

Immersion for Inclusion: Virtual Reality as a Novel Approach to Developing Faculty

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Abstract

This Work-in-Progress paper describes an exploration of the potential to position faculty to cultivate more inclusive engineering environments using virtual reality (VR) as a tool for development. The project's goal is to create a level of awareness among faculty of the marginalized experiences of people from groups traditionally underrepresented in engineering—women, Blacks, Latinxs, persons with disabilities, veterans, persons identifying as LGBTQ+, first-generation college students and those from low socioeconomic backgrounds—as they navigate engineering environments. This work introduces a novel approach to changing the culture of engineering programs from within through a focus on faculty. Specifically, this work seeks to investigate whether immersive virtual reality (IVR) experiences can be utilized as a tool to develop more inclusive and empathetic mindsets among faculty. As faculty are gatekeepers to culture in engineering environments, having more inclusive-thinking faculty could contribute to a paradigm shift to create a change in culture in the absence of a critical mass of people from underrepresented groups. The research questions are focused on exploring whether such immersive experiences could be used to create levels of awareness powerful enough to shift attitudes, beliefs and behavior. Using virtual reality as a modality to provide immersive experiences for faculty demonstrates the timely use of a technology whose potential has not yet fully been realized. If successful in enhancing inclusive awareness of faculty, such immersive virtual experiences could have a transformative impact on faculty development, particularly as it relates to the role and responsibility of faculty in creating inclusive engineering environments. This work would benefit from presentation in a round table session that affords participants an opportunity to experience the virtual reality scenario followed by a brief dialogue inspired by the potential of IVR to evolve into a tool for faculty training.

Introduction

To start thinking about inclusion in a different way, we must start asking more provocative questions such as *how might we cultivate more welcoming and inclusive environments if the numbers of diverse engineering faculty were to never increase?* This work approaches critical research questions through this lens. The long-term goal of this project is to identify how we might cultivate inclusive engineering cultures in the absence of critical masses of people traditionally underrepresented in engineering. Stated another way, this challenges us to consider how we might actualize more diverse and inclusive engineering environments starting with those already present in large numbers. This suggests as opposed to waiting until we have large numbers of individuals from diverse groups to address the issues impacting them, we start with increasing the awareness of those from majority groups to the marginalized experiences of people from underrepresented groups as they navigate heteronormative engineering cultures. One potentially transformative way of doing this is by shifting the mindsets of faculty to be more inclusive and empathetic and immersive virtual reality experiences present a modality through which this can possibly be achieved.

Rarely are intentional efforts to learn to be inclusive or empathetic embedded in formalized training as an engineer. However, Kaufman and Libby described experience-taking as an

effective way of changing mindsets and hearts—showing changes in participants’ goals, attitudes and behaviors fostered by a reduction in the self-concept that allows for the taking on of the thoughts, feelings and traits of another [1]. The potential to change mindsets exists and both inclusion and empathy are teachable and learnable constructs. With that knowledge, what if engineering faculty could be exposed to a host of underrepresented individuals and their experiences directly through an immersive virtual experience?

A growing body of evidence for analogous techniques verifies the effectiveness of simulated experiences. Techniques targeted at creating or sharing the experience of another have been used in many applications and are referred to by many different names—role-playing and perspective or experience taking [2], player focused story-telling through games and 2-dimensional simulations [3], and voluntary mimicry [4], [5] to name a few. However, interaction within a virtual environment is qualitatively different from interaction in a desktop system as it facilitates the capability for mobilization of the participant’s whole body in a given task [6].

Naturally, scholars are skeptical that the interest in virtual reality is trendy and lacking evidence of effectiveness. However, VR is currently the most optimal modality through which an individual, in a safe space, can directly encounter challenging situations without negative consequences and through the experience have the potential to generate a level of sustained awareness that could influence mindset and behavior. Specifically, immersive virtual reality provides an effective way of generating a first-person experience not limited by the constraints of reality. The sense of presence and emotional engagement afforded through IVR demonstrate its power and potential as it enables a person to readily change their body representation, i.e. gender, race, age, ability status, etc., in a process known as virtual embodiment [7].

