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EDITORIAL

Enhancing Empathy: a Role for Virtual Reality?

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The capacity for empathy is essential to clinical medicine and is of particular importance to the practice of psychiatry. The physician's experience of empathy in patient care has been described as "a sequence of emotional engagement, compassion, and an urge to help the patient" produced by a "doctor's awareness of the patient's concerns" [1]. Empathic identification with patients' suffering is the driving force behind the prevention and mitigation of suffering, pain, and distress [2], a professional obligation generated by the fundamental professional virtue of compassion.

Strengthening the capacity for empathy is an important goal of medical education, but longitudinal studies suggest that empathy declines during residency and even during medical school [3]. Fortunately, decreases in medical students' empathy, while appreciable and statistically significant in a variety of empirical projects, are not thought to be large; effect sizes appear to be small [4]. For this reason, the threats to empathy may be reversible and, we suggest, a number of steps may be taken (a) to mitigate the factors that are diminishing empathy and (b) to encourage the enhancement of empathy in residency and medical school.

Greater curricular emphasis on empathy should be considered, as well as more attempts at measuring empathy among resident and medical student populations. In order to gain or protect time for teaching empathy, educators must be able to describe precise teaching methods and evidence of positive outcomes. Such efforts are especially important in light of the growing list of topics required in the graduate and undergraduate medical curriculum.

A variety of interventions have been explored to teach empathy in residents and medical students, including writing, skills training, acting (e.g., improvisation), and problem-based learning. One systematic review calculated a mean effect size of 0.23 in the teaching of medical students [5]. Another systematic review noted promising but limited results, with eight positive studies out of only ten "highly rigorous" ones in the literature [6].

Previously, some of us wrote an editorial about nurturing emotional intelligence during psychiatric training [7]. Augmenting a psychiatrist's ability to read the emotions of patients, possibly using Web-based trainings, was used as an illustration. In the 12 years since that editorial, "Academic Psychiatry" has published a number of studies describing educational interventions to increase empathy in trainees. Seven of these studies [8–14] are referenced in Table 1, with details to give a sense of the pedagogical methods and breadth of research designs applied to date. The studies range in size from a report about a single student to a study with almost 100 participants in the experimental condition and 100 participants in the control condition. Subjects included medical students, psychiatry residents, and some residents in fields other than psychiatry. A variety of educational interventions were employed, including writing about experiences with patients, performing role play, reading, engaging in didactics, viewing a video, playing a video game, listening to audio recordings, working in a free clinic, and learning mindfulness exercises. Outcomes were often based on self-report, using scales like the Jefferson Scale of Physician Empathy. Though usually naturalistic, two of the studies had control groups, and one had randomization. All seven studies reported or suggested that the interventions enhanced empathy of the subjects. The two studies with controls suggested that empathy of experimental subjects was enhanced more than empathy of controls. Limitations included the following: the use of different scales and subjective measures of empathy across studies; several studies with very few subjects and without control groups;

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Table 1 Sample of educational interventions thought to increase empathy in psychiatry

Study	Intervention	Metrics	Trainees	Number of participants in experimental condition	Number of participants in control condition	Design
Deen et al. 2010 [9]	Write first-person narrative of three patient experiences, with supervision	Self-report, supervisor's evaluation	GME (psychiatry PGY1)	1	N/A	Qualitative
Baker and Brenner 2018 [12]	Work in student-run, free medical clinic	Field notes, semi-structured interview of students	UME (psychiatry clerks)	10	N/A	Qualitative (grounded theory)
Aggarwal and Guanci 2014 [10]	Recount personal experiences and roleplay in a one-time seminar	Self-report	UME (psychiatry clerks) > GME (medicine)	86	N/A	Post-evaluation
Bentley et al. 2018 [13]	Train in mindfulness and empathy	HRQ	GME (psychiatry PGY1)	7	N/A	Pre- and post-evaluation
Chen et al. 2018 [14]	Interactive video game	JSPE (modified)	UME (psychiatry clerks)	84	N/A	Pre- and post-evaluation
Crisafio et al. 2018 [11]	Watch 5-min video on SBIRT	Interview of student, standardized patient	UME (psychiatry clerks)	96	94	Historical controls (1 year before intervention year)
Bunn and Terpstra 2009 [8]	Listen to simulated auditory hallucinations (40 min)	JSPE	UME (psychiatry clerks)	100	50	RCT, pre- and post-evaluation

UME, undergraduate medical education; *GME*, graduate medical education; *PGY1*, postgraduate year 1; *SBIRT*, screening, brief intervention, and referral for treatment; *JSPE*, Jefferson Scale of Physician Empathy; *HRQ*, Helpful Response Questionnaire; *RCT*, randomized controlled trial; *N/A*, not applicable

no follow-up measures of sustained changes in empathy; lack of proof of generalizability beyond the study setting; no measures of impact on practice behaviors or patient outcomes; and no comparison to other interventions aimed at increasing empathy.

