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PROMOTING EMPATHY THROUGH VIRTUAL REALITY EXPERIENCE: THE CASE OF SEXUAL HARASSMENT

TESIS DOCTORAL

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“Learning to stand in somebody else's shoes,
to see through their eyes, that's how peace begins.
Empathy is a quality of character that can change the world.”

Barak Obama

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INDEX

SPANISH SUMMARY/RESUMEN EN ESPAÑOL 1
1. Introducción 2
2. Objetivos 8
3. Metodología y resultados 9
4. Discusión 16
5. Referencias 19

INTRODUCTION 27

CHAPTER 1. Background 36
1. Psychology and Technology 37
    1.1. Virtual Reality in Clinical Psychology 37
        1.1.1. Imaginal Technology 39
        1.1.2. Connectedness Technology 40
        1.1.3. Embodied Technology 41
2. Transforming Experience through Virtual Reality 42
    2.1. The concept of Transformative Experience 42
    2.2. Virtual Reality as Transformative Experience Technology 43
        2.2.1. Altering bodily self-consciousness: *walking in someone else shoes* 44
3. Virtual Reality as the *ultimate empathy machine* 44
    3.1. The concept of Empathy 44
        3.1.1. An overview to the Empathy Training Programs 45
    3.2. Study Empathy through Virtual Reality 46
        3.2.1. Study Empathy through Virtual Reality Perspective - Taking 47
        3.2.2. Study Empathy through Virtual Reality Embodiment 49
4. Sexual Harassment: the failure of empathy toward an outgroup 50
5. Outline of this dissertation 52
6. References 55

CHAPTER 2. Virtual Reality as a medium to elicit empathy: a meta-analysis 64

Abstract 65
1. Introduction 66
2. Method 67
2.1. Study selection criteria 67
2.2. Search strategy 67
2.3. Search outcome 68
2.4. Data extraction 68
2.5. Computing effect sizes 69
2.6. Statistical analysis 71
3. Results 72
3.1. Study characteristics 72
3.2. General studies review 75
3.3. Mean effect size and heterogeneity analysis 76
3.4. Analysis of publication bias 78
4. Discussion 79
5. Limitations and future direction 80
6. Conclusions 81
7. References 82

CHAPTER 3. The benchmark framework and exploratory study to investigate the feasibility of 360° video-based Virtual Reality to induce a full body illusion 86
Abstract 87
1. Introduction 88
2. Materials and method 90
2.1. Participants 90
2.2. Implementations and apparatus 91
2.3. Measures 92
2.4. Experimental procedure 93
2.5. Data analysis 94
3. Results 95
3.1. Sample characteristics 95
3.2. Embodiment questionnaire 95
3.3. Hearth Rate Variability 96
4. Discussion 97

5. References 100

CHAPTER 4. Developing a 360° video-based Virtual Reality: an explorative and a user experience studies to generate a sexual harassment scenario 104

Abstract 105

1. Introduction 107

2. Study 1: focus group 107

2.1. Method 107

2.1.1. Participants 107

2.1.2. Procedure 108

2.1.3. Data analysis 108

3. Results 108

3.1.1. Theme 1: the women feelings 109

3.1.2. Theme 2: the environments 109

3.2. Discussion 110

4. Study 2: User Experience 111

4.1. Method 111

4.1.1. Participants 111

4.1.2. 360° Scenarios 111

4.1.3. Measures 112

4.1.4. Procedure 112

5. Results 113

5.1. Discussion 113

6. Conclusions 114

7. References 116

CHAPTER 5. Predictors of the sense of embodiment of a female victim of sexualharassment through 360° video-based Virtual Reality 119

Abstract 120

1. Introduction 121

2. Materials and method 123

2.1. Participants 123

3. Measures 125

3.1. Experimental procedure 126

3.2. Implementations and apparatus 127

3.3. Data analysis 127
4. Results 128
4.1. Embodiment, sense of presence and cyber-sickness during the 360° video 128
4.2. Relationship between embodiment, presence, cyber-sickness, and traits measures 128
4.3. Regression multiple analyses: Is embodiment predicted by sense of presence, machismo and chivalry, empathetic abilities, and alexithymia? 129
5. Discussion 132
6. References 135

CHAPTER 6. How does it feel to be a woman victim of sexual harassment? The effect of 360° video-based Virtual Reality on empathy and related variables 139
Abstract 140
1. Introduction 141
2. Method 142
2.1. Participants 142
2.2. Measures 143
2.2.1. Measures administered at baseline 143
2.2.2. Measures administered at baseline, after the 360° video, and the narrative 144
2.2.3. Measures administered after the 360° video, and the narrative 144
2.2.4. Measures administered after the 360° video 144
2.3. Development of the 360° video 145
2.4. Procedure 145
2.5. Data Analyses 146
3. Results 146
3.1. Effect of the condition (360º video vs. narrative) on empathy (*ES*) and violent attitude (*ATG-S*) 146
3.2. Differences between conditions in the sense of oneness with the victim (IOS) and perspective taking (PT-S) 147
3.3. Effects of the 360º video on embodiment, presence, and sickness 149
4. Discussion 149
5. Supplement material 150

6. References 152

CHAPTER 7. Become more human: positive change on empathy and related variables after three months of an intervention 156

Abstract 157

1. Introduction 158
2. Method 159
    2.1. Participants 159
    2.2. Measures 160
    2.3. The perspective-taking task: 360° video, and first-person narrative 161
    2.4. Procedure 161
    2.5. Data Analyses 161
3. Results 162
    3.1. Results for *IRI, TAS-20, MCS,* and *ATG-S* scales 162
    3.2. Qualitative results 163
        3.2.1. Positive thoughts 163
        3.2.2. Negative thoughts 164
        3.2.3. Attitude change 164
4. Discussion 166
5. References 168

CHAPTER 8. General discussion 171

1. Introduction 172
2. Summary of the main findings 172
3. Strengths 179
4. Limitations 182
5. Future directions 183
6. Conclusions 185
7. References 187

ANNEXES 192

1. Annex 1. Ethic Committee approval University of Valencia 193
2. Annex 2. Ethic Committee approval Universidad Nacional Autónoma de México 194
3. Annex 3. Chapter 3: Informed consent 195
4. Annex 4. Chapter 4: Informed consent 198

5. Annex 5. Chapter 4: The script of the moderator of the focus groups 202
6. Annex 6. Chapter 4: The transcript of the Focus Group 1 204
7. Annex 7. Chapter 4: The transcript of the Focus Group 2 207
8. Annex 8. The 360° video-based Virtual Reality on Sexual Harassment 210
9. Annex 9. Chapter 6: Informed consent 211

Resumen

1. Introducción

Psicología y tecnología

La creciente innovación que suponen las Tecnologías de la Información y la Comunicación (TICs) ha aportado una enorme contribución a la psicología, y concretamente a la psicología clínica, gracias a su uso en el tratamiento de varios trastornos mentales y a la promoción del bienestar (Riva, 2005). La asociación entre tecnología y psicología ha dado origen al concepto de Ciberpsicología, entendida como un modelo de intervención basado en e-salud que se desarrolla a través de las TICs (Botella, 2009). La literatura ha puesto en evidencia que el uso de las TICs en los tratamientos psicológicos permite llegar a personas en condiciones críticas, que permite mejorar la disponibilidad, el anonimato y la eficacia en cuanto al almacenaje, acceso y manipulación de los datos (Botella y otros, 2009; Eysenbach y otros, 2011)**.** Además, el grupo de investigación Botella y otros (2000) dieron un paso adelante en e-salud, integrándola con la nueva tecnología de la Realidad Virtual (RV) (Botella y otros, 2000).

La Realidad Virtual en Psicología Clínica

La RV es un conjunto de tecnologías que permiten a las personas interactuar eficientemente con un sistema computarizado tridimensional en tiempo real (Riva, 2005). En la literatura, la RV se ha descrito como una forma avanzada de interfaz persona-máquina que permite al usuario interactuar y "sumergirse" en un entorno virtual percibiéndolo como si fuera real (Wiederhold, 2005). La RV tiene el potencial de evaluar objetivamente el comportamiento en un entorno seguro y ecológicamente válido, manteniendo al mismo tiempo el control experimental sobre la suministración y la medición de los estímulos (Schultheis y Rizzo, 2001). La característica principal de la RV es el *sentido de presencia*, definido como un estado mental en el que el usuario percibe estar en el entorno virtual, un entorno mediado por la computadora, como si fuera real (Slater, 1994).

La RV se beneficia de varias características que le permite ser una herramienta potencial para la psicología. En primer lugar, la experiencia de estar inmerso en el entorno virtual permite a las personas percibirlo como real y "olvidar" que están en un entorno simulado. En consecuencia, es posible evaluar los comportamientos humanos bajo un entorno más parecido a la realidad, logrando de esa manera un comportamiento natural por parte de los individuos. Esto podría llevar a una mayor validez ecológica en la evaluación e intervención (Chaytor y otros, 2006). En segundo lugar, la RV permite un control total so-

bre la presentación del estímulo y la medición de las respuestas. Específicamente, a través de la RV es posible la personalización del tratamiento, o sea el investigador o el terapeuta pueden manipular el estímulo que se quiere subministrar en el entorno teniendo en cuenta las capacidades y necesidades del individuo (Rizzo y Kim, 2005). En tercer lugar, la RV permite la evaluación segura de situaciones que puede ser "peligrosas" para el individuo. Por ejemplo, para enfrentar la fobia a volar es posible generar un entorno virtual que refleje la experiencia de volar (Wiederhold y otros, 2002). En este caso, los pacientes podrán enfrentar su miedo en un escenario seguro a través de la exposición, aumentando la conciencia de sus limitaciones y superarlas. Por último, la aplicación de la RV podría alcanzar una mayor estandarización de los protocolos, obteniendo una consistencia elevada en los resultados (Schultheis y Rizzo, 2001).

Los estudios de psicología clínica basados en RV se han focalizados en diferentes trastornos, como el tratamiento de los trastornos de ansiedad (Wiederhold, 2005), las fobias (por ejemplo, fobias específicas, fobia social, agorafobia) (Botella y otros, 2007), el trastorno de estrés postraumático (TEPT) (Rizzo y otros, 2009; Baños y otros, 2011), los trastornos alimentarios (Perpiñá y otros, 1999; Cesa y otros, 2013; Gutiérrez-Maldonado y otros, 2018), o las adicciones (como la nicotina o el alcohol) (Bordnick y otros, 2008; Girard y otros, 2009), entre otros. Además, la RV se ha utilizada no sólo con fines clínicos sino también para promover estilos de vida saludables y el bienestar, por ejemplo, la gestión del estrés (Serino y otros, 2014), el tratamiento del dolor y la promoción del bienestar en pacientes oncológicos (Gershon y otros, 2004; Espinoza y otros 2012) o la gestión del dolor crónico (Hoffman y otros, 2000; Herrero y otros, 2014), logrando resultados positivos.

La RV conlleva tres aspectos importantes que contribuyen a la eficacia y efectividad de su uso: (1) la imaginación, (2) la conexión, y (3) la encarnación (Ventura et al., 2018). (1) Imaginación: la RV ha demostrado ser una eficaz alternativa al tratamiento por imaginación porque las imágenes mentales permanecen en nuestra mente aproximadamente por 250ms (Holmes y Mathews, 2005). La RV permite superar este límite porque el paciente se siente involucrado en el entorno virtual sin necesidad de imaginar los eventos. Además, la imaginación de los acontecimientos anteriores necesita una memoria adecuada que a veces no es fiable (Rizzo y otros, 2009). Por ejemplo, durante una evaluación de TEPT (tratamiento de estrés postraumático), el terapeuta puede pedir a los pacientes que piensen en un evento traumático, y a veces los pacientes pueden fallar en esta tarea porque los recuerdos son borrosos, o también por negación por parte del paciente en recordar el

evento traumático. Mediante la RV, los pacientes están involucrados en el acontecimiento traumático ofreciendo la posibilidad de revivir la experiencia traumática y enfrentarla (Wiederhold y otros, 2002; Botella y otros, 2015). (2) Conexión: la RV permite la evolución del Ciberespacio (espacio virtual), un espacio en el que las personas interactúan (Harrison y Thomas, 2009). El ciberespacio trajo la ventaja en psicología de cortar los límites geográficos y llegar a las personas en cualquier lugar y en cualquier momento (Dunstan y Tooth, 2012). Además, en el ciberespacio ahora es posible interactuar con los avatares, o con un terapeuta virtual. Por ejemplo, el *Institute for Creative Technologies* (EE.UU.) ha desarrollado el programa *SimCoach* para apoyar los veteranos de guerra que sufren de estrés postraumático, superando las barreras geográficas y emocionales (Rizzo y otros, 2012). (3) Encarnación: la RV permite a las personas lograr un sentido de encarnación definido como un conjunto de características que permiten sentirse dentro de un cuerpo artificial (Kilteni y otros, 2012). Según esta teoría, la experiencia de estar en un cuerpo se podría dividir en tres subprocesos, a) el sentido de localización -experiencia espacial de estar ubicado en el entorno virtual-, b) el sentido de la agencia -se refiere al control motor global, incluyendo a la experiencia subjetiva de acción, control, intención, y selección motora-, y finalmente c) el sentido de la propiedad del cuerpo -se refiere a la auto atribución de un cuerpo- (Kilteni y otros, 2012). Se ha visto como estos procesos se pueden alterar de forma experimental haciendo que las personas puedan experimentarse a ellas mismas fuera del propio cuerpo y habitar en otro, permitiendo un cambio de perspectiva. Este modelo ha sido adoptado en varios estudios logrando cambios positivos en la reducción de sesgos raciales tras encarnase un cuerpo de otra raza (Peck y otros, 2013; Hasler y otros, 2017), facilitar el comportamiento de ayuda (Ahn y Bailenson, 2013), mejorar la planificación financiera (Sims y otros, 2015), o disminuir los prejuicios (Oh y otros, 2016). En esos estudios, los participantes encarnaban el avatar del grupo opuesto para percibir las emociones del otro en una circunstancia específica, conceptos que serán explicados a lo largo de la presente introducción.

En definitiva, gracias a la RV es posible estudiar aspectos clínicos, conductuales, cognitivos y emocionales que hasta la fecha eran difíciles de realizar.

La Realidad Virtual como experiencia transformativa

La RV puede transformar nuestra experiencia interna alterando nuestra autoconciencia (Riva y otros, 2016). Desde esta perspectiva, la RV ha sido definida como una tecnología transformativa porque permite a los individuos disfrutar de experiencias totalmente nuevas, generando inspiraciones, y una fuerte carga emocional (Gaggioli, 2015).

Ejemplo de experiencias transformativas es la observación de la inmensa belleza de la naturaleza, por ejemplo, cuando se sube a una montaña, se llega en Antártida o se mira la Tierra desde el espacio (Stepanova y otros, 2018). En la mayoría de los casos estas experiencias sólo son accesibles a un grupo restringido de personas que, por ejemplo, tienen condiciones para viajar a los lugares o tienen una gran capacidad de imaginación.

La emoción de asombro es uno de los efectos que las personas pueden vivir durante la experiencia transformativa (Gaggioli, 2015). El asombro es una construcción psicológica que se considera parte de un índice "auto trascendente" de emociones, y se caracteriza por la percepción de algo vasto (Keltner y Haidt, 2003). Recientemente, la RV se ha propuesta como una nueva técnica para inducir la emoción de asombro en laboratorio (Chirico y otros, 2016).

Como se ha descrito en el parágrafo precedente, otra experiencia transformativa que puede generar la RV es la alteración de la autoconciencia corporal, es decir, el sentido de ser otra persona. En particular con la RV es posible ver el mundo desde la perspectiva de otra persona y sentir las emociones de esa persona (Oh y otros, 2016). Según el autor Riva (2015), hay tres estrategias posibles que pueden utilizarse para alterar la autoconciencia corporal mediante la RV: (a) la encarnación consciente, que consiste en la modificación de la experiencia corporal facilitando la disponibilidad de su contenido en la memoria de trabajo; (b) la encarnación aumentada, que se basa en el incremento de la autoconciencia corporal mediante la alteración/ampliación de sus límites; y (c) la encarnación sintética, que tiene por objetivo sustituir el propio cuerpo con otro (encarnación).

Las experiencias transformativas a través la RV podrían facilitar la interacción social ayudando a las personas a establecer sentidos comunes (Gaggioli, 2016). En esta línea, la RV puede generar un alto sentido de compromiso emocional, y conexión social en personas que pertenecen a "grupos opuestos" como hombres y mujeres, jóvenes y ancianos, los seres humanos y la naturaleza entre otros, permitiendo ponerse en “los zapatos del otros” (Ahn y otros, 2016).

Gracias a la potencialidad actual de la RV ha surgido una nueva pregunta de investigación: ¿cómo podemos convertirnos en personas más "humanas", más empáticas, a través la RV?

La Realidad Virtual como *una máquina de empatía (the ultimate empathy machine)*

La empatía es una habilidad en la que se integran aspectos cognitivos, y emocionales (Davis, 1980). La empatía cognitiva ha sido definida como la habilidad de inferir el estado interno de un individuo, a su vez la empatía emocional supone una sintonización afectiva con ese estado, generando un acercamiento vivencial a su situación, y sirviendo de guía en la elaboración intelectual que se realiza sobre ésta.

Davis (1980) agrupa la empatía en función de su naturaleza cognitiva o emocional. En la vertiente cognitiva, se evalúa la toma de perspectiva -intentos espontáneos de adoptar el punto de vista de los demás ante diferentes situaciones- y la fantasía -tendencia a identificarse con los sentimientos y las acciones de personajes del cine, o libros-. En la vertiente emocional, se evalúa la preocupación empática -sentimientos de compasión y preocupación dirigidos hacia el sufrimiento de los demás- y el malestar personal -sentimientos de ansiedad y malestar derivados de la observación del sufrimiento ajeno-.

En el campo de la psicología social, la empatía ha sido relacionada con la inteligencia social debido a su característica de ayudar a los individuos a establecer y mantener amistades, y a moderar las actitudes agresivas (Jolliffe y Farrington, 2004). Además, la empatía contribuye con la calidad de las relaciones familiares, como la cohesión entre pareja (Finchaman y otros, 2002), y entre padres/hijos, y con la capacidad comunicativa (Padilla-Walker y Christensen, 2011). Dada la importancia de la empatía en las relaciones sociales, sobre todo en las conductas prosociales, diferentes programas para entrenarla han sido desarrollados (Yiasemina-Karagiorgi y Symeou, 2005; Rudman, 2001; Hildebrandt, 2017; Jackson y Bonacker, 2006). Dichos programas están basados sobre la técnica de la toma de perspectiva, o sea ponerse, a través la imaginación, en el lugar del otro (Teding van Berkhout y Malouff, 2016).

En los últimos años, la RV ha sido utilizada como una nueva técnica para cambiar la perspectiva y reproducir la experiencia subjetiva de esa persona, con el objetivo de fomentar la empatía (Bailenson, 2018). Hay varias razones por las cuales la RV podría ser un medio potencial para fomentar la empatía. En primer lugar, la RV ofrece una experiencia muy real, en consecuencia, la toma de perspectiva en un entorno virtual necesita menos esfuerzo cognitivo que las técnicas tradicionales de toma de perspectiva por imaginación (Oh

y otros, 2016). En segundo lugar, durante la exposición en RV las personas tienden a estar menos "presentes" en el mundo físico y más "presentes" en el mundo virtual, por lo que pueden “dejar” la percepción del propio cuerpo, y apropiarse del cuerpo y de la perspectiva de la otra persona. En tercer lugar, la toma de perspectiva con RV podría evitar los estereotipos de las personas que se pueden generar con las técnicas por imaginación, por ejemplo, el estereotipo de un joven hacia un anciano y viceversa (Ahn y otros, 2013).

A través la RV, la identificación con otra persona puede ocurrir de dos formas diferentes: (1) la toma de perspectiva apoyada por el sentido de presencia en el entorno virtual, liderada o no a través de un agente virtual, y (2) la toma de perspectiva apoyada por el sentido de encarnación a través de un avatar. (1) El video 360° ha sido utilizado para inducir la toma de perspectiva, un ejemplo es el video *Clouds Over Sidra* (Schutte y Stilinović, 2017). El vídeo se grabó en un campamento de refugiados de Jordania Za'atari donde 8000 sirios fueron desplazados por la guerra civil. El video ofrece a los espectadores la sensación de estar con los protagonistas de la historia. Después de la visión, los espectadores mostraron una fuerte respuesta empática (Schutte y Stilinović, 2017). El video tuvo un fuerte impacto que incrementó el número de personas que donaron a la Organización de las Naciones Unidas (Gaudiosi, 2016). Otro estudio basado en la toma de perspectiva con RV es un trabajo en el que los participantes toman la perspectiva de un hombre sin techo representado por un agente virtual, con el objetivo de medir el cambio del estado de empatía antes y después del estudio (Herrera y otros, 2018). (2) La toma de perspectiva a través la encarnación se logra mediante un avatar que, al contrario del agente virtual, es una representación gráfica impulsada por las acciones de personas físicas, típicamente en tiempo real (Kilteni y otros, 2012). Esto es posible gracias a un sofisticado sistema de RV compuesto por un traje (optitrack) que permite mostrar el cuerpo de los usuarios en el escenario virtual (Slater, 2018). Este sistema ha sido adoptado, por ejemplo, para poner a un hombre en el cuerpo de una mujer víctima de acoso sexual, logrando un cambio positivo en el sentido de empatía (Seinfeld y otros., 2018). En otro estudio, participantes con la piel clara encarnaban un avatar de piel oscura e interactuaban en un entorno virtual con el resultado que los sesgos implícitos hacia las personas de piel oscura se reducían significativamente (Peck y otros, 2013).

Estos estudios permiten comprender el potencial de la RV para transformar la experiencia de los usuarios, cambiando su perspectiva, y fomentando su sentimiento de empatía hacia el otro.

Acoso de género: un ejemplo de falta de empatía hacia el otro

La Organización Mundial de la Salud (OMS, 2011) define la violencia sexual como "cualquier acto violento o agresión, basados en una situación de desigualdad en el marco de un sistema de relaciones de dominación de los hombres sobre las mujeres que tenga o pueda tener como consecuencia un daño físico, sexual o psicológico, incluidas las amenazas de tales actos y la coacción o privación arbitraria de la libertad, tanto si ocurren en el ámbito público como en la vida familiar o personal".

El acoso de género es una componente de la violencia sexual y ocurre cuando las personas, en su mayoría mujeres, son objeto de comentarios, gestos o acciones sexuales no deseados. Además, las víctimas de acoso perciben la violencia como algo molesto, ofensivo, humillante e intimidante, y que puede reducir su sentido de seguridad (Burn, 2019). Estudios previos han encontrado que la falta de empatía y, específicamente, de toma de perspectiva están asociadas con los comportamientos agresivos como el acoso (Jolliffe y Farrington, 2004). Los acosadores disponen de menos tendencia empática que los que tienen un comportamiento prosocial (Seidel y otros, 2013). Una posible explicación es que los individuos con baja tendencia empática no entienden bien el sufrimiento del otro individuo, y son incapaces de tomar la perspectiva de la víctima (Barnett y Mann, 2013). Debido a la enorme penetración del problema del acoso de género, se han desarrollado varios mecanismos de prevención e intervención (Dowden y otros, 2003).

Recientemente, la RV ha sido utilizada para estudiar la empatía en los acosadores (Seinfeld y otros, 2018). Durante el estudio, los participantes hombres se ponían en un entorno virtual donde encarnaban el cuerpo de una mujer acosada, generando un cambio positivo en el sentido de empatía, y un incremento en la habilidad de reconocimiento emocional (Seinfeld y otros, 2018). Este estudio ha abierto una nueva trayectoria para utilizar la RV en programa de prevención, e intervención de acoso de género.

2. Objetivos

Tal como se ha mencionado anteriormente, en las últimas dos décadas la RV ha crecido exponencialmente en psicología. La literatura previa ha examinado y demostrado que la RV es un instrumento eficaz para la investigación en psicología y para la prevención e intervención psicológica. Además, la RV permite generar experiencias trasformativas a través el modelo de encarnación, generando la ilusión de ser otra persona y sintiendo emociones diferentes. Posteriormente, este modelo ha sido utilizado para estudiar el efecto del

cambio de perspectiva, y el sentido de empatía. Estudios previos han demostrado que el cambio de perspectiva, a través de un agente virtual o un avatar, permite cambiar las emociones hacia otra persona, en particular la empatía. Sin embargo, según nuestros conocimientos, no existe una revisión analítica que investigue la eficacia de la RV para cambiar la empatía antes y después del estudio. Asimismo, como se ha mencionado anteriormente, un ejemplo de falta de empatía es el acoso de género hacia las mujeres. En este campo, se ha iniciado a investigar los efectos de la RV con los acosadores que toman virtualmente la perspectiva de una mujer acosada, pero todavía se necesitan más investigaciones sobre el tema para comprobar su eficacia.

Por lo tanto, el objetivo de esta tesis doctoral es explorar la viabilidad de la tecnología inmersiva para generar cambios positivos en la empatía a través de un sistema de RV. Específicamente, esta tesis doctoral tiene los siguientes objetivos:

1) Revisar la literatura científica existente sobre la eficacia de la RV para promover la empatía;
2) Revisar las tecnologías inmersivas existentes utilizada para inducir la sensación de ilusión corporal, y evaluar la viabilidad de la camera 360° para encarnar otro cuerpo;
3) Desarrollar y testear la usabilidad de un escenario de acoso de género con video 360°;
4) Estudiar la eficacia de la RV basada en video 360° para generar la ilusión de un cuerpo masculino en un cuerpo femenino, y estudiar las variables predictoras;
5) Estudiar la viabilidad de un video 360° sobre acoso de género para inducir la empatía en los hombres que encarnan una mujer víctima de acoso;
6) Estudiar el cambio de empatía después los tres meses de la intervención con RV.

3. Metodología y resultados

Todos los estudios llevados a cabo en la presente tesis doctoral han pasado por el comité de ética de la Universidad de Valencia (número de registro: H1547116450036), y de la Universidad Nacional Autónoma de México (número de registro: EP/PMDPSIC/0151/19).

Inicialmente, se llevó a cabo una revisión de la literatura sobre la eficacia de la RV para promover la empatía (Ventura y otros, en revisión). El **capítulo 2**[1] de esta tesis presenta un metaanálisis dirigido a investigar y aclarar las investigaciones existentes sobre la RV como medio para promover la empatía siguiendo las normativas PRISMA (Preferred Re-

[1] El presente estudio está publicado en la revista *Cyberpsychology, Behaviour, and Social Networking.*

porting Items for Systematic Reviews and Meta-analysis). Se realizó una búsqueda sistemática en cuatro bases de datos (PsycINFO, Scopus, ScienceDirect, and Web of Science) utilizando las siguientes palabras claves: "realidad virtual" Y (empatía O compasión O "toma de perspectiva" O "comportamiento prosocial"). La selección de los estudios incluidos en el metaanálisis se llevó a cabo por parte de dos revisores independientes, y para ser incluidos en el meta-análisis, los estudios debían cumplir los siguientes criterios: (a) ser estudios empíricos publicados en una revista revisada por pares; (b) examinar el cambio en la empatía y/o en la toma de perspectivas; (c) tener una muestra de participantes adultos en población no clínica; (d) incluir los datos antes y después del estudio; (e) estar escritos en inglés, italiano o español; (f) disponer de datos estadísticos que permitan calcular los tamaños del efecto; y (g) tener el texto completo disponible.

Se llevaron a cabo dos metaanálisis separados para las medidas de empatía y toma de perspectiva. Finalmente, en el estudio se incluyeron 7 artículos, y los resultados mostraron que la RV puede considerarse una herramienta efectiva para inducir empatía en comparación con los controles. Concretamente, la exposición a RV mostró ser eficaz para incrementar la toma de perspectiva con un tamaño de efecto d_+ =.51 (95% CI: .15 y .88), y con una significancia estadística (p =.006); pero no para la tendencia empática con un tamaño del efecto de d_+ = 0.21 (95% CI: -0.37–0.79), y con una significancia estadística (p =.482).

Hasta donde sabemos, este es el primer metaanálisis que analiza la eficacia de esta intervención. Los límites del presente trabajo es el número limitado de estudios incluidos, sin embargo, los resultados han confirmado la hipótesis que la RV induce un cambio tendencialmente significativo en el sentido de empatía, y de toma de perspectiva. Todavía, los estudios futuros deberían enfocarse en los diferentes tipos de tecnologías, es decir el grado de inmersión e interactividad de cada aparato, como moderador del cambio en empatía. Así como, controlar las medidas de empatía utilizada dato que los estudios incluidos han adoptado diferentes escalas.

Las conclusiones tienen implicaciones prácticas para la psicología clínica y social. Por ejemplo, la RV puede ser un instrumento poderoso para la capacitación de futuros profesionales de la salud y también de los cuidadores formales e informales, debido a que la RV permite aprender y capacitarse de manera segura, práctica y económica (Adefila y otros, 2016; Formosa y otros, 2018). Además, la RV ha demostrado ser una herramienta de aprendizaje prosocial para entender el estado de ánimo de los demás (Raij y otros, 2009; Van Loon y otros, 2018).

El **capítulo 3**[2] de esta tesis doctoral se propuso evaluar la eficacia de un video 360° basado en RV para inducir el sentido de encarnación. Hasta la fecha han sido desarrollados varios aparatoso tecnológicos para inducir la ilusión del cuerpo, por ejemplo, un juego de cámaras conectadas a las gafas de RV (Ehrsson, 2007), un traje con varios sensores que captan los movimientos del participante y que son reproducidos de forma directa en el entorno virtual (Banakou y otros, 2016), el grupo de Bertrand (2018) ha desarrollado la "máquina de ser otro", una camera que graba el cuerpo de un actor y lo trasmite en la gafa de RV del participante (Cebolla y otros, 2019).

Nuestro objetivo era desarrollar una herramienta más ágil y económica para inducir la ilusión del cuerpo. Para ello, hemos evaluado dos grupos diferentes aleatorizado, 21 participantes por cada grupo, que recibieron diferentes niveles de inmersión: un video inmersivo 3D a través la gafa de RV, y un video no inmersivo 2D a través de una pantalla (Ventura y otros, en revisión). Los videos consistían en una serie de movimientos de las extremidades del actor, y el participante tenía que seguir tales movimientos, al final del video una pelota caía sobre la mano del actor para evaluar la sensación háptica. El video tenía una duración de 2 minutos aproximadamente. Los participantes fueron evaluados a través de la medida fisiológica de la frecuencia cardiaca (Laborde y otros, 2017), y el cuestionario de encarnación (Longo y otros, 2008), los criterios de exclusiones eran ser menor de edad, y tener algún problema físico que podían prevenir los movimientos libres de los artos.

La muestra ha sido compuesta por 27 mujeres (64,3%) y 15 hombres (35,7%), edad $M = 24.88$, $SD = 4.098$. Los resultados del cuestionario de encarnación demostraron una diferencia significativa entre las condiciones: *propiedad* $p = .003$; *agencia* $p < .001$; y *localización* $p = .013$. Además, el factor *sensación háptica* fue significativo $p = .027$. La frecuencia cardiaca no logró una diferencia significativa entre las dos condiciones.

En definitiva, la camera 360° ha demostrado ser una herramienta eficaz para inducir el sentido de ilusión del cuerpo.

El **capítulo 4** de esta tesis doctoral tiene el objetivo de generar un vídeo 360º de acoso de género (Ventura y otros, en revisión). Para eso hemos seguido el método del *User Centered Design* (desarrollo centrado en el consumidor) basado en la participación del usuario final de la tecnología diseñada, con el objetivo de mejorar la usabilidad en sí (Mao y otros, 2005). Además, hemos adoptado el método de la *User Experience* (experiencia de uso) de-

[2] El presente estudio está bajo revisión en la revista *Virtual Reality* (up to 31/08/2020).

finida como la percepción que la persona tiene de un producto, sistema o servicio, y modificarlo según su retroalimentación (Hassenzahl y Tractinsky, 2006).

Para desarrollar el video 360° de acoso de género primero llevamos a cabo dos grupos focales con mujeres de la Ciudad de México con el objetivo de recoger informaciones sobre lo que pasa en la ciudad, y como las mujeres son acosadas. En el primer grupo focal participaron 10 mujeres (edad: M = 26 años; SD = 6.60), y en el segundo 6 mujeres (edad: M = 30 años; SD = 8.15), siguiendo los siguientes criterios de inclusión: ser una mujer mayor ≥ 18 años y no haber sido víctima de acoso de género.

Desde los resultados del análisis cualitativo, se concluye que el acoso ocurre en espacio públicos, y privados, así como de noche, y de día. A partir de los análisis, desarrollamos el entorno 360° a través las grabaciones de varios entornos, y montado con el programa Adobe Premier. Para la grabación en primera perspectiva, la mujer tenía puesta la camera 360° en su cabeza con un suporte. Primero se hizo una grabación de inducción de encarnación, luego se grabaron varios escenarios siempre en primera perspectiva. La primera escena muestra algunas actividades de la vida diaria de la víctima de acoso (ponerse los zapatos, desayunar, arreglarse entre otros), después se presentan varios escenarios de acoso que ocurren en la librería de la universidad, en el taxi, en el metro, en la calle de noche, y en el hogar con la pareja.

A partir del estudio previo, llevamos a cabo un estudio de usabilidad con el objetivo de evaluar la calidad del video 360°. En el estudio participaron 3 mujeres y 7 hombres, edad M = 25.70, SD = 5.56), evaluados con la escala de mareo tecnológico (Kennedy y otros, 1993), y de movimiento (Gianaros y otros, 2001), y una pregunta abierta para mejor entender las retroalimentaciones sobre el entorno. Los resultados demostraron un alto nivel de mareo debido al movimiento del video para las subescalas de *náuseas* $p < .001$, y *oculomotor* $p < .001$. Sin embargo, los resultados de las puntuaciones de mareo debido a la tecnología fueron significativamente más bajos que el nivel de probabilidad de 2 para los factores *gastrointestinal* $p < .001$, *periférico* $p = .005$, y *tolerancia-relacionada* $p < .001$. El análisis cualitativo puso en evidencia que lo que genera mayor mareo en los participantes es el movimiento de la camera. Dado que los participantes están sentados durante toda la presentación del video, se genera una disonancia entre el movimiento real (estar parado), y el movimiento percibido (caminar), y eso genera mareo (Lee y otros, 2019). Gracias a los resultados de la usabilidad, mejoramos el video para que no generara malestar a los participantes.

En definitiva, el presente estudio ha demostrado la importancia de seguir un modelo centrado en los usuarios para generar un entorno de RV.

El **capítulo 5**[3] de esta tesis doctoral se propuso evaluar la eficacia del video 360° basado en RV para inducir el cambio de cuerpo de hombre a mujer. Estudios previos sobre el cambio de cuerpo han demostrado que algunos participantes creen fácilmente en la ilusión, y se "dejan arrastrar" por esta experiencia, mientras que otros son totalmente obstinados y no creen en la ilusión (Dewez y otros, 2019). Además, la medición del sentido de encarnación ha sido efectuada solo mediante los análisis de factores "externos" como el sistema de RV utilizado, el avatar encarnado, el entorno virtual entre otros, pero el análisis de los rasgos del participante como variables predictoras sigue estando poco investigada (Dewez y otros, 2019), así como el rol que el sentido de presencia tiene sobre el sentido de encarnación (Shin, 2018). Para eso, los objetivos del presente estudio fueron primero evaluar la eficacia del sistema para inducir el cambio de cuerpo, y segundo estudiar las variables predictoras implicadas cuales el machismo, la empatía, la alexitimia, y el sentido de presencia para favorecer o prevenir el sentido de encarnación en un cuerpo de género diferente (Ventura y otros, bajo revisión). En el estudio participaron 44 hombres de la Ciudad de México, siguiendo los criterios de exclusión: (a) tener problemas físicos que pudieran inhibir los movimientos libres (por ejemplo, dolor de espalda o de cuello); (b) antecedentes de acoso de género con consecuencias legales; (c) uso o abuso de drogas; y (d) recibir tratamientos psicológicos en el momento del estudio.

El entorno de RV utilizado para el siguiente estudio fue el mismo que el del capítulo anterior. Los participantes fueron evaluados a través de medidas sociodemográfica, la escala de empatía Interpersonal Reactivity Index (IRI) (Pérez-Albéniz y otros, 2003); la escala de alexitimia (TAS-20) (Moral de la Rubia, 2008); la escala de machismo y caballerismo (Arciniega y otros, 2008); y el cuestionario de embodiment (Longo y otros, 2008), sentido de presencia, y mareo (Usoh y otros, 2000).

Los resultados fueron significativos para los factores de *localización* $p < .001$, y de *propiedad* $p < .001$; pero no para el factor de *agencia* $p = .222$. Además, la variable del sentido de *presencia* fue significativa $p < .001$, así como la variable de *mareo* $p = .043$. Los resultados de los análisis sobre las variables predictoras demostraron que el machismo es un predictor significativamente negativo del factor *localización* (encarnación) ($F(2.43) = 8.76$, $p < .001$), y que el factor *dificultad para expresar los sentimientos* (alexitimia) es un

[3] El presente estudio está bajo revisión en la revista *Virtual Reality* (up to 31/08/2020).

predictor significativamente positivo del factor *localización* ($F(3.43) = 8.67$, $p < .001$), así como el factor *toma de perspectiva* (capacidad empática) es un predictor significativamente positivo del factor *localización* ($F(4.43) = 8.52$, $p < .001$). Además, el sentido de presencia es un predictor significativo para el factor *agencia* (encarnación) ($F(1.43) = 4.85$, $p = .033$).

Teniendo en cuenta los resultados se puede concluir que la camera 360° es una herramienta eficaz para inducir la ilusión del cuerpo de hombre a mujer, sin embargo, los estudios futuros necesitarán investigar sobre cómo reducir el sentido de mareo durante la exposición. Además, el machismo ha resultado ser un predictor negativo para inducir la ilusión del cuerpo. Una posible explicación es que, dado el elevado rasgo machista, los participantes habrán percibido el entorno como hostil, y no se dejaron ir en la experiencia (Steed y otros, 2018). Asimismo, el factor de alexitimia es un predictor positivo para la inducción de ilusión del cuerpo (Grynberg y Pollatos, 2015). Una posible explicación es que las personas con elevado rasgo en alexitimia tienen una baja capacidad de percepción corporal (su cuerpo real), por lo que dejarse apropiarse de otro cuerpo le resultaría más fácil.

