Virtual Reality for Inducing Empathy and Reducing Prejudice Towards Stigmatized Groups: a survey

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Abstract—**This paper gives an up-to-date overview of research about Virtual Reality (VR) for inducing empathy and reducing prejudice towards stigmatized groups and the measurements used in the studies. Outcomes from the studies reviewed provide only preliminary support for the use of VR for successfully inducing empathy into people and reducing their prejudice towards stigmatized groups and the preference for using self-report methods for the measurement of empathy and prejudice.**

Keywords—**Virtual reality, empathy, social stigma, perspective-taking, prejudice.**

I. INTRODUCTION

Surveys have been conducted through the years regarding the use of VR for health applications like [1]–[4] but to the best of our knowledge, none of the existent surveys or reviews tackle the fields of VR and empathy.

This survey's contribution is two fold: (i) a new categorization is proposed that is based on social stigma which has not been done before and might be useful for psychologists and professionals and (ii) a critical review on the measurements used for empathy and prejudice.

This paper is organized as follows:

Section I: Introduction – Presents the purpose of this survey, the organization of the paper, background of this area of research and definitions of key terms, .

Section II: Virtual Reality studies – Description of the studies that have been conducted in this area using VR and the ways and tools they used to measure empathy and prejudice.

Section III: Results - Discussion – The outcomes from the studies reviewed and a discussion.

Section IV: Further Research – A highlight of the areas where further research is needed.

II. BACKGROUND

Stereotypes, prejudice and discrimination all exist in our world. Unconsciously (or not) in our minds, we are hanging labels to people. We associate a certain quality, which is usually a negative one, with a person or a group of people, although this association is not proven. For example, try and fill in the blanks to the following sentences:

"I really hate _____. Women are _____. Germans are _____".

One of the many potential answers would be:

"I really hate *Muslims*. Women are *bad drivers*. Germans are *Nazis*."

These statements express prejudice toward stigmatized groups. Stereotypes are leading to prejudice [5], which is the most visible expression of intolerance and discrimination [6]. Discrimination on the other hand, has been found to directly affect the social status, psychological well-being, and physical health of the stigmatized. Members of stigmatized groups are discriminated against in their workplace, educational settings, health care, and the criminal justice system [7]. They are even discriminated against in their own family [8].

A reliable method that has been shown in reducing negative social stereotyping is *perspective-taking* [9]–[11]. Using role-play people are transported, mentally, into the mind of another. Psychologists argue that our ability to cooperate with and understand others, have supported our species' success in winning the cross-species competition for global domination [9], [10]. These abilities, are supported by the multifaceted psychological construct of *empathy*, the ability to understand and share the feelings of another.

Regarding empathy, Lori Melichar, the director at the philanthropic foundation "Robert Wood Johnson Foundation" said in an interview [12] that "Empathy is at the center of our collective efforts to build a culture of health. If we don't understand the perspectives of others, we can never help others pursue healthier lives". Additionally, a survey has shown evidence that interactive virtual worlds can have an impact in our well-being: our attitude of judging life positively and feeling good [13].

Traditionally, novelists and moviemakers through the years have been transporting people into other people's lives and minds with their works. However, the ground-breaking rise of the field of *Virtual Reality* in the last few years offers new ways to induce empathy into people. This is done by tricking them with optical and sensory illusions, and by doing so, people can adopt in an instance any other form (human or non-human), no matter how different, as their own.

A person wearing a head-mounted display (HMD), that offers wide field-of-view stereoscopic vision, can be immersed in a computer generated, three-dimensional environment, in which he can explore and interact. Moreover, by wearing specialized glasses that track head movements and by looking down toward his feet, he can see a virtual body spatially

coincident with their own. The brain at that point gets a powerful cue to feel that this virtual body is his own, because in real life when that person does the same movement, he sees obviously, his own body. Taking this a step further, using real-time motion capture, that person can move his real body and see the virtual version move correspondingly. This setup is known as embodiment in a virtual world [14].