A Role for Virtual Reality in Empathy Training?

Chen et al. [14] measured empathy before and after 84 medical students played the video game "That Dragon, Cancer." In the game, students played the role of parents of a child with cancer. Students had to navigate various environments and tasks involved in the child's care, such as needing to comfort the child when the child was distressed. Chen et al. [14] found an increase in scores on a modified version of the Jefferson Scale of Physician Empathy after the students played the game. Most of the students subsequently indicated that video games were preferable to typical didactics. This study reveals the possibility of using technology to teach empathy. Chen et al. [14] note the tremendous impact of "That Dragon, Cancer" in simulating emotional and interpersonal situations related to cancer care.

Technology may have a role in the deliberate practice of one's empathy skills. Software and artificial intelligence are getting better and better at simulating interactions with people; someday human subjects may be unable to distinguish between distance communications with a computer versus a human partner. Compared to training with people (e.g., simulated patients, role plays, patient encounters), software may be more reliable, economical, and easy to disseminate. Simulations may be repeated until educational outcomes, as measured by the computer (e.g., by emotional microexpression in response to stimuli), are met. During the course of repeated trials, the mechanism of learning might become implicit, with the intended empathy lesson outside of the subject's conscious awareness and instead embedded in a video game or virtual reality environment.

Virtual reality is a digital technology that might be utilized to enhance empathy. The power of the virtual experimental environment is the ability to program and thus control almost every detail of the experimental condition. Many details of reality can be simulated and manipulated independently. Both granular and nonverbal emotional reactions of volunteers in the experimental condition can be stored in computer memory. Early studies have attempted to evoke emotional responses, including empathetic feelings, from volunteers using virtual environments. Subsequently, studies have measured empathy in volunteers through self-reported feelings and/or observable empathic behaviors in the real world. It is hypothesized that volunteers who experience virtual reality interventions, either once or repeatedly, will demonstrate an increase in empathy beyond the experimental condition that will later transfer to the real world. In this editorial, we examine this futuristic hypothesis and discuss two possible mechanisms of virtual reality, immersion and body transfer, which have been proposed to underlie potential empathy effects.

Virtual Reality and the Mechanism of Immersion

Watching a video or playing a video game can be quite engaging and can be effective in teaching motor or cognitive skills. For acquiring emotional skills, however, one would think that technology would have to be able to consistently arouse some emotional response in order to facilitate experiential learning. Films can evoke emotions in an entertainment context, but for educational objectives, technology would need to induce emotions with a higher standard in terms of reproducibility, control, and prosocial behavior change. Additionally, emotions would need to be induced in an authentic way that would generalize to real-life situations with patients. Virtual reality technology might be more powerful and efficacious in shaping empathic behavior because it more effectively simulates being in the world of another person. Other methods attempt to give knowledge about the experiences of others through reading, listening, and watching, but virtual reality is potentially more immersive. The experience of immersion in the virtual environment is sometimes referred to as "presence"—the feeling that one is really "there."

Virtual reality is able to achieve a greater sense of immersion than a standard video through the use of head-mounted display equipment, which looks like a pair of goggles with screen displays for lenses. This equipment is a lot like a single-user movie theater, substituting the visuals of a virtual world for the real world. The head-mounted display has built-in sensors that allow tracking, by external towers, of every head acceleration, tilt, and rotation. These data are fed into a computer that constantly recalculates, pixel by pixel, the visual display. The visual world is rendered, over and over again, in accordance with the volunteer's head movements. When the volunteer swivels his or her head to the left or right, the view pans to the left or right, respectively, degree by degree, in synchrony with the head's rotation. The volunteer is given the freedom to explore the virtual environment and look wherever he or she desires. Whole body movements may also be tracked with the addition of body sensors. The perception of sensory control is the first step to feeling immersed and present in the virtual world—a world that can be digitally manipulated to simulate the view of another person.

Consider the task of teaching people to have empathy for people who are red-green color-blind. In one study [15], normal-sighted participants were immersed into a virtual world with realistic colors. A red-green filter was applied to the virtual world for individuals in the experimental condition, which mimicked what people with red-green color blindness experience. The color filter was not applied for individuals in the control condition; instead, they were instructed to imagine that they were color-blind. Experimental and control participants were asked to do color discrimination tasks in the virtual world. All participants then entered a second phase of the experiment in which they volunteered time to provide online advice to a student group creating a website for people with color blindness. The participants in the experimental condition voluntarily spent about twice as much time (and twice the number of typed words) providing online help than the participants in the control condition. If more time voluntarily given was taken as a proxy for empathic behavior, the authors suggested that virtual reality was able to increase it.