En definitiva, el presente estudio ha demostrado la importancia de tener en cuenta los rasgos de la persona antes de utilizar un entorno de RV para la intervención psicológica. Por ejemplo, antes de utilizar un entorno de acoso de género con los violadores, o con fines educativos, sería preferible trabajar primero el rasgo machista de la persona, y luego utilizar la exposición con RV.

Después haber desarrollado y testeado el entorno 360° de acoso de género, y haber demostrado su eficacia para inducir la ilusión de cuerpo de hombre a mujer, el **capítulo 6**[4] de esta tesis doctoral tiene el objetivo de probar la eficacia del entorno 360° para promover la empatía, y estudiar algunas variables relacionadas como la actitud violenta, la toma de perspectiva, la sensación de unidad hacia una mujer víctima de acoso en una muestra de hombres. Para eso comparamos dos condiciones: el video 360° (condición con RV), y una narrativa (condición tradicional de toma de perspectiva), siguiendo el método contrabalanceado.

En el estudio participaron 44 hombres de la Ciudad de México, según los criterios de exclusión: (a) ser menor de ≤ 18 años, (b) tener problemas físicos que pudieran inhibir la libertad de movimiento, (c) antecedentes de acoso con consecuencias legales, (d) uso o abuso de drogas, (e) y estar bajo tratamiento psicológico. Los participantes fueron evalua-

[4] El presente estudio está bajo revisión en la revista *Cyberpsychology, Behaviour, and Social Networking* (up to 31/08/2020).

dos a través las medidas socio demográficas, la escala de machismo y caballerismo *(MAC)* (Arciniega y otros, 2008), la escala de empatía Interpersonal Reactivity Index (IRI) (Pérez-Albéniz y otros, 2003), la escala de alexitimia de Toronto (TAS-20) (Moral, 2008) la escala de deseabilidad social (SDS) (Ferrando y Chico, 2000), la escala de empatía *ad-hoc* (ES), la escala de actitud violenta de género (ATG-S) (Glick y Fiske, 2018), la escala del sentido de unidad (IOS) (Aron y otros 1992), la escala de toma de perspectiva *ad-hoc* (PT-S), y la escala de encarnación, presencia, y mareo (Longo y otros, 2008; Usoh y otros, 2000).

Los análisis ANOVA demostraron que hay una diferencia significativa en empatía entre la línea base, y las condiciones 360º $p < .001$, y narrativa $p < .001$. Además, se encontró un importante efecto de interacción entre el tiempo y el orden de presentación de las condiciones, en el sentido de que se encontraron diferencias significativas en el sentido de empatía después de la narrativa, dependiendo del orden de la presentación ($p = .030$). Las puntuaciones demostraron ser más altas cuando el participante recogía la condición narrativa después del vídeo de 360º, y eso no se verificó en la otra condición experimental. Asimismo, se encontró una diferencia significativa entre la línea base, y las dos condiciones 360º $p < .001$, y narrativa $p < .001$ por la variable del sentido de unidad. Igualmente, se encontró un efecto tiempo con la toma de perspectiva, en el sentido de que las puntaciones en la toma de perspectiva después de la narrativa fueron más altas cuando se presentó después del vídeo de 360º ($p = .012$), y no el contrario.

En conclusión, el presente estudio ha demostrado que ambas condiciones, 360º y narrativa, son eficaces para inducir un cambio positivo en el sentido de empatía, y de unidad hacia la víctima de acoso, y de reducir la actitud violenta. Asimismo, la camera 360º ha demostrado tener un efecto de arrastre significativo en las variables de empatía, y de toma de perspectiva. Es decir, el video 360° es más potente que la narrativa para generar un cambio en los participantes; por lo tanto, el video de 360° parece ser una herramienta terapéutica prometedora para abordar el problema de acoso de género.

El **capítulo 7** de esta tesis doctoral tiene como objetivo investigar si las dimensiones psicológicas, como la empatía, el machismo, la alexitimia y la actitud violenta medidas en el estudio previo, cambian a los tres meses. La muestra original del estudio fue de 44 hombres, pero 9 abandonaron con un número final de 35 participantes (edad $M = 26.31$, $SD = 7.56$). Los participantes volvieron a contestar a las siguientes escalas: machismo y caballersimo (MAC) (Arciniega y otros, 2008), la escala de empatía Interpersonal Reactivity Index (IRI) (Pérez-Albéniz y otros, 2003), la escala de alexitimia de Toronto (TAS-20) (Mo-

ral, 2008), la escala de actitud violenta de género (ATG-S) (Glick y Fiske, 2018), y 5 preguntas abiertas sobre el estudio.

Los resultados *t*-test entre la línea base y seguimiento no demostraron ninguna diferencia significativa para el IRI: *toma de perspectiva* $p = .185$, *fantasía* $p = .085$, *preocupación empática* $p = .526$, y *angustia personal* $p = .376$. Además, no había diferencias significativas tampoco para el factor machismo $p = .079$. Sin embargo, hubo una diferencia significativa en el factor *pensamiento externamente orientado* de la alexitimia ($p < .001$), y en la *actitud violenta* ($p < .001$). Desde el análisis cualitativo se concluyó que los participantes reflexionaron mucho acerca del estudio a lo largo de los tres meses, y que, gracias al haber participado al estudio, ahora entendían mejor la perspectiva de las mujeres, e intentaban ser más empáticos. Asimismo, los participantes argumentaron que ahora reconocían las circunstancias en la cuales las mujeres podían sentirse incomodas, y como consecuencia intentaban no ponerlas en esa situación, o ayudaban a las mujeres que se encontraban en situaciones de acoso.

En conclusión, el estudio de toma de perspectiva a través el video 360° y la narrativa, ha demostrado ser una intervención eficaz para incrementar el sentido de empatía de los hombres, y sobre todo para convertirlos en personas más consciente sobre el problema del acoso de género, e intentar prevenirlo.

4. Discusión

En las últimas décadas, las investigaciones han mostrado el fuerte potencial de la RV para la intervención psicológica, para mejorar el bienestar, y para generar experiencias transformativas (Botella y otros 2009, Baños y otros 2011, Gaggioli, 2016). Recientemente, los investigadores han utilizado la RV para encarnar el cuerpo de otra persona, y estudiar su efecto, planteándose una nueva pregunta de investigación: ¿cómo podemos convertirnos en personas más “humanas”, más empáticas, a través la RV?

En la discusión de esta tesis doctoral hemos resumido los resultados, las implicaciones prácticas, y las líneas futuras de los estudios que hemos llevado a cabo para contestar a la hipótesis si la RV puede ser una tecnología eficaz para generar un cambio positivo en la empatía. Específicamente, como hemos visto primero desde el metaanálisis, la investigación científica sobre RV y empatía es todavía muy reciente. Sin embargo, los estudios incluidos en la revisión han mostrado un cambio tendencialmente significativo en el sentido de empatía, y significativo en la toma de perspectiva, antes y después la exposición a la RV. Los resultados mostraron que esta tecnología inmersiva puede ser un instrumento efi-

caz para entrenar la empatía tanto en la educación, por ejemplo, con los sanitarios para entender la perspectiva del paciente, como en la intervención, por ejemplo, con los violadores de abuso sexual. Sin embargo, aún se necesitan investigaciones para comprobar si la diferencia significativa del cambio de empatía persiste a largo plazo, dado que los estudios de nuestra búsqueda solo han medido la empatía antes y justo después la exposición con RV.

Mediante el metaanálisis, nos hemos dado cuenta de que existen varias tecnologías para inducir el cambio de cuerpo, sin embargo, son tecnologías que necesitan bastante conocimiento técnico, y una importante inversión económica. Por esa razón, hemos testeado la camera 360°, una tecnología bastante fácil de utilizar, económica, y capaz de generar entorno inmersivo (Huang y otros, 2017), con el objetivo de inducir la ilusión del cambio de cuerpo, logrando resultados significativos.

A partir de este descubrimiento, hemos intentado contestar a la pregunta: ¿puede la camera 360° inducir la ilusión de cambio de cuerpo de hombre a mujer y, en consecuencia, generar un cambio en la empatía? Para contestar a nuestra pregunta, hemos desarrollado un entorno 360° desde la perspectiva de una mujer víctima de acoso. Los primeros dos minutos del video consistían en la inducción de encarnación en el cuerpo de la mujer, luego había una serie de escenarios de acoso como por ejemplo en la calle, en los trasportes públicos, en la universidad, en el hogar entre otros, grabados desde la perspectiva de la mujer. El video inmersivo ha sido luego mostrado a una muestra de hombres (no violadores) demostrando primero su eficacia en inducir la ilusión corporal y sus variables predictoras, y luego ha demostrado un efecto significativo de arrastre en empatía, y toma de perspectiva, comparado con una narrativa (condición control). Además, hemos argumentado los límites de la camera 360°, y las implicaciones prácticas que el presente estudio puede aportar.

Finalmente, hemos discutido el impacto que el estudio de cambio de perspectiva ha tenido en los participantes a lo largo de tres meses, en particular si hubo cambio en las medidas de rasgo. Los resultados no han mostrado cambios significativos en empatía, alexitimia, y machismo, pero si en la actitud violenta. Además, a nivel cualitativo se encuentra que los participantes han reflexionado sobre el estudio durante estos meses, y que, gracias a la experiencia vivida durante el experimento, pueden ahora entender mejor la perspectiva de las mujeres, sentirse más empático hacia ellas, e intentar evitar todos aquellos comportamientos que la molestan.

Creemos que la presente tesis doctoral contribuye de forma significativa al emergente campo de estudios sobre RV y conducta prosocial, así como en intervención clínica para

los violadores. En definitiva, esperamos que este trabajo inspire a sus lectores a continuar investigando en este campo.

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Introduction

Introduction

In the past decades, Virtual Reality (VR) has been exponentially adopted in clinical psychology for treating several psychological disorders and promoting well-being (Wiederhold et al., 2005; Botella et al., 2007; Baños et al., 2011; Rizzo and Koenig, 2017). VR is an advanced form of human-computer interface that allows the user to interact with and be present into a 3-D environment in a naturalistic manner (Sanchez-Vives and Slater, 2005; Botella et al., 2009). Moreover, it is considered as a transformative medium thanks to its unique characteristic to generate a sense of self different by the real one (Riva et al., 2016). This is possible because VR not only permits to the users the illusion to be in an artificial environment that simulates the real one, but it is capable to generate an artificial sense of embodiment, the subjective experience of using and having a "virtual" body (Blanke et al., 2004; Kilteni et al., 2012). Furthermore, through VR, is now possible to experience another individual perspective, and even feeling the emotions of another person. This features of VR is achieved by activating three multisensory brain processes: the sense of self-location (the feeling of being localized at the virtual position and perceiving the world from this perspective), the sense of agency (the sense of moving the virtual body) and the sense of body ownership (the sense of one's self-attribution of a body, or self-identification) (Haans and Ijsselsteijn, 2012).

Thanks to exponential growth of VR, and its enormous potentiality to transform personal experience, in the past decade it has been adopted to study and promote social emotions, and specifically empathy (Bollmer, 2017). Empathy is defined as the tendency to be psychologically in tune with others' feelings and perspectives (Decety and Lamm, 2006). The scientific community widely accepted the multi-dimensional nature of the construct of empathy (Davis, 1983), comprised by emotional and cognitive components. Emotional empathy refers to being affected by and sharing another's emotions, matching or corresponding emotional reaction to the emotions of another individual. Whereas cognitive empathy is defined as intellectually understanding another person's emotions, and mental state while remaining an objective observer (Shamay-Tsoory et al., 2009). Beyond the multidimensional construct, empathy plays an important role in social relationships. It establishes the basis for positive relations and communities' well-being, and it moderates aggression behavior (Shanafelt et al., 2005). On the other hand, the lack of empathy implies the inability to view the world from other individuals' perspectives or be affected by others' feelings, with the risk of having prejudices or violent behaviors (Mayer et al., 2018).

Due to the importance of empathy, several training programs have been developed (Elias et al., 2000; Jackson and Bonacker, 2006; Gür and Yilmaz, 2020) and their efficacy has been analyzed in various meta-analysis (Butters, 2010; Teding van Berkhout and Malouff, 2016; Luberto et al., 2018).

Lately, consequence of the exponential growth of VR and its ability to transform experiences, novel research question has raised: could VR exposition changes empathy? Several studies have tried to answer to the question, showing interesting results when using VR to generate an empathic response, such as inducing helping behavior (Ahn et al, 2013), reducing implicit racial bias (Peck et al., 2013), reduce domestic violence (Seinfeld et al., 2018), reversing in-group bias (Hasler et al., 2017), or decreasing prejudice (Bailenson et al., 2016), giving to VR the characteristic of the *ultimate empathy machine* (Herrera et al., 2018; Bertrand et al., 2018). Those studies have adopted the change of perspective approach to induce the illusion of being someone else through two main approaches: taking the perspective through a different point of view (Adefila et al., 2016; Wijma et al., 2017), and changing the perspective through embodied a virtual avatar (Hamilton-Giachritsis et al., 2018; Van Loon et al., 2018).

Nowadays, one very alarming worldwide problem hard to face is the sexual harassment (SH). SH occurs when people −mostly women− are targets of unwanted verbal or non-verbal sexual comments, gestures, or actions (Burn et al., 2019). Previous studies have found that the lack of empathy and, specifically, the lack of perspective taking are associated with aggressive behaviors, including SH (Jollife et al., 2004). Basically individuals who offend and act antisocially show less empathy than those who have prosocial behavior (Van Langen, et al., 2014). Previous studies have found that changing perspective trough VR into a female victim of SH could induce positive change on empathy in men participants (Seinfeld et al., 2018; Steinfeld et al., 2019).

The aim of this doctoral thesis is to explore the feasibility of the immersive technology to generate positive changes on empathy, and on SH attitudes, through a VR system. The specific objectives are:

1) review the existing scientific literature about the efficacy of VR to promote empathy;
2) review the existing immersive technologies that induce the sense of body illusion, and generate a better cost-efficacy tool through the 360° video-based VR;
3) develop and test the usability of an SH 360° video-based VR scenario;

4) test the efficacy of the 360° video-based VR to generate male body illusion into a female body;
5) test the feasibility of the SH 360° video-based VR to promote empathy of men participants embodying a female victim of SH;
6) evaluate the variable empathy after three months of the VR task.

To address these objectives, this dissertation will present several chapters. First, **Chapter 1** will present a theoretical review of the background that surrounds this thesis: Psychology and Technology, Transformative Technology, Empathy Theory, and Virtual Reality Embodied Empathy. Afterward, the six studies carried out in this dissertation (distributed in six chapters) will be presented in "scientific article format". Chapters 2, 3, 4, 5 and 6 have been already submitted to scientific journals indexed in the Journal Citation Report (JCR), and they are currently under review, and chapter 7 is the follow-up study of the chapter 6. Each of these chapters follows the same schema: abstract, theoretical introduction, objectives and hypotheses, methodology, results, and discussion.

Chapter 2[5] (entitled "Virtual Reality as a medium to elicit empathy: a meta-analysis") aims to investigate the efficacy of VR to change empathy from before to after the VR exposition through a meta-analysis of published articles.

Consequently the results of the meta-analysis, and proved the efficacy of VR to elicits empathy through the change of perspective, **Chapter 3**[6] (entitled "The benchmark framework and exploratory study to investigate the feasibility of 360° video-based Virtual Reality to induce a full body illusion") aims to explore the existing technologies to induce the full body illusion, to analyze their potentialities and weaknesses, and to test the new embodied system based on 360° camera.

Chapter 4[7] (entitled "Developing a 360° video-based Virtual Reality: an explorative and a user experience studies to generate a sexual harassment scenario") presents two studies: the first study is focus on the develop of a 360° video-based VR on different SH scenarios from the analysis of the qualitative research with women, and the second study presents the

[5]The study is published in *Cyberpsychology, Behaviour, and Social Networking* journal (30 julio 2020) https://doi.org/10.1089/cyber.2019.0681.
[6]The study is under review in *Virtual Reality* as Ventura, S., Cebolla, A., La Torre, J., Escrivá-Martínez, T., Llorens, R., Baños, R. (up to 31/08/2020).
[7]The study is sub submitted at *International Conference on Disability, Virtual Reality and Associate Technologies* (2020) as Ventura, S., Cardenas, G., Riva, G., Baños, R. M.

results of the participants experience with the environment (specifically the evaluation of cyber and motion sickness), and the qualitative feedback for a better user experience.

Afterward the develop of the 360° video-based VR of SH, **Chapter 5**[8] (entitled "Predictors of the sense of embodiment of a female victim of sexual harassment through 360° video-based Virtual Reality") aims to investigate if this technology could induce the body swap illusion, namely a male body into a female body, and examine the variables that could promote or prevent the illusion.

Chapter 6[9] (entitled "How do you feel being a female victim of sexual harassment? The potentialities of the 360° video-based Virtual Reality on empathy and related variables") aims to investigate the feasibility of the 360° immersive video to generate the change of male perspective into a female perspective victim of SH. The chapter describes the results of the study, namely the potentiality of the 360° immersive video to increase scores on empathy, oneness, perspective taking, and to reduce violent attitude score.

Chapter 7 (entitled "Become more human: positive changes on empathy and related variables after three months of an intervention") reports the results of the follow-up of study described in chapter 6 on empathy and machismo traits variables.

Chapter 8 provides a general overview and discussion of the results of the studies that were presented in this doctoral thesis. Implications of the studies, their methodological limitations, as well as recommendations for future research on VR, and empathy, are presented.

We think that the present dissertation gives a significant contribution to the emerging field of studies on immersive technologies to induce positive change on human behavior, empathy toward female victim of SH in this case. We believe that technology could help people to become more "human", and to promote positive social emotions and attitudes, and this dissertation could inspire to continue to investigate in this field.

[8]The study is under review in *Virtual Reality* as Ventura, S., Cardenas, G., Miragll, M., Riva, G., Baños, R. (up to 31/08/2020).
[9]The study is under review in *Cyberpsychology, Behavior, and Social Networking* as Ventura, S., Cardenas, G., Miragall, M., Riva, G., Baños, R. (up to 31/08/2020).

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Chapter 1

Background

1. Psychology and Technology

The growing innovation of Information and Communication Technologies (ICTs) has brought an enormous contribution to psychology, and specifically clinical psychology. In the past two decades, a growing number of studies have shown important implications of the use of ICTs for treating several mental disorders and promoting well-being (Riva, 2005). The association between technology and psychology has originated the concept of Cyber-Psychology (or Cybertherapy), referring to the branch of psychology that is quickly becoming an accepted and validated method for the treatment of different healthcare concerns (Botella et al., 2009). Cyberpsychology has been also defined an e-health model intervention adopted for the treatments, typically behaviorally based, that are operationalized and transformed via Internet, with the advance to reach people who might not otherwise seek therapy (Eysenbach, 2011). Botella et al. (2009) have pointed out that the use of ICTs in delivering a psychological treatments allows to reach people in critical conditions, to improve persistency, anonymity, multimodality of the intervention, as well as the cost efficacy way which the data can be stored, accessed and manipulated. Furthermore, Botella group (2000) brought the e-health to a forward step, integrating it with the advantages technology of Virtual Reality (VR) (Botella et al., 2000).

1.1. Virtual Reality in Clinical Psychology

VR is a collection of technologies that allow people to interact efficiently with 3D computerized database in real time using their natural sense and skills (Riva, 2005). In terms of behavioral science, VR has been described as an advanced form of human-computer interface that allows the user to interact with and become immersed in a computer-generated environment in a naturalistic way (Wiederhold, 2005). VR has emerged as a potentially effective way to provide general and specialty health care services, with a variety of potential benefits for many aspects of rehabilitation assessment, treatment, and research. Furthermore, VR has the potential to objectively measure behavior in challenging but safe, ecologically valid environment while maintaining experimental control over stimulus delivery and measurement (Schultheis & Rizzo, 2001). The main characteristic of VR is the *sense of presence*, defined as a mental state in which a user feels that s/he is being there, in the computer mediated environment (Slater, 1994).

VR has several characteristics that make this technology a potential tool for psychology. First, the experience of being immersed within the virtual environment allows

users to perceived it as real, and "forget" that they are in a testing situation. By the consequence, in this condition is possible to assessment the human behaviors under a more natural and setting and provide insight into individuals typical behavior. This could bring to a more ecological validity of the assessment and intervention (Chaytor et al., 2006). Second, VR permits a full control over stimulus presentation and response measurement. Specifically, trough VR researcher and practitioners can manipulate the stimulus basing on individual's abilities and needs. This allows for individualization of treatment while maintaining consistency in desired outcome measures (Rizzo & Kim, 2005). Third, VR permits safe assessment of hazardous situations. For example, to deal the fear of fly is possible to generate a virtual environment that reflects the fly experience (Wiederhold et al., 2002). In this case patients could face their fear in a safe scenario through the exposition, increasing the awareness of their limitations and overcome them. Fourth, the application of VR could reach greater standardization of the protocols, obtaining consistency of the outcomes (Schultheis & Rizzo, 2001).

The studies on Clinical Psychology field that have adopted VR were focused on different problems such as treating anxiety disorders (Wiederhold, 2005), phobias (e.g. specific phobias, social phobia, agoraphobia) (Botella et al., 2007), post-traumatic stress disorder (PTSD) (Rizzo et al., 2009; Baños et al., 2011; Botella et al., 2015), eating disorder (Perpiñá et al., 1999; Cesa et al., 2013; Gutiérrez-Maldonado et al., 2018), addiction (e.g. nicotine or alcohol) (Bordnick et al., 2008; Girard et al., 2009), among others. Moreover, VR has been used not only for clinical goals but also to promote healthy life styles or well-being for example stress management (Serino et al., 2014), treatment of pain in oncology patients (Gershon et al., 2004) or pain management for various medical procedures (Hoffman et al., 2000), showing positive outcome. Recently, VR was adopted also in the field to promote prosocial behavior through to the paradigm of the embodied illusion (Blanke et al., 2004; Kilteni et al., 2012), such as inducing helping behavior (Ahn et al, 2013), or reducing implicit racial bias (Peck et al., 2013), explained below in this chapter.

In summary, VR protocols in psychology can offers to clinicians, and researchers a practical tool to support the objective measurement of behavior in ecologically valid, safe, and controllable environments. Additionally, VR has three min aspects that contribute to the efficacy and effectivity of its use: imagination, connection, and embodiment (Ventura et al., 2018).

1.1.1. Imaginal Technology

Mental imagery refers to perceptual experience in the absence of sensory input, commonly described as seeing with the "mind's eyes" or "hearing with the mind's ear" (Heyes et al., 2016). Mental imagery has been described also as the simulation or re-creation of perceptual experience across sensory modalities (Pearson et al., 2013). There are two different routes by which mental imagery can be created within consciousness. First, an image can be created directly from immediate perceptual information. For example, someone can look at a picture of a horse, create a mental image of the picture in their mind, and then maintain this mental image as they look away or close their eyes. Second, an image can be created from previously stored information hand in long-term memory. For example, someone can hear the "horse" and then create mental imagery based on their previous experience of what a horse look like (Pearson et al., 2013). In psychology, especially in clinical sector, imagination plays a role in influencing some key characteristics of several mental disorders (Holmes et al., 2007). This aspect is present especially in patients with disorders such as post-traumatic stress disorder (PTSD) which suffer of intrusive imagines, flashback, or sensory memories about their traumatic events (Holmes et al., 2008), social phobia (Hackmann et al., 2000), agoraphobia (Day et al., 2004), bipolar disorder (Holmes et al., 2008), and also in depression, which is associated with verbal and imaginative based process, such as negative rumination (Holmes & Mathews, 2005).

VR can be considered as an advanced imaginal system and an experiential form of imagery that is as effective as reality in inducing cognitive, emotional, and behavioral responses (Day et al., 2004). For this reason, VR exposure therapy (VRET) has been used in contemporary clinical practice with strong evidence. There are increasing proofs that VRET is more efficacious than treatment using mental imagery simulations. First, the imagination usually decays rapidly. The mental image remains in our mind approximately for 250ms. (Holmes & Mathews, 2005). VR could overcome this risk because the patient is involved into the environment without the need to evoke any imagination. Moreover, imagination of previous events needs a good memory and sometimes is not trustful (Rizzo et al., 2009). For example, during an assessment with PTSD, therapist asks patients to think about a traumatic event, and sometimes patients could fall in this task because memories are not clear. In VR, patients are already involved into traumatic event which gives them the possibility the relive the traumatic experience and to face it, as it happens in phobia (Wiederhold et al., 2002; Botella et al., 2015). Furthermore, VR as imaginal technology

has found interesting results in inducing positive emotions (Baños et al., 2008). It is common that relaxing imagination is useful to eliminate stress or negative thoughts from our mind, and VR involves people into a specific environment to reduce their level of stress (Serino et al., 2014).

Summarize, VR provides an experience that can reduce the gap between imagination and reality and to go over memory limits increasing the efficacy and effectiveness of psychological treatment.

1.1.2. Connectedness Technology

Recently, software developers and ICTs industries (e.g. Facebook and Oculus) have emphasized that next interesting and compelling work for VR is focus on helping people to connect with others through shared experiences. The first step of this change has been the creation of the new interactive communication environments called Cyberspace (Riva & Galimberti, 1997). The concept of Cyberspace clearly shows that VR is, in fact, a parallel universe created and maintained by the networks in which people interact, from which a sense of self can be built (Harrison & Thomas, 2009).

The cyberspace brought the advantage in psychology to cut geographical limits and reach people anywhere and anytime (Dunstan & Tooth, 2012). Moreover, in cyberspace is now possible to interact with avatars, such as a virtual therapist. Avatars are graphical images that represent persons and can interact with real people thanks to its Artificial Intelligence (AI) (see paragraph 3.2.2). For instance, the Institute of Creative Technology (USA) created the program *SimCoach* to face the urgent need of reducing the stigma of seeking mental health treatment for Veteran population who have a strong PTSD, cutting geographical and emotional barriers. *SimCoach* allows users to initiate and engage in a dialog about their healthcare concerns with an interactive AI therapist, demonstrating interesting results in term of mental health (Rizzo et., 2012).

VR has the potentiality of connectedness not only for psychotherapy field but also for human and environmental purpose. Thanks to VR is now possible to connect humans to other humans in a profound way, and it can change people's perception of each other (Bailenson, 2018). The connection will be possible not only between people, but also between people and the environment and to have positive impact with the nature (Smith et al., 2018). Later in this chapter the concept is better deepened, and we describe how VR can be applied to make us better people, more empathetic, more aware of the fragility of the environment.

1.1.3. Embodied Technology

Through VR is possible to experience synthetic environment as if it is "our surrounding world", but also to experience synthetic avatars as if they are "our own body". From this approach, VR could be defined also as an "embodied technology". The sense of embodiment is an ensemble of characteristics that permit the user to feel inside an artificial body (Kilteni et al., 2012). This construct is composed by three factors: (i) the sense of self-location that is a determinate volume in space where one feels to be located. Normally self-location and body-space coincide in the sense that one feels self-located inside physical body. This collocation can break down when people have an out-of-body experience in which they perceive themselves outside of their physical body; (ii) the sense of agency that is the subjective experience of action, control, intention, motor selection and the conscious experience of moving the artificial body; and (iii) the sense of body ownership that is the one's self-attribution of the body. It has been proposed to emerge from a combination of bottom-up and top-down influences. Bottom-up information refers to the afferent sensory information that arrives to the brain from our five sensory organs, top-down information consists of the cognitive process that may modulate the processing of sensory stimuli, for example how much people could believe in the illusion that the artificial body is their own (Kilteni et al., 2012).

The paradigm of the full body illusion has been adopted in psychological scientific research for various objectives such as studying body image in eating disorders, demonstrating the false perception that participants have with their body size (Serino et al., 2016; Riva & Dakanalis, 2018); increasing the connection with the nature, and get more involved with the ecological thematic by embodied an animal (e.g. the cow or the marine coral) (Ahn et al., 2016), or by embodied an avatar that, in the virtual environment, cut the trees in the forest with the objective to change paper waste behavior (Ahn et al., 2014). For instance, Salter's group has analyzed how the use of virtual bodies can promote compassion and self-compassion. They have analyzed the effects of self-identification with virtual bodies within immersive VR to increase self-compassion in persons with high self-criticism and depression (Falconer et al., 2014). Bailenson's group has studied how embodied an avatar in VR can make us better people. For example, participants embodied a Superman avatar and the results show that, after the experiment, they felt more helpful (Rosenberg et al., 2013). Moreover, a growing number of studies have been focused on changing prosocial behaviors adopting the embodied paradigm, such as inducing helping behaviour (Ahn

& Bailenson, 2013), reducing implicit racial bias (Peck et al., 2013), reversing in-group bias (Hasler et al., 2017), enhancing financial planning (Sims et al., 2015), or decreasing prejudice (Oh et al., 2016). In those studies, participants embodied the avatar of the opposite group to induce themselves to be that person, and to feel how the other is feeling in a specific circumstance.

Summarize, the potentiality of VR as an "embodied technology" opens its use wider than the only reproduction of real worlds. Thanks to this advanced technology it is possible to study behavioural, cognitive, and emotional aspects that were hard to realize so far.

2. Transforming Experience through Virtual Reality

2.1. The concept of Transformative Experience

The transformative experience is defined as an event in which a person worldview is reconstructed, with the result in the shift on the perspective of the world, or in the change on values and beliefs (Chen et al., 2017).

According to the theory of Transformative Learning, the learning is considered as a process of challenging established biases, assumptions, and behaviors (Mezirow, 1990). According to Mezirow (1990), "perspective transformation is the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand, and feel about our world; changing these structures of habitual expectation to make possible a more inclusive, discriminating, and integrating perspective; and finally, making choices or otherwise acting upon these new understanding". Furthermore, the philosopher Paul (2014) underlines the concept of Personal Transformative Experience referring to the potential of the experience to change people point of view. Specifically, transformative experiences can teach us something that we could not have known before having that experience, while changing us as a person.

Recently, the author Gaggioli (2015) proposed the concept of Transformative Experience Design (TED) reffered to the experiences that contribute to the self-actualization (Gaggioli, 2015). The concept tries to answer to the question: how the experience can be transformed? According to TED, transformative experience cannot be constructed but can only be invited, namely, the design of an experience should require specific tools to engage the participant and, on the other side, the participant should get carried away by the experience. (Gaggioli, 2015). Moreover, authentic transformation requires the active involvement of the participants in the generation of new meaning. For that, one potential trans-

formative affordance that could facilitate transformative experiences is the medium of VR.

2.2. Virtual Reality as Transformative Experience Technology

VR may have the potentiality to transform our inner experience by structuring, altering, and replacing our bodily self- consciousness (Riva et al., 2016). From this perspective, VR has been defined as a transformative technology since it allows individuals to encounter totally new experiences, and acts as a potential source of insight and inspiration (Gaggioli, 2015). The previous explained characteristics of VR could provide a unique opportunity for researchers to study a very complex and personal phenomenon of transformative experiences in a controlled laboratory environment, making these experiences accessible for both the researchers and general public (Stepanova et al., 2018).

Some transformative experiences often occur when an individual observes the vast beauty of nature, for example when one climbs a mountain, reaches Antarctica or looks at Earth from space (Stepanova et al., 2018). For most cases these experiences are only accessible to a restrictive group of people, who for example have conditions to travel to the places or have a strong imaginative ability. Furthermore, some one-shot transformative experiences that could generate new knowledges cannot be planned in advance but happen suddenly in individuals' lives, without a prior control on their contents and effects. However, VR can overcome these limits and play a significant role in transformative processes inducing a high level of emotional engagement and sense of presence that can support self-reflectiveness (Riva et al., 2016).

The sense of *awe* is one of the effects that people can live during the transformative experience. The awe is a psychological construct that is considered part of a "self-transcendent" index of emotions, and it is characterized by the perception of something vast, followed by a need to accommodate the experience (Keltner and Haidt, 2003). Recently, VR has been proposed as a new technique to induce the sense of awe in the lab (Chirico et al., 2016). Another important effect obtained from a transformative experience in VR is the alteration of bodily self-consciousness, namely the sense to be another person.

2.2.1. Altering bodily self-consciousness: *walking in someone else shoes*

As mentioned above, VR can generate a sense of embodiment, the personal experience to have and control another body (Kilteni, 2012). The sense of embodiment through VR can induce changes in self-locations, self-identification and first-person perspective, simulating the self- experience of another person, and even animal (Ahn et al., 2016). The potential of immersive VR as a transformative tool permits to see the world from another person perspective and feeling the emotions of that person.

Altering the neuropsychological basis of self-experience (self as an object), VR allows to experiment a different "ontological self" (self as a subject). For example, Blanke (2004) has used VR to generate an out-of-body experience by using conflicting somatosensory input to disrupt the spatial unity between the self and the body. According to Riva (2015) there are three possible strategies that can be used to alter bodily self-consciousness using VR: (i) mindful embodiment, which consists in the modification of the bodily experience by facilitating the availability of its content in the working memory; (ii) augmented embodiment, which is based on the enhancement of bodily self-consciousness by altering/extending its boundaries; and (iii) synthetic embodiment, which aims to replace own body with synthetic self-consciousness (incarnation). Thanks to these characteristics, VR could facilitate perspective taking in challenging situations by offering compelling experience of what it feels like to *walk in someone else's shoes* (Ahn and Bailenson, 2013).

The transformative experiences induced in VR could facilitate social interaction by helping people to establish common grounds and infer shared knowledge and beliefs between interactants (Gaggioli, 2016). In this line, VR can generate high sense of engagement and social connectedness in people that naturally belong to "opposite groups" such as men and women, young and old, human and nature, among others. Thanks to the current potentiality of VR, new research question is arising: how can we become more human through immersive VR?

3. Virtual Reality as the *ultimate empathy machine*

3.1. The concept of Empathy

The term empathy come from the Greek word "empatheia" (passion), which is composed of "en" (in) and "pathos" (feeling). The term was introduced into the English language following the German notion of "Einfühlung" (feeling into), which originally de-

scribed resonance with works of art and only later was used to describe the resonance between human beings (Decety and Jackson, 2004).

Empathy is a multidimensional construct consisting of cognitive and affective components. Cognitive empathy is defined as intellectually understanding another person's emotions and mental state while remaining an objective observer. Whereas affective empathy refers to being affected by and sharing another's emotions, matching or corresponding emotional reaction to the emotions of another individual (Harari et al., 2010; Baron-Cohen et al., 2013). According to the Theory of Mind (Goldman, 2012), it is possible to recognize other mental state through a connection between situation, feeling and action thanks to a mental simulation of them. Davis (1980), who developed the Interpersonal Reactivity Index scale (the gold standard scale used to measure empathy), have suggested that empathy is a multi-component response, involving four factors: (a) *perspective-taking,* that is the ability to adopt the viewpoint of another person; (b) *fantasy,* that is the ability to transpose oneself into the feelings of a fictitious character; (c) *empathic concern,* that refers to feelings of kindness toward another person; and (d) *personal distress,* that is the feeling of sorrow toward the others.

In social behavior field, empathy has been related to social intelligence due to its feature to help individuals to establish and maintain friendships and to moderate all forms of aggression (Jolliffe and Farrington, 2004). Moreover, empathy can enhance satisfaction in intimate relationships (Finchaman et al., 2002), improve the quality of family relationships such as cohesion, parental support, and communicative responsiveness (Padilla-Walker and Christensen, 2011). Additionally, it is an essential factor in medical and psychological treatments and care-giving relationship (Beadle et al., 2018). Given the importance of empathy in social relationships, mainly in prosocial behaviors, clinicians and researchers have developed different programs to training empathy.

3.1.1. An overview to the Empathy Training Programs

The training of empathy has the objective for one side to connect with another person creating a shared emotional experience and to get the basis for building trust and affiliation; on the other side, the goal is to connect with another to reduce his or her hurtful emotional state (Butters, 2010). There are several methodologies of learning empathy in educational contest: (a) *Social and Emotional learning* is aimed to learn how to identify and manage emotions, motivations, decisions and social relations through self-awareness, self-management, social awareness, relationship skills and responsible decision making (Elias,

2000); (b) *Reflexive Thinking* combines a series of approaches and methodologies to help individual to learn "how to learn" and to develop cognitive, social and emotional skills, based on the construction of the learning between teacher and student (Yiasemina-Karagiorgi and Symeou, 2005); (c) *Positive Intergroup Interaction* is based on the perspective-taking exercises as role play to decrease explicit and implicit stereotypes toward the individual, and to increase positive evaluations towards their group (Rudman, 2001); (d) *Mindfulness Training* has the goal to enhance abilities as perspective-taking and compassion, and to address modulators of empathy such as anxiety control and non-judgmental thinking (Hildebrandt, 2017); (e) *Victim Impact Training program* has been adopted in offender rehabilitation programs to induce intense emotional impact, shame, guilt, and empathy in the offender in order to reduce future offending behavior (Jackson and Bonacker, 2006). All these trainings have shown to be efficacious to improve empathy after the intervention program (Teding van Berkhout and Malouff, 2016).

These empathy training programs involve several methods. The results of a systematic review (Lam et al., 2011) show that the most common methods included *experiential training* based on role-play, for example the aggressor plays the role of the victim; *didactic* based on class lessons (lecture); *skills training* based on lectures, demonstrations and practice; and mixed methods. Many of these methods reflect the theory of behavioral modelling of Bandura (1974). Social learning theory posits that, under certain conditions, people imitate the behavior of other. Behavioral modelling is one facet of social learning, showing that just teaching others engage in a behavior can cause a viewer to imitate it. This happen during the train of role-play when a person takes the perspective of someone else.

The traditional empathy training programs need a lot of imaginative work. For example, a narrative or a documentary about refugee can give a lot of information about life in the camp, but it is poor at conveying what living in a camp feels like. Participants do not have a mental library of the appropriate sight, sounds, and story to imagine what it is like to be a refugee. Recently, VR was adopted as a medium to reproduce the subjective experience of another person, and it seem to foster empathy in unprecedented ways (Bailenson, 2018).

3.2. Study Empathy through Virtual Reality

In a 2015 TED talk, the immersive filmmaker Chris Milk declared that VR is a machine that makes people more compassionate, connected and empathetic. VR, explained Milk, connects humans to other humans in a profound way and in a way that no other

media form has been able to do so before, for this reason he named VR as *the ultimate empathy machine* (Bailenson, 2018).