Your brain at that point has this perceptual illusion that an alternate virtual body is your own, the so-called feeling of body ownership. This phenomenon comes from the famous "Rubber Hand Illusion", an illusion discovered by psychologists in Pennsylvania [15]. In this illusion, in front of subjects a rubber hand is located, while their corresponding (real) hand is hidden from his view. Then the subjects see the rubber hand being stroked simultaneously as the real hidden hand in the same way and they have the illusion that the rubber hand is their own, and when it is suddenly attacked, the subjects display anxiety and reflex behavior.

As technology is evolving, we are able to create and customize our virtual representations in a virtual world and the form or type of our virtual body can be quite different from our actual body. A person immersed in a virtual world and embodied in a virtual body different than his own, can see the world from a different perspective, like a member of one these stigmatized groups, and through virtually experiencing their life, they can take their place and potentially feel empathy towards them. This transformative power of VR makes it the ultimate empathy machine that could tackle prejudice towards stigmatized groups and ultimately make us better people.

III. DEFINITIONS

1) Social Stigma: The term *stigma* has Greek origins [16] and it was used to refer to a type of marking or tattoo that was cut or burned into the skin of criminals, slaves, or traitors in order to visibly identify them as blemished or morally polluted persons that were to be avoided particularly in public places. Nowadays, the term is used in something like the original literal sense but is applied more to the disgrace itself than to the bodily evidence of it.

According to Goffman's seminal work that was originally published in 1963 and reprinted in 2009, stigma is an attribute that extensively discredits an individual, reducing him or her "from a whole and usual person to a tainted, discounted one" [16].

According to him, there are three forms of social stigma:

- **Overt or external deformations**, such as scars, physical manifestations of anorexia nervosa, leprosy (leprosy stigma), or of a physical disability or social disability, such as obesity.
- **Deviations in personal traits**, including dropping out of school, working a low wage job, single parent-hood, bankruptcy, addiction, homosexuality, unemployment, suicidal attempts, radical political behavior, welfare dependency, adultery, mental disorder, teenage pregnancy, drug addiction, alcoholism, and criminal background are stigmatized in this way.

- **"Tribal stigmas"** are traits (imagined or real) of an ethnic group, nationality, or religion that is deemed to be a deviation from the prevailing normative ethnicity, nationality, or religion.

Issues associated with Goffman's classifications have been significantly revisited in the literature.

2) Stereotyping: A stereotype is a cognitive link between two human concepts (e.g., the Self, social groups, identities, attributes, traits, behaviors) that are not defining features for one another. A stereotype can be about a single person or a group of people, and a stereotype can exist in the mind of only one person or be socially shared by a group of people. Stereotypes are automatically activated, oversimplified, overgeneralized, difficult to change, and strongly influence emotions, judgments, and behavior [17].

3) Prejudice: In prejudice research there is broad consensus that prejudices arise as generalized negative attitudes towards groups and individuals and are based solely on the fact that these groups are outgroups or these persons belong to an outgroup [18] suggesting that contact between members of different groups (under certain conditions) can work to reduce prejudice. A prejudice is created through a three-stage process involving: 1) categorization, 2) stereotyping and 3) judgment (affective priming) [6].

4) Empathy: Research involving the concept of empathy can be quite a challenge for researchers in disciplines ranging from social and clinical psychology to computer science as well as individual differences. Part of this challenge derives from the lack of an universal definition for empathy.

There has been a huge empirical and theoretical literature concerning the definition of empathy which ultimately leads to a semantic confusion. Previous investigators and theorists have taken two main approaches to the study of empathy. The first approach emphasizes "cognitive empathy" which can be defined as the process of understanding another person's perspective. The second approach emphasizes "affective empathy" defined as an observer's emotional response to the affective state of others. Recently, researchers have adopted a more multi-dimensional approach, acknowledging that both components are an integral part of empathy. This approach views the cognitive and affective components of empathy as two separate, but related constructs [19].

5) Virtual Reality - Sense of Embodiment: In Virtual Reality, a person is immersed in an environment that is realized through computer-controlled display systems, and might be able to effect changes in that environment [20].