This work is situated in the embodied cognition theory. Through this framework, the body and its relationship to the environment influence cognition. IVR provides a testbed for the embodied cognition theory in that individuals regard their virtual bodies, or avatars, as extensions of themselves which creates an embodied illusion. The embodied cognition theory allows for realization that how a person experiences an avatar can alter how people think, feel and act in their bodies outside of the virtual environment. This illusion of embodiment and ownership of the avatar is made possible through sensorimotor correspondences— when the avatars movements are synchronous to the individual’s (i.e. seeing the hand movements of the avatar correspond to their natural hand movements in real time). In IVR, when an individual looks down towards themselves in the VR environment, they see a programmed virtual body, or avatar, substituting their own body. This facilitates walking in someone else’s shoes to experience their perspective in a seemingly real way without judgement being cast and/or people feeling exposed. This immersion, or ability to be embodied, is a critical capability of IVR and a further justification for why third-person experiences are incapable of creating this effect.

Research in higher education shows direct benefits of IVR as a powerful tool for education and training [8], [9]. As an example, younger adults were motivated to invest in their retirement after experiencing their aged senior avatar through embodiment [10]. And, despite the hostility that is common to ‘out-groups’ in all human cultures, IVR has been shown to reduce implicit racial bias

towards members of racial ‘out-groups.’ Peck et al. found virtual embodiment could induce changes in implicit attitudes without explicit priming for perspective taking or role-playing [11] and recent studies have shown that the formation of new in-groups or out-groups based solely on pictures could lessen racial bias towards Black members of the in-groups [12]. Temporarily transferring someone to a different in-group, by way of changing skin color in the studies referred to, proved an effective way of transforming group affiliation. It is quite plausible that similar transformations could occur in IVR for engineering faculty to temporarily transfer into the student—veteran, person with disability, woman, woman of color, LGBTQ individual, low socioeconomic status or first-generation—perspectives to encounter firsthand some of the marginalized experiences that ‘inclusion privilege,’ power and implicit bias commonly circumvent.

IVR as a Tool for Training Faculty

Presenting scenarios through IVR to create awareness of the marginalized experiences of others as well as the impact of those experiences on those that have experienced them could return “altered” individuals to the real world—possessing a heightened awareness with the hopes of shifting to be more inclusive. The natural question becomes, how might perception of the physical world change when embodiment pushes the boundaries by what is felt and seen in the virtual world? How might mindsets, and ideally behaviors, be modified by being exposed to the marginalized experiences of people navigating engineering environments? This work will be situated in the embodied cognition theory to investigate the answers to these questions. IVR scenarios will address issues such as ableism, gender stereotypes, homophobia, racism, etc., as characters in the scenarios demonstrate the attitudes, beliefs and behaviors that contribute to the marginalized experiences endured by people underrepresented in engineering. Often developed scenarios will present experiences shared by multiple people to represent common encounters to specific groups in engineering rather than unique individual experiences that may more likely represent outliers. The scenarios presented will span a variety of contexts as generated from the experiences of the focus groups and could take place in a research setting, a professor’s office, a classroom, or even in a makerspace. However, the participant will always take on the role of the individual encountering the marginalized experience in the scenario. The early scenarios will focus on student experiences for faculty to get a better understanding of the unique vantages of students from varied identities.

The research team has developed a virtual reality scenario in house for the purpose of this preliminary investigation. The specific scenario for this study was informed by a focus group interview with a group of Black engineering undergraduate students enrolled at accredited engineering programs in the U.S. The students were asked to share some of their challenging experiences navigating engineering. After students had shared some of their challenges, they were then asked to share challenges they had endured that they perceived to be related to specific aspects of their identity (i.e., race, ethnicity, gender, being a parent, etc.). Through these accounts, students described the many stereotypes, microaggressions and prejudices directly associated with aspects of their identity experienced as they navigated engineering environments, and often at the hands of faculty. The salient encounters of these students were aggregated to address several components identified across the various individual accounts. These components were developed into a storyline and associated with the Microaggression Process Model to enable identification of the marginalization occurring in and through the scenario’s components

[13]. This would create the opportunity for people experiencing the module to not only be exposed to the marginalization of the underrepresented individuals, but to also gain literacy in how certain actions, comments and behaviors manifest and marginalize others.