Beyond the mentioned characteristics of VR, there are several reasons that VR could be a potential media to elicit empathy. First VR offers a tangible experience, namely the perspective taking in an immersive virtual environment may require less cognitive effort than traditional perspective taking exercises that rely on mental simulation (Oh et al., 2016). Second, people in VR tend to be less "present" in the physical world and more "present" in the virtual world, so they may feel less self-aware when engaging in a perspective taking exercise via VR compared to traditional empathy training. Third, perspective taking in VR could be useful to avoid people stereotypes. For example, if a teenager has a negative stereotype of the elderly, they might create the images of elderly who are slow, frugal, and who tell boring stories. Creating a perspective taking narrative through VR is possible to avoid these kinds of stereotypes, and creating a real image of elderly, reaching the research goal more accurately.

One important feature of VR as an empathy machine is its ability to intervene in prosocial behaviors, especially for the outgroup's member. For example, researchers have used VR to induce helping behaviour (Ahn, Le and Bailenson, 2013), to reduce implicit racial bias (Peck et al., 2013), to reverse in-group bias (Hasler et al., 2017), enhancing financial planning (Sims et al., 2015), or to decrease prejudice (Oh et al., 2016), abating positive change on empathy variable. Literature underlines that it is possible to identify oneself into another member thanks to the process of self-association, first in the physical or bodily domain as an increase in perceived physical similarity between self and outgroup member, and then in the conceptual domain, leading to a generalization of positive self-like associations to the outgroup (Maister et al., 2014)

In VR, the identification with someone else could happen also in two different forms: (i) the perspective taking supported by the sense of presence in the virtual environment, released or not though a virtual agent, and (ii) the perspective taking supported by the sense of embodiment though an avatar.

3.2.1. Study Empathy through Virtual Reality

Perspective Taking

One successful documentary created by immersive technology with the goal to elicit empathy is the VR 360° video projected from the United Nations, *Clouds Over Sidra* (Schutte and Stilinović, 2017). The video was recorded in the Jordan Za'atari refugee

camp where 8000 Syrian were displaced by civil war. The audio of the video is the inner voice of a young girl Sidra describing the camp, while different scenes of daily life play around. The viewer can see the refugee Sidra family in the small ship container converted in their room; or can stand in the middle of a soccer field, while some young girls kick a ball around the viewer. The video gives to the viewers the feeling to be there with the protagonists of the story. After the vision, the viewers showed a strong empathic response, proving the potential of the VR media to engage users and attract their full attention on the story (Schutte and Stilinović, 2017). The video *Clouds Over Sidra* had a strong impact that incremented the numbers of people who donated to the United Nations (Gaudiosi, 2016). Chris Milk (2015), the filmmakers of the current 360° video, expressed his conviction that the immersive properties of VR make it particularly suited to sharing the experience of others, to deepening our understanding of lived outside our own (Bailenson, 2018). Another example is the documentary *The Displaced* that described the experience of three children from Syria, Ukraine, and Sudan as they attempt to rebuild their lives in the wake of war. Viewers also showed a high sense of empathy toward the protagonists of the story (Schutte and Stilinović, 2017). In these two documentaries, the viewers were simply immersed into the virtual scenario, taking the perspective of the protagonist of the story, and they could feel as if they are there depending on the level of presence perceived.

One of the main characteristics of the perspective taking studies in VR is the use of *virtual agents* (Figure 1A). The virtual agent is a representation driven by the computer program and permits to the users to enhance their sense of presence in VR, particularly the social presence, namely the illusion to share the environment with someone else (Slater, 1994). Moreover, the agent permits to the user to take his/her perspective, and to enhance the feeling of empathy toward him/her. For example, a study showed that participants can experience what is like to be a homeless by taking the perspective of the homeless virtual agent (Herrera et al., 2018). This study developed an interactive virtual environment where participants could choose the "fate" of the virtual homeless. For example, he loses the job and he is forced to sell his belonging, in that case participants have to choose which items sell (e.g. sofa, television, phone etc), until he finishes to lose everything. Results demonstrated high scores on perspective taking and empathy concerns after the VR exposition (Herrera et al., 2018). In another study, also developed by Bailenson's group, participants saw through the HMD a virtual world as if they had colorblind deficit. Results found that

take the perspective of a colorblind person helped participants to increase helping behavior toward the outgroup. (Ahn et al., 2013).

Virtual agents could also increase the sense of presence into the virtual environment and enhance the feeling of empathy of participants. This could happen because participants have a visual reference in the scenario in which they could transpose their feeling, and perspective to someone else (Blascovich and Bailenson, 2011).

3.2.2. Study Empathy through Virtual Reality Embodiment

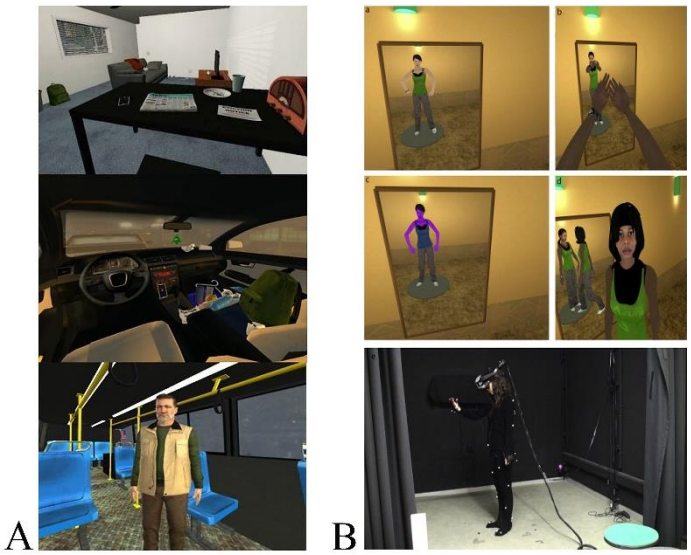
As explained above, VR could elicit the sense of embodiment, namely the illusion to have and move another body (Kilteni et al., 2012). Through this paradigm, several recent studies have demonstrated how it could be a powerful tool to enhance empathy toward the outgroup members. This is possible thanks to the *virtual avatar* (Figure 1B). The avatar, contrary to the virtual agent, is a graphic representation driven by the actions of actual people, typically in real time. This is possible because of a sophisticate VR system characterized by the optitrack suit that permits to display the body of the users into the virtual scenario. The studies using this technology, before starting the experiment, gave participants a few moments to perform a series of simple movements in front of the mirror to help them to associate their body's physical movements with the avatar's movements that they saw in the mirror, to generate the "body transfer". The group of Slater (2018) adopted this system to put a man in a female body victim of sexual harassment, showing positive change on empathy (Seinfeld et al., 2018). The same research group showed that when the light-skinned participants embodied a dark-skinned avatar (e.g. a digital representation of the user) and interact in a virtual environment, implicit biases toward dark-skinned people are significantly reduced. In another study, Ahn et al. (2014) compared the effects of cutting down a tree in tree conditions: a traditional perspective-taking task (narrative), a VR embodied perspective-taking task, and watching a video of someone cutting down a tree. Results showed that participants in the VR condition reported higher environmental behavior intentions and locus of control than their counterparts.

The body swap has been not adopted only to change bodies between people characters, but even to permit to participants to embody an animal body. For example, the group of Bailenson (2016) used the optitrack system to transform participant in a cow avatar with the goal to increase the sense of oneness with the nature. Results showed that

participants, after being a virtual cow, demonstrated higher social impact with the nature (Ahn et al., 2016).

These studies allow to understand the potential of VR to transform users experience, changing their perspective and enhancing their feeling of empathy toward the outgroup.

Figure 1. The difference between Agent and Avatar



Note: **A**: *Virtual Agent*, participants take the perspective of the virtual homeless (Herrera et al., 2018): **B**: *Virtual Avatar*, participants wear the optitrack system and embodied the dark-skinner avatar (Peck et al., 2013).

4. Sexual Harassment: the failure of empathy toward an outgroup

The World Health Organization (WHO, 2011) defines sexual violence as: 'any sexual act, attempt to obtain a sexual act, unwanted sexual comments or advances, or acts to traffic or otherwise directed against a person's sexuality using coercion, by any person regardless of their relationship to the victim, in any setting, including but not limited to home and work'.

Sexual violence is a worldwide problem, Figure 2 shows the sexual violence world penetration rates by geographic regions (up to 2016).

Sexual harassment (SH) is a subfield of sexual violence and occurs when people −mostly women− are targets of unwanted verbal or non-verbal sexual comments, gestures, or actions (Burn, 2019). The harassment could occur in private spaces, such as at home or at work, where the partner or the boss is usually the aggressor, or in public places such as

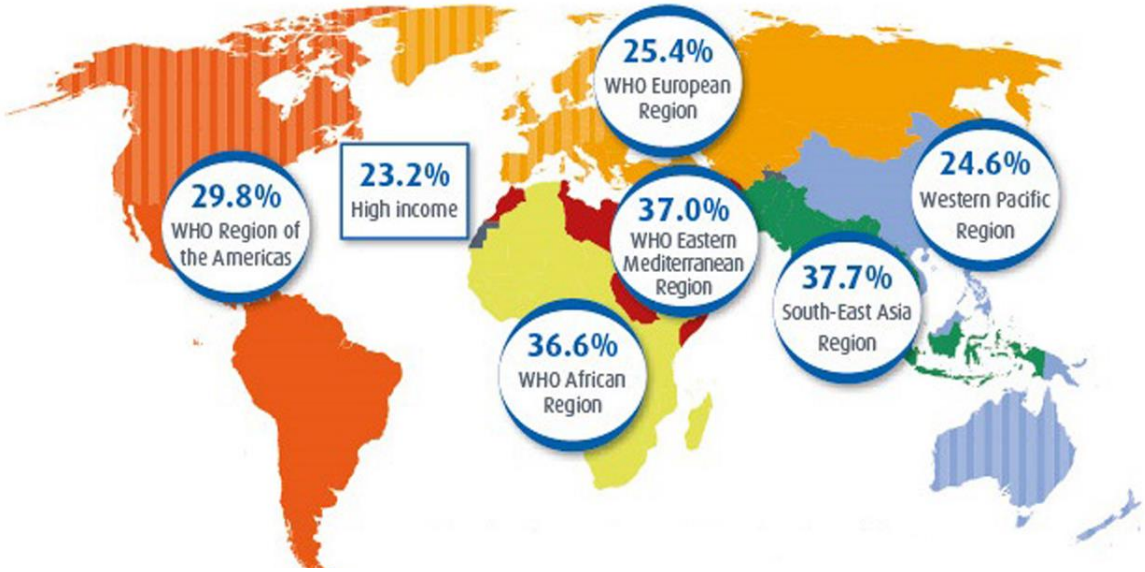
on the street, in public transportation, or at the library, among others. Victims perceive SH to be annoying, offensive, humiliating, and intimidating, and it can reduce their sense of safety. (Burn, 2019).

Previous studies have found that the lack of empathy and, specifically, the lack of perspective taking are associated with aggressive behaviors, including SH (Jolliffe and Farrington, 2004). Basically, individuals who offend and act antisocially show less empathy than those who have prosocial behavior (Seidel et al., 2013). Previous studies show that offenders have lower levels of both cognitive and emotional empathy than the general population (Seidel et al., 2013). One possible explanation is that individuals with low levels of empathy do not understand the other individual's distress, and they are unable to take the perspective of the victim, so that they continue the harassment behavior (Barnett and Mann, 2013). Moreover, individuals who have low perspective-taking ability may misinterpret other people's intentions and feelings. By the contrast, individuals who have a high ability to imagine others' distress could improve the relationship with another person and inhibit the harmful behavior (Barnett and Mann, 2013). Due to the enormous penetration of the problem of sexual harassment, several mechanisms have been developed to prevent the first harass, or for the relapse prevention (Dowden et al., 2003), they are: *offense chain or cognitive-behavioral chain*: the program teaches the offender to recognize his offense cycle or the precursory cues that warn an offender that he may be in danger of committing a criminal act; *identify high-risk situations*: the program teaches the offender to identify situations that are conducive to criminal activity and how to deal with these situations when he is placed in one; *self-efficacy*: the program aims to instill feelings of self-confidence in the offender that his efforts will be successful in avoiding future criminal activity as a result of participating in the program; *coping skills*: one of the explicit targets of the program is to develop or enhance adaptative strategies; *external support systems*: the program trains others member close to the offender such as family, friends, school and work peers so the offender is properly reinforced for displaying prosocial behaviors learned in the program.

Recently, VR has been adopted to study empathy in offenders of sexual harassment (Seinfeld et al., 2018). This study aimed to investigate the impact of perspective taking, and empathy on emotion recognition in participants including domestic violence offenders and controls. To reach the goal, the authors used the embodied paradigm through the virtual avatar. During the experiment, male participants entered in a virtual environment where their body was substituted by the body of a virtual female. From this perspective, the participants saw a virtual male entering the scene and exhibiting abusive speech and gestures

along with a progressive invasion of the victim's (e.g., the participant's) personal space. Results revealed that offenders have a significantly lower ability to recognize fear in female faces compared to controls, with a bias towards classifying fearful faces as happy. After being embodied in a female victim, offenders improved their ability to recognize fearful female faces and reduced their bias towards recognizing fearful faces as happy. This study has opened a new perspective to use VR to prevent and treat SH problems.

Figure 2. Sexual violence world penetration rates by geographic regions.



Note. Source: www.who.int

5. Outline of this dissertation

As we have seen, in the last two decades the use of VR has grown exponentially in psychology. The scientific literature has examined and proved that VR is an efficacious instrument for clinical research, and for psychological prevention, and intervention. This chapter has described the main characteristics of VR as imaginal, connectedness, and embodied technology. Additionally, VR has the feature to facilitate transformative experiences because it can transform the bodily self-consciousness generating the illusion to be someone else and feeling different emotions. Concretely, VR allows to embody another person through the alteration of the mechanisms of location, agency, and ownership. Further, various studies have adopted the paradigm of the sense of embodiment to study the effect of changing perspective and empathy. Literature showed that change perspective, with a virtual agent or avatar, allows to change emotions towards an outgroup, particularly the own feeling of empathy. However, according to our knowledge there is not an ana-

lytical review that investigate the efficacy of the studies which have used VR to change empathy variable from before to after the VR exposition.

As point out in the chapter, an example of the failure of empathy toward an outgroup is the SH toward women. The WHO showed that a quarter of the population of each continent suffered of SH at least one time in life (Figure 1). Recently, research have started to investigate the effects of VR perspective taking on offenders, but more researches are needed.

The aim of this doctoral thesis is triple: (1) to review the existing scientific literature on empathy and VR, (2) to investigate the feasibility of the 360° video-based VR to generate the body illusion with the same gender, and the body swap illusion from men to female body, and (3) to generate an immersive SH scenario through the 360° video recorded from the perspective of a female victim of SH, and investigated if it can induce positive change on empathy in men participants.

Chapter 2 presents a meta-analysis addressed to investigate and clarify existing research on VR as a medium to elicit empathy. An exhaustive literature searches (updated to February 29th, 2020) enabled us to locate 7 published articles, yielding a total of 9 independent samples, published from 2009 to 2018, demonstrating the efficacy of VR to elicits empathy, and perspective taking.

Chapter 3 aims to test the feasibility of 360° video-based VR to induce a full body illusion. The study presents two different groups that receive different levels of immersion: a 3D immersive video and a 2D non-immersive video, evaluated by the self-reported sense of embodiment and the Heart Rate Variability. The finding shows the potentiality of the 360° video to induce the sense of body illusion.

Chapter 4 explains a useful method to generate a 360° video-based VR on SH. First, the focus group with women were led to collect information about the type of SH that occur in daily life to generate the content of the video. Second, the video was tested with participants to test the user experience. Finding indicate the high risk of the 360° video-based VR to generate sickness.

Chapter 5 presents the results of a study that first examines the feasibility of 360° video-based VR to induce the body swap illusion from men to female body, and second to explore whether trait psychological variables involved in the SH (i.e., machismo, chivalry, alexithymia, empathetic abilities) predict the inclination of men to be embodied in a wom-

an victim of SH. Finding showed first the potentiality 360° video the induce the body swap illusion, and second how the traits of machismo and alexithymia determinate the score of embody illusion.

Chapter 6 reports the effect of a 360° video-based VR experience compare to a traditional perspective-taking task (narrative) on empathy and related concepts (i.e., violent attitude, perspective taking, sense of oneness) towards a woman victim of SH in a male sample. Finding demonstrate the superiority of the 360° video-based VR experience over the narrative in increasing empathy, sense of oneness, and perspective-taking towards a woman victim of SH.

Chapter 7 aims to report the results of the three months follow up study described in chapter 6 on empathy and machismo traits variables. Results show positive change on empathy, and a difference, tendency to significance, for machismo trait after the three months to the immersive exposition.

Chapter 8 provides a general overview and discussion of results of the studies that were presented in this doctoral thesis. Implications of the studies, their methodological limitations, as well as recommendations for future research on VR, and empathy, are presented.

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Chapter 2

Virtual Reality as a Medium to elicit Empathy: a meta-analysis

Abstract

The current meta-analysis aims to investigate and clarify existing research on virtual reality (VR) as a medium to elicit empathy. An exhaustive literature search (updated to February 29, 2020) enabled us to locate seven published articles, yielding a total of nine independent samples. The results reveal statistically significant positive changes in perspective-taking outcomes after VR exposure (d+=0.51 [95 percent CI: 0.15–0.88]) but they did not note in empathy (d+=0.21 [95 percent confidence interval, CI: -0.37–0.79]). A potential limitation of this work is the low number of studies included. Implications and directions for theoretical development and empirical research are also discussed.

1. Introduction

The origin of the term empathy can be traced to the German word ‘‘Einfu ¨hlung,’’ which refers to ‘‘feeling into.’’ According to the literature, empathy can be divided into cognitive empathy and emotional or affective empathy[1]. More specifically, cognitive empathy is defined as an intellectual understanding of another person’s emotions and mental state while remaining an objective observer, whereas emotional empathy refers to being affected by and sharing another’s emotions and matching or corresponding one’s emotional reaction to the emotions of another individual[2].

The gold standard model shared by the scientific community is Davis’s model[3] which describes the interaction between cognitive and affective empathy. The model is structured using four factors: (a) perspective taking, referring to the ability to adopt the viewpoint of another person; (b) fantasy, referring to the ability to transpose oneself into the feelings of a fictitious character; (c) empathic concern, referring to the feeling of being involved in others’ emotions; and (d) personal distress, regarding the feeling of sorrow about others’ pain.

Beyond the multidimensional construct, empathy plays an important role in social relationships. It establishes the basis for positive relationships and communities’ well-being and it moderates aggressive behavior[4,5]. Moreover, empathy is an essential factor in medical and psychological treatments and caregiving relationships[6]. On the other hand, the lack of empathy implies the inability to view the world from other individuals’ perspectives or be affected by others’ feelings, with the risk of having prejudices or violent behaviors[7,8].

Due to its importance, researchers have developed several interventions to increase empathy skills, mainly based on the technique of role-play to take the perspective of another person[9–13]. Previous researches have shown that one of the best ways to foster empathy is the psychological process of perspective taking described above or imaging the world from another person’s point of view[14]. Davis suggests that if a person imagines the world from another’s perspective, the gap between oneself and the other decreases[15].

In the past decade, virtual reality (VR) has been found to be an interesting instrument for studying empathy. VR is an advanced form of a human–computer interface that allows the user to interact with and become immersed in a computer-generated environment[16]. Namely, it could be a subjective experience that convinces the individual that the artificial environment where s/he is immersed is real[17]. Thanks to the proper characteristics

of VR, it is possible to share and experience the life of someone else and to understand the other point of view. For this, VR is defined as the ultimate empathy machine for its ability to better connect humans to other humans in a profound way than any other forms of media, changing people's perception of each other[18].

So far, several studies have found interesting results when using VR to generate an empathic response, such as inducing helping behavior[19], reducing domestic violence[20], reducing implicit racial bias[21], reversing in-group bias[22], and decreasing prejudice[23], thus opening the door to new investigations of empathy and VR. However, VR also received the critique of whether it could really be a crucial medium to elicit empathy because empathy is more than simply embodying or taking the perspective of a person in digital media[24], For example, Bollmer[25] states that VR presumes to acknowledge the experience of another, but it fails to do so in any meaningful way.

The present meta-analysis aims to provide an overview and preliminary evaluation about the effect of VR on empathy. In detail, the main objective is to investigate if VR could significantly change the empathy variable from before to after the exposure, among different contexts and populations.

2. Method

The current meta-analysis was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement[26].

2.1. Study Selection Criteria

To be included in the meta-analysis, studies had to fulfill the following criteria: (a) be empirical studies published in a peer-reviewed journal; (b) examine the change in empathy and/or perspective taking; (c) have a sample of adult participants from a nonclinical population; (d) include pretest and post-test data; (e) be written in English, Italian, or Spanish; (f) report statistical data that allow us to compute the effect sizes; and (g) have the full text available.

2.2. Search strategy

First, a systematic literature search was conducted on the PsycINFO, Scopus, ScienceDirect, and Web of Science databases on September 20th, 2018, and after the review process of this article, it was updated to February 29th, 2020, using the following terms: ‘‘virtual reality’’ AND (empathy OR compassion OR ‘‘perspective taking’’ OR ‘‘prosocial behav-

ior''). Moreover, the references in the located studies and recent studies were also reviewed, and authors were contacted for missing data.

2.3. Search outcome

The initial search procedure led to 3,354 potentially relevant studies. After removing 283 duplicates, 3,071 titles were scanned. From those, 2,525 studies were removed because they did not match the field of our research, and 546 abstracts were scanned. After removing 323 studies because the abstracts did not match the selection criteria, 223 full texts were examined. The selection of the studies was done individually by two researchers (S.V. and R.H.). Disagreements between researchers were resolved through discussion with a third researcher (A.C.) until consensus was reached. The researchers reviewed the full text, providing reasons for exclusion such as not an empirical study (n=37); does not examine the change in empathy and/or perspective taking from before to after the VR exposure (n=63); does not have a sample of adult participants (n=28); or from a non-general population (n=25); does not have pretest and/or post-test data (n=27); not written in English, Italian, or Spanish (n=6), does not report statistical data (n=25); or full text not available (n=5).

At the end of the literature search process, seven studies were selected (Fig. 1). In addition, because several studies reported statistical data for two or more different groups, the database for our meta-analysis included a total of nine independent samples.

2.4. Data Extraction

A protocol for extracting the characteristics of the studies was produced and applied to each study. The characteristics coded were (a) the year of the study; (b) geographical location; (c) sample size (total and by groups); (d) mean age; (e) sex distribution; (f) main intervention; (g) outcome measure: empathy and perspective taking; and (h) statistics reported to calculate the effect sizes. Finally, the methodological quality of the study was measured on a scale from 0 to 9 points[27], but with a few adaptations to our selected studies (most of them were studies without a control group). The items that made up the scale were (1) internal validity of the design (including the active control group, nonactive control group, or no control group); (2) random versus nonrandom assignment of participants to the groups; (3) the sample size at the post-test; (4) the use of blinded assessors to measure outcomes; (5) the use of a measurement instrument to assess outcomes that show good psychometric properties (reliability) in the study sample; (6) an acceptable dropout rate; (7)

the use of both point measures (e.g., differences in group outcomes or as the outcome for each/all groups) and measures of outcome variability (e.g., standard deviation); (8) appropriate statistical analyses of data (nonparametric methods vs. parametric methods); and (9) calculation of the statistical power; that is, the sample size was calculated to detect an effect. Each item received a score of 1 when the study met a criterion and 0 otherwise. A total quality score was also calculated for each study by adding up all the corresponding item quality scores (range: 0–9), with a higher score indicating higher overall quality.

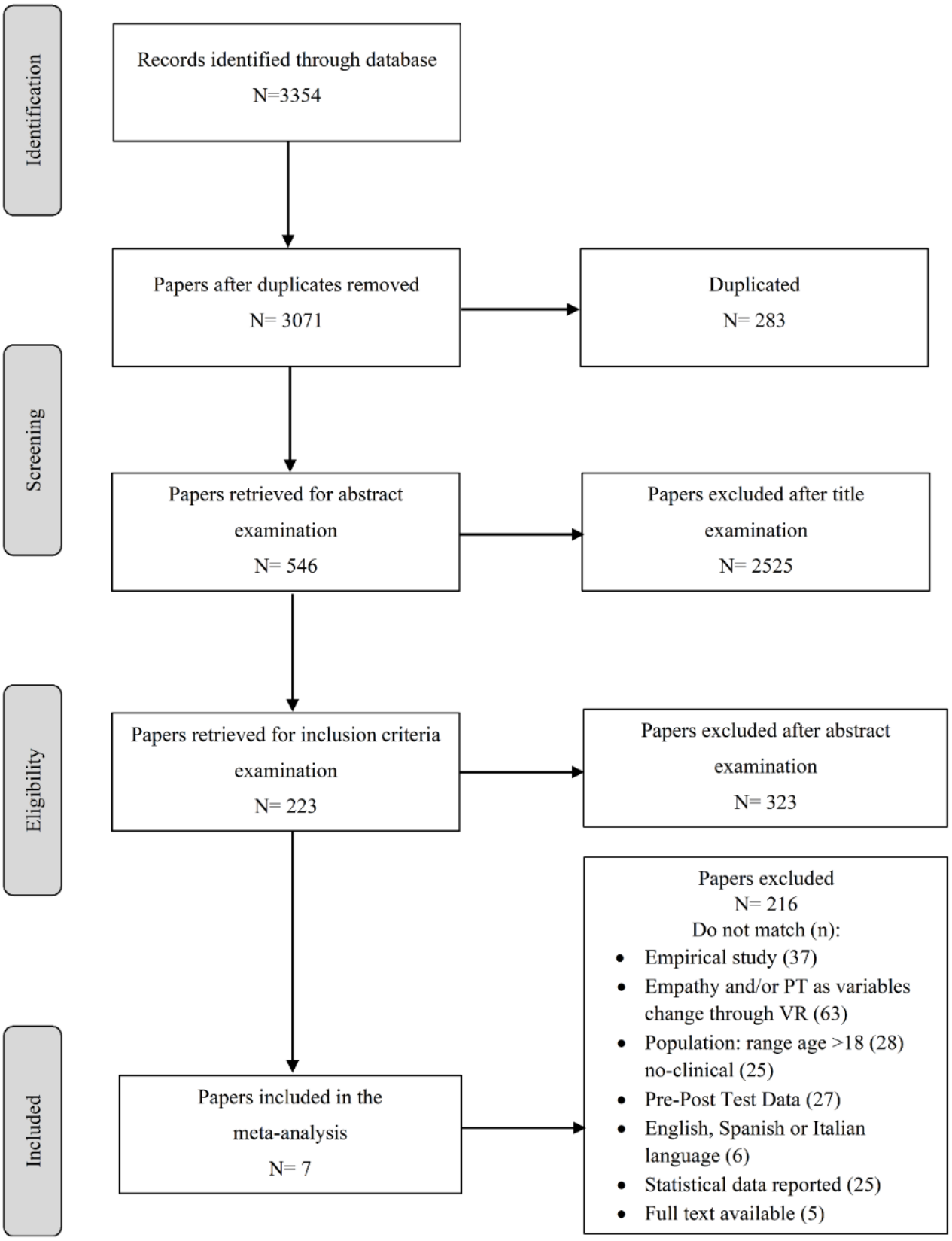
The coding process was carried out in a standardized and systematic manner, and the data were doubly coded by two independent researchers (L.B-R. and L.G.). Disagreements during the coding process were resolved by consensus.

2.5. Computing Effect Sizes

The types of designs used in the studies conditioned the selection of the effect size index in our meta-analysis. Only one of the seven articles included a control group[28]. Consequently, our analysis unit was the group, rather than the study, and the effect size index was the standardized mean change score, defined as the difference between the posttest and pretest means divided by the pretest standard deviation: d=c(m) (MeanPost – MeanPre)/SPre, withc(m) being a correction factor for small sample sizes[29,30]. Positive values for d indicated a favorable change in the group from pretest to post-test, and vice versa. Effect sizes of 0.20, 0.50, and 0.80 refer to small, moderate, and large effect sizes, respectively[31].

To check the reliability of effect size calculations, two independent researchers (L.B-R. and L.G.) carried out the calculations for all of the studies, reaching an average intraclass correlation coefficient of 0.967 (range: from 0.869 to 1), which was also highly satisfactory.32

Figure 1. PRISMA flow diagram: selection process of studies included in the metaanalysis. PRISMA, Preferred Reporting Items for Systematic Reviews and MetaAnalyses.



2.6. Statistical Analysis

Separate meta-analyses were carried out with the effect sizes for two different outcomes: empathy and perspective taking. However, the individual studies did not necessarily include all the measures. For example, there were studies that only reported measures of empathy, but not of perspective taking, and so these studies contributed only to the corresponding meta-analyses. Therefore, each meta-analysis included a different number of studies, ranging from four to nine. In all cases, random-effects models were assumed in the statistical calculations. Random-effects models yield results that are identical to those of the fixed-effects model in the absence of heterogeneity and they allow conclusions to be generalized to a wider array of situations[33,34]. In each meta-analysis, a pooled standardized mean difference and its corresponding 95 percent confidence interval (CI) were calculated, and the statistical significance of the pooled standardized mean difference was assessed using the Z test. In addition, a forest plot was constructed to represent the individual and pooled effect size estimates, with their 95 percent CIs, and to allow visual inspection of study heterogeneity. Additionally, to assess the heterogeneity of effect sizes, both Cochran's Q statistic and the I^2 index were calculated[35]. A Q statistic with $p<0.05$ was indicative of heterogeneity among the effect sizes. The degree of this heterogeneity was estimated using the I^2 index. I^2 values of around 25 percent, 50 percent, and 75 percent denoted low, moderate, and large heterogeneity, respectively[36]. Finally, to assess publication bias, a funnel plot with Duval and Tweedie's trim and fill method for imputing missing data and the Egger test were used[37,38]. Funnel plots with Duval and Tweedie's trim and fill method use available data to impute missing (unreported) studies and recalculate the overall effect that would be observed with their inclusion[37]. The Egger test is an unweighted simple regression that takes the precision of each study as the independent variable (with precision being defined as the inverse of the standard error of each effect size) and the effect size divided by its standard error as the dependent variable. A nonstatistically significant result of the t test for the hypothesis of an intercept equal to zero means that publication bias can be ruled out as a threat to the validity of the pooled effect[38].

Statistical analyses were performed with the Comprehensive Meta-Analysis software program, version 3.3.39 All statistical tests were interpreted assuming a significance level of five percent ($p<0.05$), using two-tailed tests.

3. Results

3.1. Study characteristics

Characteristics of the included studies are presented in Table 1. There were seven studies identified in the current review. They included a total of 335 participants, with a mean age of 31.7. Sample size of the included studies varied considerably, ranging from 16 participants[40] to 65 participants[28]. The results of the critical appraisal of the selected studies are presentedin Table2. The average score obtained with the quality scale (range: 0–9) was 5 (minimum: 4 and maximum: 7). Only one study[28] used a control group, and in two studies, the participants were randomized[28,41]. In addition, three studies[42–44] did not report the reliability of the measurement instruments used. However, all studies met the following criteria: point estimate and variability, appropriate statistical analysis, and an acceptable dropout rate. Finally, none of the studies estimated the statistical power *a priori* or blinded the assessor.

Table 1. Study characteristics

Study/location	N	Age (mean)	% Males	Technology	Sense of Illusion	Empathy Questionnaire
Adefila et al. 2016,UK[42]	55	NR	NR	Immersive VR	Presence	IRI
Bouchard et al. 2013. KVHF,Canada[43]	22	37	38	Immersive VR	Presence	Proper Questionnaire
Bouchard et al. 2013. UVF,Canada[43]	20	37	38	Immersive VR	Presence	Proper Questionnaire
Formosa et al. 2018,Australia[41]	50	34.60	44	Immersive VR	Presence	Proper Questionnaire
Hamilton-Giachritsis et al. 2018,Spain[44]	20	39.30	0	Immersive VR	Embodiment	AAPI-2
Raij at al. 2009,USA[40]	16	NR	62.5	Immersive VR	Presence	Ad. JES
Van Loon et al. 2018. Direct Empathy,USA[28]	52	20.28	36.5	Immersive VR	Embodiment	IRI (PT and EC sub-scales)
Van Loon et al. 2018. Indirect Empathy,USA[28]	65	20.28	40	Immersive VR	Embodiment	IRI (PT and EC sub-scales)
Wijma et al. 2017,Netherlands[45]	35	55.10	23	Immersive VR	Presence	IRI (PT subscales)

Note. NR = Not reported; IRI = Interpersonal Reactivity Index, (PT = Perspective Taking, EC = Empathy Concern) (Davis, 1980); AAPI-2 = Adult Adolescent Parenting Inventory (Bavolek, 2001); Ad. JES = Adaptation of. Jefferson Empathy Scale (Hojat et al. 2002).

Table 2. Methodology quality of studies included.

	Internal validity	*Random allocation*	*Sample size post-test*	*Blind assessors*	*Reliability of instruments*	*Drop-out rate is acceptable*	*Point estimates and variability*	*Statistical analysis appropriate*	*Statistical power*	*Total (0-9)*
Adefila et al. 2016[42]	0	0	1	0	0	1	1	1	0	4
Bouchard et al. 2013[43]	0	1	1	0	0	1	1	1	0	5
Formosa et al. 2018[41]	0	0	1	0	1	1	1	1	0	5
Hamilton-Giachritsis et al. 2018[44]	0	0	1	0	0	1	1	1	0	4
Raij at al. 2009[40]	0	0	1	0	1	1	1	1	0	5
Van Loon et al. 2018[28]	1	1	1	0	1	1	1	1	0	7
Wijma et al. 2017[45]	0	0	1	0	1	1	1	1	0	5

3.2. General Studies Review

This section presents a brief description of the articles included in the meta-analysis, specifically the experience with VR, and the empathy measures adopted.

Adefila et al.[42] tested myShoes, a VR environment to experience living with dementia. The goal of the study was to improve awareness of dementia symptoms and empathy. Participants are asked to perform common daily tasks. The tasks incorporate misdirection as an approach to instill a sense of confusion. Fifty-five health care students tested the VR environment, and results showed significant differences in empathy (p<0.001). Through the D'mentia Lens is another program[45] designed also to improve empathy toward the dementia disorder. It is a 360° movie where participants could experience, in first perspective, living with dementia. The 360° scenario reflected a normal day of someone in the early stage of Alzheimer's with the usual activity's limitations. The movie was accompanied by an inner voice that reflected the thoughts of the person. Thirty-five informal caregivers took part in the study and significant changes in empathy were found (p<0.002). In a related study, Formosa et al.[41] tested a VR environment to improve empathy toward people with schizophrenic spectrum disorder. The VR environment was developed following the work ''Living with Voices: 50 Stories of Recovery''[46]. The stories showed how patients with schizophrenia perform some daily life activities. First, participants read a vignette describing the background of a person with a psychotic disorder. Then, participants were immersed into the VR simulation, where the person represented in the vignette is looking inside his/her house. Participants have to interact with the environmental objects and explore the virtual world. Fifty participants from the general public and undergraduate psychology students were included. Results showed significant improvement in attitudes and empathetic understanding (p<0.001) after the VR exposure. Empathy was measured through an *ad hoc* questionnaire. Raij et al.[40] developed the virtual social perspective-taking intervention where participants have to interview a virtual patient diagnosed with breast cancer, who expressed fear and pain. Sixteen medical students took part in the study. The scenario includes patient challenges that should prompt the students to express empathy. Empathy was measured through the adapted version of the Physician Empathy Scale[47]; results showed no significant change in empathy (p=0.227) or perspective taking after the interaction with the virtual patient (p=0.778). Bouchard et al.[43] studied the difference in empathy toward known (KVHF) and unknown (UVHF) persons represented by virtual humans who express pain during the VR exposure. Forty-two participants (n=22 KVHF and n=20

UVHF) were recruited. Empathy was measured through an *ad hoc* questionnaire. Results showed that participants felt more empathy toward the KVHF virtual human than the UVHF person (p=0.010).

The studies described above are based on the sense of presence in VR[48], where the participants took the perspective of the protagonist in VR, but they did not embody someone else. Van Loon et al.[28] adopted the embodiment paradigm to induce participants to have the illusion of being someone else[49] and compare two conditions: taking the perspective of the partner in the VR simulation (direct empathy, n=52) and taking the perspective of a different person (indirect empathy, n=65). In this study, first, participants were given few moments to generate the body transfer by performing a series of movements to associate their movements with the avatar's movements. Second, participants started to navigate into virtual scenarios, completing three tasks: a morning routine, speaking in front of the class, and working out at the gym. Undergraduate students took part in the study and used a tracker VR system to induce a high sense of immersion and interaction. The Perspective Taking and Empathic Concern subscales of the Interpersonal Reactivity Index[50] were applied. Results showed a higher score on perspective taking both for direct empathy (p<0.001) and indirect empathy conditions (p<0.001). In this line, Hamilton-Giachritsis et al.[44] adopted an embodied VR system to allow 20 mothers to embody a 4-year-old child. The goal was to help parents understand what it feels to be a child. Participants wore the OptiTrack suit to associate their movements with the avatar's movements. Then, in the VR environment, a virtual mother entered into the virtual scenario and started to talk with the child (the participant). The Adult–Adolescent Parenting Inventory-2 (AAPI-2)[51] was adopted to test empathy, and results showed a significant difference in empathy (p<0.001).

3.3. Mean effect size and heterogeneity analysis

A separate meta-analysis was carried out for each outcome measure. Table 3 shows the main results for the two metaanalyses and Figures 2 and 3 present a forest plot for each of them. Overall, the two average effect sizes were positive, in favor of the treatment (Table 3), but only for perspective— taking the mean effect size was statistically significant. Furthermore, the mean effect size for perspective-taking had a moderate magnitude and for empathy had a small magnitude, according to Cohen's criterion[31].

Table 3. Mean effect size and heterogeneity analysis for the two outcome measures.

	k	d_+	95% CI		*Q*	df	*p*	I^2
Outcome			d_l	d_u				
Empathy	9	0.207	-0.370	0.785	288.170	8	<0.001	97.22
Perspective Taking	4	0.513	0.146	0.880	22.930	3	<0.001	86.92

Note. k: number of studies. d_+: mean effect size. d_l and d_u: lower and upper confidence limits of the 95% confidence interval around the mean effect size. *Q*: heterogeneity statistic. df: degrees of freedom. I^2: heterogeneity index.

Figure 2 presents a forest plot for empathy, with a mean effect size of d_+=0.21 (95 percent CI: -0.37–0.79), not statistical significance (p=0.482), and effect sizes that exhibited great variability (I_2=97.2 percent).

Figure 2. Forest plot of the effect sizes for empathy.

