VIRTUAL REALITY IN THE HEALTH CARE INDUSTRY AND THE PUBLICS PERCEPTION

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Joshua Garrison
Sprint 2023

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor
Pedro A. P. Francisco, Department of Engineering and Society

Is society ready for the health care industry to switch to virtual training environments? As technology has advanced, our society has started to switch more from the traditional video and text education that we have used the last several generations to a more interactive training, and in the case of some extreme or dangerous working environments such as healthcare shifted to virtual reality (VR) training. Transitioning to these new forms of education transforms how people are trained, and by training in the most accurate VR environments our society will be able to make actual work environments safer, and better prepare those being trained to go into the healthcare workforce (Blazauskas & Gudoniene, 2020, p. 82). Though the benefits of having health care professionals trained in these environments may seem obvious to some, there is a portion of individuals who are skeptical of the shift toward virtual training and wonder if the benefits seen by the corporations and medical staff will also be as positive for the patients. According to a study published by the Journal of Medical Internet Research when individuals were informed about the healthcare's shift to VR 15.55 percent of the responses were coded as having a negative perception or expressing concern. This concern seems to be mostly generated by men where almost a third elicited a negative response (Keller S., Park H., Cunningham M., Fouladian J., Chen M., & Spiegel B, 2017). The objective of this research is to illustrate if this shift to VR is a benefit to all and investigate how to address these concerns so that this transition can continue and grow.

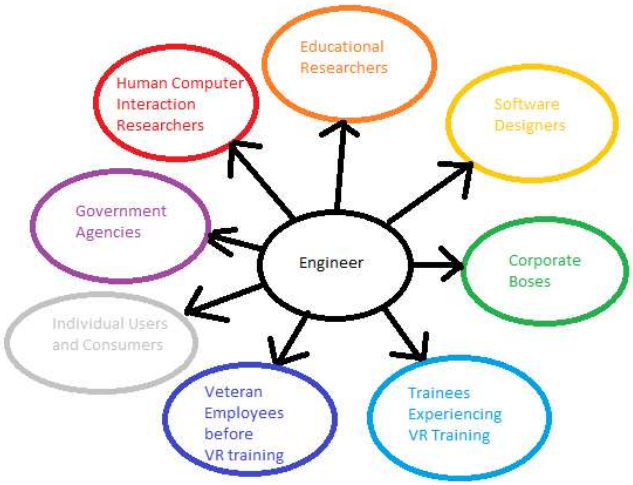
The objective of this research will be achieved first by gathering some initial data by observing some case studies of virtual reality training environments and case studies that observe and measure how individuals who have received virtual reality training preform in the field, with anecdotal and empirical comparisons. Most of the data will be collected by conducting interviews with certain hospital staff from the University of Virginia who are involved in virtual

reality training, as well as the opinions of some additional staff members who are not as involved to get see the perspective of both professionals who are closely involved with VR and those who are not. Finally, interviews will be conducted with individuals who receive care from the University of Virginia, or have been patients in the past, to get a collective perception from those who will receive or have received minor or major treatment from individuals who have received large amounts of their training in virtual environments. These interviews will allow for fresh data of the rising virtual reality trend since the practice has only truly started to gain popularity after the pandemic and does not have a lot of case study research that truly highlights everyone's perspective.

To best demonstrate this data, a Social Construction of Technology (SCOT) framework will be used, a framework originally authored and illustrated by Trevor Pinch and Wiebe Bijker (Bijker & Pinch, 1984). The SCOT frameworks place the engineer in the center with all the individual different represented groups on the outside, as shown in figure 1. In this research model the engineer will need to take the role of receiving and exchanging information between groups to evaluate the current state of virtual reality training in the medical field to see the impact and perception for all groups who are affected either directly or indirectly by addressing each groups concerns and making sure that

Figure 1

Virtual Reality SCOT model



Note. The engineer negotiates between each social group to correctly incorporate and encapsule each group's values and goals in the design. (Adapted by Joshua Garrison (2022) from Carlson, 2009)

this change is able to match each groups expectations and needs, while being able to address and help alleviate some of the concerns. This will allow for the creation of stable VR testing models that will be profitable and accessible to the corporations, useful and helpful for the staff, while being safe and trusted by the patient and other individual users. To truly receive a complete model interviews of hospital administration would also need to be gathered but unfortunately, as of now, I have not been able to reach any member of this group.

