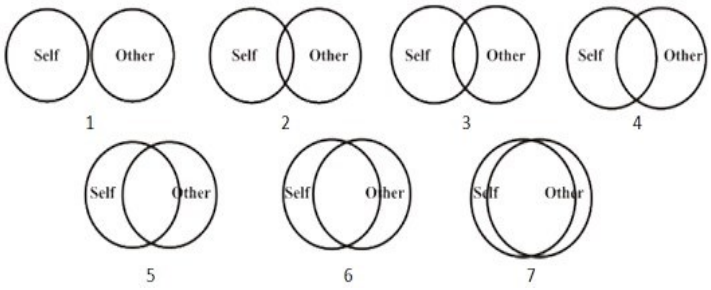


Fig. 7. Inclusion of the Self in the Other Scale (Aron et al., 1992)

Empathic Accuracy. To operationalize empathy, this study utilizes William Ickes (1993) empathic accuracy technique and coding. Ickes adapted the humanist psychologist Carl Rogers' criteria for assessing the convergence between the therapist's and the client's perception of the client's self-concept. Specifically, the Rogerian view stipulates that empathy involves a moment-to-moment sensitivity to the changing feelings and emotions in another person, and thus a measurement of empathic accuracy should be a temporally extended, repeated-measures assessment to track empathy as a developing and ongoing process. Moreover, the perceiver should generate his or her own inferences about the content of the target person's thoughts and feelings, as opposed to choosing from a set of pre-specified optional responses. Most importantly, the operational definition of empathy should be the degree to which a perceiver's inferences matches and is congruent with the target person's actual thoughts and feelings (Rogers, 1974, as cited in Ickes, 1993). Thus, subjects generated their own inferences about the painter's experience while painting, and this was compared with the painter's generated report. Responses were coded from 0 to 2, 0 being "completely different", 1 being "different thoughts but along the same lines", and 2 being "almost identical." The experimenter and an independent coder both coded the responses for inter-coder reliability. Percent agreement was 90-100% across all subjects except for one (70%), which the coders discussed to increase to 90% agreement. Scott's Pi was between .52 and 1. Cohen's Kappa was also between .55 and 1, and Krippendorff's Alpha for inter-coder reliability was between .66 and 1.

The following four dependent measure survey items were adapted from Osimo, Pizarro, Spanlang, & Slater (2015). All items were measured on a 5-point Likert Scale.

Presence. Two items on the Virtual Reality Survey measured presence and immersion. The items "I felt the canvas I was painting upon was the canvas I was shown in the virtual environment" and "I lost sense of my physical body and felt myself to be in the world presented in the virtual environment."

Immersion. The item "I felt like the painter and I were creating something together within the virtual world." was measured immersion on a 5-point Likert Scale.

Ownership. The item "I felt like the painter's hand was my own hand." measured ownership.

Agency. The item "I felt like my movements were indistinguishable from the movements of the painter" measured agency.

3 Results

ONENESS

A linear regression was conducted with oneness as the dependent variable and HSP, IRI and their interaction terms as the

predictors. Oneness is positively correlated with total IRI score (r = .812 p < .001), empathic concern subscale (r = .645, p = .009), and perspective-taking subscale (r = .675, p = .006). Personal Distress (r = .012, p = .967) and the Highly Sensitive Person scales (r = .069, p = .814) were not statistically significantly correlated with Oneness.

EMPATHIC ACCURACY

There was a statistically significant correlation with Empathic Accuracy and Oneness (r = .571, p < .05). Empathic Accuracy Scores had a significantly negative correlation with the Highly Sensitive Person Scale (r = -.608, p = .021), but was not statistically significant with the Interpersonal Reactivity Index (r = .152, p = .588) or any of its sub-categories.

Target (Painter)	Subject
Thinking that I am totally talking about myself all the time when referring to the "face", and I find this quite funny.	She is thinking about herself and her own relation to the motif.
Thinking that painting dark around the face rather than hair allows the being in the painting to have fewer existential boundaries.	Feeling a need to open up the face in order to connect with it more.
Reflecting on people I know and thinking that this is a good way of viewing the beings in paintings.	She is projecting or recognizes someone she knows as the face.
Realize how much I read into other people's faces and expressions without actually knowing them. Maybe it is intuition or maybe prejudice.	I sense that she feels she can read people by their expression but regrets loving this "gift."
Feeling a bit silly and childish and uncertain.	Thinks about childhood.

Fig 8. Items scored "2" as "Very similar" on Empathic Accuracy Scale.

PRESENCE/IMMERSION

Presence was highly correlated with the Empathic Concern subscale of the IRI (r = .692, p = .004). There were no significant correlations between immersion and the independent variables.

AGENCY/OWNERSHIP

Ownership scores were relatively low (M=2.1/5.0), whereas Agency scores were much higher (M=4.2/5.0). There was an approaching statistically significant negative correlation between Ownership and Oneness (r = -.511, p = .056). There were no significant correlations between agency and the independent variables.