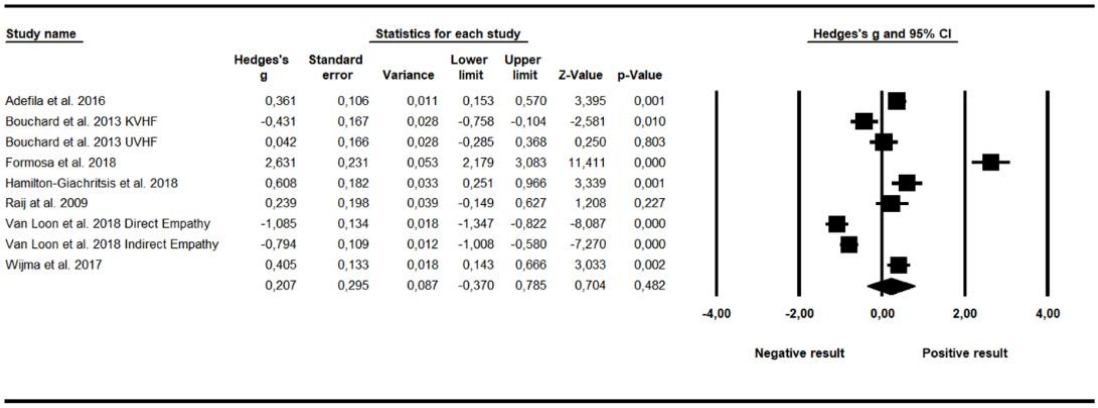
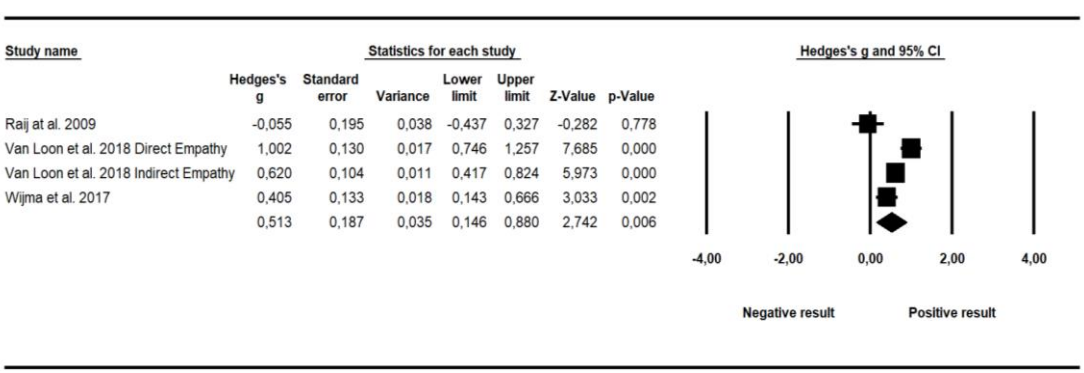


Figure 3 presents a forest plot for perspective taking, with a mean effect size of d_+=0.51 (95 percent CI: 0.15–0.88), statistical significance (p=0.006), and effect sizes that exhibited moderate variability (I_2=86.9 percent).

Figure 3. Forest plot of the effect sizes for perspective taking.



3.4. Analysis of Publication Bias

Because all the included studies were published articles, analyses were carried out to determine whether publication bias might be a threat to the validity of results of the metaanalysis. The Duval and Tweedie[37] trim and fill method did not impute any effect size (Figs. 4, 5).

Additionally, the Egger test applied to the intercept of a simple regression model of effect sizes did not reach statistical significance [intercept=12.143, $t(7)=1.611$, $p=0.151$, for the empathy outcome and intercept=-6.923, $t(2)=1.069$, $p=0.397$, for the perspective-taking outcome]. Therefore, publication bias can be reasonably ruled out as a serious threat to our meta-analytic findings.

Figure 4. Funnel plot of effect sizes for measures of empathy to assess publication bias. *White circles* represent each of the included studies.

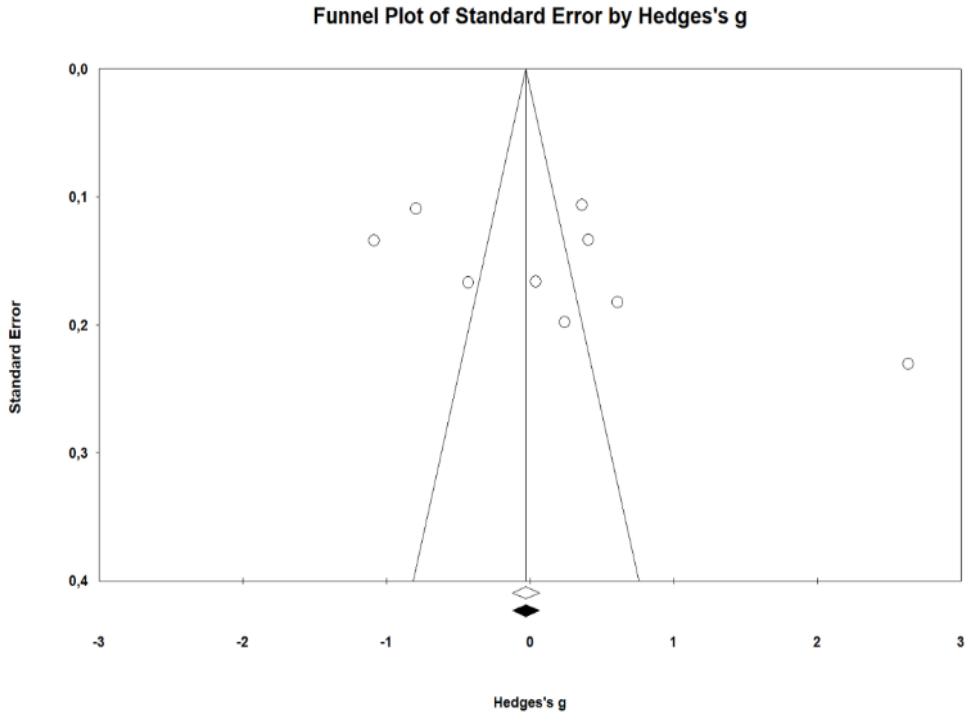
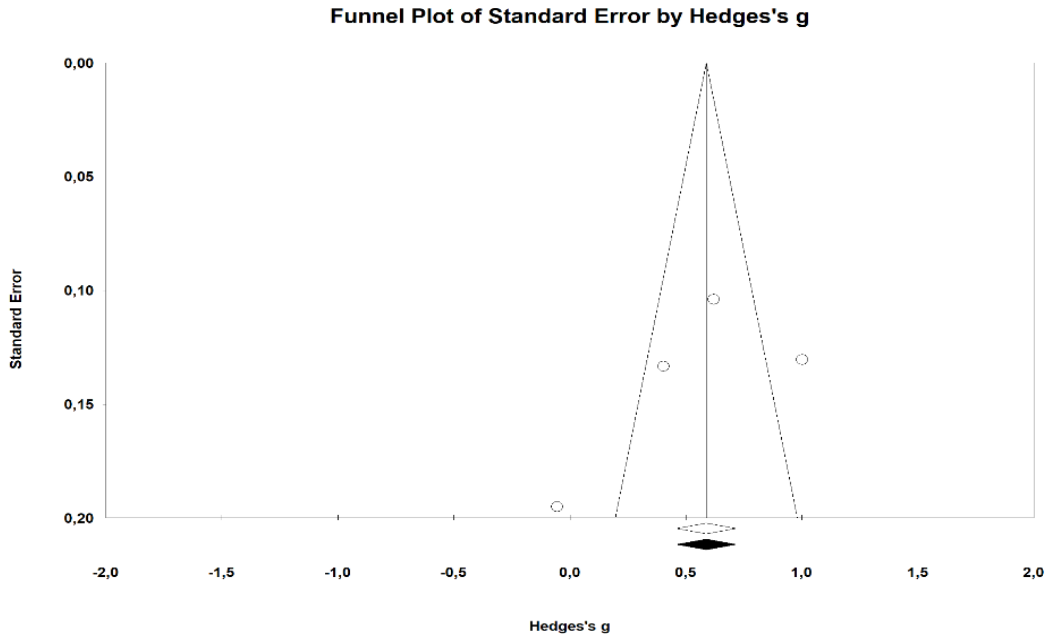


Figure 5. Funnel plot of effect sizes for measures of perspective taking to assess publication bias. *White circles* represent each of the included studies.



4. Discussion

The purpose of the current meta-analysis was to determine whether VR could be an efficacious medium to elicit empathy. To our knowledge, it is the first study to use an analytic strategy to examine this question. Separate metaanalyses were carried out for effect sizes obtained from measures of empathy. An analysis of publication bias enabled us to rule it out as a threat to the validity of our results. The average score on the critical appraisal was 5 for all the studies included, which represents moderate quality, adding to the credibility of the conclusions. Our findings suggest that there were positive changes due to empathy interventions. Regarding empathy outcomes, the mean effect size was small and not statistically significant (d_+=0.21). Regarding perspective taking, the mean effect size was moderate and statistically significant (d_+=0.51).

According to the articles included, VR was adopted to study empathy for two reasons. First, because VR allows creating environments that reflect the real one, participants inside the VR condition have the illusion of being in a real environment[48]. Second, thanks to VR, it is possible to create the laboratory control studies and, in some cases, overcome ethical limitations[52].

Furthermore, from the current meta-analysis, two important concepts emerged from the VR field to elicit empathy: the sense of presence and embodiment. Previous researchers

demonstrated that the sense of presence facilitates feelings of connection with others and accurately understanding others' perspectives[53]. This might occur because empathy and the sense of presence have common features[54,55] that include thoughts and feelings related to an imagined experience and the projection of the self into the experience of another person. Recently, the concept of the sense of presence has been broadened to include the sense of being present inside someone else's body (embodiment). VR has the ability to modify the perception of the body's boundaries, giving the illusion of being another person[48]. One of the studies included in the meta-analysis found that the sense of embodiment could induce participants to virtually take the perspective of someone else, changing the emotional state[28], thanks to the illusion that VR generates[56].

The findings have practical implications for clinical psychology and other fields in which interpersonal relationships play a fundamental role. For instance, VR can be a powerful tool for training future health and social care practitioners, as well as other formal and informal caregivers, due to the fact that VR makes it possible to learn and train in a safe, practical, and cost-effective way[41,42,45].

5. Limitations and future direction

The meta-analysis has several limitations. The main goal of the meta-analysis was to demonstrate the capability of VR to generate empathy, therefore even though there are more studies using VR for empathy, several studies were excluded given that they do not present empathy measures before and after the use of VR; this led to the inclusion of a low number of studies (also triggered by the fact that the field is in its early stages), which limited our ability to examine moderating variables. In addition, the absence of control groups in the primary studies forces the meta-analysis to use an effect size index with low internal validity, conditioning the scope of the results.

Future studies should use different measures of empathy, taking into account, for example, implicit measures. Another point to consider is investigating whether the results of the study last over time because no followup measurements were carried out in any of the studies. Moreover, five studies focused on the sense of presence, and two studies addressed the sense of embodiment (see Table 2 for details); however, no studies have investigated which one is better to elicit empathy. Furthermore, the studies adopted different immersive technologies such as the OptiTrack system[44] or the 360° video-based VR system[45] to induce the body swap illusion or for changing perspectives; future studies should investigate if the change in empathy variable is moderated by the technology used.

Despite these limitations, results of this study provide encouraging evidence supporting the use of VR to promote empathy toward outgroup members. Our study is the first meta-analysis on the effect of VR exposure on empathy, allowing a more accurate view of this phenomenon, although with the limitations described above.

6. Conclusions

Empathy is a key construct in social relationships and has been shown to be associated with prosocial behavior in previous research. VR is a medium that uses technology to get an individual to take the perspective of someone else. Eliciting empathy through VR is a research field that is grown exponentially, and the results of the analysis provide evidence that VR tasks may be more effective at improving attitudes toward specific social targets and motivating prosocial behavior compared with traditional interventions adopted so far.

7. References

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Chapter 3

The benchmark framework and exploratory study to investigate the feasibility of 360° video-based virtual reality to induce a full body illusion

Abstract

The feeling of ownership of a virtual body has been a topic of interest in recent years. In order to observe the mechanisms involved in the perception of this body illusion and its manipulation, the use of Virtual Reality (VR) has been essential. Various technical VR set-ups have been adopted by different authors to induce the illusion. Recently, 360° technology camera emerged as an innovative instrument to generate an immersive experience, with positive results in terms of involvement with the scenario. The current study aims to test the feasibility of 360° recorded videos to induce a full body illusion. To do this, we evaluated two different groups receiving different levels of immersion: a 3D immersive video and a 2D non-immersive video. Self-reported sense of embodiment and Heart Rate Variability (HRV) measures were analyzed. The results of the embodiment questionnaire showed that the 360° video can trigger a full body illusion, with significant differences between the 3D and 2D conditions. No difference was found on the RMSSD index of the HRV measure. Based on these results, future studies are needed to investigate 360° technology as a medium to generate the sense of embodiment.

1. Introduction

According to Longo (2008), embodiment refers to the personal awareness that a body is our own without the sense of feeling it, and it is mostly related to the sense of self and identity. The sense of embodiment refers to the ensemble of sensations of being inside and having and controlling one's body (Blanke et al., 2004; Lopez et al., 2008; Kilteni et al., 2012).

Several studies have investigated how to manipulate the sense of embodiment. The Rubber Hand Illusion (RHI) was the first method to manipulate this sense. During the RHI, a person watches a fake (rubber) hand while receiving synchronous tactile stimulations with his or her own real hand. After a few minutes of the precise synchronous touch between the real and fake hands, the participant might develop the vivid impression that the fake hand is his or her own (Botvinick and Cohen, 1998; Cebolla et al, 2016; Palomo et al., 2018). On the basis of this experiment and its results, researchers have hypothesized and confirmed the possibility of inducing the illusion in the entire body through the experimental manipulation of the visual perspective and sensory signals (Petkova and Ehrsson, 2008), which is referred to as Full Body Illusion (FBI). Both RHI and FBI reveal that the sense of embodiment occurs if three factors are achieved: 1) *the sense of self-location,* which refers to a certain volume of space where people feel located with their body; 2) *the sense of agency,* which refers to the sense of having conscious motor control, as in action, intention, and motor selection; and 3) *the sense of body ownership,* which refers to one's self-attribution of the body (Longo et al., 2008).

In recent years, several studies have adopted Virtual Reality (VR) to study and manipulate the sense of body ownership (Haans and Ijsselsteijn, 2012). VR can not only create an environment that simulates the real one, but it can also modify the body's boundaries. More specifically, some technologies combined with VR made possible to study the RHI and FBI (Figure 1), and some studies have demonstrated that these illusions could be induced through VR (IJsselsteijn et al., 2006), giving participants the "impression" of having another body (Kilteni et al., 2012, Pavone et al., 2016; Riva et al., 2019). To induce this illusory ownership of artificial bodies, different set-ups have been developed. One of the first technical set-ups used was an ensemble of cameras connected to a Head Mounted Display (HMD) (Ehrsson, 2007). Specifically, two cameras were positioned on a mannequin, so that each recorded event from the position corresponded to one of the mannequin's eyes. The HMD was connected to the cameras and worn by the participants. It was con-

nected in such a way that the images from the left and right video cameras were presented on the left and right eye displays, respectively, providing a true stereoscopic image (Ehrsson, 2007) (Figure 1A). The second set-up to induce the body swap was utilized by Slater (2010). It consists of an Optitrack full body motion capture suit with a specific software to track user movements. At the same time, the user wears the HMD in order to become immersed in the environment (Banakou et al., 2016) (Figure 1B). Bailenson (2016) has adopted optical sensors and inverse kinematics to track body movements and display them on an HMD to create these illusions (Figure 1C). Moreover, the Bertrand group (Bertrand et al., 2018) designed a novel body swap set-up structured by a camera fixed to torso equipment and worn by the researcher during the experiment and connected to the HMD by software (Cebolla et al., 2019) (Figure 1D). These set-ups can induce a high sense of body illusion, but they have a consistent cost-efficacy gap due to the economic investment and human resources needed for the software development and study design process.

All these technical set-ups were adopted for several studies that involved the body swap paradigm, addressing topics such as helping behaviour (Ahn et al., 2013), reducing implicit biases (Maister et al., 2013; Peck et al., 2013), reversing racial in-group bias (Hasler et al., 2017), enhancing financial planning (Sims et al., 2015), decreasing prejudice (Oh et al., 2016), and inducing compassion (Hamilton-Giachritsis et al., 2018), self-compassion (Cebolla et al., 2019), or empathy (Seinfeld et al., 2018).

In the present work, we use an alternative VR system to induce the sense of body illusion: the 360° camera. Instead of a classical graphic-based VR scenario (Slater and Sanchez-Vives, 2016), we adopt the 360° camera to record body movements before playing them on the HMD.

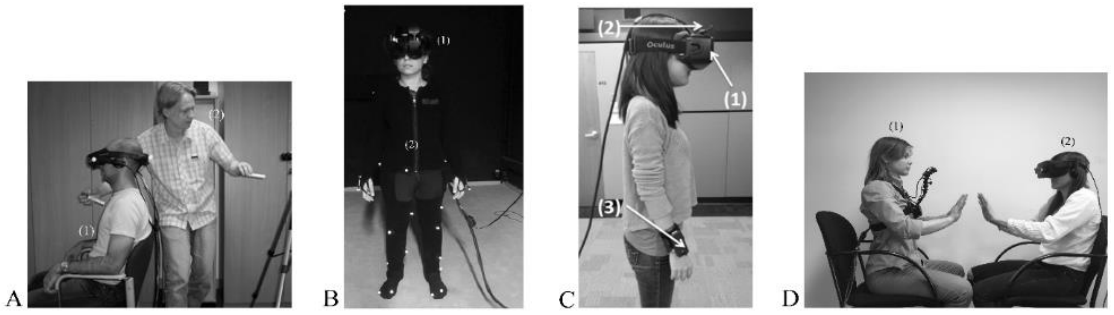
The 360° camera is an immersive technology that can record the surrounding environment (Huang et al., 2017; Repetto et al., 2018). The recorded 360° scenario allows users to look up and down, left and right, and from a first-person perspective, as in real life, thanks to VR support (HMD) from various commercial VR headsets for smartphones (e.g. cardboard) or the Oculus Rift - HTC Vive with its own commercial software. The immersive set-up has been shown to have positive outcomes in term of involvement with the scenario and generating an emotional response (Schutte and Stilinović, 2017).

The aim of this study is to analyze the feasibility of a 360° camera to generate the sense of embodiment. In particular, the objective is to investigate whether a pre-recorded video of some body movements could induce the illusion in the participants that they are simply following specific movements. The study compares two types of videos: a 3D rec-

orded video display on the HMD (immersive condition) and a 2D recorded video display on a Computer Desktop (non-immersive condition), to analyze the influence of immersion on inducing the illusion. Two measures are analyzed: the subjective embodiment experience (body-ownership, body location, and body agency) and two items that measure the haptic sensation (Slater, 2010), and Heart Rate Variability (HRV). In particular, HRV has been shown to be a response variable that significantly correlates with states of stress and anxiety induced by sudden unpleasant stimuli (Cacioppo et al., 2007), and it has been successfully used in previous studies as a psychological correlate of the full body ownership illusion (Slater et al., 2010; Guterstam et al., 2015).

We hypothesize that an immersive 360° video will modulate the intensity of the body illusion compared to a non-immersive one. Specifically, we expect that by simply following and becoming synchronized with the recorded movements in the immersive set-up, participants will experience a higher sense of embodiment compared to the non-immersive set-up.

Figure 1. Body swap apparatus.



body motion capture suit connected to HMD (Slater, 2016); **C:** (1) HMD, (2) head tracking system and (3) arm tracking system (Bailenson, 2016); **D:** "the machine to be another" (1) camera tracking movements connected to (2) HMD (Bertrand, 2014).

2. Materials and methods

2.1. Participants

The study was approved by the Ethics Committee of the University of Valencia (Spain), with registration number: H1547116450036. We recruited a total of 42 participants, randomly assigned to one of two groups: 21 in the 3D condition (immersive) and 21 in the 2D condition (non-immersive). The inclusion criteria were: (a) being 18 years older, (b) being a Spanish speaker, and (c) not having a severe physical disorder that interferes with free

body movements. All the participants were volunteers and signed the informed consent document before starting the experiment, in accordance with the Declaration of Helsinki.

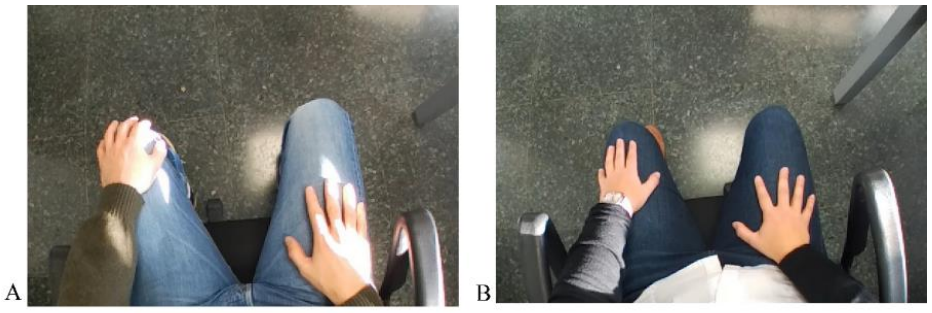
2.2. Implementation and Apparatus

The 2D and 3D scenes were recorded with the LG360-105 camera (LG Group, South Korea) and the LG360 viewer software. The 3D video was recorded through the 360° option (double eyes), and the 2D video was recorded through the 180° option (one eye) from the same LG camera. To record the videos, both female and male performers (both researchers in the Lab) sat on a chair and wore the camera on their heads, using a head strap. Figure 2 shows the camera perspective.

During the video recording, the performers made a set of movements: first they had to move their hands or legs up and down, caress their limbs, and rotate their hands. At the end of the video, a yellow ball was suddenly thrown to the performer's right hand. This "disturbing event" was chosen because we looked for an event that could explicitly break the "experimental harmony", in order to evaluate how the virtual scenario and real tactile perception could interact each other. The videos last almost 4 minutes, and their structure follows the typical experimental structure for HRV experiments: baseline, event, and post-event resting, reactivity, and recovery (Laborde et al., 2017). The baseline and post-events are the screenshot of the video, and they last 6 seconds each, according to the HRV literature for baseline measures (Malik et al., 1996; Laborde et al., 2017). Both videos, immersive and non-immersive, are composed of three parts: hand, leg, and arm movements to analyse the difference between conditions for each limb in detail.

The video was edited and synchronized with the HRV system Polar H10 (Polar Electro, Kempele, Finlandia) using the development platform Unity 3D (Unity Technologies ApS, San Francisco, CA, USA). The 3D video is played on the Oculus Rift connected to the Computer Alienware 15, and the 2D video is displayed on the Desktop of the Alienware (15.6 inch - UHD display).

Figure 2. Perspective point of view and body appearance used during the experiment for both conditions.



Note: **A**: male perspective **B**: female perspective.

2.3. Measures

Embodiment Questionnaire

It is an adaptation of the original questionnaire to assess the Rubber Hand Illusion experience developed by Longo et al. (2008). It is composed of 10 items rated on a Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). The original scale contains 3 subscales: 5 items assess body-ownership, 3 items assess location, 2 items assess agency. At the present, we added 2 items that assess the haptic sensation of the ball at the end of the videos, for a total of 4 subscales (Table 1). The scale was translated from English to Spanish by a bilingual professional to correct conceptual discrepancies. In this study, internal consistency was $\alpha = .95$.

Heart rate variability (HRV)

HRV represents the change in the time interval between successive heartbeats and provides an index of the parasympathetic nervous system (Berntson et al, 1997). The parasympathetic nervous system is associated with many aspects of psychophysiology, such as the self-regulation mechanism linked to cognitive, affective, social, and health phenomena (Laborde et al., 2017). The HRV was recorded by the Polar H10 technology, which claims to offer high quality HR and HRV measurements and has been widely used as a reference for wearable HR measurement systems (Plews et al., 2017; Gilgen-Ammann et al., 2019).

Table 1. The list of the items used for the questionnaire in the experiment and its scoring scale.

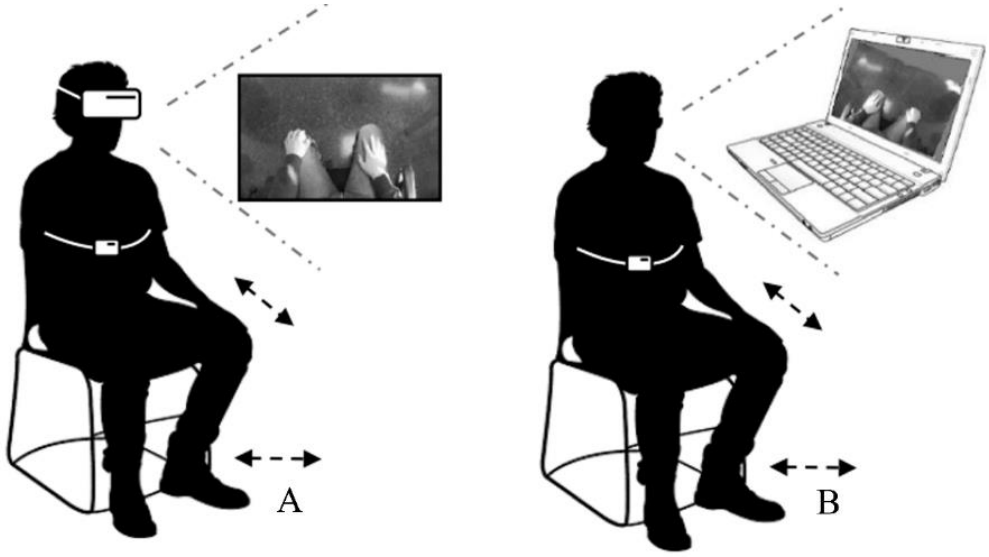
I felt as if I was looking at myself.	*Ownership*
I felt as if I was looking my own arms.	*Ownership*
I felt as if I was looking my own legs.	*Ownership*
I felt as if I was looking my own body.	*Ownership*
I had the feeling that I was wearing different clothes during the experiment.	*Ownership*
I experienced the arms of the performer as my own arms.	*Ownership*
I experienced the legs of the performer as my own legs.	*Ownership*
I experienced the body of the performer as my own body.	*Ownership*
I had the feeling that the virtual body belonged to me.	*Ownership*
I had the sensation that the ball hit my hand.	*Haptic sensation*
I had the sensation of the ball on my hand.	*Haptic sensation*
I had the illusion of sitting in the same place as the performer.	*Location*
I felt I had control over the arms of the performer.	*Agency*
I felt I had control over the legs of the performer.	*Agency*
I felt I had control over the body of the performer.	*Agency*
I felt I could move the arms of the performer if I wanted to.	*Agency*
I felt I could move the legs arm of performer if I wanted to.	*Agency*
I felt I could move the body of the performer if I wanted to.	*Agency*
Requested for each item:	
Fully disagree O 1 O 2 O 3 O 4 O 5 O 6 O 7 Fully agree	

2.4. Experimental Procedure

The experiment took place at the Faculty of Psychology at the University of Valencia. After giving their consent, participants were invited to wear, in a separate room for privacy, the Polar H10 on their chest, and they were instructed to sit comfortably on a chair with their legs resting on a footstool and their arms resting on their legs. Before starting the video, the researcher gave them the instruction to follow and synchronize with the body movements of the performer as much as possible during the entire experiment. Depending on the gender and the condition assigned, each participant was exposed to one of the videos. As Figure 3 shows, participants in the experimental condition (3D - immersive) were exposed to the scene through the HMD (Figure 3A), whereas participants in the control condition (2D - non-immersive) were exposed through the Computer Desktop (Figure 3B). In both conditions, participants never saw the performer's face, only his or her body. After

the experimental session, participants were invited to fill out the embodiment questionnaire and take off the Polar H10.

Figure 3. Study design.



Note: **A**: immersive condition. Participants look through the HMD the body movements and follow them while wearing the Polar H10. **B**: no-immersive condition. Participants look the desktop and follow the body movements of the video while wearing the Polar H10.

2.5. Data analysis

For the analysis of the questionnaire responses, we performed descriptive statistics and MANOVAs (ownership, location, agency, and haptic sensation), all with two-way interactions (2D and 3D).

For the HRV, we analysed the RMSSD index, which is the HRV time domain index, primarily connected to vagally-mediated change and relatively free of respiratory influence (Shaffer and Ginsberg, 2017). HRV analyses were performed through BioSignalsPlux propriety software OpenSignals with the respective HRV analysis pack, following established guidelines (Shaffer and Ginsberg, 2017). The HRV data were divided into two sections: limb movements and video recorded time. The limb movements were hands, legs, and arms, whereas the video recorded time was divided into the first 90 seconds and the last 90 seconds. We split the video time because, according to the literature (Malik et al., 1996), 1 minute is the minimum time to obtain a reliable assessment of RMSSD and evaluate its change. Considering the RMSSD index as the dependent variable with a group factor (experimental and control), we performed the following analysis: i) an independent t-

test to analyse the difference between conditions (2D and 3D) and the video recorded time (first 90 seconds and last 90 seconds); ii) an independent t-test to analyse the difference between conditions (2D and 3D) and the limb section (hands, legs, and arms); iii) a mixed 2 × 2 ANOVA to analyse the difference between conditions (2D and 3D) and the video recorded time (first 90 seconds as T1 and last 90 seconds as T2), in order to analyse the differences in the RMSSD index due to embodiment induction. All the statistical analyses were performed with SPSS for Windows v.24 (SPSS Inc., Chicago, USA).

3. Results

3.1. Sample characteristics

The sample was composed of 27 females (64.3%) and 15 males (35.7%), aged from 19 to 36 (M = 24.88, *SD* = 4.098). The level of education was undergraduate N = 8 (19%), bachelor's degree N = 15 (35.7%), and master's degree N = 19 (45.3%). None of participants declared having any body illness that impedes limb movements, such as back or neck pain.

3.2. Embodiment questionnaire

Results of the embodiment questionnaire revealed significant differences between conditions and the subscales: ownership, $t(40) = 3.161$, $p = .003$; 95% CI (.448, 2.038); agency $t(40) = -3.959$, $p < .001$; 95% CI (.640, 2.901); location, $t(40) = 2.588$, $p = .013$; 95% CI (.250, 2.035). Moreover, the factor haptic sensation was significant: $t(40) = .009$, $p = .027$; 95% CI (.114, 2.236) (Figure 4). Descriptive statistics are shown in Table 2.

Figure 4. The Bar Chart shows the average of the embodiment questionnaire responses by each factor: ownership, location, agency, and the haptic sensation is also included.

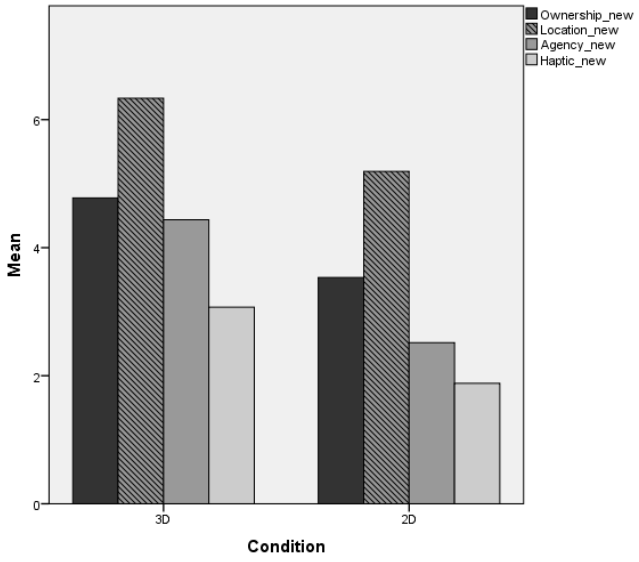


Table 2. Descriptive statistics of the embodiment questionnaire and its subscales: ownership, location, agency, and haptic sensation.

	3D (n =21) *M (SD)*	**2D (n =21) *M (SD)***
Ownership	4.78 (1.07)	3.53 (1.45)
Location	6.33 (.97)	5.20 (1.78)
Agency	4.44 (1.67)	2.51 (1.46)
Haptic Sensation	3.07 (1.96)	1.88 (1.34)

Table 3. Sample characteristics and Heart Rate Variability (HRV) baseline values.

	3D (n =21) *M (SD)*	**2D (n =21) *M (SD)***
RMSSD	49.12 (32.70)	92.28 (141.26)
SDNN	49.39 (32.88)	92.78 (142.08)
LF	3289.73 (1062.31)	5460.50 (6388.11)
HF	1389.29 (1053.50)	4771.29 (11224.83)

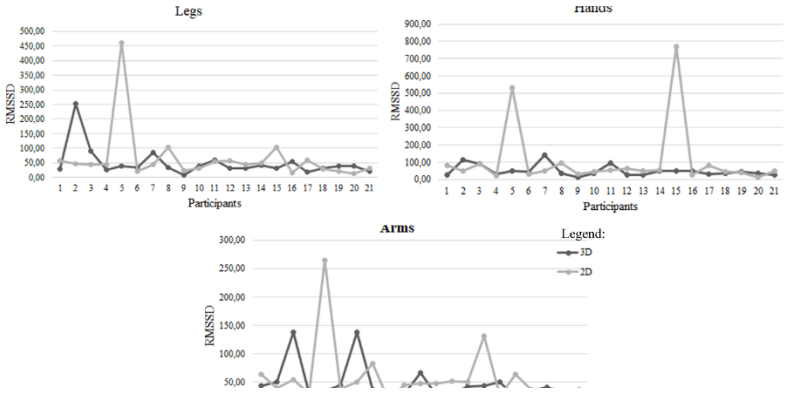
3.3. Heart Rate Variability

Descriptive stat

istics for all participants are shown in Table 3. Regarding the effects of the conditions on the video recorded time, there were no significant differences in HRV on the RMSSD index: first 90 seconds, $t(40) = -1.405$, $p = .168$, 95% CI (-130.12, 23.39) and last 90 seconds, $t(40) = -.849$, $p = .401$, 95% CI (-41.25, 16.84). Regarding the effects of the conditions on the limb movements, there were no significant differences in HRV on the RMSSD index: hands, $t(40) = -1.424$, $p = .162$, 95% CI (-141.32, 24.5); legs, $t(40) = -.647$, $p = .521$, 95% CI (-61.98, 31.91); and arms, $t(40) = -.922$, $p = .362$, 95% CI (-40.27, 15.05) (Figure 5). Moreover, no significant interaction effect was found between the conditions (3D and 2D) and the video recorded time (first 90 seconds and last 90 seconds): $F(1, 40) = 1.974$, $p = .168$, $\eta^2_p = .047$. This last result showed that the embodiment induction through the

2D or 3D set-up did not significantly change the RMSSD index of HRV from T1 (first 90 seconds) to T2 (last 90 seconds).

Figure 5. The figure shows the RMSSD index for the three body movements: hands, legs and arms for both conditions: 3D and 2D.



Note: RMSSD: square root of the mean of the sum of the squares of differences between adjacent NN intervals SDNN: Standard deviation of all NN intervals, LF: low frequency power.

4. Discussion

This study aimed to explore the feasibility of the 360° camera technology to induce the sense of body illusion. We expected that by synchronizing one's own body movements with a pre-recorded performer's movements in an immersive set-up, the body illusion would occur. To do so, we compared two groups: 3D immersive and 2D non-immersive set-ups, and we hypothesized differences between conditions in the self-reported sense of embodiment and physiological measures (HRV).

Regarding the results, significant differences emerged between conditions on the embodiment questionnaire. All the subscales, agency, location, ownership have higher scores in the immersive condition than in the non-immersive condition, even for the added factor haptic sensation. These differences were statistically significant, and the 360° immersive video induced a higher sense of presence in the users (Serino and Repetto, 2018). Results showed significant differences even for the haptic sensation; namely, participants in the immersive condition could feel the ball (event that occurs at the end of the video) hit their hands. This result is in line with a previous study (Slater et al., 2010) in which an avatar that slaps the female virtual body induces the participants to feel the slap, even on their faces.

Regarding the HRV results, no significant differences emerged between the conditions on the RMSSD index for limb movements or video time, perhaps because the dura-

tion of the video, almost 4 minutes, was not long enough to detect the change in HRV (Shaffer and Ginsberg, 2017). Future studies could increase the video time to see if any differences in the HRV index occur. Even if the change in HRV did not match the study hypothesis, according to the embodiment questionnaire response, the video time was long enough to induce the illusion in the participants. A longer video might stress the participants and break the illusion.

The study confirms that VR can be used to produce the body swap, as in previous studies. This occurs for two main reasons: first, the synchronized movements performed with the recorded video allows participants to identify with the video performer. Second, as in other VR systems, the recorded video allows participants to feel like they are in the place depicted by the system. When the virtual body is perceived to be in the same place where the real body should be, this provides very strong evidence the brain can use to generate the illusion that the virtual body is one's own (Slater et al., 2010). Our findings are analogous with what has been established for the RHI: first, the hand needs to pass a fitness test in terms of anatomical, volumetric, and postural constraints (Tsakiris, 2010). Once the fitness test has been passed, other features enhancing the realism of the object can be incorporated, e.g., the skin texture, to modulate the intensity of the illusion (IJsselsteijn et al., 2006).

The fundamental advance made in this study is the demonstration that a 360° camera could be an efficacious tool to induce the body illusion. What does the current system add to the previous one? The 360° camera is a small, low-cost, and user-friendly system for research purposes. Compared to other tools, the camera is accessible to a wide range of users, and specific technical skills are not required to operate it. Moreover, the video content could be reproduced by a smartphone through an appropriate App (both for iOS and Android), such as VRPlayer or VR360 (from App Store), or the video could be uploaded to YouTube and played. Then, the VR headset allows the immersive experience, and so it is effortless to move the VR content outside the laboratory setting.

The current study presents two main limitations. The first is the sample because 42 participants is the minimum number to reach the power effect (Faul et al., 2007). Moreover, the sample was homogeneous in term of demographic characteristics, especially age. Future studies, in addition to a larger sample, should include a wide range of ages and investigate whether the illusion can occur even in the elderly. Second, both conditions are synchronous. In the 2D and 3D set-ups, the participants are asked to follow the pre-recorded

movements, but we do not know if they would have followed the movements even without the instructions, but only on their own initiative.

