Empathic Skills Training in Virtual Reality: A Scoping Review

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Abstract

This scoping review identifies and summarizes previous research exploring the efficacy of Virtual Reality (VR) training for empathy and compassion. It clarifies working definitions of empathy and compassion by breaking the constructs down into three components: emotional, cognitive, and behavioral. These components are matched to three key design features of immersive VR technologies: biofeedback, perspective taking, and simulation. Although techniques for empathy-enhancing VR have been reviewed previously, the topic of empathy training in VR has not been comprehensively explored. This paper will present findings on VR empathy training to date, research gaps, and recommendations for future research.

Keywords: Empathy training, virtual reality, biofeedback, perspective-taking, simulation.

Index Terms: K.6.1 [Management of Computing and Information Systems]: Project and People Management—Life Cycle; K.7.m [The Computing Profession]: Miscellaneous—Ethics

1 Introduction

This scoping review investigates prior research and proposes a conceptual framework of design features and empirical methods for empathy and compassion training interventions in Virtual Reality (VR). Empathy and compassion involve many skills that can be trained and strengthened with exposure and practice[1]. These skills can be useful for inferring thought processes of other people, collaborating in teams, responding appropriately to the emotions of others, and enriching interpersonal relationships[2]. Empathic skills addressed in this scoping review include empathic communication, emotional self-regulation skills, and mentally projecting oneself in another person's situation.

Three key VR design features have demonstrated potential to enhance skills related to empathy and compassion; simulation [3], perspective-taking [4], and biofeedback [5]. This scoping review investigates relevant research on the efficacy of these features. Effects of using these design features in VR include decreases in negative biases [6], violent behavior [7], and intergroup conflict [8]. Given the potential of VR as a pedagogical tool for empathy, research in this direction can benefit from a deep exploration into a variety of empirical methods that can be used to validate the efficacy of these VR interventions. Hence the goal of this scoping review is to combine findings from a variety of different disciplines addressing empathy and compassion training into a cohesive understanding of the most robust tools available to measure different dimensions of empathy through training.

To date, only one other review by Carey et al. [10] has explored empirical methods measuring empathy in VR. This review is from 2017 and the field of VR and empathy research has rapidly grown since then with more and more empirical findings and novel methodologies. Additionally, the review touches upon empathy training but does not explicitly address empirical methods for training effects. Similarly, another 2020 review by Ventura et al. [11] addresses interventions to increase empathy but predominantly evaluates pretest and posttest effects at the time of intervention rather than longitudinal effects and real-world transference. Bertrand et al. [12] present embodied interventions in VR using body-ownership illusions training cognitive empathy rather than emotional or behavioral empathy. Perspective-taking has been so strongly used in VR to evoke empathy that many studies focus too narrowly on this one feature of VR and this one component of empathy. Indeed, some researchers have identified that perspective-taking in isolation may be insufficient to promote other-focused empathy [13]. This scoping review takes the stance that embodiment in isolation is a very limited way of evoking long-term and mature empathy, as it relies too heavily on self-other overlap and does not involve deep reflection on emotional processing or the lived experience for the empathic target. Therefore the focus of this scoping review is more on the lesser-studied and reported aspects of empathy training in VR, moving beyond embodiment interventions to include emotional and behavioral components of empathy. On this note, in an opinion paper by Schoeller et al. [14], biofeedback is identified as a feature of VR that can be added to perspective-taking to facilitate empathy. However, the paper then deviates to discuss embodied virtual reality and psychogenic shivers rather than emotion regulation or interoceptive awareness biofeedback interventions explicitly designed towards emotional empathy training.

Another important limitation in the existing literature is the lack of emphasis on empathy training. The prevailing theme in existing VR empathy applications is a focus on decreasing barriers to empathy rather than promoting skills related to empathy. For example, VR embodied simulations of being in the body of an avatar representative of a minority group with a different skin color [15], gender [16], socioeconomic status [4], physical ability [13], or age [19] have effectively reduce negative stereotypes. While these offer a promising start, the research community still could benefit from a more robust approach to empathic training. Hence the overall goal of this scoping review is to catalogue the state-of-the-art tools available to measure build empathic skills beyond just perspective-taking and decreasing negative stigmas and prejudices. Moreover, previous empirical studies on the effects of an empathy intervention in VR lack follow-up measures on sustained changes in empathy and do not report generalizability beyond the study setting. Our proposal is that VR can be used for deeper compassion cultivation beyond just returning empathic processing to an equilibrium. Therefore, this scoping review presents techniques to train more mature aspects of empathy that combine cognitive, emotional, and behavioral interventions and outcomes.