3.1 Results Discussion

The results indicate that the Interpersonal Reactivity Scale (IRI) is a predictor for feelings of oneness. That is, subjects who are predisposed to put themselves into someone else's shoes report feeling more connected to another person than less empathic subjects after seeing from another person's point of view in virtual reality. This finding was reinforced by the strong correlations between the perspective taking and empathic concern subscales of the IRI as predictors for greater feelings of oneness with the painter. Moreover, although there were no statistically significant correlations between the IRI and Empathic Accuracy, there was a significant correlation between oneness and empathic accuracy, indicating that people who feel more in touch with the painter have stronger empathic accuracy. Thus, perspective taking and empathic concern are predictors for stronger feelings of oneness, which is correlated to stronger empathic accuracy. Personal Distress was significantly positively correlated with the Highly Sensitive Person Scale (r = .563, p = .036), which is significantly negatively correlated with Empathic Accuracy. Taken together, this means being highly sensitive (sensitive to physical and emotional stimuli) is correlated to higher personal distress, which can have a negative effect on accurately gaging the thoughts and feelings of others.

An interesting new finding in the study was that the low Ownership scores and high Agency scores, indicating an important distinction between these two dependent measures for future research. More than half of the subjects remarked on the oddness of the Ownership question in the Qualitative Interview, suggesting that this question seemed very odd because the subjects were so aware that they were witnessing an experience from another person's point of view. However, subjects did report that they felt very surprised to see their own canvas because they were convinced that they were painting something very similar to the painting in the virtual world and that they felt a sense of creative agency over the painter's painting moreso than their own physical painting. Moreover, the correlation between Empathic Concern subscale of the IRI and Presence indicates that persons predisposed to have greater empathic concern for another person might be more susceptible to the presence illusion in virtual environments, and future research could explore this correlation in greater depth.

3.1.1 Qualitative Interview

The interview consisted of 6 anchored questions. First, subjects were asked to describe their experience. This was done to explore indicators of states correlated with creativity, as described above. Subjects reported feeling very calm, that the experience was almost "therapeutic", and that they felt like they were creating something. Subjects expressed an increased insight into what it was like to create an image by painting, and many subjects said that they felt empowered to try drawing or painting again with this newly informed perspective. Subjects were almost always very surprised to see their own painting, often disappointed because they felt that they were really moving with the painter and creating something much more similar to her painting. Despite this, subjects still felt inspired to paint more. Moreover, most subjects described the experience as very intimate.

Several subjects reported that they initially felt very nervous and self-conscious of their body and their ability to accurately hit the correct corresponding points on the canvas, but that after awhile that fell away and they forgot about their own canvas. (Interestingly, almost all subjects had accurately captured the features of a face in a way that looked impressively similar to the artist's painting, and then gradually the painting got destroyed, however this "destruction" of the painting was correlated to when subjects reported feeling the most immersed in the experience.) Several subjects remarked that when the painter mentioned changing something about the face to change the expression, the subjects themselves felt like they were putting that intention into their painting. One subject explains, "When she was talking me through the expressions that she was painting and talking about the mood of the person, I felt very much 8like I wanted to capture that mood." Another subject reflected, "It almost feels like collectively discovering something that was in her head all along" and that it "allowed this completely different way of connecting to someone that doesn't rely on facial expressions or anything."

The next questions were focused on how well subjects felt they understood the creative process for painting, as well as this artist's specific subjective processes. The responses were mixed; while most subjects reported that the experience was very intimate, and that it gave them much more than they would have been able to access by painting next to a painter in person or watching a normal video, some subjects felt like the experience was incomplete because they had only minimal access to the artist's mental imagery and thoughts. Interestingly, almost every subject reported that this experiment taught them a lot about how to hold a paint brush, how to move a paint brush, how to mix colors and layer paint, and other crucial details about technique, and even though subjects could not see what they were doing, most reported that they felt like they had learned something about how to paint. Although this was not the direct goal

of this experiment, it does suggest a marketable possibility of developing a POV educational tool to train skills for painting, drawing, illustration, calligraphy, etc.

The interview closed with questions about how people would feel if this technology were to be widely available and easily accessible. I asked how they felt this could change the way we communicate with one another and transform our ability to communicate our subjective experiences. The most interesting finding was that this experience combines learning something in a new way with communicating in a new way. That combination could be valuable for training various skills, cognitive debiasing, and empathy.

3.1.2 Extended Discussion

One subject in the study told the experimenter that he was on the autistic spectrum. During the qualitative interview, the subject continued to talk about himself when asked to describe the thoughts and feelings of the painter. Finally, he reported that he was confused and that he thought that he was the painter, indicating that he had difficulty relating to the painter's subjective states as a mental representation separate from his own subjective states. Alexithymia is the inability to maintain a boundary between self-representations and representations of other's mental/emotional states, and it is often comorbid with autism. Neuroscientific evidence (specifically in line with simulation theory) points to this distinction as essential for empathy (Lamm, Bukowski, & Selani, 2012). This subject scored extremely high on the HSP scale and very low on empathic accuracy.