Regarding the limitations, it is interesting to highlight that previous works have achieved important results in inducing the sense of embodiment through VR (Kilteni et al., 2012; Ahn et al, 2013; Slater et al., 2010). However, developing a VR system is expensive in terms of the economic investment and human resources employed. The 360° camera could be an alternative instrument to induce the sense of body illusion, although more studies are needed.

Based on our findings, future studies on 360° video-based VR could include a short video of embodiment induction before starting the entire environment. This procedure could be interesting for studies that have the goal of changing people's perspective and finding out whether the embodiment illusion can last during the entire VR exposure.

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Chapter 4

Developing a 360° video-based Virtual Reality: an explorative and a user experience studies to generate a sexual harassment scenario

Abstract

The 360° camera is a practical and low-cost system that generate 360° content-based Virtual Reality (VR), both pictures, and videos of all around the environment. Moreover, through the VR Headset and the proper VR Mobile Applications, it is possible to watch the 360° content in an immersive way, inducing high sense of presence. Recently, the 360° video-based VR has been amply adopted in research to create immersive environments, but the study of the procedure of how the contents are designed and developed is lack. The aim of the current work is to explain a useful method to generate a 360° video-based VR for Sexual Harassment (SH) scenario. First, two focus group with women were led to collect information about the SH events that usually happen in the city. Second, from the content analysis of the focus group, the 360° video was developed. Third, the user experience test was carried out with 10 participants to evaluate if the video could generate sickness, and to collect qualitative feedbacks for possible changes of the video content. The current study is a part of a pilot study that investigates the feasibility of 360° video to study empathy (and related variables) in men in SH scenario.

1. Introduction

Human Computer Interaction (HCI) is a cross-disciplinary area (e.g., engineering, psychology, ergonomics, etc.) that deals with the design, implementation, and evaluation of the ways that humans engage with the computing device for a given task (Kim, 2012). The objective of the HCI is to design interactions between users and hardware with an high usability, so the final interfaces of the technologies should be easy to use, efficient for the task, ensure safety, and lead to a correct completion of the task. Usable and efficient interaction with computing devices bring to higher productivity (Card, 2018). For this reason, the quality of the usability should be one of the main initial orienting design decisions while developing new technologies to guarantee positive, engaging, and self-actualizing experiences to the users.

One important approach of the HCI is the User Centered Design (UCD). The UCD is based on the active involvement of the potential user of the technology designed, with the aim to improve the usability of the product or the service itself (Norman, 1986; Mao et al., 2005). The UCD has the objective to create a product that not only reflects the abilities and the ideas of the designers, but also to involve the final users in the development process, following a bottom-up approach where the final user is the co-designer of the product (Abras et al., 2004). This is an important step for the development of the product because various factors are involved such as users' gender and age of the users, the target sector of the product (e.g. education, entertainment, e-commerce etc.), and the culture among others (Vredenburg et al., 2002).

The forward step of the UCD is the User Experience (UX), defined as a person's perception and responses that result from the use and/or anticipated use of a product, system, or service (Hassenzahl and Tractinsky, 2006). Specifically, the UX includes individual preferences, and psychological and behaviors responses that happen before, during, and after the interaction with the product, and/or the system (Kolski et al., 2011). However, the UX is often conducted without considering the opinions of the final users (Triberti et al., 2016).

Considering the case of Virtual Reality (VR), the environments are often poorly evaluated with users, and the VR content is often created without the voice of the target to who the content is addressed (Triberti et al., 2018). In particular, the 360° video-based VR, the emerge immersive technology, requires a deep attention to the UX due to the 360° video weakness to generate sickness (Narciso et al., 2019).

Cybersickness is the manifestation of symptoms such as headaches, disorientation, stomach awareness, and nausea that can occur during or after the exposure to a VR environment (Mousavi et al., 2013). Previous studies on cybersickness while using 360° videos (Jung et al., 2017; Lee et al., 2019) showed its influence over the usage of the VR content, causing sense of physical discomfort to participants, specially a sense of dizziness. For this reason, studying the cybersickness is relevant to the field of usability as it allows to identify which factors influence it, and posteriorly to eliminate or to reduce them, assuring that people can enjoy the VR content.

The current study is based on a develop of a 360° video-based VR in a sexual harassment (SH) scenario. This work is a part of a pilot study that investigates the feasibility of the 360° video to study empathy (and related variables) in men in SH scenario. We first developed the 360° scenario, then we analysed its usability to test if the content could generate sickness to participants (Jung et al., 2017; Lee et al., 2019).

The study was approved by the Ethics Committee of the Universidad Nacional Autónoma de Mexico (UNAM) with the code EP/PMDPSIC/0151/19.

2. Study 1: focus groups

The aim of the first study is to collect ideas and information from women to record the 360° immersive video that reproduces different harassment scenarios. In order to address the research goal two focus groups were conducted. The focus group is a discussion among participants useful to generate ideas, opinions, and a constructive debate about the discussion topic. The moderator, that usually is the researcher of the study, moderates the debate to avoid misunderstanding and to keep the conversation in line with the research goal (Nili et al., 2017). This method was adopted because, to develop the 360° video content, we needed to know and to understand from women what usually happens in the city, and specifically what are the common harass behaviors that occur to women.

2.1. Method

2.1.1. Participants

All participants were Mexican women who voluntary participated at the discussion. The first focus group was composed by 10 women (age: M = 26 years old; SD = 6.60) and the second one by 6 women (age: M = 30 years old; SD = 8.15). The inclusion criteria were being an older woman ≥ 18 and do not have been victim of sexual abuse. Participants were

recruited at the university among students and professionals. Written consent was obtained from all participants in accordance with the Declaration of Helsinki.

2.1.2. Procedure

Both focus groups were held at the Faculty of Psychology of UNAM University, Mexico City. The groups were led by the first author of the article and a researcher acted as an observer to document relevant contributions. Both focus groups were carried out in a room where participants were sitting in a circle and facing each other. The discussions were recorded to have later the possibility to transcribe verbatim the contents, and to avoid the risk to miss out important information. Before starting the discussion, to participants were giving all the information about the nature of the study before to firm the consent to participate. Both groups were conducted following a structure previously developed by the main researcher, and it consisted in some open-ended questions about the typical SH behavior committed by men. Both groups were conducted in Spanish language and last approximately one hour and half. The script of the moderator is reported in Anexo 1 (original language).

2.1.3. Data analysis

The audio registrations were transcribed by the researcher and uploaded to Atlas.ti software for the analysis (Smith, 2002). The thematic analysis was adopted following the current process: familiarization with the data, generation of initial code, searching and naming the themes (Braun and Clarke, 2006). In order to ensure the rigor and reliability of the study, another member of the research team checked the analysis and refined the results.

2.2. Results

Most of the participants have been victims of harass behaviours such as harass in the street, in the metro, at university or with their spouse (none of them had legal consequences as it was an exclusion criteria). According to the objective of the present study, we identified two main themes: (1) “the women feeling” consequent to the harass, and the (2) “environments” where the harasses occurred. The transcripts of both focus group are reported in Anexo 2 (original language). Figure 1 showed the words cloud of the transcript.

Figure 1. The words cloud of both focus groups.

2.2.1. Theme 1: the women feelings

From the discussion emerged how women feel during the harassment. One of the most important result was that the sexual violence is perceived as a normalized behavior. Participants believed that is hard to remove the violent attitude from men because it belongs to their trait. The harass make women to feel uncomfortable, insecure, and under threat (participant: "they violate your privacy, your body"). Most of the participants said: "I'm scary to walk alone during the night…I'm disgusted and threatened about what happen in the city". The 40% of participants feel bother from men, they have constantly lack of comfort. Moreover, women argued that they are not free to wear whatever they want because they are scare of men reactions, and this always affect participants' emotions. By the consequence, women who participated at the discussions strongly believed that it is necessary to develop some interventions that work directly with men to shape their behavior.

2.2.2. Theme 2: the environments

Results showed that most of the harass behaviour occur both in public, and private spaces. The main results from the thematic analysis was the metro: "men look at me for no reason and make me feel unsafe and uncomfortable" (participant); "in the metro of the city we have wagons reserved to women, and kids to prevent sexual abuse" (participant). The second result was the street where men look and whistle at women, and say sexual comments. Moreover, the results of the verbatim showed that sometime a man follows a girl at home from the bus station, to induce her to feel uncomfortable. All these harass behaviours emerged happen independently during the day, and the night. Other result was the taxi where women are victim of harass from the taxi driver: "he looks at me from rear-view-

mirror with sexual comments, and sometime the driver invites me for a drink*"* (participant). Moreover, the university is another common place where the harass occurs especially in the library where, for example, a man takes photos to a girl without her permission. From the analysis figured out another important result that was the harass at home with the spouse: "I was with a man who constantly controlled my mobile" (participant).

2.3. Discussion

In the present study we explored the themes of SH from women perspective. The goal of the discussion groups was to collect information from women about what type of SH behavior the women are victim for, and how they feel during these negative experiences.

Results confirm previous works (Gruber & Fineran, 2016; Burn, 2019) that SH creates intimidating, hostile, and offensive environments that undermine the women sense of safety. From the results emerge several scenarios where the harasses occurs, the most common are the metro, follow by the street, and the taxi drive where man looks at women saying sexual comments. Furthermore, the partner is the protagonist of the harass that violates the privacy, and the respect of his spouse. This result is in line with previous study (Flury & Nyberg, 2010) that considers domestic violence the most common form of gender related violence, indeed between 10% and 35% of women experience domestic violence at some point in their lives. Moreover, from the focus groups emerged that in the university harassment occurs between students where young men violate the privacy of the women with sexual comments or gestures. This data is confirmed by a systematic review on SH of college and university students (Klein & Martin, 2019) which explain that women are significantly more likely to be sexually harassed than men. Due to the constant harass that women suffer every day, from the analysis emerged the participants' need to develop prevention programs for men to make them to understand how women feel during the harass. According to the results, previous literature has already investigated the importance of intervention programs for men to train prosocial behavior (Nickerson et al., 2004), also with the support of technology. Steinfeld (2020), for example, adopted the 360° technology to put the man in a perspective of women victim of SH at work, obtaining positive change on empathy.

From the analysis of the present study, it was possible to collect enough details to record and develop the 360° scenarios for SH, described in the next section.

3. Study 2: Users Experience

The goal of the second study was to analyze the experience of the user during the exposition of the 360° video, previously recorded. Specifically, the aim of this step was to test if the environment developed generates sickness to participants and collect feedbacks to improve the user experience.

3.1. Method

3.1.1. Participants

A total of 10 participants took part at this step: 3 women and 7 men, age *M* = 25.70 (*SD* = 5.56), participants were selected among students and professionals of the university. Written consent was obtained from all participants in accordance with the Declaration of Helsinki.

3.1.2. 360° Scenarios

The 360° video were recorded with the LG360-105 camera. To generate the first-person perspective of the video, the camera was hold by the female performer on her head with a proper support. We first recorded videos in different places where several harass scenarios occur; then all the videos were edited by the Premiere Adobe program (Adobe System, San Francisco, CA, USA) to generate a single immersive 360° video (Annex 8). Videos were recorded in different places where different harassment scenarios occur that reflect a typical day of a victim of SH. The videos were recorded with actors and no real harassment happened during the recording. The first scenario is aimed to generate embodiment of the female victim's body, where participants follow the woman's body movements in the video (e.g., move their hands up and down, caress their limbs, and rotate their hands). This embody exercise was included in the study to induce the body-swap illusion, and to allow men participants to perceive themselves as women during the entire experiment (Seinfeld et al., 2018). After the embodied induction, the video starts with the victim doing daily life activities (e.g., putting on her shoes, having breakfast, brushing her teeth, preparing her backpack for the university, etc.). This scene was recorded to improve the participants' engagement with the future victim. Then, several harassment scenarios took place with the victim: a man tries to take a photo of her without her permission in the university library; a taxi driver makes several sexual comments to the victim; a man says aggressive words to his spouse; a man checks his girlfriend's mobile without her permission;

and a man looks at the victim when she is on the subway and tries to hold her hand. The video ends with a night scene where the woman is followed by a man until she gets home. The entire 360° video-based VR lasts 20 minutes.

3.1.3. Measures

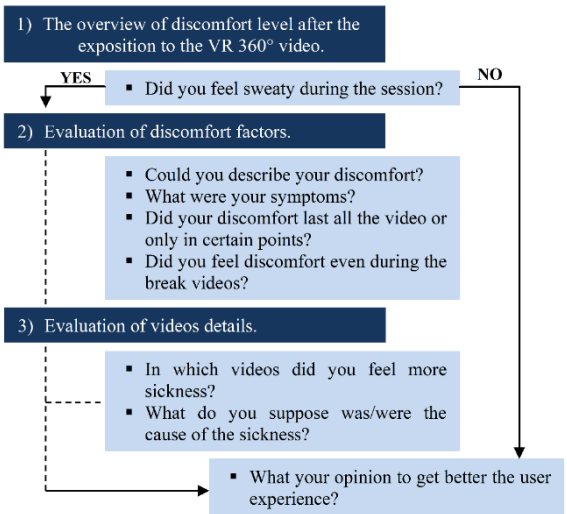
Simulator Sickness Questionnaire (Kennedy et al., 1993): This is a 16-item questionnaire that measures the level of discomfort perceived during the experiment. The scale includes two subscales: (1) nausea and (2) ocular-motor sickness, rated on a 4 points scale (from 1 = not at all to 4 = completely). It is an adaptation to Spanish from the original scale, reviewed by a bilingual English-Spanish researcher. Internal consistency for this study is α = .57 for nausea factor, and α = .76 for ocular-motor sickness factor.

Motion Sickness Questionnaire (Gianaros et al., 2001): This is a 16-item questionnaire that measures the level of discomfort perceived during exposition due to the 360° environments movements. The scale includes four subscales: (1) gastrointestinal, (2) central, (3) peripheral, (4) tolerance-related; rated on a 4 points scale (from 1 = not at all to 4 = completely). It is an adaptation to Spanish from the original scale, reviewed by a bilingual English-Spanish researcher. Internal consistency for this study ranges from α = .48 to α = .85

Open questions: qualitative measure composed by 8 open questions referred to the user experience during the exposition to immersive 360° video (Figure 3).

Figure 3. Framework of the open questions of the user experience test.

3.1.4. Procedure



The 360° video was played by the VRPlayer App with IPhone6 and supported by the VR GLASS FOV: 120° Headeset to generate the immersive experience. The experiment took place at Laboratorio de Enseñanza Virtual y Ciberpsicologia of UNAM University. Before starting the exposition, participants filled the firmed consent and the sociodemographic questionnaire. During the exposition, participants sat on a wheelchair to have the opportunity to look around the 360° video. After, participants filled the Simulator and Motion sickness questionnaires to evaluate if they suffered any kind of discomfort, moreover they also answered to some open questions to explain their experience with the environment, essential to generate feedback for any future changes of the 360° scenarios.

3.2. Results

Results showed low levels of sickness in the participants. A one-sample t-test indicated that simulator sickness scores were significantly lower than the chance level of 2 for both factor: Nausea (M = 1.31, SD = .250), $t(9) = -8.71$, $p < .001$ and Oculomotor (M = 1.43, SD = .398), $t(9) = -4.54$, $p < .001$. However, the results for the motion sickness scores were significantly lower than the chance level of 2 for the factors Gastrointestinal (M = 1.37, SD = .358), $t(9) = -5.51$, $p < .001$; Peripheral (M = 1.43, SD = .487), $t(9) = -3.74$, $p = .005$ and Tolerance-Related (M = 1.20, SD = .230), $t(9) = -11.01$, $p < .001$, and tendency to significance factor Central (M = 1.71, SD = .272), $t(9) = -2.25$, $p = .51$.

Moreover, from the analysis of the open questions emerged that what mostly caused the sickness to participants were the movements of the camera and, by the consequence, the movements of the video, and its duration. These caused the eyestrain effect, and dizziness when participants took off the HMD. To overcome the limits, participants suggested to reduce the speedy of the performer while she walks, and to shorten the video.

3.3. Discussion

The goal of the second study was to investigate the usability of the recorded video. To reach the objective, 10 participants watched the 360° video, and answered to motion and sickness questionnaires, and some open questions. The analysis of the questionnaires reveals in general no high level of sickness during the exposition beside the factor Central of the motion sickness test. However, from the analysis of the open questions emerged that the sickness is mostly caused by the video movements of some frames. This result is not surprising since it is in line with previous literature about the sickness generated by the

360° video (Lee et al., 2019). Previous works have found out that the motion sickness is caused by disparity between information on rotation coming from vestibule, and visual information coming from eyes (Jung et al., 2017). The current mechanism is the same that happens while people ride on cars or airplanes and their eyes see the inside of cars or airplanes, but their bodies are moving. Due to this discrepancy, people mostly feel nausea or vomiting (Jung et al., 2017). The second reason share by scientific community on sickness is that there are not sufficient updates occurring about sensory information coming from vestibular system, and the visual information that keep changing. An example of this case is the situation where the user moves fast in VR contents while the user is wearing the HMD (Lee et al., 2019). Although visual information keeps changing, the user's actual body is sitting down or standing up without movement, which causes disparity of information. This drastic change on visual information, causes motion sickness (Lee et al., 2019). According to the literature and from what emerged by the UX, we decided to reedit the video through three steps: first, we recorded again the scenes of the performer walking and we better fixed the camera on her head to reduce sudden movements, second, we deleted some video frames that have too much movements that could cause disparity between visual information and the real user movements (e.g. when the performer stand up from a chair), and third, we added some frame video breaks that permit to the user to relax for a while, consisting of three black images that come up each 7 minutes for 5 seconds. These steps follow previous model to reduce simulator and motion sickness (Jung et al., 2017).

Motion sickness that occurs when viewing VR content is considered one of the major obstacles to the popularization of the VR system (Solimini, 2013). Finally, thanks to the changes made to the video, we expect to improve the UX and to reduce as much as possible the sickness.

4. Conclusions

The aim of these two studies were to develop a 360° video-based VR for an SH research addressed to study empathy and related variable of men participants. To reach this objective, we followed first the UCD method to collect ideas from women about the typical SH that happens in the city. The UCD method was adopted because, very often the VR contents are developed using the Designer Centered method (Daalhuizen et al., 2009), namely the final product is the result of only the designer, and the co-workers contribute. This method could be risky because the culture factor, and the personal biases of the designer play an important role in the develop process, and the final product could be far

from “reality”. Consequently, the final users could be less engaged with the VR content (O'Brien et al., 2008). Second, we tested the VR content. The UX permits to include the final users as part of the development process (Kuniavsky, 2003). Involving participants that are extern to the design of the product allows the designer to collect important feedbacks to better improve the final product or service. In our case, the cybersickness generate from the 360° video was the main obstacle to overcome, for this reason we conducted an UX test to ensure that the content would not generate any kind of uncomfortableness to participants. We believe that, without the UX, the VR content could comprise the research goal.

Future direction about the UCD study could be to adopt the big data to collect information about the VR content to develop. Actually, we have enormous online information from social network, and forum discussion that, with a proper analysis, could give important information on what we want to investigate. For example, in our study we needed information about the SH that happen in Mexico City and we did focus group, but there are several online group discussions about the topic that could provide us interesting materials without the involve of the participants. The analysis through the machine learning (ML) (Qiu et al., 2016) could be an intriguing method for qualitative analysis. Moreover, the ML could be adopted also for the analysis of UX (Yang et al., 2018). It is since decades that people interact with technology, and a lot of user information were stored. The information could be analyzed with ML expert and adopted to develop and improve new products.

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Chapter 5

Predictors of the sense of embodiment of a female victim of sexual harassment through 360° video-based Virtual Reality

Abstract

The sense of embodiment refers to the ensemble of sensations of having (i.e., ownership), being located (i.e., location), and controlling (i.e., agency) a virtual body. Recently, 360° video-based Virtual Reality (VR) –using a VR Headset and Mobile Applications- has been used to manipulate the sense of embodiment and to study several behavioural and psychological processes. However, the study of the interaction between sense of presence, user's psychological dimensions, and embodiment in the context of sexual harassment (SH) using 360° video-based VR is scarce. The aim of this study is to investigate the feasibility of the 360° video-based VR to induce embodiment on a women's body in a sample of Mexican men; and to explore whether sense of presence and psychological variables related to SH behaviours (i.e., machismo, chivalry, alexithymia, empathetic abilities) predict the sense of embodiment. Forty-four men participated in the study, and results indicate that the 360° video-based VR is efficacious to induce embodiment. Hierarchical multiple regression analyses showed that the sense of presence was a predictor for the three dimension of embodiment, but specific psychological dimensions (i.e., low scores in machismo, high scores in difficulties in expressing feelings and high scores in perspective taking) were also predictor variables of experiencing a greater sense of location and agency of the female virtual body. This study shows that both technological issues and participant's psychological dimensions are involved in the experience of embodiment in an SH scenario using 360° video-based VR.

1. Introduction

In the past decade, several studies have demonstrated the potentiality of Virtual Reality (VR) to induce the sense of embodiment, referred to the illusion of using and "having" a virtual body (Ehrsson, 2007; Kilteni at al., 2012; Slater et al., 2010). The body illusion is related to three multisensory brain processes: (i) the sense of body ownership, that is the sense of one's self-attribution of a body, or self-identification; (ii) the sense of agency, that is the sense of causing the body action; and (iii) the sense of self-location, that is the feeling of being an entity localized at a position in space and perceiving the world from that position and perspective (Blanke and Metzinger, 2009). The body swap illusion can be induced using different technologies, For instance, it can occur thanks to sophisticated VR systems, such as the optical sensors that track the body movements and display them on an Head Mounted Display (HMD) (Oh et al., 2016); or it can be elicited through the optitrack suit that permits to display the body of the users into the virtual scenario, and they see themselves with another body (Peck et al., 2013). An alternative system able to induce the body swap illusion is the 360º camera, which is a low-cost immersive technology that can record the surrounding environment (Huang et al., 2017; Repetto et al., 2018), and the users can look all around from a first-person perspective, as in real life, thanks to the HMD. The 360º video-based VR has demonstrated to induce a high sense of presence (Aitamurto et al, 2018), which is defined a mental state in which the user feels that s/he is being there (Slater, 1994)

VR enables users to be embodied even in avatars which differ from their real self-representation –such as embodying an avatar with other gender (Slater et al, 2010), a child's body (Banakou et al., 2013), a different skin colour (Peck et al., 2013) or different age (Oh et al., 2016)– inducing change on interpersonal attitudes. For example, previous studies have demonstrated that the virtual alteration of age through embodying an old person can reduce negative stereotypes toward the elderly (Oh et al., 2016), or the virtual alteration of the skin tone from light-skinned participant to dark-skinned avatar causes a significant reduction of the implicit biases toward dark-skinned people (Peck et al., 2013). Furthermore, the studies aimed at modifying the violence and harassment towards women through VR are also promising. Seinfeld et al. (2018) found that the alteration of gender from male participants to the female body victim of sexual violence permitted them to improve their ability to recognize the female emotion. Recently, Neyret et al. (2020) have found that the male who embodied a female avatar victim of harassment reduced their be-

haviour conformity during the Milgram's Obedience experiment one week later (i.e., men who embodied a female avatar one week before, gave less shocks to a woman in the obedience's task than controls). Moreover, Gonzalez-Liencres et al. (2020) in a study of intimate partner violence in VR, found that the level of identification with the female avatar correlated with the decrease in prejudice against women after the exposition to VR.

In previous studies, the sense of embodiment experienced by the participants during the study has been mostly induced through the analysis of "external" factors such as the VR systems adopted, the avatar embodied, or the virtual environment, but the users' differences remain poorly researched (Dewez et al., 2019). However, during the embodiment induction some participants easily experience the illusion, and they drag themselves into the experience, while others are resistant to this experience (Dewez et al., 2019). On this matter, Shin (2018) carried out a study to explore the variables involved in the user experience of a 360° video-based VR about the story of three children refugees, and found that the sense of presence was an important predictor of the embodiment and empathy, which led in turn to a greater engagement with the VR experience. Moreover, this author found that participants who understood the issues in the story and could relate to them, found it much easier to embody the content than those who did not. Thus, evidence suggest that, besides the sense presence, some user's psychological dimensions could be also influencing the sense of embodiment (Shin and Biocca, 2018).

However, the study of the interaction between presence, user's psychological dimensions (e.g., dimension of empathy), and embodiment in the field of 360° video-based VR is scarce. These observations led us to investigate how the sense of presence and individual psychological dimensions could influence the sense of embodiment –specifically in a gender body swap in a sexual harassment (SH) scenario– in a sample of Mexican men. The main objectives of the present study are[10]: (1) to confirm the feasibility of the 360° video-based VR to generate the sense of embodiment in terms of location, ownership and agency (i.e., the body swap illusion from male to female body); (2) to study the associations between sense of presence, psychological variables associated with the SH (i.e., machismo, chivalry, alexithymia, empathetic abilities), embodiment, and cybersickness (i.e., a variable

[10] The aims of the current study constitute the secondary objectives of a pilot study (currently under review), that investigated the feasibility of the 360° video-based VR (vs. narrative task) to study empathy and related variables in an SH scenario. Hence, participants of this study went through another condition (i.e., narrative task without VR). However, as we followed a within-subjects design and all participants received the 360º camera based-VR condition in a counterbalance way (1st narrative, 2nd 360º camera or 1st 360º camera, 2nd narrative) and we are only interested in the measures of embodiment, we do not distinguish between conditions for testing the aims of the present study.

that could be affecting the sense embodiment); and finally, (3) to analyse whether sense of presence and men's psychological variables associated with the SH are predictors of embodiment. This objective would allow us to confirm whether psychological variables involved in the SH –in addition to the sense of presence– might cause either resistance or predisposition of men to be embodied in a woman victim.

2. Materials and methods

2.1. Participants

Participants were recruited through advertisements at Universidad Nacional Autónoma de Mexico (UNAM - Mexico City) and social networks. The inclusion criterion was being a man older than ≥ 18 years old. The exclusion criteria were: (1) having physical problems that could inhibit free movements (e.g., back or neck pain); (2) history of SH with legal consequences; (3) use or abuse of drugs; and (4) receiving psychological treatments at the time of the study.

Forty-four male participants took part at the study, all of them were volunteers and signed the informed consent document before starting the experiment, in accordance with the Declaration of Helsinki. Descriptive statistics for sociodemographic (i.e., age, education, history of mental and chronic illness, and history of legal consequences for sexual abuse) and trait measures of machismo and chivalry (MCS), empathetic abilities (IRI), and alexithymia are shown in Table 1.

Table 1. Descriptive statistics of sociodemographic and trait measures (n = 44).

	M ***(SD)***	**%**
Age	26.20 (8.36)	-
Educational level		
Secondary studies	-	6.8%
Degree	-	77.3%
Master	-	15.9%
History of mental or chronic illness (% yes)	-	9.1%
Alcohol consumption		
Never	-	25.0%
Once per month	-	36.4%
2-4 times per month	-	34.1%
> 2-3 times a week	-	4.5%
Machismo and Chivalry (MCS)		
Machismo	2.01 (0.84)	-
Chivalry	5.36 (0.97)	-
Empathetic abilities (IRI)		
Perspective taking	4.78 (0.77)	-
Fantasy	4.66 (0.99)	-
Empathy concern	5.17 (0.81)	-
Personal distress	3.15 (1.13)	-
Alexithymia (TAS-20)		
Difficulty in express feelings	3.67 (1.46)	-
Externally oriented thinking	2.49 (0.73)	-
Difficulty in identify feelings	2.93 (1.47)	-

Note. MCS = Machismo and Caballerismo Scale; IRI = Interpersonal Reactivity Index; TAS-20 = Toronto Alexithymia Scale.

3. Measures

Sociodemographic Questionnaire: This is an *ad-hoc* questionnaire developed to collect information about age, sex, education level, history of mental or chronic illness, use or abuse of drugs, alcohol consumption, current psychological treatments, and whether the participants have/had legal problems due to SH.

Empathetic abilities: ***Interpersonal Reactivity Index (IRI)*** (Pérez-Albéniz et al., 2003; Davis, 1980): This is a self-report containing 28 items rated on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree), adapted from the original scale. The scale is composed of four factors: (1) perspective taking (ability to adopt the viewpoint of another person); (2) fantasy (ability to transpose oneself into the feelings of a fictitious character); (3) empathic concern (feeling of being involved in others' emotions); and (4) personal distress (feelings of sorrow about others' pain). The mean for each subscale was calculated (scores ranged from 1 to 7). In this study, the internal consistency for all the subscales ranged from $\alpha = .60$ to $\alpha = .87$.

Alexithymia*: Toronto Alexithymia Scale (TAS-20)* (Moral de la Rubia, 2008; Taylor et al., 1985): This is a self-report scale containing 20 items that measure: (1) difficulty expressing feelings, (2) difficulty identifying feelings, and (3) externally oriented thinking. It is rated on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree), where a higher score indicates higher alexithymia. The mean for each subscale was calculated (scores range from 1 to 7). In this study, internal consistency ranged from $\alpha = .51$ to $\alpha = .91$.

Machismo and Chivalry: ***Machismo and Caballerismo Scale (MCS)*** (Arciniega et al., 2008): This is a self-report scale containing 20 items that measure the constructs of "machismo" (referring to power and men's aggressive attitudes) and "caballerismo*"* (chivalry) (referring to emotional connectedness, honour, and men's nurturance). The scale is rated on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree), where a higher score indicates higher levels of machismo and chivalry. The mean for each subscale was calculated (scores ranged from 1 to 7). In this study, internal consistency was adequate for the two subscales: machismo ($\alpha = .80$) and chivalry ($\alpha = .78$).

Embodiment, Presence, and Sickness: ***Embodiment, Presence, and Sickness Scale***: This is a self-report questionnaire with 16 items rated on a 7-point scale (1 = strongly disagree; 7 = strongly agree). Ten items were adapted from Longo's original questionnaire to assess the ownership, location, and agency of the victim's body (Longo et al., 2008) ($\alpha = .88$); three items were developed by the authors to assess the sense of presence felt during

the whole immersive experience (Usoh et al., 2000) (α = .46); and three items were developed by the authors to detect the sickness level of the participant during the VR experience (Kennedy et al., 1993) (α = .87). The mean for each construct was calculated (scores ranged from 1 to 7) (Table 2).

Table 2. The list of the items used for the questionnaire in the experiment and its scoring scale.

I felt as if I was looking at myself.	Ownership
I experienced the arms of the performer as my own arms.	Ownership
I experienced the legs of the performer as my own legs.	Ownership
I experienced the body of the performer as my own body.	Ownership
I had the feeling to have another body.	Ownership
I had the illusion of sitting in the same place of the performer.	Location
I felt I had control over the arms of the performer.	Agency
I felt I had control over the legs of the performer.	Agency
I felt I had control over the body of the performer.	Agency
I had the feeling to have a female body.	Ownership
I had the illusion to be there, in the virtual environment.	Presence
I was confused if the environment was real or a video recorded	Presence
When I think to the scenario, I have the feeling that I was there	Presence
I felt dizzy	Sickness
I had unpleasant physical sensation (e.g. nausea)	Sickness
I had vertigo	Sickness
Requested for each item:	
Fully disagree O 1 O 2 O 3 O 4 O 5 O 6 O 7 Fully agree	

3.1. Experimental Procedure

The experiment took place at the Laboratorio de Enseñaza Virtual y Ciberpsicologia UMAN (Mexico City). After giving their consent, participants filled the *socio-demographic*, *IRI, TAS-20* and *MSC* questionnaires. Then they were instructed to sit comfortably on a chair with their legs resting on a footstool and their arms resting on their legs. Before starting the video, the researcher gave them the instruction to follow and synchronize with the body movements of the female performer that they are going to watch on the video, as much as possible during the entire experiment. Moreover, participants had the possibility to quit the experiment if they feel any sickness, and people wearing glasses could keep them if they did not feel any discomfort. During the experimental session, participants wore the HMD and they were left alone in the room while doing the embody ex-

ercises, and watching the entire video. When the video finished, the participants were invited to fill out the embodiment questionnaire, and to ask any questions about the study. All the procedure last almost 30 minutes.

The procedures and materials were approved by the Ethics Committee of the UNAM with the code EP/PMDPSIC/0151/19.

3.2. Implementation and Apparatus

The 360° video was recorded with the LG360-105 camera and the LG360 viewer software (LG Group, South Korea), and it was edited with the Adobe Premiere Program (Adobe System, San Francisco, CA, USA). Videos were recorded in different places where different harassment scenarios occur that reflect a typical day of a victim of SH. However, the first scenario is aimed at generating embodiment of the victim woman's body, in which participants follow the woman body movements watch in the video (e.g., move hands up and down, caress their limbs, and rotate their hands). To record the embodiment scene, a female performer sat on a chair and wore the camera on her head using a *head strap* to record the entire body from the first-person perspective (Figure 1). The embodiment induction last almost 2 minutes. After the embodiment frame, there are several scenes of the victim daily life activities, and several SH scenarios recorded in first-person perspective (e.g., a man try to take a photo of her without her permission in the library university, a man says aggressive words to his spouse, and a man looks at the victim when she is the metro and tries to hold her hand among others (Annex 8). The entire 360° video-based VR lasts 20 minutes. Then, the video was uploaded on YouTube, played on an IPhone6 with the VR option supported by a VR GLASS FOV: 120° to generate the VR immersion experience

3.3. Data Analyses

All statistical analyses were performed using the SPSS v.26. First, descriptive statistics were calculated for sociodemographic data and for the trait measures. Second, one-sample t-tests were conducted to explore whether the effect of the 360º video on the embodiment scores, the sense of presence, and cyber-sickness were significantly different from the chance level of 4 (on a scale ranging from 1 to 7). Third, Pearson's correlations were carried out in order to assess the relationships between embodiment, and presence, cybersickness, and trait measures (MCS, IRI, TAS-20). Finally, three hierarchical multiple regression analyses (using the stepwise method) were performed to test whether the trait measures (MCS, IRI, TAS-20) predicted the embodiment scores after controlling for the

sense of presence. The sense of presence in the first step of the multiple regression, while the trait measures were entered in the second step. Two-tailed significance tests were considered at $p < .05$.

Figure 1. The 360° video to induce the body swap illusion.

Note. (a) = recording the video; (b) = participant's perspective; (c) = man participant doing the experiment.

4. Results

4.1. Embodiment, sense of presence and cyber-sickness during the 360º video

A one-sample t-test indicated that embodiment scores were significantly greater than the chance level of 4 for location ($M = 5.82$, $SD = 1.33$), $t(43) = 9.04$, $p < .001$, and ownership ($M = 5.12$, $SD = 1.10$), $t(43) = 6.79$, $p < .001$; but not for agency ($M = 4.28$, $SD = 1.50$), $t(43) = 1.24$, $p = .222$.

Scores on sense of presence ($M = 5.23$, $SD = 1.00$) were also greater than the chance level of 4, $t(43) = 8.23$, $p < .001$. Similarly, scores on cyber-sickness ($M = 4.64$, $SD = 2.02$) were also greater than the chance level of 4, $t(43) = 2.09$, $p = .043$.

4.2. Relationships between embodiment, and presence, cyber-sickness, and trait measures

Pearson's correlations between the embodiment (ownership, location, and agency) and presence, cyber-sickness, and trait measures (MCS, TAS-20 and IRI) are shown un Table 3.

As regards presence, positive significant relationships were found with embodiment scores (ownership, location, and agency).

Regarding the scores in machismo and chivalry (MCS), a negative significant relationship was found between location and machismo.

As regards the scores in alexithymia (TAS-20), a significant positive relationship between agency and difficulty in expressing feelings was found.

Moreover, it should be highlighted the positive significant relationship between ownership and cyber-sickness. Finally, non-significant relationships were found between empathetic abilities (IRI) and embodiment scores.

Table 3. Pearson's correlations between embodiment, and presence, cyber-sickness, and trait measures (MCS, TAS-20, and IRI).

	Ownership	Location	Agency
Presence	.69**	.43**	.32*
Cyber-sickness	.35*	-.09	.09
Machismo (MCS)	.04	-.30*	-.13
Chivalry (MCS)	.04	.09	.25
Difficulty in express feelings (TAS-20)	.10	.29	.39**
Externally oriented thinking (TAS-20)	.13	.06	.25
Difficulty in identify feelings (TAS-20)	.23	.11	.28
Perspective Taking (IRI)	-.14	.21	-.22
Fantasy (IRI)	.01	-.01	-.24
Empathy concern (IRI)	.06	.03	-.12
Personal distress (IRI)	.09	.03	.25

Note. MCS = Machismo and Caballerismo Scale; TAS-20 = Toronto Alexithymia Scale; IRI = Interpersonal Reactivity Index.

4.3. Regression multiple analyses: Is embodiment predicted by sense of presence, machismo and chivalry, empathetic abilities, and alexithymia?

The first multiple regression analysis to predict ownership showed that *sense of presence* was a significant positive predictor. This model was statistically significant, $F(1,43) = 38.04$, $p < .001$, explaining 46.3% of the variance (Model 1). None of the trait variables entered in the second step was significant ($p > .05$) (see Table 3).

The second multiple regression analysis to predict location showed that *sense of presence* was a positive significant predictor. The model was statistically significant, $F(1,43) = 9.53$, $p = .004$, explaining 18.5% of the variance (Model 1). After introducing the trait variables in the second step of the multiple regression, three different models were

also significant: $F(2,43) = 8.76$, $p < .001$ (Model 2), $F(3,43) = 8.67$, $p < .001$ (Model 3), and $F(4,43) = 8.52$, $p < .001$ (Model 4). In Model 2, *Machismo* (MSC) was a negative significant predictor of location that increased 11.4% of the variance, while sense of presence remained significant. In Model 3, *difficulty in expressing feelings* (TAS-20) was a positive significant predictor of location that increased 9.5% of the variance, while the sense of presence and machismo remained also significant. Finally, in Model 4, *capacity of perspective taking* (IRI) was a positive significant predictor of location that increased 7.2% of the variance, while sense of presence, machismo, and difficulty in expressing feelings remained significant. The linear combination of the sense of presence and these trait variables was the best fitting model, explaining 41.2% of the variance (see Table 4).

The third multiple regression analysis to predict agency showed that *sense of presence* was a significant predictor of the model. The model was significant, $F(1,43) = 4.85$, $p = .033$, explaining 8.2% of the variance (Model 1). After introducing the trait variables in the second step of the multiple regression, a second model was significant (Model 2). In model 2, *difficulty in expressing feelings* (TAS-20) was a positive significant predictor, that increased 12.0% of the variance. The model was significant, $F(1,43) = 5.89$, $p = .006$, explaining 18.5% of the variance. However, the sense of presence was marginally significant in Model 2, $\beta = .27$, $t = 1.95$, $p = .059$ (see Table 4).