These limitations in the existing review literature on VR and empathy are important to note because empathy is a multidimensional construct that can be trained in different ways. Previous reviews and empirical studies on VR and empathy do not integrate insights and methodologies from empathy training that have been used with and without technology in the healthcare community, as well as trainings in mindfulness-based practices. Therefore, the goal of this review is to synthesize these various threads of research into a coherent model and framework for measuring the effects of empathy training in VR. In order to help researchers to evaluate the efficacy of VR empathy trainings, this scoping review summarizes ways to measure various aspects of empathy and the real-world transference of skills trained.

2 RELATED WORK

Empathy is an emotional and cognitive process that involves an attempt to understand and respond appropriately to the thoughts and feelings of other people. It is essential for prosocial behaviors that helped drive human evolution, including cooperation, bonding, altruism, morality, and trust [19, 20]. For the purposes of this scoping review, empathic processing is divided into three components: emotional (affective arousal or physiological response), cognitive (empathic understanding and perspective taking), and behavioral (compassionate action). Empathy is more conventionally divided along cognitive and affective domains, stipulating behaviors as outcomes of empathy, but this scoping review divides the three components to match them to specific training interventions and design features in VR. Empathic interventions and trainings can address all three of these components by understanding challenges individuals experience that create barriers to empathy. This scoping review presents three technology-supported solutions for these challenges. Those include emotion regulation training using biofeedback for the emotional empathy, perspective-taking designs to support cognitive empathy, and simulation designs to help individuals to practice empathic behaviors such as appropriate communication techniques and helpful actions.

The main challenge for the emotional component of empathy is feeling overwhelmed by the emotions of another person. The emotional component of empathy involves two distinct reactions to the needs and misfortunes of other people: empathic distress and empathic concern. Importantly, these two empathic responses (distress and concern) have inverse effects on prosocial behaviors. Empathic distress is an aversive reaction to another person that often involves anxiety and discomfort [20]. It can cause emotional fatigue and inhibit or block one's ability to engage with others in a helping way, and as such is a barrier to other-focused empathy and prosocial behaviors [22]. By contrast, empathic concern is an other-focused response involving feelings of tenderness, care, and concern for the other person's welfare, and is associated with positive affect [25]. Compassion, often regarded as being strongly linked with (if not synonymous to) empathic concern, involves the feeling of concern for another person's plight, the desire to enhance the welfare of another person, and the motivation to relieve the person's suffering. Compassion motivates helping behavior, predicts positive social attitudes, and promotes altruistic behaviors. Importantly also, compassion has been found to inhibit fear, stress, and anxiety, while one focuses attention on another in a caring way [26]. Emotion regulation has been posited as a primary mitigating factor between empathic distress and empathic concern[27]. Hence, emotion regulation training can help people to avoid excessive empathic distress and facilitate the transformation of a distress response towards greater empathic concern. Indeed, previous research has demonstrated effects of compassion training techniques on decreased stress-related behavioral and neurobiological responses [29].

Another issue for empathy is that that perspective-taking is cognitively demanding, and research indicates that we are less able to empathize when we experience high cognitive load. The cognitive component of empathy involves the ability to understand another person's thoughts and emotions, usually by imagining a situation from their perspective. Decety and Meyer [30] stipulate that the mature capacity for empathy requires the ability to distinguish own's own felt emotions to another person from the empathic target, who is the source of those emotions [30]. When we are cognitively loaded, the ability for this self-other distinction might decrease. The perception of higher cognitive effort in empathic activities (such as imagining and sharing others' feelings) decreased the likelihood that participants would choose to engage in these tasks [31]. VR offers unique opportunities to take new perspectives and to mediate embodiment, which can be helpful for individuals who struggle with mental imagery to imagine what someone else might be seeing, thinking, and feeling. Moreover, VR can integrate biofeedback and help users to understand how what they are feeling in response to a target's emotions might be different from their own emotional response.