When a separate subject was asked about how she felt about this technology as an apparatus to help us better understand and contextualize conversations about the creative process and subjective experiences, she replied: "[This technology] is new, it's a different way of showing somebody else's perspective …To me, the main point was not so much experiencing her point of view and agreeing with it, or making it my own, or feeling it at least for a moment as my own, but it was a very intimate way of communicating her point-of-view…just getting a look into it, without it necessarily becoming your own." This points to questions regarding the most optimal relationship to have in order to facilitate empathy and understanding of another. Perhaps having a replaced subjectivity of another person can cause subjects to confuse their own subjectivity with that person, which is arguably not the best relationship to have when trying to understand someone. However, this study did show a positive relationship between self-other merging and empathic accuracy, which is consistent with the notion that feeling close to someone increases attunement towards that person's thoughts and feelings. This is something that could be explored through further research on first-person point-of view and empathy.

Seven subjects independently reported that they felt inspired to engage in their own creative processes in a new way, and two subjects actually tried painting after the study. More specifically, the qualitative interview indicates that subjects had an increased understanding of the artist's creative process. One subject summarized, "I think I got to experience the process of her painting. Whereas before if you look at the painting it gives off a feeling, but this journey lets you understand why she painted it a certain way because she was explaining the process…you get the artist's own meaning and feelings. It's interesting too because since I am not a professional painter, it helps to understand what a painter thinks or goes through while he or she paints." Similarly, another subject remarked, "I was like making my own version of her thoughts in her painting, I think."

Decety and Lamm (2006) argue that empathy is more than just the sharing of an emotion, but is an other-oriented social emotion that contributes to moral reasoning, motivates prosocial behaviors, and inhibits aggression toward others. Hoffman (1981) conceptualizes empathy as being a largely involuntary vicarious response to another person. The automatic habit of mimicry in affective expressions is contrasted to the slower, higher-order cognitive capacity to imaginatively render the thoughts and feelings of another person and transpose oneself into the other's shoes (Decety & Jackson, 2006). According to Preston & Hofelich, (2012), prior experience is thus essential to trigger the appropriate representations to understand and interpret another person's emotional states. However, only one subject in the present study reported having prior artistic experience, and all subjects scored quite high on the empathic accuracy scale. In this study, mimicry was sufficient to stimulate empathic understanding. Further exploration is needed to clarify the relationship between self-awareness and awareness of another person's experience.

4 Conclusion

This study explores the extent to which Highly Sensitive Person scores and Interpersonal Reactivity Scores predict feelings of oneness, presence, agency, ownership, and empathic accuracy. IRI was predictive of inclusion of other in the self (oneness), which corresponded to higher empathic accuracy. Stimulation of empathy through the experience is unclear, and further studies will need to clarify the conditions that contribute to greater empathic stimulation. Because this study was so new, designing a suitable control condition was very difficult, but this would be needed to measure and track the differences between empathic accuracy in virtual environments compared to face-to-face interactions, video media, or even cognitive perspective taking. Stimulation of creativity was indicated by subject's responses during the qualitative interview, and most subjects felt as though they were creating something together with the painter and doing something that they normally would not think that they could do. This pilot study indicates that this virtual environment provides users with a relaxing environment in which to learn a relatively stressful, complex technical skill for novices. Moreover, several subjects reported that the virtual environment provided a new means of communication which felt very offering a new instructional style. One subject described the experience as "trancelike" and remarked, "I didn't notice the passage of time at all."

Lastly, the environment offers a new way to teach creativity. Whereas traditional painting instruction requires students to watch and then replicate an expert instructor or artist, this setup reduces the space between an expert and a novice to an absolute zero, literally putting the student in the shoes of the teacher. This makes it so that the student can learn by tracing the movements of an expert to allow painting instruction to be movement based. Future developments for this project as a software application could develop motion tracking, 3D modelling for different paint brushes and illustration/drawing pens/pencils, and movement analyses with interactive video feedback to pause or slow down the video accordingly with the similarity of movement between the teacher/expert and the student/novice.

In the future, the project would benefit from using an augmented reality headset, such that the user could see through the semi-transparent video screen onto their own physical canvas. Future directions and considerations for the project involve a live interactive setup with a video stream directly from the painter's camera and canvas to the user. Moreover, the possibility of sharing two screens with cameras and augmented reality head-mounted displays, allowing both the user and the painter to see one another's canvases as overlays on top of their own physical canvases is being explored through Microsoft HoloLens, Osterhout Design Group, and Magic Leap headsets. This has implications for grander-scale educational implications for expert to novice mentorship and training in a live and interactive setup, but the technology is still in development.

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