Table 4. Stepwise multiple regressions of embodiment scores.

Outcomes	Predictors	R	Adjusted R^2	R^2 Change	B	SE	β	t
Ownership	**Model 1**							
	Constant				1.15	0.66		1.75
	Sense of presence	.69	.46	.48	0.76	0.12	.69	6.17***
Location	**Model 1**							
	Constant				2.80	1.00		2.81**
	Sense of presence	.43	.17	.19	0.58	0.19	.43	3.09**
	Model 2							
	Constant				3.69	1.00		3.71***
	Sense of presence				0.61	0.18	.46	3.48***
	Machismo (MSC)	.55	.27	.11	-0.54	0.21	-.34	-2.59*
	Model 3							
	Constant				3.13	0.96		3.24**
	Sense of presence				0.56	0.17	.42	3.33**
	Machismo (MSC)				-0.64	0.20	-.41	-3.22**
	Difficulty in expressing feelings (TAS-20)	.63	.35	.10	0.29	0.12	.32	2.5*
	Model 4							
	Constant				-0.02	1.65		-0.01
	Sense of presence				0.62	0.16	.46	3.85***
	Machismo (MSC)				-0.53	0.20	-.33	-2.68*
	Difficulty in expressing feelings (TAS-20)				0.33	0.11	.36	2.95**
	Perspective Taking (IRI)	.68	.41	.07	0.51	0.22	.29	2.30*
Agency	**Model 1**							
	Constant				1.74	1.17		1.48
	Sense of presence	.32	.08	.10	0.49	0.22	.32	2.20*
	Model 2							
	Constant				0.82	1.17		0.71
	Sense of presence				0.41	0.21	.27	1.95
	Difficulty in expressing feelings (TAS-20)	.47	.19	.12	0.36	0.14	.35	2.51*

Note. *p < .05; **p < .01; ***p < .001. MCS = Machismo and Caballerismo Scale; IRI = Interpersonal Reactivity Index; TAS-20 = Toronto Alexithymia Scale. R = Multiple Correlation Coefficient; R^2 = Coefficient of determination; R^2 Change = Coefficient of determination Change; B = Unstandardized coefficient; SE = Standard Error; β = Beta coefficient; t = t statistic (estimated coefficient divided by its own SE).

5. Discussion

The main objectives of the present study were to confirm the feasibility of the 360° video-based VR to generate the sense of embodiment (i.e., location, ownership, and agency of a female body), and to analyze which psychological variables associated with the SH –in addition to the sense of presence– predicted the sense of embodiment in a sample of Mexican men, in a SH scenario using 360° video based-VR technology. The 360° video-based VR initially started with an explicit induction of embodiment (i.e., the female virtual body doing some movements with her arms and legs that men should follow), and then, several SH scenarios in Mexico City were displayed (e.g. harass behavior at the university, at home with the spouse of the victim, in the subways). Self-reports to measure the dimensions of machismo and chivalry, empathetic abilities, and alexithymia, were administered before the VR experience, while the sense of presence, cyber-sickness, and embodiment were measured after the VR experience.

Results show that men participants showed a significant high sense of location and ownership of the female body victim of SH, but not a high sense of agency. These low scores in this dimension of embodiment could be explained because the 360° video-based VR was pre-recorded, so participants simply followed the movements of the female performer, but they do not have the freedom to do the movements they want. Consequently, this embody exercise induced the illusion to own a female body (i.e., ownership) and to perceive their body located in the virtual scenario (i.e., location), but did not promote the illusion to move the female virtual body (i.e., agency). These findings confirm previous literature that concluded that synchronized movements between the participant and the virtual avatar are crucial to induce the illusion (Petkova and Ehrsson 2008), and more specifically, in the case of embodying a virtual body that is different to the participant's body in terms of gender, race or age (Peck et al., 2013, Oh et al., 2016).

The sense of presence and the cyber-sickness experienced during the exposition were also significantly high. These results are in line with previous work that underlines the potentiality of the 360° video-based VR to induce high sense of presence (Breves and Heber, 2019), but also the generation of cyber-sickness (Jung et al., 2017). One possible solution to this problem could involve the use of a 360° camera with higher resolution, and the decrease of the movement of the camera during the recording. Thus, future studies should test whether these possible solutions solve this specific limitation of this technology.

Regarding the interactions between the sense of presence, psychological dimensions, cyber-sickness, and embodiment, several relationships were significant. A negative significant relationship between machismo and embodiment was found, as a lower score in machismo was associated with a higher illusion to feel located in the female virtual body. Machismo is defined as a strong sense of masculinity (Hurtado and Sinha, 2016), and has been previously associated with the low ability to take the perspective of the women (Mayer et al., 2018). In this study, the scenario could have been lived by some men as an unpleasant experience because it was not consistent with their masculinity-related values and did not reflect their own perception of women's reality. Previous studies have found that the illusion of "being in a rendered space and that the unfolding events were really happening" could be prevented if the VR scenario is perceived as hostile (e.g., Steed et al., 2018). Related to this matter, the positive significant relationship between cyber-sickness and the sense of ownership could be explained by the fact that men who felt the illusion of owning a female body in a greater extent felt more sickness (i.e., dizzy, unpleasant physical sensations and vertigo) due to the disturbing psychological impact of this experience. Future studies should explore deeply the qualitatively experience of cyber-sickness in this context in order to analyze whether it is due to the content of the video or the quality of the video.

Moreover, a significant positive relationship was also found between embodiment and alexithymia, as a lower ability to express emotions was associated with a higher illusion to move the body of the female virtual body (i.e., sense of agency). Alexithymia has been negatively associated with interoceptive awareness (i.e., the ability to detect, accurately monitor, and regulate internal bodily process) (Brewer et al., 2016; Murphy et al., 2018; Trevisan et al., 2019). In addition, this low interoceptive awareness has been related to a higher susceptibility to the embodiment of other bodies, such as occurs in eating disorders (Herbert and Pollatos, 2012, Eshkevari et al., 2012; Tsakiris, Tajadura-Jiménez and Costantini, 2011). Future studies should test whether the low interoceptive awareness is the mediational variable that could explain the increased sense of embodiment in those men with difficulties in expressing feelings.

As regards the relationships between the sense of presence and embodiment, it was found that this variable was positively and significantly related to the three dimensions of embodiment. Indeed, the sense of presence was a significant positive predictor of the three dimensions of embodiment, explaining 46% of variance in sense of ownership, 17% in sense of location, and 8% in the sense of agency. However, the men's psychological dimensions were also predictive variables of location and agency. On the one hand, once the

sense of presence was controlled, lower scores in machismo, higher scores in difficulty of expressing feelings, and higher scores in perspective taking predicted higher scores in sense of location (11%, 10% and 7% of the variance, respectively). On the other hand, once the sense of presence was controlled, higher scores in difficulty in expressing feelings predicted the sense of agency, accounting for the 12% of the explained variance. Hence, men with lower scores in machismo and difficulties in expressing feelings, but a higher ability to adopt the viewpoint of another person, had a higher illusion of being into the female virtual body. Maybe, the fact of not perceiving the scenario as hostile (due to the low machismo), the willing to understand the women's perspective, and the low alexithymia (and presumably, the low interception) are the psychological dimensions more favourable to experience the sense embodiment of a female body in the SH context. These finding are in line with previous works that pointed out the influence of sense of presence and the user's psychological dimensions in the quality of the VR experience (Shin, 2018; Shin and Biocca, 2018). Future studies should take into account that the sense of embodiment not only depend on the technical issues (e.g. high quality of the apparatus, and how much the movements are synchronized), but also depends on cognitive and affective processes.

Limitations of this study should be noted. The first limitation is related to the fact that the results are only generalizable to a sample of young Mexican who showed motivation to participate in a study related to understand the experience of being a woman. The second limitation is related to the lack of information about the effect that experiencing high embodiment has in the mid- and long-term on the violence and SH towards women. Hence, future studies should test whether this higher embodiment leads to higher changes in the violence and SH towards women, especially in men perpetrators of SH. If this were confirmed, a "target" profile of men for this kind of VR-based interventions could be delineated.

The current study shows that the 360° video-based VR is a potential tool to induce embodiment, in which the sense of presence and cognitive and affective traits of the user are key components. More specifically, the sense of presence was a predictor for the three dimension of embodiment, but specific psychological traits (i.e., men with low machismo, willing to understand the women's perspective, but with difficulties in expressing feelings) were also predictor variables of experiencing a greater sense of location and agency of the female virtual body in a SH scenario. This study shows that both technological issues and participant's psychological traits are involved in the experience of embodiment in an SH scenario using 360° video-based VR.

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Chapter 6

How does it feel to be a female victim of sexual harassment? The effect of 360° video-based Virtual Reality on empathy and related variables

Abstract

Sexual harassment (SH) is defined as a type of violence involving negative behavior toward women, and it is associate with the lack of empathy. Virtual Reality (VR) has been defined as the "ultimate empathy machine", allowing the user to take other people's perspective. The present work aims to study the effect of a 360° video-based VR experience (vs. traditional perspective-taking task) on empathy and related concepts (i.e., violent attitude, perspective taking, sense of oneness) towards a woman victim of SH in a male sample. A within-subject design was used with 44 men who experienced both conditions (360º and narrative). Results showed the superiority of the 360° video experience over the narrative in increasing empathy, sense of oneness, and perspective-taking towards a woman victim of SH. Limitations and future directions are discussed.

1. Introduction

Sexual harassment (SH) occurs when people −mostly women− are targets of unwanted sexual comments, gestures, or actions[1], both in private and public spaces[2]. Victims perceive SH to be annoying, humiliating, and intimidating, and it can reduce their sense of safety[3].

Previous studies have found that the lack of empathy and, specifically, the lack of perspective taking are associated with aggressive behaviors, including SH[4]. *Empathy* is considered a personal skill that establishes the basis for positive relations and community well-being, which moderates aggressive behavior[5]. It is composed of two factors: cognitive empathy (the intellectual ability to understand another person's emotions and mental state while remaining an objective observer), and emotional empathy (the feeling of being affected by and sharing another's emotions)[6]. Studies show that offenders have lower levels of both cognitive and emotional empathy than the general population[7]. One possible explanation is that individuals with low levels of empathy do not understand the other individual's distress, and they are unable to take the perspective of the victim[8]. The *perspective-taking* ability is a specific component of empathy that has been defined as the ability to "put oneself in another person's shoes"[9]. Individuals who have a high ability to imagine others' distress could improve the relationship with another person and inhibit the harmful behavior[10].

In the past decade, Virtual Reality (VR) has been named as the "ultimate empathy machine", as allows a person to take the perspective of someone else[11]. VR can induce feelings of being present in the virtual environment (sense of presence), and to generate the illusion of inhabiting a virtual body (sense of embodiment)[12]. Previous studies have found that taking the perspective of someone else through VR can be an effective way to promote empathy in different situations, such as increasing helping behavior[13], reducing domestic violence[14], reducing implicit racial bias[15], or decreasing prejudice[16].

Recently, the 360° video-based VR has proved to be effective to increase empathy in several contexts such as intergroup conflicts[17,18], improving communication in healthcare professions[19], or creating a connection with nature[20]. This technology is considered a subfield of VR that records the environment, which allows users to look all around from a first-person perspective, through a Head Mounted Display[21,22].

The present study aims to analyze the effect of using the 360° video on empathy and related concepts (i.e., violent attitude, perspective taking, sense of oneness), towards a woman

victim of SH in a sample of men. Two conditions are compared: a 360° video (VR task) and a narrative (traditional perspective-taking task), through a counterbalanced within-subject design. We hypothesized that participants would show more positive changes in empathy, violent attitudes, perspective-taking, and sense of oneness with the victim after the 360º video than after the narrative. Moreover, we also expected a carry-over effect on the change in the dependent variables when the participants experienced the 360º video before the narrative. Finally, we expected that the sense of embodiment and presence would be high, and sickness would be low in the 360° video.

2. Method

2.1. Participants

Forty-four Mexican men participated in this study. The exclusion criteria were being younger than ≤ 18 years old, having physical problems that could inhibit free movements; history of SH with legal consequences; use or abuse of drugs; and being under psychological treatments. Descriptive statistics for sociodemographic and trait measures are described in Table 1.

Table 1. Descriptive statistics of sociodemographic and trait measures (n = 44)

	M (SD)	%
Age	26.20 (8.36)	-
Educational level		
Secondary studies	-	6.8%
Degree	-	77.3%
Master	-	15.9%
History of mental or chronic illness (% yes)	-	9.1%
Alcohol consumption		
Never	-	25.0%
Once per month	-	36.4%
2-4 times per month	-	34.1%
> 2-3 times a week	-	4.5%
Machismo and Chivalry (MCS)		
Machismo	2.01 (0.84)	-
Chivalry	5.36 (0.97)	-
Empathetic abilities (IRI)		
Perspective taking	4.78 (0.77)	-
Fantasy	4.66 (0.99)	-
Empathy concern	5.17 (0.81)	-
Personal distress	3.15 (1.13)	-
Alexithymia (TAS-20)		
Difficulty in express feelings	3.67 (1.46)	-
Externally oriented thinking	2.49 (0.73)	-
Difficulty in identify feelings	2.93 (1.47)	-
Social Desirability (SDS)		
Attribution	1.63 (0.18)	-
Denial	1.46 (0.25)	-

Note. MCS = Machismo and Caballerismo Scale; IRI = Interpersonal Reactivity Index; TAS-20 = Toronto Alexithymia Scale; SDS = Social Desirability Scale.

2.2. Measures

2.2.1. Measures administered at baseline

Machismo-Chivalry: Machismo and Caballerismo Scale (MCS)[23]. This self-report contains 20 items (1 = strongly disagree; 7 = strongly agree) that measure the constructs of "machismo" (power and men's aggressive attitudes) and chivalry (emotional connectedness, honor, and men's nurturance). Internal consistency ranged from $\alpha = .80$ to $\alpha = .78$.

Empathetic abilities: Interpersonal Reactivity Index (IRI)[24,25]. This self-report contains 28 items (1 = strongly disagree; 7 = strongly agree), adapted from the original scale[25]. It is

composed of four factors: perspective taking, fantasy, empathic concern, and personal distress. Internal consistency ranged from α = .60 to α = .87.

Alexithymia*:* Toronto Alexithymia Scale (TAS-20)[26,27]. This self-report contains 20 items (1 = strongly disagree; 7 = strongly agree) that measure: difficulty expressing feelings, difficulty identifying feelings, and externally oriented thinking. Internal consistency ranged from α = .51 to α = .91.

Social Desirability: Social Desirability Scale (SDS)[28,29]. This self-report contains 33 items, in two subscales: the denial factor (participants' intention to manipulate their external appearance), and the attribution factor (participants' perceptions of themselves). Internal consistency ranged from α = .66 to α = .81.

2.2.2. Measures administered at baseline, after the 360º video, and the narrative

Empathy: Empathy Scale (ES). This is an *ad-hoc* self-report containing 5 items (1 = not at all; 5 = totally) that measure empathy state, which is based on a previous study[30] (Appendix 1). Internal consistency was adequate across administrations (ranging from α = .65 to α = .75), except for baseline (α = .45).

Violent Attitude: Attitude Towards Gender-Based Violence Scale (ATG-S). This is an *ad-hoc* self-report with 5 items (1= not at all; 5 = totally) based on the original scale of Ambivalent Sexism[31] (Appendix 2). Internal consistency was low across administrations (ranging from α = .40 to α = .57).

2.2.3. Measures administered after the 360º video, and the narrative

Sense of oneness: Inclusion of Other in the Self Scale (IOS)[32]. This self-report contains 7 Venn-like diagrams that represent the sense of oneness (i.e., closeness and connectedness) with the victim, in which more overlap between the two circles represent a closer relationship with the victim (Appendix 3).

Perspective taking: Perspective Taking Scale (PT-S). This is an *ad-hoc* self-report, based on a previous study[30], with 8 items (1 = not at all; 5 = totally) that measure participants' capacity to take the perspective of the victim (Appendix 4). Internal consistency ranged from α = .78 to α = .82.

2.2.4. Measures administered after the 360º video

Embodiment, Presence, and Sickness Scale. This self-report contains 16 items (1 = strongly disagree; 7 = strongly agree). Ten items were adapted from Longo's original ques-

tionnaire to assess the embodiment of the victim's body[33] (α = .88); three items were developed to assess the sense of presence felt during the 360º video experience[34] (α = .46); and three items were developed to detect the sickness level during the 360º video experience[35] (α = .87). (Appendix 5).

2.3. Development of the 360° video

The 360° video was recorded with the LG360-105 camera (LG Group, South Korea). To create the first-person perspective, the camera was attached to the female performer's head with a proper support. The content was developed according to the results of previous focus group with female participants which described the type of SH that occur in the city (Annex 8). The video was edited by the Premiere Adobe program, uploaded on YouTube, and played on an IPhone6 with the VR option. The mobile was supported by a VR GLASS FOV: 120° to generate the VR immersion experience.

2.4. Procedure

The experiment took place at Universidad Nacional Autonoma de Mexico (Mexico City). After signing the informed consent and answering the baseline questionnaires, participants were counterbalanced to the two conditions (Table 2). In the 360º video condition, participants watched the video in order to experience what it is like to be a woman victim of harassment from a first-person perspective. The narrative condition consisted of the same story, written from a first-person perspective, but in text format (Anexo 6, original language). Participants read the narrative with the instruction to imagine the content of the story as if it were happening to them. This task lasted 10 about minutes.

After the experience of the first condition, participants answered the ES, ATG-S, IOS, and PT-S questionnaires (and Embodiment, Presence, and Sickness Scale in the case of the 360º video condition). Then, participants carried out the second condition (360º video or narrative depending on what they did first) and again filled in the questionnaires. All procedures and materials were approved by the Ethics Committee of the UMAN with the code EP/PMDPSIC/0151/19.

Table 2. Structure of the counterbalancing method

Group 1 (*n* = 22)	**Group 2 (*n* = 22)**
1. Answer to the pre-test (T1)	1. Answer to the pre-test (T1)
2. Watch the 360° video	2. Read the narrative
3. Answer to the post-test ($T2_I$)	3. Answer to the post-test ($T2_I$)
4. Read the narrative	4. Watch the 360° video
5. Answer to the post-test ($T2_{II}$)	5. Answer to the post-test ($T2_{II}$)

2.5. Data Analyses

All statistical analyses were performed using the SPSS v.26. First, two 3x2 mixed-design ANOVAS with 3 time points (baseline, 360º video, narrative) as within-subject factor, and order of the conditions' presentation (360º video→narrative, narrative→360º video) as between-subject factor were performed to analyze the effects of the condition (360º video vs. narrative) on empathy and violent attitude (main effect of time), and the effects of the order of the conditions on these measures (interaction effect). Second, two 2x2 mixed-design ANOVAS with 2 time points (360º video, narrative) as within-subject factor and order of the conditions' presentation as between-subject factor were performed to analyze the effects of the condition on the sense of oneness with the victim and perspective taking. Post-hoc analyses using Bonferroni corrections were carried out when significant effects were found. Third, one-sample t-tests were conducted to explore whether the effect of the 360º video condition on the embodiment scores, the sense of presence, and sickness were significantly different from the chance level of 4 (on a scale ranging from 1 to 7).

3. Results

3.1. Effect of the condition (360º video vs. narrative) on empathy (ES) and violent attitude (ATG-S)

A 3x2 mixed-design ANOVA to analyze the effect of the condition on empathy (ES) showed a significant main effect of time on empathy, $F(1.64,68.92) = 19.95$, $p < .001$, $\eta^2_p = .32$. Post-hoc analyses showed that there were significant differences in empathy between the scores at baseline and after the 360º video ($p < .001$), and between baseline and after the narrative ($p < .001$). Participants achieved higher scores on empathy after the 360º video and the narrative condition than at baseline. However, there were no significant dif-

ferences in the scores found after the 360º video and the narrative (p = .060) (Table 3). Moreover, there was a significant interaction effect between the time and the order of presentation of the conditions, $F(1.64,68.92) = 8.25$, $p < .001$, $\eta^2_p = .16$. Post-hoc analyses showed that there were no significant differences in empathy after the 360º video, regardless of the order of the presentation (p = .821). However, significant differences were found after the narrative depending on the order the presentation (p = .030) because the scores were higher when the participant received the narrative after the 360º video rather than before the 360º video (Figure 2).

Regarding the effect of the condition on the violent attitude (ATG-S), a 3x2 mixed-design ANOVA showed a significant main effect of time on the violent attitude, $F(1.63,68.31) = 8.83$, $p < .001$, $\eta^2_p = .17$. Post-hoc analyses showed that there were significant differences between the violent attitude scores at baseline and the scores after the 360º video (p = .007), and between baseline and after the narrative (p = .006). Hence, participants achieved higher scores on violent attitude after the 360º video and the narrative condition than at baseline. However, there were no significant differences in the scores found after the 360º video and those found after the narrative (p = 1.00) (Table 3). There was no significant interaction effect between the time and the order of presentation of the conditions, $F(1.63,68.31) = 1.08$, p = .343, $\eta^2_p = .03$. Therefore, there were no significant differences in violent attitude after the 360º video or after the narrative depending on the order of presentation (Figure 2).

3.2. Differences between conditions in the sense of oneness with the victim (IOS) and perspective taking (PT-S)

A 2x2 mixed-design ANOVA showed that there was a significant main effect of time on the sense of oneness with the victim (IOS), $F(1,42) = 10.44$, p = .002, $\eta^2_p = .20$. The sense of oneness with the victim was significantly higher after the 360º video than after the narrative (Table 3). Moreover, there was a significant interaction effect between the time and the order of presentation of the conditions, $F(1, 42) = 15.94$, $p < .001$, $\eta^2_p = .28$. Post-hoc analyses showed that there were no significant differences in the sense of oneness with the victim after the 360º video (p = .076) or after the narrative (p = .278) depending on the order of presentation (Figure 2).

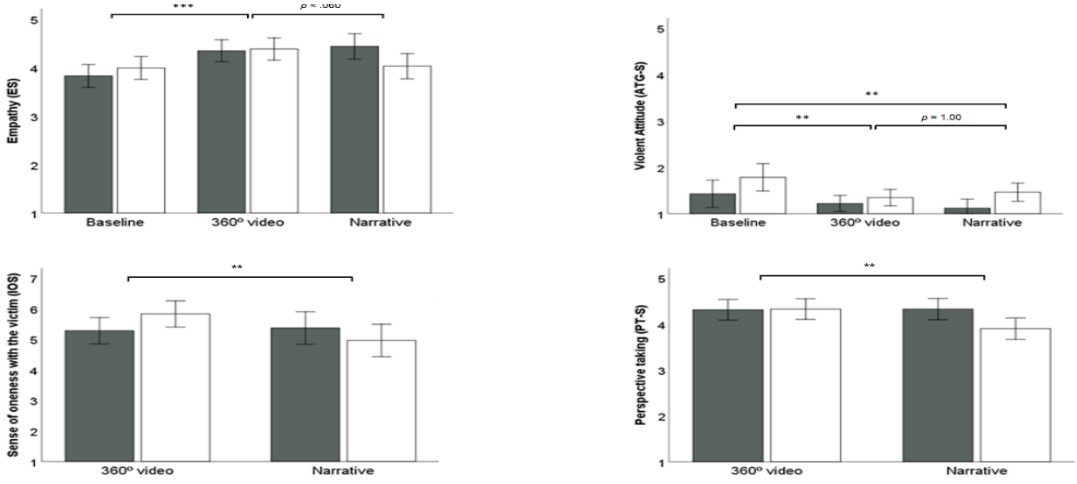
Regarding perspective taking, a 2x2 mixed-design ANOVA showed that there was a significant main effect of time on perspective taking (PT-S), $F(1,42) = 8.87$, p = .005, η^2_p = .17. Perspective taking was significantly higher after the 360º video than after the narra-

tive (Table 3). Moreover, there was a significant interaction effect between the time and the order of presentation of the conditions, $F(1,42) = 10.41$, $p = .002$, $\eta^2_p = .20$. Post-hoc analyses showed that there were no significant differences in perspective taking after the 360º video depending on whether it was presented after or before the narrative, $p = .914$. However, perspective taking after the narrative was higher when it was presented after the 360º video rather than before it, $p = .012$ (Figure 2).

Table 3. Means and standard deviations for the dependent variables in this study at each time point in the within-subjects design.

	Baseline	**After the 360º video**	**After the narrative**
Empathy (ES)	3.91 (0.55)	4.36 (0.52)	4.23 (0.63)
Violent attitude (ATG-S)	1.60 (0.70)	1.28 (0.41)	1.29 (0.48)
Sense of oneness with the victim (IOS)	-	5.55 (1.02)	5.16 (1.24)
Perspective taking (PTS)	-	4.32 (0.52)	4.11 (0.57)

Figure 2. Graphical representations of the order effect of presentation of the 360º video and narrative on the main dependent variables in the study.



Note. ** $p < .01$; *** $p < .001$. Symbols of significance are referred to the post-hoc analyses of the main effects of time. Error bars represent the 95% confidence interval of the mean.

3.3. Effects of the 360º video on embodiment, presence, and sickness

A one-sample t-test indicated that embodiment scores were significantly greater than the chance level of 4 for location (M = 5.82, SD = 1.33), $t(43) = 9.04$, $p < .001$, and ownership (M = 5.12, SD = 1.10), $t(43) = 6.79$, $p < .001$, but not for agency (M = 4.28, SD = 1.50), $t(43) = 1.24$, $p = .222$.

Scores on sense of presence (M = 5.23, SD = 1.00) were also greater than the chance level of 4, $t(43) = 8.23$, $p < .001$. Similarly, scores on sickness (M = 4.64, SD = 2.02) were also greater than the chance level of 4, $t(43) = 2.09$, $p = .043$.

4. Discussion

The present study aimed to analyze the effect of 360° video-based VR (vs. a narrative task) on empathy and related concepts (i.e., sense of oneness, perspective-taking, violent attitudes) towards a female victim of SH in a sample of men.

Results showed that both types of tasks led to positive changes in empathy and violent attitudes, compared to baseline. Nevertheless, we found a tendency (marginally significant) to experience higher empathy after the 360º video than after the narrative, but not a less violent attitude. The results for the change in empathy but not in violent attitudes could be explained by the fact that 360° video has a stronger impact on the affective process than on the cognitive one. Compared to empathy, the attitude is a slower and complex process that requires conscious effort, and it is difficult to manipulate after only one intervention[36]. Furthermore, we found a carry-over effect of the 360º video condition. That is, empathy after the narrative was significantly higher when the 360º video was presented before the narrative task rather than after it. This means that the high score on empathy after the narrative is probably because of the immersive experience through the 360º video; future studies can better explain this hypothesis. However, these finding should be interpreted with caution because the internal consistency of these self-reports are limited.

Regarding the sense of oneness and perspective-taking, they were significantly higher after the 360º video than after the narrative task. A carry-over effect was also found on perspective-taking after the narrative because it was higher when the 360º video was presented before the narrative task than when it was presented after it, pointing out the superiority of this technology for increasing perspective-taking. These results confirm previous findings that highlight VR's potential to induce changes in perspective taking and the sense of oneness[11].

An important component that the present study introduces is the embodiment exercise at the beginning of the VR experience. The superiority of 360º video in changing empathy-related variables could be associated with the embodiment with the victim and the sense of presence experienced. However, future research should test this tentative explanation.

Future studies should overcome the limitation of this technology related to the generation of sickness, as previous studies have largely discussed[37,38]. In this study, sickness is caused by the movements of the camera. One possible solution would be to improve the resolution with an apparatus that could better fix the camera to the performer's head.

Limitations of this study should be noted. First, empathy, violent attitude, and perspective-taking were evaluated with *ad-hoc* questionnaires because we did not find any validated questionnaires that test the "state" of these variables (and not the traits). Second, results are only generalizable to a sample of young Mexican men who were motivated to participate in a study aimed at understanding the experience of being a woman. Although the findings are encouraging, considering the high rates of violence towards women in Mexico[39], future studies should replicate these results in other populations (e.g., men in prison, older men, etc.). Third, the narrative task was slightly shorter than the 360º video, and the induction time might be a confounding variable that could explain the results. Fourth, the lack of information about the maintenance of the laboratory results in the mid- and long-term in the participants' daily life.

Despite its limitations, this study opens new possibilities for prevention and treatment of SH towards women. Empathy, perspective-taking, and sense of oneness could be target therapeutic components in interventions designed to decrease SH behaviors through a VR technical tool that is affordable for any clinician. Hence, 360° video seems to be a promising therapeutic tool for addressing SH behaviors.

5. Supplement material

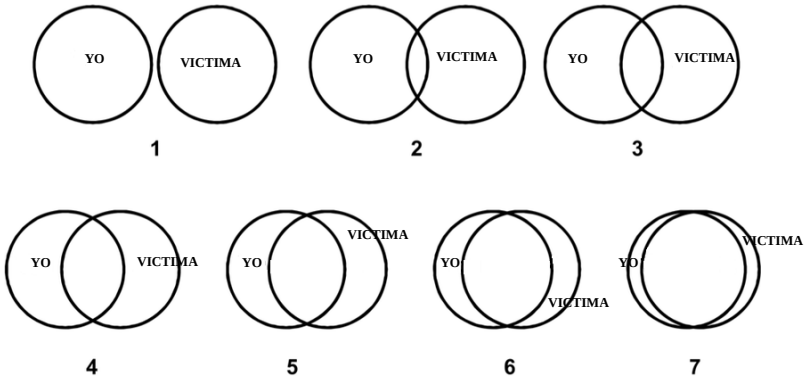
Appendix 1

1) I am aware of how a woman feels when she is being harassed.
2) If I saw a woman alone on the street surrounded by men who were bothering her, I'd help her.
3) I am able to empathize with a woman who has suffered from gender-based violence.
4) Thinking about a woman who is a victim of gender-based violence gives me negative emotions.
5) I think I'm a person who understands women's feelings.

Appendix 2

1) If a man hits a woman only once, it is not a problem.
2) Violent conduct is innate in man; it is part of his nature.
3) I believe that work should be done to prevent sexual harassment.
4) Some types of sexual harassment (e.g. street, political, school, etc.) are not violence.
5) Calling the attention (e.g. shouting, whistling, etc.) of the women on the street is a well-received practice among young people to be part of the group.

Appendix 3



Appendix 4

1) To what extent did you identify with the woman, the victim of harassment, during the experience?
2) To what extent did you see yourself from the perspective of the woman, the victim of harassment, and experience the situation as if you were her?
3) To what extent did you experience the situation as if it were real?
4) Did you ever feel that you were more vulnerable because the character that represented you in the narrative was a woman?
5) To what extent did you feel affectively involved with the feelings of the harassed woman?
6) Did you ever imagine how you would act if you really were a victim?
7) To what extent did you feel worried about what was happening to the woman?
8) To what extent did you understand the woman's emotions while she was being bullied?

Appendix 5

1) I felt as if I were looking at myself. *(ownership)*
2) I experienced the arms of the performer as my own arms. *(ownership)*
3) I experienced the legs of the performer as my own legs. *(ownership)*
4) I experienced the body of the performer as my own body. *(ownership)*

5) I had the feeling that the virtual body belonged to me. *(ownership)*

6) I felt as if I had a female body. *(ownership)*

7) I had the illusion of sitting in the same place as the performer. *(location)*

8) I felt I had control over the arms of the performer. *(agency)*

9) I felt I had control over the legs of the performer. *(agency)*

10) I felt I had control over the body of the performer. *(agency)*

11) I felt as if I were there, inside the environment. *(presence)*

12) I was confused about whether the environment was real or not. *(presence)*

13) Now, when I think of the experience, I think of the environment more as a place I visited than as an image I saw. *(presence)*

14) During the experience, I felt nauseated. *(sickness)*

15) During the experience, I felt disoriented. *(sickness)*

16) During the experience, I felt dizzy. *(sickness)*

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Chapter 7

Become more human: positive changes on empathy and related variables after three months of an intervention

Abstract

Sexual Harassment (SH) has been associated with a limited ability to take the perspective of the others. The current study is three months follow up of a previous one that investigated the feasibility of 360° video to study empathy (and related variables) in men in SH scenario, and compared this intervention with a traditional one. In the original study, results showed that the both interventions with men participants produced positive changes in the empathy state, the sense of oneness and violent attitude. The aim of the present study is to investigate whether psychological dimensions, such as empathy, machismo, alexithymia, and violent attitude, change after three months. Thirty-five men participated in the study, who fulfilled the both conditions (intervention through 360° video based Virtual Reality, and intervention from a traditional perspective narrative) following a counterbalanced method, and fulfilled several questionnaires to measure the psychological dimensions in pre-intervention moment and tree months later. Results showed an increase in empathy, and a decrease in machismo and violent attitude variables. Future directions are discussed.

1. Introduction

Sexual Harassment (SH) is one of the worldwide problems that the society must face (Quick and McFadyen, 2017). SH occurs when people are targets of unwanted sexual comments, gestures, or actions, and women are usually the main victims (Burn, 2019). The SH events happen in private spaces such as at home or at work where, most of the time, the partner or the male job head are the aggressors; or in public places such as in the street, in the public transports, in the library among others (Williams, 2018). The women victims perceive SH to be annoying, humiliating, and intimidating, and it can reduce their sense of safety (Gruber and Fineran, 2016).

The literature on SH underlines that the lack of empathy and, specifically, the lack of perspective taking are associated with the harass behavior (Jolliffe and Farrington, 2004). Empathy is a multidimensional construct consisting of a cognitive component -the intellectual ability to understand another person's emotions while remaining an objective observer-, and an affective component -the state of being affected by and sharing another's emotions- (Harari et al., 2010; Baron-Cohen et al., 2013). Previous studies have shown that men who offend women show less empathy than those who have prosocial behavior (Seidel et al., 2013), and individuals who have low perspective taking ability may misinterpret other people's intentions and feelings (Barnett and Mann, 2013). Due to the enormous penetration of the problem of SH, and the relation with empathy, several programs have been developed to prevent and treat SH behavior (Dowden et al., 2003). Recently, Virtual Reality (VR) has been included as new procedures to study SH (Seinfeld et al., 2018; Steinfeld, 2020).

VR has been defined as the *ultimate empathy machine* since it allows people to experience emotions from another person's point of view (Bailenson, 2018). Extensive research shows that taking the perspective of someone else (i.e., imagining what it would be like to be another person) can be an effective method of promoting empathy and motivating prosocial behavior (Ahn et al., 2013; Peck et al., 2018; Oh et al., 2016; Hasler, et al., 2017; Seinfeld, et al., 2018).

In a previous study we adopted this approach with the 360° video-based VR, and a first-person narrative, to induce men to take the perspective of a women victim of SH. During the perspective exercise, participants were immersed in various SH scenarios, lately were measured their level of empathy and related variables. Results showed significative differences on empathy, perspective taking, and violent attitude variables in both condi-

tions (360° video, and narrative). Specifically, participants achieved higher scores on empathy, and perspective taking, and a lower score on violent attitude after the 360º video and the narrative conditions than at baseline. Furthermore, the 360° video condition showed a significative carry-over effect for the variables of empathy, and perspective taking (see Chapter 6).

The current work aims to test the hypothesis if the changes on empathy and other variables last over time (Day et al., 2010; Herrera et la., 2018). In particular, the present study tests if several psychological variables (empathy, machismo, violent attitude, and alexithymia) change after three months of the intervention, comparing scores on questionnaires obtained in the pre-intervention moment and the months follow-up.

2. Method

All procedures and materials were approved by the Ethics Committee of the Universidad Nacional Autonoma de Mexico (UNAM) with the code EP/PMDPSIC/0151/19.

2.1. Participants

The original sample of the study was 44 men, but 9 abandoned with a final number of 35 participants. The exclusion criteria were: (1) being younger than ≤ 18 years old, (2) having physical problems that could inhibit free movements. (3) history of SH with legal consequences. (4) use or abuse of drugs, and (5) being under psychological treatments. Descriptive statistics for sociodemographic measures are described in Table 1.

Table 1. Descriptive statistics of sociodemographic measures (n = 35)

	M (SD)	**%**
Age	26.31 (7.56)	-
Educational level		
Secondary studies	-	8.6%
Degree	-	71.4%
Master	-	20.0%
History of mental or chronic illness (% yes)	-	11.1%
Alcohol consumption		
Never	-	28.6%
Once per month	-	31.4%
2-4 times per month	-	34.3%
> 2-3 times a week	-	5.%
Legal Problem for Sexual Harassment (% yes)	-	0.0%

2.2. Measures

Machismo-Chivalry: Machismo and Caballerismo Scale (MCS) (Arciniega et al., 2008). This self-report contains 20 items (1 = strongly disagree; 7 = strongly agree) that measures the constructs of "machismo" (power and men's aggressive attitudes) and chivalry (emotional connectedness, honor, and men's nurturance). Internal consistency is adequate for this study: machismo ($\alpha = 0.75$) and chivalry ($\alpha = 0.83$).

Empathetic abilities: Interpersonal Reactivity Index (IRI) (Davis 1980; Pérez-Albéniz et al., 2003). This self-report contains 28 items (1 = strongly disagree; 7 = strongly agree), adapted from the original scale (Davis, 1980). It is composed of four factors: perspective taking, fantasy, empathic concern, and personal distress. Internal consistency is adequate for all the subscales for this study: perspective taking ($\alpha = 0.78$), fantasy ($\alpha = 0.89$), empathy concern ($\alpha = 0.72$) and personal distress ($\alpha = 0.89$).

Alexithymia*:* Toronto Alexithymia Scale (TAS-20) (Taylor et al., 1985; Moral de la Rubia, 2008) This self-report contains 20 items (1 = strongly disagree; 7 = strongly agree) that measure: difficulty expressing feelings, difficulty identifying feelings, and oriented thinking. Internal consistency is adequate for the three subscales for this study: difficulty to explain feelings ($\alpha = 0.89$), difficulty to identify feelings ($\alpha = 0.94$) and extremely externally oriented thinking ($\alpha = 0.70$).

Violent Attitude: Attitude Towards Gender-Based Violence Scale (ATG-S). This is an *ad-hoc* self-report with 5 items (1= not at all; 5 = totally) based on the original scale of Ambivalent Sexism (Glick and Fiske, 2018). Internal consistency is low for this study ($\alpha = 0.57$).