And finally, a barrier for empathy is in not knowing how to choose the most appropriate, helpful action or supportive communication. This is most clearly exemplified in instances of the bystander effect, wherein a group of people surround a target who is suffering and become collectively immobilized [32]. While this shared responsibility immobilizes people in the moment, in reflection many wish they had intervened. Although other components of empathy influence helping behaviors, VR offers a unique opportunity to simulate specific events and practice real-world scenarios in an immersive and interactive context that can evoke strong psychological and emotional responses that mirror real life. Participants could re-play a certain scenario, anticipating an adverse consequence, and choose an alternative action such as the VR simulation of the "trolly problem" in ethics [34]. In this simulation, participants function as an elevator operator taking other avatars to different floors of an art exhibit. Suddenly, one of the guests who is taken to the floor with more occupants takes out a gun and shoots these patrons. The participants were able to re-live this simulation and take a different action to alter the course of events. This allows for an enriched simulation of moral decision-making that could potentially give participants more practice to avoid uncertainty and overwhelming emotions in a similar real-life scenario.

Similarly, doctors, nurses, and caregivers often need to deliver a difficult health diagnosis to a patient and listen deeply to a patient's symptoms to assess the best prognosis. VR can simulate patient interactions to help healthcare workers to reflect on their own verbal and non-verbal communication patterns [35]. In summary, technologies can help to train empathy by making it a more salient feature of human interactions, specifically by signaling empathic deficits and training people in effective empathic responses [36].

3 METHODOLOGY

This scoping review addresses three research questions:

1. What is the existing evidence supporting the effectiveness of empathy and compassion training in VR?
2. What empirical methods can be used to measure empathy and empathy training effects?
3. How can the three design features of VR be used as interventions in empathy training?

This scoping review was conducted based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRIMSA) extension for Scoping Reviews[37]. APA PsycINFO, Scopus, Google Scholar, Google, ACM Digital Library, IEEE Xplore Digital Library were searched on January 5, 2022.

3.1 Eligibility Criteria

The following study selection criteria were used in this scoping review:

1. Empirical studies in a peer-reviewed journal (excluding review papers and opinion articles)
2. Include pretest and posttest data with statistical data reported (specifically effect sizes)

3. Include a sample of adult participants from a nonclinical population
4. Written in English

3.2 Search Strategy

This scoping review was conducted based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRIMSA) extension for Scoping Reviews. APA PsycINFO, Scopus, Google Scholar, Google, ACM Digital Library, IEEE Xplore Digital Library were searched on January 5, 2022 using terms "virtual reality" AND "empathy OR compassion" AND "training". References in located studies were also reviewed.

3.3 Search Outcome

Initial search results using the terms "virtual reality" and "empathy" on Google Scholar generated 39,800 results. Adding the word "training" "empathy" in this this search string ("virtual reality" and "empathy training") found only 453 results. This identified the first finding in this scoping review – empathy training is less prevalent in VR research than more general discussions of empathy, which often use words like "facilitate" "enhance" or "elicit" in their titles (rather than "train"). The term "empathy training" alone led to 10,900 results, with a number of article titles mentioning physicians, helping professionals, nursing students, and human services or health science disciplines. Other studies were geared towards children, which did not meet the selection criteria. A SCOPUS search with the terms "Empathy VR" generated 463 results, whereas the terms "Empathy Training VR" produced only 7 results. Of the 463 results on SCOPUS, 215 studies were removed that did not match. 248 abstracts were scanned. 173 abstracts did not fit the selection criteria. 75 studies were selected for the scoping review.

3.4 Data Extraction

The variables coded for the search outcome results included:

1. Year of study
2. Geographical location
3. Sample size (total and in each group)
4. Component(s) of empathy targeted
5. VR design feature(s)
6. Outcome measure(s)
7. Statistics reported

In addition, the empirical quality of the studies was scored on a scale of 0 to 9. This scoring was based on the extent to which the studies included a mixed methods designs, measures beyond self-report questionnaires, and longitudinal results.

4 RESULTS

This section presents a brief description of the articles included in the analysis, specifically the design features in VR, and the empathy measures implemented.

4.1 Design Features in VR

Simulation involves human actors or digital avatars representing the empathic target (the person for whom participants' empathy is developed) [38]. ***Perspective-taking*** places the participant in the embodied perspective of the empathic target and presents aspects of the target's subjective perception [4]. ***Biofeedback*** involves heart rate and respiratory rate biofeedback during an empathically arousing encounter with the target to increase awareness of physiological arousal related to empathic distress [39].

4.1.1 Simulation Training for Behavioral Empathy

Simulation training has previously been used in medical training to present clinical scenarios in safe environments and train reflection and communication. One of the key benefits to simulation training is that it allows trainees time to think about their responses [35]. Simulation trainings in medical education have effectively increased knowledge and confidence [38] and improved attitudes towards the empathic target [40].