In the scenario, participants become the avatar, Becky Nelson, an Afro-Cuban woman student meeting to interview with a Caucasian, male Professor White for a research position in his laboratory. Participants first undergo a VR tutorial in the event that they have not had experience navigating in a virtual space. This increases the level of familiarity participants have when entering the actual scenario and creates for a better immersive experience. The scenario begins with participants being introduced to themselves, Becky Nelson, and their living space. Participants are instructed to maneuver through the apartment and interact with artifacts that provide background related to Becky's identity, responsibilities, interests, motivations and purpose. As participants explore their apartment, they learn several pieces of information that are necessary to enable them to have greater context regarding their character during the main scene of the scenario where they have the interview with the professor.

The interview with the professor involves a dialogue tree that allows the participant to choose how they wish to respond in real-time in the conversation. This ability, coupled with the participant having Becky's vantage and mirrored body movements, enables participants to feel more immersed as the actual character. Although the evolution of conversation is dependent upon the selections of the participant, there are key statements made by the professor that are independent of the participant's response. These statements reflect what is constant in all interactions. Specifically, all constants in the dialogue involve at least one of the following concepts—(P)rejudice, (R)acism, (I)mplicit bias, (S)exism, (M)icroaggression and (S)tereotype—which the research team has coined as *PRISMS*. Each constant segment spoken by the professor involves one or more of the *PRISMS* components. At the end of each segment in the dialogue, participants are instructed to select which, if any, of the *PRISMS* components they recognized in that segment. The *PRISMS* components are consistently presented and defined at the conclusion of each segment for the participants. Participants' ability to detect the manifestation of marginalization will be measured by their *PRISMS* score that calculates the difference in the number of components they identify correctly from the number they answer incorrectly over the total number of answers. Low percentages will correspond to low levels of detection of marginalized experiences with high percentages relating to acute levels of awareness. It is worth noting participant performance in the scenario will be reflective of their pre-exposure awareness. However, the goal is that as participants experience the scenario, they will gain an awareness of the experience that the individual is having. Upon completion of the scenario, participants will receive an output comparing their detections of marginalization to the actual components embedded in each of the segments. This will serve to provide more explicit knowledge to support their experience having residual learning effects.

Challenges, Limitations and Lessons Learned

The extent to which exposure to a scenario can truly be “real” depends on the scenario itself [14], [15].

But at the end of the day, the temporary glimpse into disability that such exercises provide are just that — temporary. It is simply impossible to fully immerse yourself in another person's being [15, pg.1].

If nothing else, disability simulations can create a positive discourse about persons with disabilities and societal reactions [16, pg.76].

It is important to acknowledge that in no way can the full spectrum of the lived experiences of these marginalized individuals be replicated or imagined from mere virtual simulation and such is not the goal of this work. However, virtual reality, and immersive experiences, specifically, currently provide an optimal avenue for creating first-hand experiences that can serve to promote a level of awareness with respect to the role that external people play in dynamics and interactions related to marginalization. Rather than fixate on the inability of immersive experiences to represent the lives of people from underrepresented groups, this work seeks to explore the potential of creating a window of insight to gain perspective among those that benefit from an inclusion privilege that precludes them from such experiences. This is an open debate and grounds for why sharing this work with the greater community is imperative. We must engage in a dialogue that explores the balance of creating awareness without assuming that the technology is the answer or an immersive experience alone is capable of creating full understanding. Moving forward, one way that we are vetting the work is to have the developed modules to be experienced by people sharing the identities of the marginalized character in the scenario that were not part of the focus group used to develop them. Being able to determine whether the created scenario resonates with people from the underrepresented identity across random samples will serve to confirm that we have, in fact, created work that represents common encounters to specific groups rather than outlier experiences. After generating feedback from a sample of the underrepresented group, the scenario will undergo an iteration to incorporate any recommendations to make the experience more reflective of the targeted voice and/or experience.

Another limitation to development of the work is the longer time scale necessary to observe positive changes in both inclusion and empathy. Further consideration will be necessary to consider how performance, progress and learning can most accurately be assessed from the immersive experience given such a short exposure time (~5-8 minutes depending on the individual). Results for three faculty members in the pilot study will be presented at the conference.

Though there are many challenges to optimizing the research design and approach, the potential payoffs of this approach could have transformative impacts. It is logical that a shift in awareness might facilitate a shift in mindset which could potentially impact adopted behaviors. Through this experience, faculty will address attitudes and stereotypes that affect our understanding, actions and decisions in an unconscious manner. Overall, this work holds promise in advancing our understanding of whether exposures can promote learning around empathy and inclusiveness with particular implications for faculty training and development, an area of critical importance, though understudied.