The term embodiment, is used in various contexts due to its multidisciplinary use and its various application areas like in philosophy, in cognitive neuroscience, in psychology, in robotics and in virtual worlds and for this reason its conceptualization depends on the viewpoint from which the issue is considered. The existence of multiple meanings of the term embodiment can cause confusion in the research community [21]. In a VR setting, the term embodiment is used for the setup in which a virtual body is spatially coincident with your real body and you see through the eyes of that

virtual body, with various types of synchronous multisensory correlation [14].

In 2012, Kilteni, Groten & Slater [21] created the term *"Sense of Embodiment"* (SoE) to refer to the ensemble of sensations that arise in conjunction with being inside, having, and controlling a body especially in relation to VR applications. More specifically they define SoE as "SoE toward a body B is the sense that emerges when B's properties are processed as if they were the properties of one's own biological body". They state that SoE consists of three subcomponents: the sense of *self-location*, the *sense of agency*, and the *sense of body ownership* [21] as seen in Figure 1.

Self-location is a determinate volume in space where one feels to be located. The sense of self-location refers to one's spatial experience of being inside a body and it does not refer to the spatial experience of being inside a world (with or without a body). According to Gallagher [22] the sense of agency is "the sense that I am the one who is causing or generating an action". According to Tsakiris, Prabhu & Haggard [23] body ownership refers to the sense that one's own body is the source of sensations. As they note, on an "additive" model, agency and body-ownership are strongly related; the ability to control actions is a powerful cue to body-ownership.
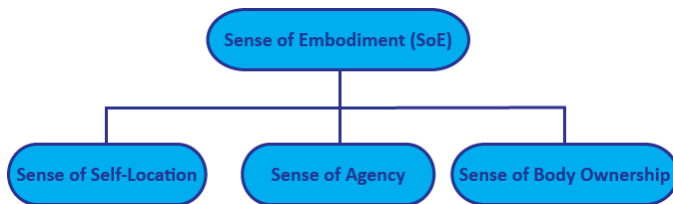

Fig. 1. The three sub-components of the Sense of Embodiment (SoE)

Body ownership illusions refer to the illusory perception of non-bodily objects (e.g., artificial limbs) as being parts of one's own body and as being the source of the associated bodily sensations, such as touch [24].

IV. VIRTUAL REALITY STUDIES REGARDING EMPATHY AND PREJUDICE

VR can be a powerful tool in the research of empathy and prejudice because it can transfer you in another world and change your sense of self. Additionally, our self-representations (avatars) in a virtual world can influence our behavior in that world and even outside of it. This effect has been replicated and shown in a lot of experiments in different settings (VR and non-VR) by a lot of studies through the years [25]–[33].

A. Categorization

The VR studies related to empathy and prejudice reviewed in this paper are grouped according to the social stigma form that the group investigated belonged to, as defined by Goffman [16]:

1) Overt or external deformation: Jackson et. al in 2015 developed a unique platform, the Empathy-Enhancing Virtual Evolving Environment (EEVEE) [34], which had three main components: (1) different avatars capable of expressing feelings and emotions at various levels based on the Facial Action Coding System (FACS); (2) systems for measuring the physiological responses of the observer (heart and respiration rate, skin conductance, gaze and eye movements, facial expression); and (3) a multimodal interface linking the avatar's behavior to the observer's neurophysiological response. This platform provides a unique tool to study and even modulate empathy in a comprehensive and ecological manner in various populations, notably individuals suffering from neurological or psychiatric disorders. Their data showed that healthy adults can discriminate different negative emotions, including pain, expressed by avatars at varying intensities. They also provided evidence that masking part of an avatar's face (top or bottom half) does not prevent the detection of different levels of pain.

Ahn, Le & Bailenson in 2013 conducted three experiments [35] that explored whether embodied experiences via Immersive Virtual Environment Technology (IVET) would elicit greater self- other merging, favorable attitudes, and helping toward persons with disabilities compared to traditional perspective taking. Participants in the embodied experiences (EE) condition were exposed to a red-green colorblind simulation using IVET while participants in the perspective taking (PT) condition were exposed to a normal colored IVET world and instructed to imagine being colorblind. The three experiments compared EE against PT and investigated underlying mechanisms. With EE, the user was able to vividly, accurately, and realistically experience the sensations of another person and feel as if they have merged with that person. They demonstrated the increase of actual helping behavior through the use of IVET.