The process of tracking movements and rendering a constantly changing visual display in accordance with these movements requires massive amounts of computational capacity and speed. Only in recent years has computer technology developed such capability and, coincidentally, has miniaturization allowed head-mounted display equipment to become smaller, lighter, and affordable to the public, thus paving the way for practical applications of virtual reality in medicine.

Virtual Reality and the Mechanism of Body Transfer

Another possible mechanism for enhancing empathy with virtual reality is suggested by a 20-year-old study and what is known as the "rubber hand illusion" [16]. This low-technology illusion utilizes a psychological mechanism now dubbed as "body transfer" (also "embodiment"), in which the individual experiences the world through another's body (or body part). In this illusion, the volunteer is seated with both arms stretched out across a table toward a researcher. One of the volunteer's arms is obscured from view under a drapery. The volunteer sees a rubber hand protruding from the drapery and resting on the table. The volunteer then sees the researcher stroking the rubber hand with a brush. At the same time, under the drapery, volunteers in the experimental condition have their real hand stroked in the same place with another brush; volunteers in the control condition do not receive this tactile treatment. In other words, the individuals in the experimental condition experience the sensation of having their hand brushed while seeing the rubber hand being brushed. This experience is said to create an "illusion" that the rubber hand is part of the volunteer's body in the experimental condition. One might say that the volunteer experiences a body transfer into the rubber hand; stabbing the rubber hand (and not the real hand!) in front of the volunteer causes a strong galvanic skin response [17] and activates brain areas normally associated with a threat to one's real hand, like the anterior cingulate cortex and insula and motor planning to withdraw the hand [18]. This response does not occur if the rubber hand and the real hand are brushed asynchronously [16].

The rubber hand illusion may be explained by the theory of multisensory integration [16] and, perhaps, predictive coding. Simplistically, the brain constructs sensory-motor models of the world on the basis of multisensory inputs from which it makes predictions for the future. For instance, on the basis of past sensory data, the brain has a model of the likely motor movements needed for lifting a coffee mug from the table to one's mouth. The hand and arm initiate this lifting using the previously stored model that predicts the necessary movements. Sensory feedback detects any errors in this prediction (e.g., the mug is much heavier than usual), and movements are modified on this attempt (e.g., engaging more muscle strength to lift the heavier mug) or, at least, on the next attempt. In the rubber hand illusion, the predictive coding system is alerted to a prediction error. The brain has to make sense of experiencing the tactile sensation of the real hand being brushed simultaneously with the visual image of a rubber hand being brushed. The brain constructs a model to explain these unexpected multisensory inputs, with one interpretation being that the rubber hand is now part of the volunteer's body. In responding as if the rubber hand were now his or her own, the volunteer is said to have "embodied" the rubber hand and inhabited something outside the volunteer's traditionally defined body.

Some investigators have tried to extrapolate the rubber hand illusion to body transfer into a whole body avatar, a three-dimensional representation of the volunteer in the virtual environment [19]. For example, a volunteer views the back of his or her avatar being brushed in the virtual world while, simultaneously, the volunteer's back is brushed in the real world. Another approach to achieving the same effect utilizes a virtual mirror. In this case, body transfer occurs when an individual enters virtual reality and is confronted by a virtual mirror. Instead of a real reflection, an avatar is seen in the virtual mirror. The virtual reality software detects the limb, trunk, and head movements of the individual with tracking devices, and the avatar in the virtual mirror mimics the movements of the individual just like a reflection in a real mirror. In fact, with facial tracking, the avatar might even reflect the individual's facial expressions. On the basis of previous life experience with mirrors, the volunteer may come to feel that the avatar is himself or herself. Imagine the effect on the volunteer if the researcher begins to gradually alter the avatar, conceivably making it older, heavier in weight, or sickly in appearance. Analogous to feeling pain when the rubber hand is stabbed, the volunteer might be induced to empathize with the people who are older, overweight, or visibly ill.

Over the past 15 years, many studies have been published exploring the phenomenon of body transfer using virtual reality and measuring its effects on empathy. Reviewing these studies and their scientific rigor is beyond the scope of this editorial, but we will mention several to provide an idea of their range and nature to date. While this literature is quite promising, the effect sizes are variable. Most relevant to our discussion here are studies that place the individual learner in a world that is more abstractly altered than the color-blind example previously described. For instance, some studies seek ways to induce empathy for marginalized or vulnerable populations by simulating prejudices like ageism, racism, and other types of stigma in virtual worlds. For instance, in ageism studies, individuals needed to take on the perspective of the elderly [19]. Body transfer was utilized with a virtual mirror, as described earlier. In virtual reality, volunteers saw avatars of themselves simulating their reflection in a virtual mirror, but the appearance of the avatars had been progressed to an elderly age. Volunteers in the control condition saw avatars of themselves at their current age. Volunteers then encountered another person, a young-looking avatar with whom they had to interact by doing a memory task. After the virtual reality session, subjects who had inhabited an elderly avatar enumerated relatively more positive adjectives associated with an elderly person during a word association exercise.