Qualitative measure: This is an open questions questionnaire to explores the impact of the intervention during the three months, and the type of feeling the participants experienced: (Q1) *In these months, have you thought about the sexual harassment study you participated in?*, (Q2) *Have you had any negative thoughts or feelings after your participation to the study?*, (Q3) *Have you had any positive thoughts or feelings after your participation to the study?*, (Q4) *Have you had any strange, unusual or unexpected thoughts or feelings regarding the sexual harassment study you participated in?*, (Q5) *Do you feel that your attitude towards women has changed after your participation to the study?*.

2.3. The perspective-taking tasks: 360° video, and first-person narrative

The 360° video was recorded in different places where different harassment scenarios occur, and it reflects a typical day of a victim of SH. The first scenario is aimed to generate embodiment of the female victim's body, where participants follow the woman's body movements in the video (e.g., move their hands up and down, caress their limbs, and rotate their hands). Then, the video includes daily life activities of the victim (e.g., putting on her shoes, having breakfast, brushing her teeth, preparing her backpack for the university, etc.), and several harassment scenarios that occur in different places such as at university library, in a taxi, at home with the partner, at the metro, and during the way back home (see Chapter 6, Figure 2). The narrative condition consisted of the same story, written from a first-person perspective, but in text format.

2.4. Procedure

The experiment took place at Universidad Nacional Autonoma de Mexico (Mexico City). Participants first signed the informed consent, and answered the baseline questionnaires (MCS, IRI, TAS-20, ATG-S), then they were counterbalanced to the two conditions (360º video and narrative). In both conditions, participants took the perspective of the woman in order to experience what it is like to be a woman victim of harassment from a first-person perspective. In the 360° video condition, participants do first an embodied exercise to give them the illusion to have a female body, and then they simply watch the immersive video for almost 20 minutes. In the narrative condition, participants read the story with the instruction to imagine the content as if it were happening to them, this condition lasted 10 about minutes.

After three months of the study, participants filled again the MCS, IRI, TAS-20, ATG-S questionnaires, and answered to the open questions.

2.5. Data Analyses

The statistical analyses were performed using the SPSS v.26. Paired-simple *t*-tests were conducted to evaluate the difference between pre-intervention, and the 3-months follow up for TAS-20, IRI, MCS, and ATG-S scales. The analysis of the open questions was conducted through the content analysis to identify major categories and subcategories. We primarily identified the conceptual category, and then we created the subcategories. Finally, the general meaning was abstracted (White and Marsh, 2006).

3. Results

3.1. Results for IRI, TAS-20, MCS, and ATG-S scales

Descriptive statistics for IRI, TAS-20, MCS, and ATG-S are shown in Table 2.

A paired-samples *t*-test indicated no significant different for IRI scale: *perspective taking* $t(34) = -1.352$, $p = .185$, $d = .21$, 95% CI (-.368, .074), *fantasy* $t(34) = -1.777$, $p = .085$, $d = 1.20$, 95% CI (-.551, .037), *empathy concern* $t(34) = -.641$, $p = .526$, $d = .19$, 95% CI (-.298, .155), *personal distress* $t(34) = .898$, $p = .376$, $d = .10$, 95% CI (-.156, .404); no significant different for machismo $t(34) = 1.812$, $p = .079$, $d = .27$, 95% CI (-.026, .449). Moreover, results shows no significant different for alexithymia scale for the subscale *difficulty to explain feelings* $t(34) = .281$, $p = .780$, $d = .18$, 95% CI (-.391, .517), and *difficulty to identify feelings* $t(34) = 1.831$, $p = .076$, $d = .22$, 95% CI (-.025, .482), but a significant difference for the subscale *extremely oriented thinking* $t(34) = -4.996$, $p < .001$, $d = .11$, 95% CI (-.618, -.261). Finally, results shows significant difference for violent attitude measure $t(34) = 10.041$, $p < .001$, $d = 1.71$, 95% CI (.807, 1.216).

Table 2. Descriptive statistics of related measures ($n = 35$).

	Baseline (n =35) *M* *(SD)*	**Follow-Up (n = 35) *M (SD)***
Machismo and Chivalry (MCS)		
Machismo	1.96 (0.77)	1.75 (0.60)
Chivalry	5.36 (0.91)	5.36 (0.98)
Empathetic abilities (IRI)		
Perspective taking	4.78 (0.80)	4.92 (0.73)
Fantasy	4.58 (1.02)	4.84 (1.21)
Empathy concern	5.24 (0.83)	5.31 (0.73)
Personal distress	3.21 (1.19)	3.09 (1.26)
Alexithymia (TAS-20)		
Difficulty in express feelings	3.74 (1.54)	3.68 (1.45)
Externally oriented thinking	2.49 (0.73)	2.93 (0.66)
Difficulty in identify feelings	2.95 (1.55)	2.72 (1.39)
Violent Attitude (ATG-S)	2.26 (0.57)	1.25 (0.38)

Note. MCS = Machismo and Caballerismo Scale; IRI = Interpersonal Reactivity Index; TAS-20 = Toronto Alexithymia Scale; ATG-S = Attitude Towards Gender-Based Violence Scale.

3.2. Qualitative results

The percentage (yes/not) for each question are reported in Figure 1.

From the content analysis of the 5 open questions emerged the following thematic, Table 3 shows the percentage of participates include in each category.

3.2.1. Positive Thoughts

After to the study, participants said they feel more empathic toward women. Thanks to the perspective taking exercise did during the study, participants reported that they put themselves in the women perspective, and now they know how women could feel in certain circumstances: "*I feel empathy, and sensible to prevent and act in situations of harassment, I perceive the need and desire to transform the Mexican social reality*" (participant); "*Now, I try to be more empathetic to women*" (participant); "*I feel more empathetic to women's claims, and I think I can at least make a change in my environment*" (participant); "*I like the idea that now I can have this more empathic perspectiv*e" (participant). Moreover, from the analysis emerged the feeling of compassion. Participants answered that thanks to the study they could recognized the situations where women feel uncomfortable, so they try to alleviate their suffer avoiding that behaviours: "*thanks to the study, I was able to capture some scenarios where women feel uncomfortable, and that helps me know when I can help them*" (participant); "*Now I try to understand the violence suffered by the woman, and I try to help them, and to explain them that they are not alone and that they have my support*" (participant). Finally, the study helped participants to be more awareness about the SH problem. After taking the perspective of the victim, they were more aware about what it means to be victim of harassment: "*The experiment gave me the possibility to see another perspective of the harassment situation, it's very easy to listen news about the harassment, but the study helps a lot to be able to see the situation from a woman's perspective. As I'm a man, it is difficult to live these situations unless the study I did helps me"* (participant); "*Before to participate to the study, it was usual for me to look at women, I believed that it was not violent, that it was even normal, among friends we said "see and not eat what sin I will commit" and now I am a little more conscious that it is like to conceptualize the woman as an object*" (participant).

3.2.2. Negative Thoughts

The answers were mostly focused on the sense of impotence of participants to face the SH problems. Participants reported they wanted to do something to improve the women social situation, but they fetl powerless, and alone fighting against the problem: "*I feel I can't do nothing*" (participant), "*I have feelings of isolation and fighting for a mean society*" (participant). Moreover, after taking the perspective of the victim, participants felt sad, and angry because what they perceived during the perspective taking exercise could happen to their family such as sister, niece, or spouse.

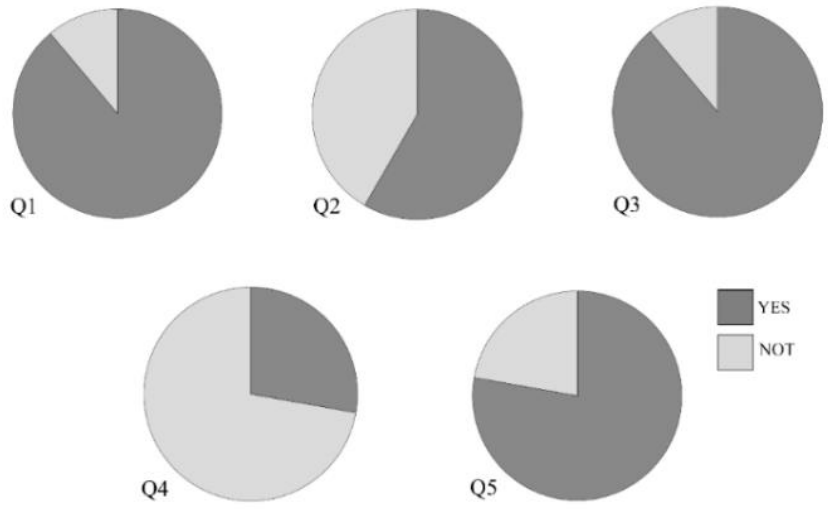
3.2.3. Attitude change

After the intervention, participants said that they revaluated their violent attitude toward women, namely they were more kind, in particular they did not express sexual comments towards women when they were with friends because now they understood how women could feel: "*I keep more attention on my behavior towards women, even in my work I shared readings with other men to understand women perspective*" (participant); "*The experiment helped me to think more about my views and analyze more the situations*" (participant). Another import result emerged from the content analysis is the subcategory of the social activism. After the intervention, participants said that now they were more involve with the feminist movements, they participated to the social manifestation such as the 8th of March, and they gave more value to these initiatives: "*I understand more the objective of the movements from the perspective of the girls who are carrying it on*" (participant); "*now when I see a manifestation I'm for it and I understand why they do it*" (participant).

Table 3. Percentage of emotions experienced by participants and the respective subcategories (N = 35).

Categories Subcategories	***n (%)*** ***%***
Positive Thoughts	31 (100%)
Empathy	52.32%
Compassion	30.25%
Awareness	16.43%
Negative Thoughts	21 (100%)
Awkward (lack of comfort)	23.80%
Sadness	14.33%
Anger	9.5%
Loneliness	14.28%
Helplessness	38.09%
Attitude Change	27 (100%)
Activism	76.42%
Violence	23.58%

Figure 1. Open questions answers.



Note: Q1) In these months, have you thought about the sexual harassment study you participated in? Yes = 88.89%, Not = 11.11%; Q2) Have you had any negative thoughts or feelings after your participation to the study? Yes = 58.33%, Not = 41.67%; Q3) Have you had any positive thoughts or feelings after your participation to the study? Yes = 88.89%, Not = 11.11%; Q4) Have you had any strange, unusual or unexpected thoughts or feelings regarding the sexual harassment study you participated in? Yes = 27.78%, Not = 72.22%; Q5) Do you feel that your attitude towards women has changed after your participation to the study? Yes = 77.78%, Not = 22.22%.

4. Discussion

The SH is an important social problem in many countries. In Mexico, data from the Executive Secretary of the National Public Security System show that in 2016 there were approximately 29,725 investigation files for crimes of femicide (Melgar, 2019). Due to this large penetration of the problem, it is needed to propose and test efficacious solutions for this issue.

The results of the present study show results of a three months follow of a pilot study that investigated the feasibility of an empathy intervention based on the perspective taking mechanism. During the intervention, the change of perspective between men into a women victim of SH was made through the 360° video-based VR system, and a traditional perspective taking task (narrative). In particular, the present study is focused on the change of the dimensional variables such as Empathy, Machismo, Alexithymia, and Violent Attitude, administered during the pre-intervention moment and three months later. The results show no significant differences for empathy, assessed with the IRI (Pérez-Albéniz, 2003).

However, we found a tendency (marginally significant) to the decrease of machismo trait after three months of the study. This is an interesting result because underlines the potential of the intervention based on perspective taking to change male trait (Steinfeld, 2020). Furthermore, this finding should be interpreted with caution because the effect size of the scale is small. Moreover, the results of the machismo could be also moderate by the social and historical situation that Mexico is living with the SH problem. Since several time, and especially during the three months after the study, Mexico City suffered by a feminist movement (Sepúlveda, 2018). The social movement, and the amount of news about the topic, could influence the machismo dimension, and how men perceive the SH. Future studies must take into account the engagement of the participants to feminist campaigns.

Results showed significant differences for the subscale “extremely oriented thinking” of alexithymia scale, this means that participants are now more able to be focused on their thinking and feeling. This result is in line with those obtained from the open questions. From the content analysis emerges that participants are now more awareness about their feeling toward woman in general, and toward their family (spouse, sister, niece) in particular. After three months, participants affirm that they feel closer to women, they understand how women could feel in certain circumstances, and they try to avoid situation that could

induce a woman to feel uncomfortable (e.g. constant look to women, sexual comments with friend, whistle to women). The attention, and empathy toward the women could have helped them to be more focus on their feeling. This result could open future direction of the training of empathy and compassion to improve men self-awareness toward women feeling (Gilbert, 2018).

Regarding the result of violent attitude, it was significantly lower than the pre-intervention moment. This result confirms previous studies that perspective taking could change attitude toward an outgroup over time (Herrera et al., 2018). However, the finding should be interpreted with caution because the internal consistency of the self-report is limited.

Limitations of this study should be noticed. First, the original pilot study follows a counterbalance method, namely to the participants are administered both conditions (VR and narrative), it is not possible to know the specific weight of the two conditions in the observed changes. Future studies should adopt a randomized control trial method to evaluate which condition between the 360° video and the traditional task is better to elicit positive change in empathy and related variables. Second, the effect size was small for most of the measures. Third, the current sample was composed mostly by university students, and future research could be addressed to other populations (e.g., men in prison, older men, etc).

Despite the limitations, the study opens new directions for the mechanism of perspective taking, to develop education programs based on the prevention, and to generate interventions for offenders to face the problem of SH.

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Chapter 8

General Discussion

1. Introduction

The main objective of this doctoral thesis was first, to analyze the efficacy of Virtual Reality (VR) to promote empathy, second to test the feasibility of the 360° video-based VR to generate the body swap illusion from male to female body, and third to study the change on empathy in a male sample through a Sexual Harassment (SH) scenario.

Whit these aims, several studies were conducted. First, a meta-analysis of the efficacy of VR to elicit empathy was carried out. Second, a study to investigate the efficacy of the 360° video-based VR to generate a body swap illusion. Third, the develop of a 360° video-based VR that represent the SH scenario from a female perspective following the User Centered Design (UCD), and the User Experience (UX) methods. Fourth, the 360° video-based VR developed in the previous step was tested to induce the body swap illusion from male to female body, and to investigate the predictive variables that could promote or inhibit the illusion experience. Fifth, the 360° video-based VR of the previous step was adopted to study the change in empathy and the relate variables on male participants from before to after the study. Concretely, two conditions were compared, the 360° video, and a narrative wrote in first person following a counterbalanced method, to test the superiority of the 360° video to increase empathy. Finally, we examined if the study conducted in the previous step has induced positive change in the trait variables after three months of the perspective taking intervention.

This chapter will summarize the main results obtained in this work and then, the strengths and limitations of this dissertation will be discussed. Next, future directions will be pointed out, and finally, a general conclusion of the whole work will be highlighted.

2. Summary of the main findings

The main results obtained in this work will be presented following the research questions that the doctoral thesis was intended to respond.

Is the VR an efficacious medium to elicit empathy?

Chapter 2 presented a meta-analysis with the objective to investigate if VR could significantly change empathy score from before to after the exposition, among different context, and population. As far as we know, this is the first meta-analysis that try to answer to this question.

According to the literature, empathy can be divided into cognitive empathy -intellectually understanding another person's emotions and mental state-, and emotional empathy -being affected by and sharing another's emotions- (Harari et al, 2010). So far, several studies have found interesting results when using VR to generate an empathic response, such as inducing helping behavior (Ahn et al., 2013), reducing domestic violence (Seinfeld et al., 2018), reducing implicit racial bias (Peck et al., 2013), reversing in-group bias (Hasler et al., 2017), and decreasing prejudice (Oh et al., 2016), thus opening the door to new investigations of empathy, and VR. However, VR also received the critic if it really could be a crucial medium to elicit empathy because empathy is more than simply embody or take the perspective of a person in a digital media (Andrejevic and Volcic, 2019).

The meta-analysis contained in chapter 2 included 7 articles that investigated the change on empathy from before to after the exposition in VR. The total sample included in this work was 335 participants, with a mean age of 31.7. Sample size of the included studies varied considerably, ranging from 16 participants to 65 participants.

Results reveal statistically significant positive changes in perspective-taking outcomes (p=0.006) after VR exposure, with a mean effect size of (d+=0.51 [95 percent CI: 0.15–0.88]) but they did not note in empathy (p=0.482), with a mean effect size of (d+=0.21 [95 percent confidence interval, CI: -0.37–0.79]). Two of the studies included in the meta-analysis have the objective to improve awareness of the dementia symptoms through a VR environment that lead to experience how living with dementia is (Adefilia et al., 2016; Wijma et al., 2018), and another study had the goal to improve empathy toward patients with schizophrenic spectrum disorder (Formosa et al., 2018). One study adopted VR to train empathy in medical staff where participant interacted with a virtual patient diagnosed with breast cancer (Raij et al., 2009). The author Bouchard (2013) adopted VR perspective taking to study the difference in empathy between known and unknown virtual agents. These studies are based on the sense of presence in VR (Sanchez-Vives and Slater, 2005), namely the participants took the perspective of the protagonist in VR, but they did not embody someone else. On the other side, two of the studies included in the meta-analysis used the paradigm of the embodiment, namely participants embodied the avatar in VR. The authors Van Loon (2018) studied the change on empathy score between direct and indirect empathy depending if the avatar embodied was in first or in third person (Van Loon et al., 2018). In another study, the participant embodied a 4 years old child with the objective to help parents to understand what it feels to be a child (Hamilton-Giachritsis et

al., 2018). All these studies demonstrated significative change in empathy and/or perspective taking from before to after the exposition in VR.

In sum, this study indicate that VR is an efficacious medium to tendency elicit empathy. Eliciting empathy through VR is a research field that is grown exponentially, and the results of the analysis provide evidence that VR tasks may be more effective at improving attitudes towards specific social targets and motivating prosocial behavior, compared to traditional interventions adopted so far.

Could the 360° video-based VR be an efficacious instrument to induce the sense of body illusion?

According to Longo (2008), the sense of embodiment occurs if three factors are achieved: (a) the sense of self-location, which refers to a certain volume of space where people feel located with their body; (b) the sense of agency, which refers to the sense of having conscious motor control, as in action, intention, and motor selection; and (c) the sense of body ownership, which refers to one's self-attribution of the body (Longo et al., 2008). In the past decade, several studies have adopted VR to study and manipulate the sense of embodiment, giving to participants the illusion to have another body (Ehrsson, 2007; Haans and Ijsselsteijn, 2012; Banakou et al., 2016; Bertrand et al., 2018).

Chapter 3 of this dissertation aimed to analyze the feasibility of the 360° camera to generate the sense of embodiment. In particular, the objective was to investigate whether a pre-recorded video of some body movements could induce the illusion to participants by simply following the movements of the video. Two conditions were compared with 21 participants por group: a 3D recorded video display on the Head Mounted Display (immersive condition), and a 2D recorded video display on a Computer Desktop (non-immersive condition), to analyze the influence of immersion in inducing the illusion. The 360° videos were recorded with the LG360-105 camera. During the video recording, the performers wore the 360° camera on the head to generate the first-person perspective and made a set of movements (e.g. move the hands or legs up and down, caress their limbs, and rotate their hands). At the end of the video, a yellow ball was suddenly thrown to the performer's right hand to evaluate the haptic sensation. The video lasted almost 4 minutes. Participants were evaluated with the Embodiment questionnaire (Longo, 2008), and the Hearth Rate Variability (HRV) measure (Laborde et al., 2017).

Results of the embodiment questionnaire revealed significant differences between conditions for all the subscales: ownership, $p = .003$; agency $p < .001$; and location, $p =$

.013. Moreover, the factor haptic sensation was also significant, p = .027; results showed no significant different in the HRV for all the limbs: hands, p = .162, legs, p = .521, and arms, p = .362.

The finding of this study demonstrated that the 360° video-based VR could be an efficacious instrument to induce the sense of embodiment, and underlined the potentiality of a new cost-efficacy instrument to induce the body illusion compared to the other embodied technologies present in the market.

What is the suitable method to develop a 360° scenario of sexual harassment centered to the final user?

Chapter 4 is focused on the Human Computer Interaction (HCI) method to develop a 360° scenario. The objective of the HCI is to design interactions between users and hardware with a high usability (Card, 2018). One important approach of the HCI is the User Centered Design (UCD), based on the active involvement of the potential user of the technology designed, with the aim to improve the usability of the product or the service itself (Norman, 1986; Mao et al., 2005). Consequently, the User Exeprience (UX) includes individual preferences, and psychological and behaviors responses toward the use of the product with the goal to improve the product itself (Kolski et al., 2011).

Study 1 of this chapter aimed to collect ideas and information from women about the harassment behavior that happen in Mexico City. For this, two focus groups were conducted with Mexican women who voluntary participated at the discussion. The first focus group was composed by 10 women (M_{age} = 26 years old; SD = 6.60) and the second one by 6 women (M_{age} = 30 years old; SD = 8.15), that matched the inclusion criteria to be an older woman ≥ 18 and do not have been victim of sexual abuse. From the results of the groups discussion emerged various scenarios that later were recorded with the 360° camera (LG360-105) from the woman perspective. The first frame of the video (almost 2 minutes) consisted in some female body movements with the goal to induce the future male participants to embody the female body. Then, the video was composed by several SH scenarios, for example: harassment at university, in the taxi, in the metro, at home with the spouse, among others.

Study 2 tested the user experience of the 360° video. A total of 10 participants took part at the study: 3 women and 7 men (M_{age} = 25.70, SD = 5.56), and they were evaluate with the Motion Sickness questionnaire (Gianaros et al., 2001), the Simulator Sickness questionnaire (Kennedy et al., 1993), and an open questions about the experience. During

the experiment, participants sat on the wheelchairs and watched the entire 360° video (25 minutes almost), then they answered the evaluation. Results showed that the scores in cybersickness were significantly lower than the chance level of 2 for both factors: nausea, $p < .001$, and oculomotor, $p < .001$. However, the results for the motion sickness scores were significantly lower than the chance level of 2 for the factors: gastrointestinal, $p < .001$, peripheral, $p = .005$ and tolerance-related, $p < .001$, but not for the factor central, $p = .51$. From the analysis of the open questions emerged that what most caused the sickness is the movement of the video. Then, we edited again the video to increase the usability.

In sum, through this chapter, we intended to demonstrate the efficacy of the UCD method to develop a VR environment. Thanks to this method we developed an environment that first reflect the reality of Mexico City about the SH problem, and second that the video could been comfortable as much as possible for the user.

Could the 360° video-based VR be an efficacious instrument to induce the body swap illusion? If yes, what are the predicted variables, and the role of the sense of presence?

After demonstrated in Chapter 3 that the 360° camera could generate the sense of body illusion, and after developed in Chapter 4 a 360° video on SH, Chapter 5 aimed to investigate the feasibility of the immersive video of SH to generate the body swap illusion from male to female body. Furthermore, the chapter aimed to explore whether trait psychological variables involved in the SH (i.e., machismo, chivalry, alexithymia, empathetic abilities), and the sense of presence might cause either a resistance or a predisposition of men to be embodied in a woman victim[11].

Forty-four men participated to the study according to the inclusion criteria: (a) having physical problems that could inhibit free movements (e.g., back or neck pain); (b) history of SH with legal consequences; (c) use or abuse of drugs; and (d) receiving psychological treatments at the time of the study. Participants were evaluated through the Interpersonal Reactivity Index (IRI) (Pérez-Albéniz et al., 2003), Toronto Alexithymia Scale (TAS-20) (Moral de la Rubia, 2008), Machismo and Caballerismo Scale (MCS) (Arciniega et al., 2008), Embodiment (Longo et al., 2008), Presence (Usoh et al., 2000), and Sickness Experience (Kennedy et al., 1993) questionnaires. The 360° video used in the study was the same developed in the previous chapter. Before watch the video, participants filled the

[11] The study reported in this chapter is part of the main study reported in chapter 6.

IRI, TAS-20, and MCS scales, and after the video they answered to the embodiment, presence, and sickness questionnaires.

Results indicated that embodiment scores were significantly greater than the chance level of 4 for location, $p < .001$, and ownership, $p < .001$; but not for agency, $p = .222$. Scores on sense of presence were also greater than the chance level of 4, $p < .001$. Similarly, scores on cybersickness were also greater than the chance level of 4, $p = .043$. The results of the analyses of the predictor variables have shown that machismo was a significant negative predictor of the location (embodiment), $p < .001$, and that the difficulty in expressing feelings (alexithymia) was a significant positive predictor of the location, $p < .001$, as well as the perspective-taking (empathic ability) was a significant positive predictor of the location, $p < .001$. In addition, sense of presence was a significant predictor for the agency factor (embodiment), $p = .033$.

The present study permitted to answer to our question that the 360° video could induce the body swap illusion for the factor of ownership, and location, but not for agency. This could be explained because participants must synchronize their body movements with the movements of the performer watched in the video, and this could have caused asynchrony between the movements (Petkova, 2008). Moreover, the factor machismo demonstrated to be a negative predictor for inducing the body's illusion. One possible explanation is that, due to the machismo trait, participants could have perceived the environment as hostile, and this prevented the participants to engage with the virtual experience (Steed et al., 2018). Likewise, the alexithymia factor demonstrated to be a positive predictor for the induction of body illusion (Grynberg and Pollatos, 2015). One possible explanation is that people with strong alexithymia trait have a low interception ability, by the consequence, it is easy for them to embody another body.

In sum, this study underlined first the potentiality of the 360° video to induce the illusion of body swap, and second the importance to consider the psychological trait before to adopt a VR environment for clinical purpose.

Is the 360° video-based VR an efficacious medium to elicit empathy?

In chapter 2 we presented a meta-analysis that demonstrated the efficacy of VR to significantly change empathy from before to after the exposition. Lately, first we proved the efficacy of the 360° video-based VR to induce the body illusion (Chapter 3), second to developed 360° video-based VR on SH following the UCD (Chapter 4), and third to use the previous video to induce the body swap illusion from male to female body (Chapter 5).

Chapter 6 aimed to investigated if the 360° video-based VR developed in chapter 4, and also studied in chapter 5, could change empathy and related concepts (e.g., violent attitude, perspective taking, sense of oneness), towards a woman victim of Sexual Harassment (SH) in a sample of men.

SH is a worldwide problem which targets women with unwanted sexual comments, gestures, or actions (Burn, 2019). Previous studies have found that the lack of empathy and, specifically, the lack of perspective taking are associated with aggressive behaviors, including SH (Jollife et al., 2004). Recently, the 360° video-based VR has proved to be effective to increase empathy in several contexts such as intergroup conflicts (Steinfeld, 2019), improving communication in healthcare professions (Buchman et al., 2019), or creating a connection with nature (Breves and Heber, 2019). In the present study, two conditions were compared: a 360° video (VR task) and a narrative (traditional perspective-taking task), through a counterbalanced within-subject design.

Forty-four men participated to the study and they were evaluated through the Machismo and Caballerismo scale (MAC) (Arciniega et al., 2008), the Interpersonal Reactivity Index (IRI) (Pérez-Albéniz et al., 2003), the Alexithymia Toronto scale (TAS-20) (Moral, 2008), the Social Deseability scale (SDS) (Ferrando and Chico, 2000), the empathy scale *ad-hoc* (ES), the Attitude Towards Gender-Based Violence scale (ATG-S) (Glick and Fiske, 2018), the Inclusion of Other in the Self Scale (IOS) (Aron et al., 1992), the Perspective-Taking scale *ad-hoc* (PT-S), and the embodiment, presence, and sickness scales (Longo et al, 2008; Usoh et al., 2000). As the study follow the counterbalanced method, all participants were administered both conditions, 360° video and narrative, namely 22 participants passed first to the 360° condition, and then to the narrative, and 22 participants vice-versa, following a random method.

The results of the ANOVA analyses demonstrated that there was a significant difference in empathy between baseline, 360º $p < .001$, and narrative $p < .001$ conditions. However, significant differences were found after the narrative depending on the order of the presentation, $p = .030$, because the scores were higher when the participant received the narrative after the 360º video rather than before it. Also, there was a significant difference between the baseline, and the 360º conditions $p < .001$, and narrative $p < .001$ for the sense of oneness. Moreover, perspective-taking after the narrative was higher when it was presented after the 360º video rather than before it, $p = .012$.

In conclusion, this study demonstrated that both conditions, 360º video and narrative, were effective in inducing a positive change in empathy, and the sense of oneness toward

the victim of SH, and in reducing violent attitudes. Moreover, the 360º video showed a significant carry over effect for the variables of empathy, and perspective taking. Specifically, the 360° video could be more powerful than the narrative in inducing change; hence, this immersive technology seems to be a promising therapeutic tool for addressing SH behaviors.

Could the change on empathy last over time?

Chapter 7 aimed to investigate if the psychological variables (e.g. empathy, machismo, violent attitude, and alexithymia) measured during the screening of the study presented in chapter 6, change after three months of the intervention. Specifically, we compared scores on questionnaires obtained in the pre-intervention moment and the three months follow-up.

Thirty-five participants took part at the study (9 abandoned) and they answered to the traits questionnaires of the previous study (MAC, IRI, TAS-20, ATG-S), and five open questions that investigate the impact of the study.

Results showed no significant difference between the baseline and the follow-up for empathy scale: perspective-taking, $p = .185$, fantasy, $p = .085$, empathy concern $p = .526$, and personal distress $p = .376$., neither for machismo $p = .079$. However, results showed significant difference for the factor externally oriented thinking of alexithymia**,** $p < .001$, and for violent attitude, $p < .001$. Furthermore, from the qualitative analysis emerged that participants reflected about the study over the three months. Participants argued that, thanks to the study, they now better understand the women's perspective, and try to be more empathetic. Moreover, participants stated that they now can recognize the circumstances in which women may feel uncomfortable, so they try to prevent those actions, and to help women in the harassment situations.

To sum, the study of perspective-taking through the 360° video, and the narrative, demonstrated to be an efficacious intervention to increase empathy in men, to become more aware toward the SH problem, and to prevent it.

3. Strengths

This doctoral thesis has several strengths that are worth to highlight in order to fully interpret the main findings:

Methodology

This doctoral thesis is composed by different studies which have followed high methodological standards. Through a rigorous methodology, the meta-analysis presented in Chapter 2 served as a starting point to the subsequent studies of this dissertation. It followed the PRISMA guidelines and we used a rigorous methodology to shed light on the efficacy of the VR technology to significantly change empathy. Chapter 3 contributed, with a randomized method, to underline the feasibility of the 360° technology to induce the body illusion. Chapter 4 followed the User Centered Design method to develop the 360° environment on SH, considered a valuable methodology to develop a VR scenario taking the users in the mind (Mao et al., 2005; Hassenzahl and Tractinsky, 2006). Chapter 5 carried out the regression analysis to know what are the personal traits that could promote or inhabit the sense of body illusion. According to our knowledge, to date the measurement of the sense of embodiment was based only in external factors such as the VR systems adopted, the avatar embodied, the virtual environment among others, but the inner-user variability remained poorly researched (Dewez et al., 2019). Chapter 6 presented a counterbalanced method to carry over the effect of the presentation of the conditions, the 360° video, and the narrative (Chalikias, 2019). To finish, Chapter 7 presented results of the follow up study that measured the traits variables, not evaluate immediately after the study because they are hard to change in short time.

Moreover, all the studies presented in this doctoral thesis were approved by Ethics Committee of the University of Valencia (Spain), with registration number: H1547116450036, and by the Universidad Nacional Autónoma de México (Mexico), with registration number: EP/PMDPSIC/0151/19.

Novelty and originality

This dissertation involved novel researches in several aspects, according to our knowledge, and the literature published so far. First, we made the first meta-analysis that investigate the efficacy of VR to positively change empathy from before to after the exposition. Second, we made the first study that evaluate the feasibility of the 360° video-based VR to induce the sense of body illusion. Third, we investigated the predicts variable that promote or inhabit the sense of embodiment, poorly researched so far. Finally, we investigated the feasibility of the 360° video-based VR of SH in first-person perspective to study the change in empathy, and if it lasted over time.

It is also important to highlight that in this doctoral thesis we used the 360° camera to develop the studies. This is an affordable, and practice technology with an enormous potential to bring the VR intervention outside the laboratory. What the patient only needs, it is a low-cost Head Mounted Display to support the smartphone for the immersive experience. On the contrary of the VR technologies present in the market such as the Oculos Rift or the HTC Vive that are more expensive, and not everyone could have at home.

Relevant results

This doctoral thesis provided significative results. First, the meta-analysis in Chapter 2 demonstrated significative scores for the variables of empathy and perspective taking that positive change after the exposition in VR. Second, Chapter 3 demonstrated significant difference between the 360° video, and the non-immersive video to induce the sense of body illusion. Third, Chapter 6 showed a significant carry over effect for the 360° video condition compared with the narrative condition to change empathy and perspective-taking from before to after the experimental session.

Practical implication

This dissertation involved research in a novel field in experimental and clinical psychology, which fills an important gap in a field in the scientific literature where several authors have pointed to the need for more research, in particular the intervention for sexual violence. Moreover, considering the thematic of SH, this dissertation had point out for *whom* the paradigm of embodiment will better work, and for *whom* is recommendable a psychoeducation before the exposition.

Multidisciplinary

This doctoral thesis embraced technological, and psychological aspects. We examined the potentiality of an innovative immersive technology, the 360° camera, to induce the body illusion through the Unity program (Chapter 3), and the VR Player from the smartphone (Chapter 5), evaluating, at the same time, the psychological mechanisms that influence the embodiment paradigm. Moreover, we studied the change in empathy variable through the mechanism of VR perspective-taking, highlighting the important relation between psychology and technology.

Multiculturality

This doctoral thesis embraced studies realized in two different countries, Spain, and Mexico. The SH study was developed in Mexico City during the exchange program of the PhD, and we decided to make this study due to the relevant problem of sexual violence against women present in Mexico City.

4. Limitations

This work has also limitations that should be discussed. After the individual limitations of the different studies already discussed in previous sections, some general limitations of this dissertation can be pointed out:

Methodology

Participants: The studies presented in this doctoral thesis had small samples. Moreover, the participants were mostly University students, so the findings are not completely generalizable to other population. In particular, the studies based on SH (Chapter 5, 6 and 7) were developed with no clinical participants and being sexual offenders with legal consequence was an exclusion criterion. Consequently, the findings are not completely generalizable to the clinical population, particularly for Empathy, Machismo, Alexithymia, or Violent Attitude.

Setting: The studies were carried out in a laboratory context, not in a clinical context, which represents a threat to external validity, the extent to which the causal relationship can be generalized. Moreover, the studies were carried out with a highly homogeneous and selected sample such as meeting specific inclusion and exclusion criteria, in which the individuals had to carry out tasks that were "simulating" the techniques used in a clinical context.

Instruments: The study presented in Chapter 6 presented two *ad-hoc* questionnaires with limited internal consistency, so the finding should be interpreted with caution. Furthermore, the Interpersonal Reactivity Index (Davis, 1980) is the most used empathy questionnaire by the previous literature to evaluate the change of the variable. Unlikely, there is not a validate empathy questionnaire that measure the state and not the trait of empathy.

The apparatus and the 360° environment: The 360° video used in this doctoral thesis have several limitations. First, the camera adopted was the LG360-105 camera and it is a 2K with low resolution. Second, the 360° video used in Chapter 6 caused sickness to participants because it was long, 25 minutes, and it had not an excellent edit work, so the

frames were unstable and not clear at all. Moreover, the environment was not validated, hence, the data should be considered carefully because it was the first time that this environment was adopted for a study.

Within-subjects design: The study included in Chapter 6 (and the follow-up in Chapter 7) was a within group study, so all participants were administered both conditions (Charness et al., 2012), consequently the study did not have a control group.

Social influence

The study of SH included were carried out in Mexico City where there were various feminist movements against the sexual violence. During the study, the Universidad Nacional Autónoma de Mexico was completely occupied by the *feminist* for a couple of weeks, and for some students was impossible to enter the university, and some professors were obligated to interrupt the lessons. Those events happening in the city, probably compromised the results of the study (www.dgcs.unam.mx).

5. Future directions

Science grows continuously: answers provided by previous research lead to new research questions, and so on. This dissertation helped to answer some of the questions about the efficacy of VR to elicit empathy. In this dissertation was underline that VR can and should be used to put people together (Granados, 2018), and to make people care about groups such as the refugee, the homeless, and those with physical and mental impairments (Shin, 2018); in few words, VR should have the ability to generate intense feeling of empathy (De la Peña et al., 2010). However, much more is still unknown and further research is needed, below we present some questions that could address future studies.

Does the change in empathy last over time?

The majority of the study included in the meta-analysis reported change in empathy from before to immediately after the exposition in VR, but the research that investigate if the change last over time is lack (Herrera, 2018). It would be interesting to study if the intervention trough VR perspective-taking could have long term effect in empathy.

Do the levels of immersion, and interactivity of VR moderate the empathy score?

It is still uncertain if the technology could be a moderator variable that might influence the efficacy of VR to elicit empathy. Chapter 2 presented a meta-analysis on this field, but

due to the low numbers of articles included, it was not possible to analyze the technologies adopted by the different studies as moderator variable. Previous literature showed that the sense of immersion, and the interactivity in VR are important factors to induce a high sense of presence to participants (Mütterlein and Hess, 2017). Consequently, could these factors even moderate the empathy score? Future meta-analysis should better investigate this point.

Could the body illusion through the 360° video-based VR be efficacy for clinical purpose?

It would be interesting to test the feasibility of the 360° video-based VR to generate the sense of body illusion for specific population. Chapter 3 demonstrated that this technology could induce the sense of embodiment (Longo, 2008), however this paradigm was adopted, so far, only in laboratory context but not in psychological intervention. Previous study adopted this paradigm for eating disorder (Serino et al., 2016), it would be interesting to use it even for other psychological disorder, for example, for specific phobia such as animals (e.g. cockroaches, spiders, dogs, cats among others). Future studies should better investigate the potentiality of the embody paradigm for clinical purpose.

Could the studies be generalized?

It would be interesting to replicate the studies (Chapter 3, 5 and 6) with a larger number of participants. Moreover, it would be interesting to replicate the study with other population. For example, for the development of the virtual environment presented in Chapter 4, it would be interesting to include in the focus group the victim of SH, and to develop, through their testimonies, an environment that reflect the assault. In this way, the virtual environment recorded in first-person perspective could be used both, as an environment for the treatment of the post-traumatic stress disorder of women victim of SH, as well as for the empathy training of sexual offenders. Furthermore, it would be interesting to replicate the study with sexual offenders because in the study reported in Chapter 6 it was an exclusion criterion.

Does the clinical intervention influence the sense of body illusion?