Rosenberg, Baughman & Bailenson in 2013 [37] discussed how giving participants an enhanced ability in VR, the power to fly using their arms, affected helping behavior after they were out of the VR world and examined whether inhabiting an avatar that is helpful would cause someone to become more altruistic. Participants were assigned to receive either the virtual power of flight, akin to Superman's ability to fly (the super flight condition), or to fly as a passenger in a helicopter (the helicopter flight condition). Participants were also assigned either to a helping condition to find a young, lost diabetic child in need of life-saving insulin immediately, or a touring condition to navigate and explore the virtual city. Thus, the study was a two-by-two design. Stage 2 was the collection of the behavioral dependent variable, measured after the VR experience: The experimenter knocked over a cup of pens, ostensibly by accident, in order to allow the participant an opportunity to help by picking them up. Their results showed that flying participants were quicker to help than helicopter participants. In addition, there was a significant effect of number of pens picked up such that flyers picked up more pens than helicopter riders. In fact, six participants did not help at all, and these participants were all in the helicopter

condition. The virtual power of flight facilitated subsequent helping behavior in the real world.

2) Deviations in personal traits: Gillath, McCall, Shaver & Blascovich in 2008 conducted two studies [39] to determine whether social behavior and behavioral tendencies in a virtual environment could be predicted from dispositional measures of compassion and empathy. In the first study, they examined whether people would have any kind of reaction to a virtual person. About half of their sample had some sort of reaction to the needy person, and about one-third of that sample reacted in a concerned, empathic way. The main goal of Study 2 was to replicate and extend the results of Study 1 using behavioral measures made available by the virtual-reality headpiece: looking at a virtual person and staying near him in the Virtual Environment (VE). In fact, more compassionate people (compared with their less compassionate peers) were more inclined to look at and stay near a virtual beggar, and people who were inclined to feel personally distressed when seeing people in need were less likely to stay near the beggar. Their findings suggest that IVET might be used educationally and therapeutically to foster prosocial behavior.

Hershfield et all in their 2011 work [32] encouraged people to make more future-oriented choices by having them interact with age-progressed renderings of their own likenesses. More specifically, they conducted four studies, in which participants interacted with realistic avatars of their future selves using immersive virtual reality hardware and interactive decision aids. In all cases, those who interacted with their virtual future selves exhibited an increased tendency to accept later monetary rewards over immediate ones.

The Virtual Human Interaction Lab of the Stanford University is currently studying whether VR makes people more empathetic to homeless people than other forms of media do [40]. One group gets a video or some literature and the other group has the VR experience. The VR experience puts you in the shoes of someone who goes through a journey that ends in homelessness. After the VR experience the participants are asked to sign a petition for housing for the homeless. The study will look at whether they or the people who read material and saw a video are more likely to sign.

3) Tribal stigma: It has been showed by several studies [41]–[46] that embodiment of light-skinned participants in a dark-skinned virtual body significantly reduced implicit racial bias against dark- skinned people.

Hasler, Spanlang and Slater in 2017 [41] studied about "in-group bias" and mimicry behaviors. More specifically, they carried out an experiment with 32 White (Caucasian) female participants. Half were embodied in a White virtual body and the remainder in a Black virtual body. Each interacted in two different sessions with a White and a Black virtual character, in counterbalanced order. Their results showed that dyads with the same virtual body skin color expressed greater mimicry than those of different color. Although their study didn't focus on inducing empathy to the participants, they measured the participants racial bias before and after the experiment. They found that there was no change in implicit racial bias as measured by the IAT simply as a result of the embodiment, i.e., the mean changes are the same whether the participants were embodied in the White or Black body.

Farmer, Tajadura-Jimnez and Tsakiris in 2012 [42] conducted a study in which results from two studies using introspective, behavioural and physiological methods show that, following synchronous visuotactile (VT) stimulation, participants can experience body-ownership over hands that seem to belong to a different racial group. Also, the overall strength of experienced body-ownership seemed to predict the participants post-illusion implicit racial bias.