References

- [1] G. Kaufman and L. Libby, "Changing beliefs and behavior through experience-taking.", *Journal of Personality and Social Psychology*, vol. 103, no. 1, pp. 1-19, 2012. Available: 10.1037/a0027525.
- [2] A. Todd, A. Galinsky and G. Bodenhausen, "Perspective Taking Undermines Stereotype Maintenance Processes: Evidence from Social Memory, Behavior Explanation, and Information Solicitation", *Social Cognition*, vol. 30, no. 1, pp. 94-108, 2012. Available: 10.1521/soco.2012.30.1.94.
- [3] Gutierrez, B., Kaatz, A., Chu, S., Ramirez, D., Samson-Samuel, C. and Carnes, M. (2014). "Fair Play": A Videogame Designed to Address Implicit Race Bias Through Active Perspective Taking. *Games for Health Journal*, 3(6), pp.371-378.
- [4] Gutsell, J. and Inzlicht, M. (2010). Empathy constrained: Prejudice predicts reduced mental simulation of actions during observation of outgroups. *Journal of Experimental Social Psychology*, 46(5), pp.841-845.
- [5] Johns, M., Inzlicht, M. and Schmader, T. (2008). Stereotype threat and executive resource depletion: Examining the influence of emotion regulation. *Journal of Experimental Psychology: General*, 137(4), pp.691-705.
- [6] Roussou, M. and Slater, M. (2017). Comparison of the Effect of Interactive versus Passive Virtual Reality Learning Activities in Evoking and Sustaining Conceptual Change. *IEEE Transactions on Emerging Topics in Computing*, pp.1-1.
- [7] G. Riva, R. Baños, C. Botella, F. Mantovani and A. Gaggioli, "Transforming Experience: The Potential of Augmented Reality and Virtual Reality for Enhancing Personal and Clinical Change", *Frontiers in Psychiatry*, vol. 7, 2016. Available: 10.3389/fpsy.2016.00164.
- [8] S. De Freitas, G. Rebolledo-Mendez, F. Liarokapis, G. Magoulas and A. Poulouvasilis, "Learning as immersive experiences: Using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world", *British Journal of Educational Technology*, vol. 41, no. 1, pp. 69-85, 2009. Available: 10.1111/j.1467-8535.2009.01024.x.
- [9] Z. Merchant, E. Goetz, L. Cifuentes, W. Keeney-Kennicutt and T. Davis, "Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis", *Computers & Education*, vol. 70, pp. 29-40, 2014. Available: 10.1016/j.compedu.2013.07.033.
- [10] Bailey, J., Bailenson, J. and Casasanto, D. (2016). When Does Virtual Embodiment Change Our Minds? *Presence: Teleoperators and Virtual Environments*, 25(3), pp.222-233.

- [11] T. Peck, S. Seinfeld, S. Aglioti and M. Slater, "Putting yourself in the skin of a black avatar reduces implicit racial bias", *Consciousness and Cognition*, vol. 22, no. 3, pp. 779-787, 2013. Available: 10.1016/j.concog.2013.04.016.
- [12] H. Farmer and L. Maister, "Putting Ourselves in Another's Skin: Using the Plasticity of Self-Perception to Enhance Empathy and Decrease Prejudice", *Social Justice Research*, vol. 30, no. 4, pp. 323-354, 2017. Available: 10.1007/s11211-017-0294-1.
- [13] Sue, D. W. (2010). *Microaggressions in everyday life: Race, gender, and sexual orientation*. John Wiley & Sons.
- [14] G. Behler. "Disability Simulations as a Teaching Tool: Some Ethical Issues and Implications", *Journal on Postsecondary Education and Disability*, vol. 10, no. 2, 1993. Available: 10.1080/02674649266780061.
- [15] "I Won't Pretend That Disability Simulation Works", *HuffPost*, 2019. [Online]. Available: https://www.huffingtonpost.com/emily-ladau/i-wont-disability-simulation_b_4936801.html. [Accessed: 05- Feb- 2019].
- [16] G. Kiger, "Disability Simulations: Logical, Methodological and Ethical Issues", *Disability, Handicap & Society*, vol. 7, no. 1, pp. 71-78, 1992. Available: 10.1080/02674649266780061.