The most common framework used to evaluate the effectiveness of these training programs is *Kirkpatrick's Four Levels of Evaluation Model* [41], which uses post-training questionnaires and interviews to assess reactions, learning, behaviors, and results from a training intervention. For example, Maindonald et al. [42] used this framework to measure satisfaction with a mental health communication skills training amongst non-mental health professionals working in urgent care settings. The authors specifically assessed changes in confidence, mental health-related stigma, health-care kills, mental health knowledge, application of learning to the workplace, and satisfaction with the care received by people experiencing a mental crisis [42].

Recently, Lev et al. [32] created a VR simulation of the bystander effect by allowing participants to take the perspective of multiple different bystanders and understand their point-of-view, stream of consciousness, and memory of the event of a person drowning. This type of simulation could potentially allow individuals to understand the nature of the bystander effect, or to potential "re-live" experiences to practice different ways of responding to crises. Similarly, Garcia and colleagues used a bystander effect simulation in VR to allow participants to take the perspective of a person using a successful bystander intervention strategy. However, both of these studies were design-focused and lack strong empirical data, specifically on the behavioral effects of the training. Garcia and colleagues conducted a small qualitative user study that included a post-survey and an audio recorded semi-structured interview, with results indicating a slight change in perception on the bystander effect and strategies of responding and a perception of strong usefulness of the application for preparing individuals to respond to similar situations in real life.

Simulation training is also a valuable component to empathy training, as it targets the behavioral components of empathy rather than just the cognitive aspects. Indeed, training that focuses exclusively on the cognitive or affective aspects of empathy may not result in improvements of behavioral skills. In contrast, simulation training involves opportunities to interactively explore and practice empathic communication skills. It involves reflective questions and practical experiences that motivate learners to develop empathy. For example, Shao et al. [43] used a simulation-based empathic communication training with neonatal nurses and reported outcomes of a stronger ability to recognize and respond with empathy to patient's emotions.

Self-feedback involves seeing oneself from another person's perspective can provide an additional dimension in simulation. Self-feedback allows participants to observe their own behaviour from the point of view of the empathic target to promote reflection on their own behaviours to improve communication. For example, Raij et al. [44] developed a medical interview training application to help medical students communicate more empathically towards patients. The medical students interview and examine a patient called Amanda, a virtual human who expresses fear about a persistent pain in her breast indicating she may have breast cancer. The doctors conduct the medical interview and breast examination in VR from their own point of view, and then see the entire interaction from Amanda's point of view. The VR setup is designed to assist students in reflecting on their communication skills and to aid empathic listening to patients. Thus, rather than just seeing from Amanda's point of view, the students are encouraged to contemplate her thoughts and emotions.

Foster et al. [35] found that providing medical students with immediate feedback about empathic communication during a simulated conversation with a patient expressing a suicide attempt expressed more verbal empathy and were more proficient in suicide risk assessments with future patients. Their simulation training intervention used narrative video vignettes to provide backstory on the patient and offered potential response alternatives during a long conversation with the patient.

4.1.2 Perspective-Taking for Cognitive Empathy

Perspective taking involves *self-transposal*, which is imagining seeing from another's viewpoint and imagining seeing oneself from another's perspective [45]. Perspective-taking has been used as a key tool in transforming attitudes and behaviors in technology-enhanced simulations. For example, white study participants who embody a black avatar in VR exhibit decreases in racist attitudes [15]. In another study, male perpetrators of domestic violence showed greater recognition of fear in the faces of their female victims after having an embodied, perspective-taking experience of becoming their victims in VR [15]. Participants who experienced the simulation of a puzzle from the perspective of an individual with color-blindness were much more likely than a control group to volunteer to help a confederate posing as a person with color-blindness and spent more time with the confederate [17].

In 2008, Petkova and Ehrsson created a VR body swap that allowed participants to experience themselves from the point of view of a partner in the experiment [46]. This virtual body swap mirrors that of The Machine to Be Another's (MBA) Body Swap experience [12], which is a performance art installation in which two audience members swap visual perspectives. Within the MBA Body Swap, two facilitators conduct a protocol of interaction that synchronizes tactile information to each participant, and participants are instructed to move slowly and synchronously. Combined, this synchronous visuotactile and visuomotor information can create the illusion of being in the body of the other person.

4.1.3 Biofeedback Training for Emotional Empathy

Biofeedback involves recording data from tracking devices or sensors to provide real-time feedback to the user through changes within data visualizations, games, cinematic narratives, or virtual environments. Biofeedback uses biosensor measures of heart rate, breathing, and skin conductance, and provides feedback to the user usually in the form of a data display or control of an interface. Biofeedback training aims to develop the ability for individuals to self-regulate biological processes in the body and nervous system.