Maister, Sebanz, Knoblich and Tsakiris in 2013 [43] employing the "Rubber Hand Illusion", delivered multisensory stimulation to light-skinned Caucasian participants to induce the feeling that a dark-skinned hand belonged to them. We then measured whether this could change their implicit racial biases against people with dark skin. Across two experiments, the more intense the participants illusion of ownership over the dark-skinned rubber hand, the more positive their implicit racial attitudes became. These findings suggest that inducing an overlap between the bodies of self and other through illusory ownership is an effective way to change and reduce negative implicit attitudes towards outgroups.

Peck, Seinfeld, Aglioti and Slater in 2013 [44] showed that embodiment of light-skinned participants in a dark-skinned VB significantly reduced implicit racial bias against dark skinned people, in contrast to embodiment in light-skinned, purple-skinned or with no VB. Their results show that embodiment may change negative interpersonal attitudes and thus represent a powerful tool for exploring such fundamental psychological and societal phenomena. *Measures:* Participants implicit racial bias was calculated by the administration of a racial IAT [48] twice, one at the first visit to the laboratory and the second immediately after completion of the virtual reality scenario, but while still wearing the HMD.

Groom, Bailenson and Nass in 2009 [45] conducted a study to determine how peoples implicit racial bias is affected by the race of their avatar in an immersive virtual environment (IVE). Our results indicate that the effects of avatar race extend beyond digital spaces. People embodied by Black avatars in an IVE demonstrated greater implicit racial bias outside the IVE than people embodied by White avatars. These findings have important implications for strategies to reduce racial prejudice and provide new insights into the flexibility of racial identity and racial attitudes afforded by virtual technologies.

Behm-Morawitz, Pennell and Gerding Speno in their 2016 [46] research experimentally examined the effectiveness of the use of virtual racial embodiment in a digital gaming application for reducing bias against a non-dominant group. Results showed that creating and embodying a Black avatar produced more favorable beliefs about African American men, but not African American women, and greater support for pro-minority policies in comparison to creating and playing a White avatar.

Additionally to all these studies, other efforts have been made like making VR 360° films from charities like the

International Rescue Committee (IRC) [56] and the Amnesty International [57] immersing people in the world of a refugee camp in Lebanon and Syria and the Clinton Foundation [58] where the user sees a eight-minute virtual reality film that allows people around the world to join President Clinton and Chelsea Clinton on their trip to East Africa in 2015. Moreover, the United Nations currents runs a program called *United Nations Virtual Reality (UNVR)*, which is implemented by the UN SDG Action Campaign, and uses the power of immersive storytelling to inspire viewers towards increased empathy, action and positive social change [59].

You can see a summary of the studies, their categorization according to the social stigma form that the group investigated in the study belonged to (according to Goffman's social stigma forms) and the final outcome of each study in Table I.

B. Measuring empathy and prejudice

This survey covers papers that deal with research about Virtual Reality (VR) for inducing empathy and reducing prejudice towards stigmatized groups. An important part of these studies is to properly measure the participants empathy and prejudice in order to conclude whether their VR interventions were successful. In this section we review the measurements these studies used.

1) Measures of empathy: Jackson's et. al [34] platform consisted of a series of apparatus that allowed real time measurement of behavioral and physiological responses of the participants. The current version of EEVEE uses an emotional face recognition tool (Noldus FaceReader), measures of heart electrical activity, respiration rate, and skin conductance (MP150, Biopac Systems Inc.), as well as eye-tracking and pupillometry (Smart Eye Pro, Smart Eye).

Rosenberg, Baughman & Bailenson in 2013 [37] collected two behavioral variables, measured after the VR experience: The experimenter knocked over a cup of pens, ostensibly by accident, in order to allow the participant an opportunity to help by picking them up. They had two behavioral variables, time to help and number of pens picked up. Additionally they measured the intention to help using the Prosocial Orientation Questionnaire (POQ) [38].

Gillath, McCall, Shaver & Blascovich [39] administered to the participants of their both studies the Interpersonal Reactivity Index (IRI) [19], which contains four 7-item scales, each assessing a separate aspect of dispositional empathy:

- Empathic concern (the tendency to feel compassion and care)
- Perspective-taking (the ability to take someone elses point of view)
- Fantasy (the tendency to be absorbed in stories, fantasies, or films)
- Personal distress (the tendency to feel distressed in the face of someone elses suffering)

Farmer, Tajadura-Jimnez and Tsakiris [42] asked the participants to complete the IRI [19].