It would be interesting to test whether man embodying a female body after receiving a psychoeducation about the gender equality would have a greater effect on the sense of body illusion. As demonstrated in Chapter 5, participants with higher machismo score have

lower ability to embody the female body. This study would give us valuable information about whether it is feasible to include some strategies as part of the sexual violence therapy.

Does the social/cultural context moderate the outcomes of the study?

Future study should consider the social and historical period in which the study is developed. During the study presented in Chapters 6 and 7, Mexico City lived a *feminist movement* period, namely there were various protests from women against sexual violence, and for a couple of weeks during November 2019, February and March 2020[12], the University was occupied by the feminist. This social movement could have influenced the study, and future studies should probably consider the engagement of men in social problem as moderator variable.

Is it needed a cultural adaptation of the VR environment to replicate the study in other countries?

The 360° environment was tested only in Mexico City, it would be interesting to test it even in other countries, such as in Spain or Italy, and evaluate if the cultural contest could influence the study. The video recorded in Mexico City reflects a reality that is completely different from other countries, and a question arise: Is the cultural factor of the virtual environment a crucial aspect for the efficacy of the treatment on sexual violence? Future studies should answer to this question. Moreover, future studies based on 360° video should improve its quality. During the exposition, participants suffered the cybersickness due to features of the frames, and the instability of the camera during the recording.

What the next?

Finally, it is highly necessary to continue to study the mechanisms underlying the embodiment, and the change of perspective to promote empathy. Only a comprehensive theoretical framework will allow us to perform effective therapeutic interventions, and only controlled studies will provide appropriate responses.

[12] The months before the follow up presented in Chapter 7.

6. Conclusions

In conclusion, this doctoral thesis contributed to the knowledge of the efficacy of VR to elicit empathy, and to answer the novel questions about the paradigm of the body illusion through an innovative immersive technology, the 360º video-based VR, and how it could work to change empathy in sexual harassment intervention. Concretely, it produced the following results:

- VR could be an efficacious medium to elicit empathy, and perspective taking from before to after the exposition.
- The 360º video-based VR could be an efficacious instrument to induce the sense of body illusion, and the body swap illusion from male to female body.
- The involvement of the final users in the VR develop process is an important step to create environment for clinical purpose.
- The 360º video-based VR could be an efficacious instrument to change male perspective into the female one in the SH scenario, and to carry-over the effect in empathy, and perspective taking score, compared to traditional perspective-taking task.
- The intervention on perspective taking through the 360º video-based VR, and a narrative, could be an efficacious mechanism to generate long term effect in empathy.

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Annexes

1.Annex 1. Ethic Committee approval University of Valencia

VNIVERSITAT DE VALÈNCIA Vicerectorat d'Investigació

D. José María Montiel Company, Profesor Contratado Doctor del departamento de Estomatología, y Secretario del Comité Ético de Investigación en Humanos de la Comisión de Ética en Investigación Experimental de la Universitat de València,

CERTIFICA:

Que el Comité Ético de Investigación en Humanos, en la reunión celebrada el día 7 de marzo de 2019, una vez estudiado el proyecto de investigación titulado:
"Tne potentiality of 360º Technology to induce full body Illusion", número de procedimiento H1547116450036,
cuya responsable es Dña. Rosa Mª Baños Rivera,
ha acordado informar favorablemente el mismo dado que se respetan los principios fundamentales establecidos en la Declaración de Helsinki, en el Convenio del Consejo de Europa relativo a los derechos humanos y cumple los requisitos establecidos en la legislación española en el ámbito de la investigación biomédica, la protección de datos de carácter personal y la bioética.

Y para que conste, se firma el presente certificado en Valencia, a once de marzo de dos mil diecinueve.

Av. Blasco Ibáñez, 13 tel: 9638 64109 vicerec.investigacio@uv.es
València 46010 fax: 9639 83221 www.uv.es/~serinves

2. Annex 2. Ethic Committee approval Universidad Nacional Autónoma de México

VNIVERSIDAD NACIONAL
AVTÓNOMA DE
MEXICO

Estudios de Posgrado
Programa de Maestría y Doctorado en Psicología
Coordinación

Folio: EP/PMDPSIC/0151/19
Asunto: Comité de Ética

SARA VENTURA
ALUMNO (A) DE DOCTORADO
PROGRAMA DE MAESTRÍA Y DOCTORADO EN PSICOLOGÍA
P R E S E N T E

Por medio de la presente hago llegar a usted el dictamen de la **Comisión de Ética**, asignada por el Comité Académico de este Programa, sobre el protocolo de investigación **"**Evaluación de un procedimiento basado en tecnología inmersiva con cámara 360° para estudiar el sentido de empatía en comparación con un procedimiento tradicional en población mexicana. Un estudio exploratorio para enfrentar el problema del acoso de género**".**

Consideraciones:

Las normas éticas de la APA (Ethical Principles of Psychologists and Code of Conduct // http://www.apa.org/ethics/code/index.aspx), señalan 5 principios generales básicos, a saber: 1. Beneficiar y no perjudicar, 2. Fidelidad y responsabilidad, 3. Integridad, 4. Justicia y 5. Respeto a las personas y la dignidad. No se oberva que el proyecto de investigación sometido a dictamen viole alguno de ellos.

En virtud de lo anterior la comisión no aprecia que haya elementos de objeción ética para impugnar el protocolo de investigación utilizado, por lo que emite un DICTAMEN FAVORABLE para su realización.

Sin otro particular por el momento, envío a usted un cordial saludo, reiterándole mi más alta consideración académica y personal estima.

A t e n t a m e n t e
"POR MI RAZA HABLARÁ EL ESPÍRITU"
Ciudad Universitaria, CdMx a 18 septiembre de 2019.
LA COORDINADORA

DRA. SARA EUGENIA CRUZ MORALES

c.c.p. Dr. Georgina Cárdenas, Tutor principal
c.c.p. Comité de Ética

Unidad de Posgrado, edificio B, oficina B-105
Voz: 56 23 02 22 ext.: 80002

UNAM POSGRADO Psicología

3. Annex 3. Chapter 3: Informed consent

DOCUMENTO DE CONSENTIMIENTO INFORMADO

Y COMPROMISO DE CONFIDENCIALIDAD

1. INFORMACIÓN AL SUJETO DE EXPERIMENTACIÓN.

El proyecto de investigación para el cual le pedimos su participación se titula:

"The potentiality of 360 Technology to induce full body illusion – La potencialidad de un sistema de tecnología 360 para inducir la ilusión corporal."

Para que usted pueda participar en este estudio es necesario contar con su consentimiento, y que conozca la información básica necesaria para que dicho consentimiento pueda considerarse verdaderamente informado. Por ello, le ruego que lea detenidamente la siguiente información. Si tuviera alguna duda exprésela, antes de firmar este documento, al investigador principal del proyecto, bien personalmente, bien a través del teléfono o por correo electrónico. Los datos del investigador principal del proyecto aparecen también en el presente documento.

La información básica que debe conocer es la siguiente:

a) *Objetivo del estudio*: validar un nuevo sistema de tecnología 360 para inducir la ilusión corporal.
b) *Metodología a utilizar para el estudio, tipo de colaboración que se espera de usted y duración de dicha colaboración*: el estudio requiere una participación de 15 minutos aproximadamente por participante. El estudio está basado en mirar un video 360 y hacer algunos movimientos con los brazos y piernas. Si el participante tiene dolor en algunos miembros, se requiere de avisar el investigador antes del estudio. El participante deberá contestar un cuestionario sociodemográfico y uno de experiencia corporal. Además, el participante, durante toda la durada del estudio, debe ponerse una banda de frecuencia cardiaca.
c) *Procedimientos:* el participante, una vez firmado el dicho consentimiento informado, es invitado a sentarse a una silla del laboratorio y seguir las instrucciones del investigador. El participante observará un video y hará algunos movimientos con los brazos y piernas. Durante la durada del estudio, el participante se pondrá una banda de frecuencia cardiaca y, una vez acabado el video, compilará un cuestionario de experiencia corporal.
d) *Posibles molestias y riesgos de su participación en el estudio*: de acuerdo con el conocimiento existente, el protocolo utilizado en este estudio no implica un riesgo para su salud.
e) *Beneficios que se espera obtener con la investigación*: los resultados de este proyecto de investigación pueden contribuir a la mayor comprensión de los procesos de "encarnación" y su tecnología de investigación.

f) *Posibilidad de retirada en cualquier momento y consecuencias*: Usted puede retirarse del proyecto en cualquier momento firmando la revocación del consentimiento que se incluye al final del documento. Su retirada no tendrá ninguna consecuencia negativa para usted, y será aceptada sin problemas por el equipo investigador.

g) *¿Qué institución lo realiza?*: Se realiza en la Universitat de València.

h) *Gratuidad por la participación*: no percibirá ninguna compensación económica o de otro tipo por participar en esta investigación. La información no será vendida o distribuida a terceros con fines comerciales.

i) *Previsión de uso posterior de los resultados*: los datos que se deriven de la participación pueden ser utilizados con fines de investigación, estudio y publicación, salvaguardado siempre el derecho a la intimidad y el anonimato.

j) *Datos de contacto del investigador principal para aclaraciones o consultas*: si necesita cualquier aclaración, contacte con la investigadora principal del proyecto, Rosa Mª Baños Rivera, en el teléfono 96 386 44 12 o en la dirección de correo electrónico banos@uv.es

k) El proyecto se realizará siguiendo los criterios éticos internacionales recogidos en la Declaración de Helsinki.

2. COMPROMISO DE CONFIDENCIALIDAD.

Los datos serán tratados de forma confidencial, siguiendo para ello las medidas y niveles de seguridad de protección de los datos personales exigidos por la Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal y su normativa de desarrollo.

3. CONSENTIMIENTO.

En el caso de que el sujeto de experimentación sea mayor de edad:

Don/Doña

_____

___

mayor de edad, titular del DNI : _____, por el presente documento

manifiesto que:

He sido informado/a de las características del Proyecto de Investigación titulado: “The potentiality of 360 Technology to induce full body illusion – La potencialidad de un sistema de tecnología 360 para inducir la ilusión corporal.”

He leído tanto el apartado 1 del presente documento titulado “información al sujeto de experimentación”, como el apartado 2 titulado “compromiso de confidencialidad”, y he podido formular las dudas que me han surgido al respecto. Considero que he entendido dicha información.

Estoy informado/a de la posibilidad de retirarme en cualquier momento del estudio.

En virtud de tales condiciones, consiento participar en este estudio.

Y en prueba de conformidad, firmo el presente documento en el lugar y fecha que se indican a continuación.

Valencia, _____ de _____ de 20___.

Nombre y apellidos del / de la participante: Firma:	Nombre y apellidos del padre, madre o tutor (en el caso de menores o incapaces): Firma:	Nombre y apellidos del investigador principal: Firma:

4 REVOCACIÓN DEL CONSENTIMIENTO

Revoco el consentimiento prestado en fecha _____ para participar en el proyecto titulado “_____” y, para que así conste, firmo la presente revocación.

En Valencia, a _____ de _____ de 20___.

Nombre y apellidos del / de la participante: Firma:	Nombre y apellidos del padre, madre o tutor (en el caso de menores o incapaces): Firma:	Nombre y apellidos del investigador principal: Firma:

4. Annex 4. Chapter 4: Informed consent

Consentimiento Informado para Participar en una Investigación

Título del proyecto: Acoso de género: evaluación de un procedimiento basado en tecnología inmersiva con video 360° para estudiar el sentido de empatía.

Investigador principal: Sara Ventura (bajo la asesoría de la profesora Georgina Cárdenas)

Sede donde se realizará el estudio: Laboratorio de enseñanza virtual y Ciberpsicología (Levyc), Universidad Nacional Autónoma de México (UNAM), Ciudad de México.

Nombre del participante: _____

Se le invita a participar en esta investigación. Antes de tomar una decisión sobre su participación, es importante que usted conozca y comprenda la siguiente información sobre la investigación. Por favor pregunte sobre cualquier duda o información que desee conocer.

Su consentimiento para participar en la presente investigación se dará por entendido al firmar y recibir una copia de la presente forma. Sin su consentimiento, no podrá participar al estudio.

Objetivo del Estudio

El objetivo general del siguiente proyecto es explorar un nuevo procedimiento de tecnología inmersiva, la camera 360°, para el estudio y el entrenamiento de la empatía en un entorno de acoso de género. El objetivo específico del siguiente estudio es generar informaciones e ideas para el desarrollo de un video de acoso de género.

Beneficios del Estudio

El fin general del siguiente estudio es sensibilizar los jóvenes hacia el respeto de las mujeres y enfrentar el problema del acoso de género. El beneficio del grupo focal es el desarrollo de un entorno cuanto más realístico de una mujer víctima de acoso.

Procedimiento del Estudio

Los *grupos focales* se realizarán en la facultad de psicología de la UNAM de la Ciudad de México en el Laboratorio de Enseñanza Virtual y Ciberpsicología. Un investigador del proyecto modera el debate entre los participantes siguiendo una serie de preguntas previamente redactadas. Un segundo investigador del grupo de investigación tomará apuntes de los comentarios de las participantes. La discusión será grabada bajo consentimiento (solo audio). Antes del estudio se recabará el consentimiento informado (conforme a la Declaración de Helsinki, 2004) tras la lectura de los objetivos y la finalidad del experimento.

Una vez que las participantes llegan al estudio se le destina un código que serán utilizados para apuntar las respectivas aclaraciones de cada participante. Con respecto a las protecciones de datos, no se utilizará el nombre del participante, sino solo su código.

Riesgos o Molestias Asociados con el Estudio

En cuanto a la procedencia y protocolos previstos para su utilización en la investigación, a tenor de los conocimientos existentes en este campo hasta el momento, no existe nada en el proyecto que implique riesgos para los participantes.

Rescisión

Si yo decido rescindir esta autorización, no se permitirá posteriores usos de mis declaraciones.

Derechos

Puedo solicitar que cese la grabación en cualquier momento. Puedo rescindir esta autorización hasta una fecha razonable (entro el 31 de octubre 2019, fecha límite para los análisis de estudio) antes de que se utilice la grabación, pero debo hacerlo por escrito, remitido a sara.ventura@uv.es

Tengo derecho a recibir una copia de esta autorización. Entiendo que no recibiré ningún tipo de compensación financiera.

Observaciones:

- Su decisión de participar en el estudio es completamente voluntaria.
- No habrá ninguna consecuencia desfavorable para usted, en caso de no aceptar participar.
- Recibirá respuesta a cualquier pregunta, duda y aclaración acerca de los procedimientos, riesgos, beneficios y otros asuntos relacionados con la investigación antes, durante y después de la investigación.
- Si decide participar en el estudio puede retirarse en el momento que lo desee, solo se le pedirá que informe las razones de su decisión, la cual será respetada.
- Su participación en la investigación no tiene coste económico.
- En el transcurso del estudio podrá solicitar información actualizada sobre el mismo al investigador responsable.
- La información que usted proporcione (nombre, datos de contacto, antecedentes, etcétera), así como los resultados de su participación serán tratados con estricto apego confidencial y se encontrarán bajo resguardo de los investigadores.

Este estudio ha sido avalado por el Comité de Ética del Programa de Maestría y Doctorado en Psicología de la Universidad Nacional Autónoma de México. Coordinadora del Programa: Dra. Sara Eugenia Cruz Morales (saracruz@posgrado.unam.mx, 56230222, ext. 80020).

Si desea más información sobre la naturaleza de la investigación, por favor comuníquese con Sara Ventura, responsable de la investigación, sara.ventura@uv.es;

Nota: En caso de que existiera algún tipo de dependencia, ascendencia o subordinación del participante al investigador, que le impida otorgar su consentimiento libre, éste debe ser obtenido por otro miembro del equipo de investigación. (Reglamento de la Ley General de Salud en Materia de Investigación para la Salud 02-02-2014).

Autorización

Yo, _____, comprendo la información anterior y mis preguntas han sido contestadas de manera satisfactoria. También me han informado que los datos obtenidos en el estudio pueden ser publicados o difundidos con fines científicos. Acepto participar en este estudio de investigación y doy mi consentimiento para que se grabe mis declaraciones durante el grupo focal. Por la presente, autorizo el uso y difusión con fines científicos. Recibiré una copia firmada de esta forma de consentimiento.

_____ _____

Firma del participante o representante Legal Fecha

Investigador responsable:

He explicado a _____ en qué consiste el estudio, cuáles son sus objetivos, los riesgos y beneficios que implica su participación. Declaro que conozco la normatividad para realizar investigación con seres humanos y me apego a ella.

_____ _____

Firma del investigador Fecha

Carta de Revocación del Consentimiento

Título del proyecto: Acoso de género: evaluación de un procedimiento basado en tecnología inmersiva con video 360° para estudiar el sentido de empatía.

Investigador principal: Sara Ventura (bajo la asesoría de la profesora Georgina Cardenas)

Sede donde se realizará el estudio: Laboratorio de enseñanza virtual y ciberpsicologia (Levyc), Universidad Nacional Autónoma de México (UNAM), Ciudad de México.

Nombre del participante: _____

Por este medio deseo informar mi decisión de retirarme de esta investigación por las siguientes razones:

_____
_____
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_____
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Firma del participante o representante Legal Fecha

5. Annex 5. Chapter 4: The script of the moderator of the focus groups

Buenos días a todas. Primero quiero agradecer para vuestra disponibilidad en participar al siguiente grupo focal. El presente estudio tiene el objetivo de generar ideas y comentarios sobre un video que voy a grabar después haber analizado vuestras aclaraciones. El tema es el acoso de género. La literatura previa afirma que el cambio de perspectiva genera un cambio en el sentido de empatía. Las nuevas tecnologías ayudan ese tipo de mecanismo, un ejemplo es la cámara 360º que permite observar un entorno con los ojos de otra persona. Con ustedes quiero generar ideas para la grabación de un video basado sobre el acoso de género.

Una idea podría ser de una mujer que regresa a casa sola rumbo a su casa y un grupo de chicos la molestan con palabras groseras. Eso suele pasar a las mayorías de las mujeres que regresan a casa sobre todo de noche. Un entorno también bastante común es ser víctima de acoso en el metro. El objetivo final del siguiente estudio es sensibilizar los hombres y comprometerlos a cambiar su conducta machista hacia la mujer. Eso porque, gracias al video, los hombres comprenderán como las mujeres se sienten a ser molestada.

Si por favor os podéis presentar porque vamos a pasar una hora juntos, para conocernos y romper el hielo.

Ahora os pongo algunas preguntas para generar un debate sobre el tema:

- ¿Que pensáis cuando hablo de acoso de género?
- ¿Cuándo, según ustedes se puede iniciar hablar de acoso de género? Hay el violentometro
- ¿Por favor dibujáis cuanto es difícil volver a casa o ir de un lugar a otro? ¿Cuánto os sentéis seguro? Donde una línea recta es muy fácil

A _____ B

A B

- ¿Ustedes, han sido algunas veces víctima de violencia de género como el acoso callejero? Por ejemplo, volviendo a casa o yendo a algunos lugares, ¿han sido molestadas por parte de los hombres?
- Si algunas veces han sido víctima de acoso, ¿cómo se ha evolucionado el entorno? ¿Por dónde ha ocurrido y que ha pasado exactamente?
- ¿Cuántos hombres eran presente durante la agresión?
- ¿Durante la agresión, ustedes estabais solas o con amigas?

- ¿Conocéis la camera 360° y sabéis que también se ha utilizado en ámbito psicológico?
- Según ustedes, ¿Como podría ser el contenido del video que describe el escenario de un acoso? Me gustaría saber exactamente el lugar, por ejemplo: metro, universidad, parque etc.
- ¿Cuántos hombres deberían estar presente en el video?

- ¿Qué deberían hacer exactamente los hombres para intimidar la mujer?
- Más en detalle, ¿cómo debería desarrollarse la agresión? Me gustaría saber de cada una de ustedes como debería ser el escenario desde el principio hasta el final.
- ¿A parte la idea del video 360, cual podría ser otra forma de educación para los hombres?
- Si no tenéis más comentarios, os agradezco mucho por haber participado al grupo focal.

6. Annex 6. Chapter 4: The transcript of the Focus Group 1

Moderator (Mod): hablando de acoso de género, que pensáis sobre el tema. ¿Como lo definirías?
Participant (P)1: cualquier interacción que no es consensuada y que tiene que ver con fin sexual. La disposición del cuerpo de la persona acosada.
P2: una forma de violencia en general, hay violencia de hombre hacia la mujer, pero de hombres hacia otros hombres, pero no es sancionado a la misma manera, pero ahora es algo normal la violencia.
P3: es una forma de violencia, creo que tiene que ver con la ideología de genero que la mujer es inferior. ¿Porque vas vestida así? Por eso te acosen…
Mod: acoso callajero….victima o amigas lo han sido
P1: el acoso no es solo sexual, sino incomodar otra persona cuanto emocional y físicamente, incluso solo con palabras, pero te hace sentir incomoda porque es como que tu debe algo a el. Un chico toma foto a una chica y eso molesta porque no pregunta, y eso es un tipo de acoso porque no se controla.
P2: inseguridad, incomodidad. Te siente amenazada, te quita de ese momento.
P3: reacione fisiológica, respuesta de defensa y por eso nos sentimos incomoda y queremos quitarnos de esta situación. Pero no buscan solución a eso.
P4: también en la vida cotidiana
P5: todas las mujeres han sufrido acoso sexual porque están violentando tu intimidad. Por ejemplo, no me puedo poner una falda porque me siento incomoda. Por ejemplo, en una violencia y la primera pregunta fue que ropa llevaba...yo puedo llevar cualquier ropa y sentirme libre.
Mod: entorno más común, donde ocurre
P1: en el metro, las primeras ocasiones me iba en los vagones de los hombres, pero al momento de entrar cuando hay muchas gentes te agarran. A partir de eso me fui al vagón de las mujeres, por eso hay este tipo de iniciativa, para protegernos.
P2: aunque va vestida de manera normal, eso suele pasar. No eres tú, es otra persona y que visión tiene de las mujeres en general.
Mod: ¿los hombres cuando cumplen este acto están solos o en grupo?
P1: solos…o hay de todo
P2: la mayoría solo
P3: a mi me toco mas en grupo, solo por el metro
P4: el típico grupo que te encuentra por la calle y se hacen mas valentón y te molestan chispeándote. Y tu tratas de evitarlos
Mod: ¿qué hacen en concreto? Dicen palabras groseras, intentan tocarla
P1: no te tocan porque como entre ellos quien lo más se acerca

P2: algunas veces los hombres pasan también de víctima, a mi me tocó con una amiga que la insultaron que ha sido ella a ventarse en la combi. Pasan situaciones que no tienen coherencia.
P3: algunas veces los hombres dicen las mujeres los acusan por algo que no han hecho
P4: uno tenia una camera tomando foto
Mod: suele pasar de día de noche
P1: no hay horario
P2: aceptación de los hombres…si no te acosan es porque no eras guapa y no cumple con lo estándar de belleza.
P3: cuando vas a un puesto y te dicen algo
P4: cada persona tiene una personalidad que la va a llevar a ciertas cosas. Algunas quieren que el otro me mire, como las personas ha recibido el afecto de los padres. No como una persona, pero como un objecto, toso eso favorece una violación, un acoso mas directo. Sobre todo, los hombres que no te ven como personas, pero solo como un medio para satisfarás su deseo.
P5: a veces se trata como privilegio de género.
P6: hablando de este aspecto hacia los hombres depende también de la educación para saber hasta que punto tu puede actuar sin molestar. Ahora ha cambiado la visión del acoso, las mujeres salen mas a la calle, nos defendemos y nos da miedo también un acto pequeño. Y como nosotros recibimos el mensaje
Mod: ¿hay programa de educación con los hombres?
P1: en la escuela hay algunos programas sobre como tratar a las mujeres.
P2: los hombres no lloran, no expresan sus sentimientos, el hombre tiene que ser agresivo. Por eso las familias crean hombres que no saben como comportarse.
P3: además de la educación en casa…la idea que el hombre tiene el poder hacia las mujeres llega del pasado porque el hombre ha sido siempre considerado poderoso. Es muy difícil quitar ese pensamiento milenario.
P4: también la religión cristiana influencia mucho. Como la mujer que quería acercarse a Jesús y las personas lo impedían
P5: ya inicia desde niño cuando los padres le preguntan: ¿ya tienes novia? Pero tu hermana que tiene tu misma edad aun no puede tener novia porque es muy pequeña
P6: hay gente que no están informada o que llaman de mente cerrada
P7: la educación es también un privilegio y muchas no tienen privilegio. Yo tuve el privilegio de estudiar, pero las personas que viven en calle que no están estudiando es otra cosa
Mod: ¿el nivel de educación influye sobre el acoso? ¿También chicos educados acosan las mujeres?
P1: control de impulsos. Ahora todo es inmediato, ni te preguntan y ya quieren todo. Los hombres sienten autoridad a pretender rápido
P2: vivemos en una cultura en donde se normalizan

Mod: juego de la línea - riesgo para volver a casa

P1: siempre hay un chavo que me cierre el ojo y me incomoda y me habla. Algunas veces también me seguía hasta la casa

P2: paradero y están los camiones, voy a contar los insultos que me hacen todo el día y han sido 14, P7 a la ida y 7 a la vuelta.

Mod: cual puede ser un entorno representativo

P1: publico pero también privado como en la oficina

P2: calle, metro…vas pasando y caminando y de repente te pasa un coche….alguien que te sigue. Solo y en grupo, depende del entorno.

Mod: ¿la edad del agresor?

P1: cualquiera, a mí me toco también un niño de la secundaria

P2: la mayoría son sobre los 25.

P3: una idea es poner los hombres en un cuarto y dejarle que le pase lo que ocurre a las mujeres molestada, por ejemplo, en un cuarto obscuro y con un palito tocarlo para que se sienten como ella, de como se siente feo…nuestra idea de como nos sentimos, porque nos están haciendo eso si yo no le estoy haciendo nada.

P4: llevar cierta propuesta en la escuela.

7. Annex 7. Chapter 4: The transcript of the Focus Group 2

Moderator (Mod): ¿cual puede ser el entorno ideal para grabar el video?

Participant (P) 1: me pasa que cuando espero en la parada del metro, sobre todo cuando pasan estos camiones y están hombres arriba que se voltean y te miran…todos los carros que pasan y la mirada es de acoso.

P2: yo un día venia del metro y un tipo se detiene y me pregunta donde esta el metro, yo di las informaciones, pero me miraba da arriba abajo. En el metro precisamente es donde se presta más…por lo mas que ponga distancia hay siempre un hombre que se acerca demasiado y intenta tocarte.

P3: me toco en el metro que los señores traen el suéter y el periódico y con eso se cubren y siento que el me toca, lo único que hice fue bajarme pero si que me sentí incomoda.

MOD: otro lugares?

P1: por ejemplo, en las escuelas, un amigo quería agarrarme la mano y lo sentía muy pecada. O una vez andaba con mi novio en el metro y llevaba un vestido y un hombre me miraba de arriba y abajo. Yo me quede en shoch…

P2: es que no hay empatía, puede ser que si el sujeto se pone en un entorno, cambia su actitud…se corre el riesgo que una mujer es acosada como provocadora. A veces consideran las mujeres locas, histéricas…

P3: una chica denuncio en un tribunal acusando la pareja por violencia sexual, el chavo dentro de la audiencia la puñalò…que mas prueba quieren…

P4: en la escuela por ejemplo con un profesor, cuando los alumnos pasaban al pisaron nos miraban el trasero

P5: por ejemplo una chica con mucho pecho, el maestro la abrazaba…

P6: a vece me pongo en analizar que onda con los hombres porque los señores la miran

P7: en el taxi, que los taxistas primero te miran cuando subes de arriba abajo y luego te miran desde el espejo

Mod: en especifico?

P1: un tipo, cuando me subo en el taxi, me preguntaban si quisiera salir, no me importa que tenía una hija. De repente me bajo y me voy corriendo. Pienso que tienen esos en la cabeza

P2: en un taxi también me pasó, el señor empezaba a molestarme con palabras, eres muy bonita

P3: en una papelería, había un viejo y compraban mis cosas y me daban un cicle y me agarraban las manos. Siempre me pasó

P4: una vez en el metro estaba con un vestido con mi novio, y el señor me miraba de arriba abajo y sacaba la lengua, esta bien bonita tu novia. A veces no le importa que estas con alguien

P5: igual los chavos molestan, por ejemplo, en los buses hay personas cerca del autista que invitan la gente a subir y una vez que te sube te miran de arriba abajo. Igual cuando te baja del bus te miran el trasero o te gritan mamacita..

Mod: ¿cuándo acosan, los hombres están solo o en grupo?

P1: los chavos están en grupo y te chiflan o gritan, cuando están solo nada mas te miran. El adulto es mas solo

P2: los adultos tienen más malicia. En la oficina también, los jefes te miran. Por ejemplo, en los lugares privado hay botones de seguridad en los baños y en algunos dicen, cuidado que no te tomen fotos o no dejar tu hija sola en el baño porque varias veces han encontrado alguien que se escondían en el baño y nunca lo han despedido

P3: por ejemplo, a mí en el trabajo encontré a una amiga y me dice: estoy bien ahora esoy viuda. Pero sabes que, te digo la verdad, en realidad estoy divorciada pero aquí digo que soy viuda porque el hecho de ser divorciada puede llevar los hombres a acosarte.

Mod: ¿en la universidad que pasa?

P1: en ingeniería, yo estudio en diseño y son mas mujeres y en ingeniería hombres y cuando en el pasillo pasan mujeres, los hombres le chiflan y le dicen algo desde el edificio y se le hacen divertido, como animales

P2: cuando están en grupo se comportan así, se envalentonan mucho

P3: mucho depende del ejemplo de casa, por ejemplo, antes los padres llevaban los niños de 15 años a los bórdelos.

Mod: ¿otro tipo de entorno?

P1: por ejemplo, en ciencia social, los baños todos llevan botón de emergencia porque se metían chicos y tomabas fotos

Mod: ¿el nivel de estudio influye o no?

P1: no, también los maestros lo hacen

P2: antes estaban estereotipados los albañiles, pero no, hay de todos…una licenciatura no te cambia tu valor

Mod: ¿otras ideas que quieres agregar?

P1: gente que se quedan en la calle y te miran

P2: el vecino, una vez sale a tirar la basura y me toca

P3: también si estas embarazada te acosan, una vez estuve con mi prima embarazada en un mercado y se pusieron a acosarla, decirle como eres bonita…o sea, esta embarazada déjala en paz…

P4: también en el mercado, aprovechan de un descuido para alargar la mano y tocarte

P5: una vez me toco en el metro lleno de mujeres, se sube la chava y inician a molestarla y yo estuve allí para ayudarla

P6: por ejemplo si yo veo a una chica que lleva una falda y sube la escalera, yo me voy detrás de ella para que los hombres no la miren, es como cuidarse entre otras.

Mod: ¿hay diferencia entre día y noche?

P1: yo creo que hay horas, por ejemplo, siento que durante la noche pasa mas

P2: yo me siento mas insegura en la tarde, y depende de la zona

Mod: ¿conocéis algún programa de prevención para los hombres?

P1: jendes..son psicólogos y sociólogas que hacen terapia grupales y hacen actividad sencilla como juego de rol

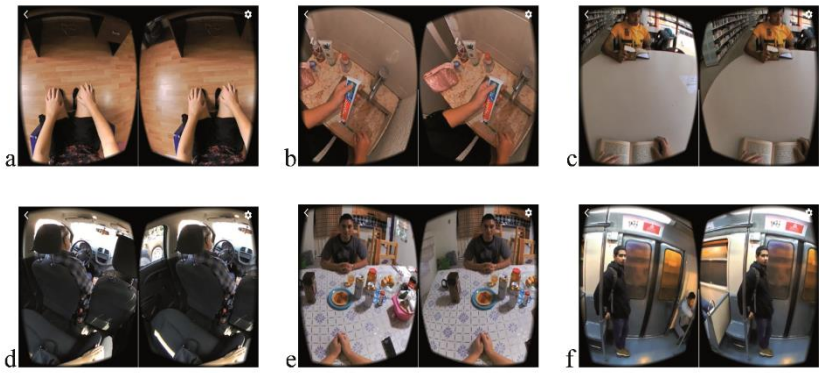
P2: pero no es muy extendido, pero no llega a toda la población, es muy restricto.

P3: a parte que el machismo en México esta muy radicado

P4: es como que todo está más focalizado en las mujeres, como rehabilitación o como cuidarse, como defensa personal.

Mod: muchas gracias por participar

8. Annex 8. The 360° video-based Virtual Reality on Sexual Harassment



The first scenario (a) is aimed to generate embodiment of the female victim's body, where participants follow the woman's body movements in the video (e.g., move their hands up and down, caress their limbs, and rotate their hands). This embody exercise was included in the study to induce the body-swap illusion, and to allow men participants to perceive themselves as women during the entire experiment. After the embodied induction, the video starts with the victim doing daily life activities (e.g., putting on her shoes, having breakfast, brushing her teeth, preparing her backpack for the university, etc.) (b). This scene was recorded to improve the participants' engagement with the future victim. Then, several harassment scenarios took place with the victim: (c) a man tries to take a photo of her without her permission in the university library; (d) a taxi driver makes several sexual comments to the victim; (e) a man says aggressive words to his spouse; a man checks his girlfriend's mobile without her permission; (f) and a man looks at the victim when she is on the subway and tries to hold her hand.

The link of YouTube for the 360° experience:

https://www.youtube.com/watch?v=7a3fKhxxMgA&list=UUMgOrrTlRoIYpeTTqLL7PlQ&index=5

9. Annex 9. Chapter 6: Informed consent

Consentimiento Informado para Participar en una Investigación

Título del proyecto: Acoso de género: evaluación de un procedimiento basado en tecnología inmersiva con video 360° para estudiar el sentido de empatía.

Investigador principal: Sara Ventura (bajo la asesoría de la profesora Georgina Cárdenas)

Sede donde se realizará el estudio: Laboratorio de enseñanza virtual y Ciberpsicología (Levyc), Universidad Nacional Autónoma de México (UNAM), Ciudad de México.

Nombre del participante: _____

Se le invita a participar en esta investigación. Antes de tomar una decisión sobre su participación, es importante que usted conozca y comprenda la siguiente información sobre la investigación. Por favor pregunte sobre cualquier duda o información que desee conocer.

Su consentimiento para participar en la presente investigación se dará por entendido al firmar y recibir una copia de la presente forma. Sin su consentimiento, no podrá participar al estudio.

Objetivo del Estudio

El objetivo del siguiente proyecto es explorar un nuevo procedimiento de tecnología inmersiva, la camera 360°, para el estudio de la empatía en un entorno de acoso de género.

Beneficios del Estudio

El fin del siguiente estudio es sensibilizar los jóvenes hacia el respeto de las mujeres y enfrentar el problema del acoso de género.

Procedimiento del Estudio

El estudio se realizará en la facultad de psicología de la UNAM de la Ciudad de México en el Laboratorio de Enseñanza Virtual y Ciberpsicología.

Durante el estudio te pediremos que conteste a algunos cuestionarios y algunos de esos serán presentados más de una vez cómo requisito para lograr el objetivo del estudio.

Nota: un terapeuta estará siempre a lado del investigador para intervenir en cualquier momento si los participantes lo necesitaran. Durante el estudio podrá ocurrir algunas desregulaciones emocionales por parte de los participantes como tristeza o ansiedad, el terapeuta será siempre disponible para ofrecer servicio. Además, el servicio de atención psicológica será a disposición de los participantes también después el estudio, en tal caso se canalizará según las necesidades.

Riesgos o Molestias Asociados con el Estudio

En cuanto a la procedencia y protocolos previstos para su utilización en la investigación, a tenor de los conocimientos existentes en este campo hasta el momento, no existe nada en el proyecto que implique riesgos para los participantes. El protocolo de evaluación se compondrá de instrumentos estandarizados y validados que no suponen riesgos para los participantes y que serán aplicados y supervisado por personal experto.

Observaciones:

- Su decisión de participar en el estudio es completamente voluntaria.
- No habrá ninguna consecuencia desfavorable para usted, en caso de no aceptar participar.
- Recibirá respuesta a cualquier pregunta, duda y aclaración acerca de los procedimientos, riesgos, beneficios y otros asuntos relacionados con la investigación antes, durante y después de la investigación.
- Si decide participar en el estudio puede retirarse en el momento que lo desee, solo se le pedirá que informe las razones de su decisión, la cual será respetada.
- Su participación en la investigación no tiene costo económico.
- En el transcurso del estudio podrá solicitar información actualizada sobre el mismo al investigador responsable.
- La información que usted proporcione (nombre, datos de contacto, antecedentes, etcétera), así como los resultados de su participación serán tratados con estricto apego confidencial y se encontrarán bajo resguardo de los investigadores.

Este estudio ha sido avalado por el Comité de Ética del Programa de Maestría y Doctorado en Psicología de la Universidad Nacional Autónoma de México. Coordinadora del Programa: Dra. Sara Eugenia Cruz Morales (saracruz@posgrado.unam.mx, 56230222, ext. 80020).

Si desea más información sobre la naturaleza de la investigación, por favor comuníquese con Sara Ventura, responsable de la investigación, sara.ventura@uv.es.

Nota: En caso de que existiera algún tipo de dependencia, ascendencia o subordinación del participante al investigador, que le impida otorgar su consentimiento libre, éste debe ser obtenido por otro miembro del equipo de investigación. (Reglamento de la Ley General de Salud en Materia de Investigación para la Salud 02-02-2014).

Autorización

Yo, _____, comprendo la información anterior y mis preguntas han sido contestadas de manera satisfactoria. También me han informado que los datos

obtenidos en el estudio pueden ser publicados o difundidos con fines científicos. Acepto participar en este estudio de investigación. Recibiré una copia firmada de esta forma de consentimiento.

_____ _____

Firma del participante o representante Legal **Fecha**

Investigador responsable:

He explicado a _____ en qué consiste el estudio, cuáles son sus objetivos, los riesgos y beneficios que implica su participación. Declaro que conozco la normatividad para realizar investigación con seres humanos y me apego a ella.

_____ _____

Firma del investigador Fecha

Carta de Revocación del Consentimiento

Título del proyecto: Acoso de género: evaluación de un procedimiento basado en tecnología inmersiva con video 360° para estudiar el sentido de empatía.

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Nombre del participante: _____

Por este medio deseo informar mi decisión de retirarme de esta investigación por las siguientes razones:

_____
_____
_____

_____ _____

Firma del participante o representante Legal Fecha