Similarly, other investigators have studied body transfer of white volunteers into black avatars in a virtual mirror. In one study [19], the volunteer, as a black avatar, interacted with another avatar in a mock job interview. The implicit-association test was later used to assess implicit negative and positive racial reactions. Unexpectedly, implicit racial bias was actually increased by the experimental condition. Exposure to the black avatar may have primed and activated implicit racial stereotypes, resulting in loss of empathy. The priming of racial stereotypes is not in conscious awareness and has been demonstrated in multiple studies of the implicit-association test, even when volunteers are members of the stereotyped racial group. Another research group also explored the body transfer of white participants into black avatars but reinforced the body transfer by utilizing more elaborate body tracking technology in the virtual mirror [20]. Here, the implicit-association test indicated decreased implicit bias with the experience. It is possible that in the earlier findings, insufficient body transfer was not able to overcome the priming effect of implicit stereotypes. Sufficient embodiment, however, was able to overcome the priming effect and allowed participants to take on the perspective of the black avatar. Intensity, duration, and other measures of body transfer may make a difference in whether bias is decreased or inadvertently increased [19].

Virtual reality should, theoretically, be a tool to decrease a wide variety of biases, including stigma toward mental illness and addictions. For instance, Kalyanaraman et al. studied the effects of a virtual reality simulation of having the symptoms of schizophrenia on empathy, attitudes, and social distancing relative to this disorder [21]. They compared four conditions: control, empathy perspective-taking task, virtual reality simulation, and empathy perspective-taking task plus virtual reality simulation. The latter combination condition resulted in the greatest increase in empathy and positive attitudes, along with lessening of social distancing. Interestingly, the virtual reality simulation condition alone did not improve empathy or attitudes and increased social distancing in comparison to the control and empathy perspective-taking task alone. Thus, virtual reality simulations may need to be blended with other tasks to obtain the desired direction of outcome changes.

Virtual reality could also be used as a tool for enhancing empathy for oneself. Many people hold negative perspectives and stereotypes about themselves; sometimes these negative perspectives are associated with having a mental illness like depression or anxiety. One design was applied to increase self-compassion in subjects with major depression [22]. Briefly, volunteers, as adult avatars, interacted with a distressed virtual child, and their consoling verbal and nonverbal behaviors were recorded. Next, the volunteers were transferred into the body of the virtual child and heard the previous recording of their own consoling behaviors coming from an adult avatar (i.e., the volunteers became recipients of their own consoling). Undergoing this protocol three times resulted in an increase in self-compassion and a decrease in depression measures; this finding was limited by the absence of a control group, however.

The Proteus effect [23] is based on the finding that when an individual transfers to an avatar, he or she begins to take on the extant characteristics of that avatar. People who seek self-improvement might be transferred to avatars who are happier, healthier, and more productive. Yee et al. [23] studied how the appearance of a volunteer's avatar in a virtual environment changed the volunteer's behaviors. For example, volunteers were randomly assigned to avatars that were either shorter or taller in the same online world. After freely interacting online using the assigned avatar, the subjects left the online portion of the experiment and engaged in an in-person negotiation task with a partner in the lab. The negotiations were designed along the lines of the "prisoner's dilemma." Volunteers who had been assigned to taller avatars were more aggressive during the negotiations and rejected unfavorable offers more often than those who had been assigned to shorter avatars [23].

In summary, a nascent literature suggests that using virtual reality to enhance empathy may become a practical consideration, especially if mechanisms such as immersion and body transfer are effectively leveraged. Yet, many questions remain, and more critical study is needed. Major challenges include demonstrating the transferability of enhanced empathy outside the laboratory into real-world contexts and documenting the sustainability of empathy enhancement with a significant effect size. Future research might include blending virtual reality with debriefing protocols, determining the mediating role of individual differences among volunteers, testing for a ceiling effect, assessing adherence to use of virtual reality, measuring adverse effects, and more. If proven effective and safe, digital technologies like virtual reality may become a highly automated, cost-effective, and widely disseminated means of enhancing empathy skills.

Compliance with Ethical Standards

Disclosures On behalf of all authors, the corresponding author declares that there are no conflicts of interest.

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