Maister, Sebanz, Knoblich and Tsakiris' [43] participants were asked to completed the IRI [19].

A list of all empathy measures used in the studies reviewed in this survey and the study they appeared in can be seen in Table II.

Through the review of the studies it is observed that the Interpersonal Reactivity Index (IRI) [19] is widely used for the measurement of empathy in the majority VR studies reviewed in this survey. It is important to note that only in one study neuroscientific methods were used to measure the physiological responses of the participants as well as behavioral methods to measure the helping behavior of the participants.

2) Measures of prejudice: Ahn, Le & Bailenson [35] measured the participants attitude using the Attitude Toward Disabled Persons Survey [36] which is a widely used scale to determine the extent to which people perceive disabled people as inferior to people without disabilities.

Hasler, Spanlang and Slater [41] measured their participants racial in-group bias using a racial IAT [47] before and after the experiment that they conducted.

Farmer, Tajadura-Jimnez and Tsakiris [42] measured the prejudice and attitudes of their participants the Implicit Association Test (IAT) [48].

Maister, Sebanz, Knoblich and Tsakiris' [43] participants were asked to complete the Implicit Association Test (IAT) [48] to provide them with a baseline measure of the participants implicit attitudes.

Peck, Seinfeld, Aglioti and Slater [44] administered the racial Implicit Association Test (IAT) at least three days prior to the experiment to their subjects, and immediately after the IVR exposure. The change from pre- to post-experience IAT scores suggests that the dark-skinned embodied condition decreased implicit racial bias more than the other conditions.

Groom, Bailenson and Nass [45] immediately following participants interactions in the virtual environment, the Implicit Association Test [48], or IAT, was administered. They also measured the Interpersonal distance. To determine if racial embodiment affects interpersonal distance, participants locations within the virtual environment were tracked in the IVE. Interpersonal distance was measured by how far away from the confederate the participant stood. Self-esteem was measured following the IAT using Rosenbergs [51] Self-Esteem scale. Self-esteem was included as a covariate because it has been demonstrated to moderate the effects of perspective taking on prejudice. Because perspective taking relies on the application of self-concept to an out-group, people with higher self-esteem produce more positive evaluations of an out-group following perspective taking [52]. To measure conscious self-reported beliefs and attitudes towards African Americans, the Racial Argument Scale (RAS) [49] and portions of the Modern Racism (MRS) scale [50] were administered.

Behm-Morawitz, Pennell and Gerding Speno [46] measured the race-related beliefs of their participants in two ways. First, participants beliefs about Blacks/ African Americans were measured by having participants assign characteristics (via a series of semantic differential items) to pretested images of African American faces [53]. Second, race-related policy

TABLE I
VIRTUAL REALITY STUDIES

Study Reference	Goffman's Social Stigma form	Study Outcome (effectiveness)
[34]	Overt or external deformation	They created a unique tool to study and even modulate empathy in a comprehensive and ecological manner in various populations.
[35]	Overt or external deformation	Increase of actual helping behavior through the use of IVET.
[37]	Overt or external deformation	The virtual power of flight facilitated subsequent helping behavior in the real world.
[39]	Deviations in personal traits	IVET might be used educationally and therapeutically to foster prosocial behavior.
[32]	Deviations in personal traits	Those who interacted with their virtual future selves exhibited an increased tendency to accept later monetary rewards over immediate ones
[41]	Tribal stigma	They found no change in implicit racial bias as measured by the IAT simply as a result of the embodiment
[42]	Tribal stigma	The overall strength of experienced body-ownership seemed to predict the participants post-illusion implicit racial bias.
[43]	Tribal stigma	Inducing an overlap between the bodies of self and other through illusory ownership is an effective way to change and reduce negative implicit attitudes towards outgroups.
[44]	Tribal stigma	Embodiment of light-skinned participants in a dark-skinned virtual body significantly reduced implicit racial bias against dark skinned people, in contrast to embodiment in light-skinned, purple-skinned or with no virtual body.
[45]	Tribal stigma	People embodied by Black avatars in an IVE demonstrated greater implicit racial bias outside the IVE than people embodied by White avatars.
[46]	Tribal stigma	Creating and embodying a Black avatar produced more favorable beliefs about African American men, but not African American women, and greater support for pro-minority policies in comparison to creating and playing a White avatar.