One goal of integrating biofeedback training into VR empathy training interventions is to train emotion regulation. Although there is a lot of research on biofeedback and emotion regulation, the VR community is lacking integrating this technique in emotional empathy training. VR can use real-time physiological and psychophysiological data feedback to the user to increase self-awareness and regulation in response to witnessing the distress and suffering of others.

One verified technique for improving emotion regulation is compassion meditation training [47]. Compassion practices and biofeedback both rely on emotion regulation as a key component. For example, a main objective in mindfulness-based meditation with a compassion focus is to increase self-awareness and regulation of one's own emotional and physiological arousal states. Previous research has demonstrated effects of compassion training techniques on decreased stress-related behavioral and neurobiological responses [47]. Brief compassion training may influence activity in neural areas related to stress such as the anterior cingulate cortex and amygdala [29]. Thus, compassion meditation practice could be implemented in combination with biofeedback to improve emotion regulation when confronted with high empathic arousal in VR empathy training.

Affective computing applications use biometrics to help virtual agents and computer algorithms automatically recognize human emotions and respond in more empathic ways using facial expression tracking and biometric sensors. These emotion detection tools can also be used to facilitate and augment human-human interactions to train skills related to empathy and compassion by helping users to become more aware of their own and another's emotions. One recent development that uses this framework is interpersonal biofeedback. Interpersonal biofeedback delivers real-time physiological feedback to two participants such that each participant can see both their own biofeedback, as well as their partner's biofeedback. The effectiveness of interpersonal biofeedback to improve skills related to empathy relies on subjects learning from both their own and their partner's physiology [49]. Previously, interpersonal biofeedback allowed couples in therapy to better understand their own emotional and physiological reactivity, which helped them to recover from stressful communications faster and to make their partner aware of the physical and emotional effects of their negative and positive communication styles [50]. As a result, couples are encouraged to become more aware and responsible for their own physiology and to increase their attentiveness to their partner's physiology. This increased self-awareness and self-regulation promotes emotional empathy and reduces impulsiveness and reactivity ([50].

Hence biofeedback as a psychophysiological intervention for promoting interpersonal connection is helpful in two domains. The first is an increased awareness of the body's empathic response, which means that the participant recognizes and understands their own physiological changes, as well as those of another person. The second is an increase in emotional self-regulation, which means that the participant can now contain their own emotional impulses and can choose to act in response to the other's physiology as a way to reduce any interpersonal tension. In other words, through the acknowledgements of one's own physiological responses, one can stay calm and clear headed when facing criticism or conflict and be attentive to another's needs. This suggests a future direction for work on VR empathy training that could allow for an empathizer to process the emotions of a target in real-time through interpersonal biofeedback.

5 Conclusion

This scoping review aims to review various design components that have and can be used to assess training outcomes for empathy-related training interventions using emerging technologies, specifically VR. We specifically highlighted three pedagogical tools that can be used for training empathic skills which are enhanced by technology: simulation, perspective-taking, and biofeedback. Existing VR applications in the empirical literature were categorized into cognitive, emotional, and behavioral empathy interventions. Findings indicate that the existing applications for training empathy in VR tend to narrowly focus on one component of empathy rather than combining multiple different components.

One of the biggest limitations that this scoping review identified is that existing research lacks solid long-term behavioral and quantifiable outcomes on empathic gains that transfer into real life for the participants. Specifically, more mixed-methods research can help to establish the effects of VR trainings on empathy. Behavioral changes are a benchmark outcome to reveal strong effects of training interventions. However, most research only measures the participants' self-reported intentions to behave in a certain way versus their actual behaviors. While future behavioral intentions do often align with actual behavior, this is not always the case. Thus, using a mixed methods design that includes self-reported changes as well as real-world behaviors would be more ideal.

In conclusion, although initial research indicates potential for VR in training empathic skills across cognitive, emotional, and behavioral domains, longitudinal studies beyond pretest and posttest at the time of exposure are highly lacking. It is not well-established whether experiences and trainings in VR influence real-world functioning in terms of empathy skills gained. To help resolve these challenges, VR researchers can look to established empirical methods demonstrating long-term efficacy for empathic training in medical and mindfulness interventions. Moreover, researchers can combine various design features of VR to facilitate the various components of empathy in a more robust way and hence give a more comprehensive lesson on how to incorporate the trainings into real life.

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