TABLE II
MEASURES OF EMPATHY

Empathy Measures	Study Reference
Prosocial Orientation Questionnaire	[37]
Time to help	[37]
# of pens picked up	[37]
Interpersonal Reactivity Index (IRI)	[39], [42], [43]
Emotional face recognition tool (Noldus FaceReader). Systems for measuring the physiological responses (Heart electrical activity, Respiration rate, Skin conductance (MP150, Biopac Systems Inc.), Eye-tracking and pupillometry (Smart Eye Pro, Smart Eye)	[34]

TABLE III
MEASURES OF PREJUDICE

Prejudice Measures	Study Reference
Attitude Toward Disabled Persons Survey	[35]
Implicit Association Test (IAT)	[41]–[46]
Racial Argument Scale (RAS)	[45]
Modern Racism Scale (MRS)	[45]
Interpersonal distance	[45]
Self-Esteem scale	[45]
Race-related beliefs	[46]
Race-related policy beliefs	[46]

beliefs were measured. These items were adapted from Tan, Fujioka, and Tans [54] and Ramasubramanians [55] examinations of the influence of media models on White college students beliefs about affirmative action policies.

A list of all prejudice measures used in the studies reviewed in this survey and the study they appeared in can be seen in Table III.

According to this table, it is observed that in the VR studies reviewed in this survey, prejudice is mainly measured by self-reports (questionnaires), mainly the Implicit Association Test (IAT) which was used in six studies in total and one behavioral method (Interpersonal distance). The lack of neuroscientific methods for the measurement of prejudice is observed.

V. RESULTS - DISCUSSION

In our everyday lives it can sometimes be easier to avoid or ignore an issue that may not seem to directly affect us like discrimination but we can't deny that it exists throughout our society. Changing people's attitudes and institutional practices is hard but necessary work.

Outcomes from the studies reviewed provide preliminary support for the use of VR for successfully inducing empathy into people and reducing their prejudice towards stigmatized groups. Studies and efforts so far were dealing with people with a disability (colorblindness), helping people in need, homeless people, a lot of studies focused on reducing implicit racial bias against dark-skinned people and other efforts like developing 360 VR films to induce empathy for refugees and people in East Africa.

The majority of the studies focused the third form of social stigma, and most specifically on reducing implicit racial bias against dark-skinned people as seen in Table I. Although there has been research in all three forms of social stigma, its still in its early stages and further research is needed in these three forms.

Researchers have found that perspective-taking induces empathy which, in turn, not only improves attitudes towards the target of empathy, but also improves attitudes towards the target's group. The studies reviewed in this survey involving VR have shown that the type of body over which participants have in the virtual world and the illusion of ownership can influence their behavior, actions and perception inside and outside of the virtual world. They show only evidence that VR could be potentially used as an effective way to induce empathy to people because its transformative power makes them as close as they can be to "walk a mile in someone's shoes".

As far as the measurements used for empathy and prejudice, it was observed that in the reviewed studies they tended to use self-report instruments more and rarely used behavioral

observational and neuroscientific methods which could be more accurate than self-reports from the participants.

Future studies should focus more on behavioral methods like recording the actions and movements of the participants in the virtual world and their interactions within it and coding them somehow to a level of empathy or prejudice.

Another method that should be used more are neuroscientific methods like one of the famous techniques to study brain activity; EEG (Electroencephalography) which records the brains electrical activity. This technique can also record eye movement (and blinking) which could really be useful in VR studies because of the fact that the participants eyes are covered while wearing the HMD and its a way to know where the participant is looking at which can give insight for how the participant is feeling about a certain event happening in the virtual world. This technique or similar ones can also record emotions which can help in the measurement of empathy and prejudice more accurately.

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