VR training has continued to integrate into many aspects of health care now being used to teach students various scenarios appropriate bed side manner, provider trauma care, and in some cases even some levels of surgery (Bowditch & Williams, 2021). This training not only allows for immersive training in stressful environments before actual exposure, but also ensures that all medical staff can be trained to the same standard on simulated state of the art equipment, which is essential considering that access to the newest and most advanced equipment can be very limited and this allows for essential medical equipment to still be available to the patients who need it while creating a way for individuals in training to gain experience with this medical equipment (Immerse, 2020). As the Covid-19 pandemic shut the world down, virtual reality became even more essential, allowing for health care workers to be properly trained "how to safely use PPE, how to navigate an unfamiliar intensive care ward, how to engage with patients and their families, and how to use a ventilator" (Towers-Clark, 2021). Despite all these positive results, there are some studies that do cause people to question the usefulness of these virtual environments. A study done by department of Trauma & Orthopaedic Surgery conducted by experts Vaghela, Trockles, Lee, & Akhtar (2022) found when running a study to see if the VR FAST program could discriminate the differences between novice, intermediate, and expert surgeons that "six of eight VR FAST modules did not demonstrate construct validity" and when

using them they "found no correlation between anthroscopic experience and ambidextrous performance" (para. 5). Although this test showed the VR FAST modules are ready to be used to test and train students, it does bring some validity to the argument that skeptics wonder if VR is really advanced enough to train surgeons on such a level of experience and precision for them to feel comfortable with real operations.

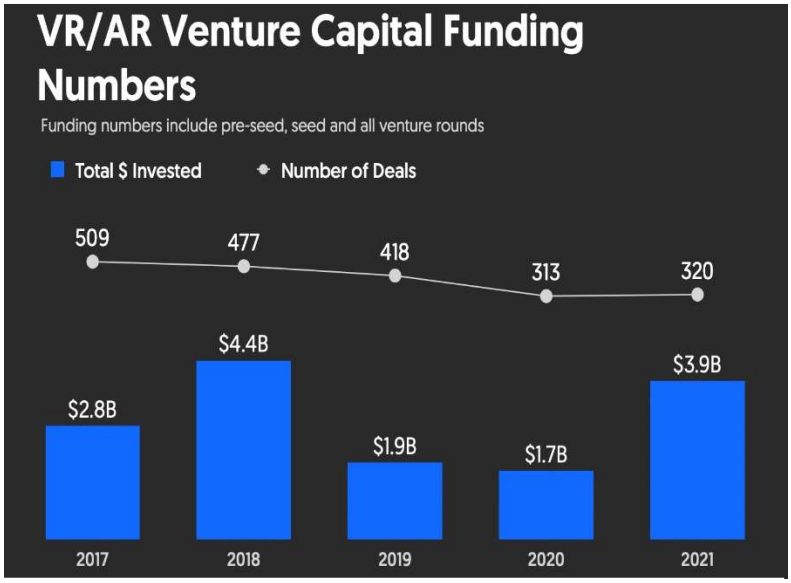
The negative studies are not the only factor causing people to speculate VR's usefulness. Even with mostly positive studies, it is normal for people to fear change, especially in a field that they indirectly depend on such as healthcare. This fear can be completely rational, since some changes can be dangerous but often comes from ignorance, or fear that their life may be worse because of this change. Fear from ignorance can be a contributing factor to be weary of change, such as the fear of trains in the early 1800's (Marshall, C.) Many people feared that the human body was not made to travel at speeds as high at 30 miles per hour, and that there would surely be some instant or long-term side effects or like the fear that spread before entering the 21st century where people believed that computers use of two digit year fields was going to cause some kind of major system error and systems around the world were going to begin to malfunction, causing such havoc as falling planes or in some circumstances, unintentional use of WMDs. This means that when there is a change as revolutionary as virtual reality that could potentially change the educational landscape completely it will be initially met with some skepticism. This skepticism is even worse for virtual reality because it has a legacy of being heavily marketed and then disappearing. Virtual reality has been around for quite a while and talk of virtual reality becoming revolutionary and sweeping through the nation has been around for a few decades, and yet thirty years have passed and even though virtual reality has become more popular than before it is still far from being a household item (Edwards, 2018). The big

reason for this is because VR is often just thought of us as a tool that accompanies gaming, with most of the marketing and investing over the last few decades being spent on that demographic (*Swagger*, 2020). These investments have caused some of the public to associate VR with the goofy gamer commercials that appeared throughout the late 20th century in order to get the attention of the gaming demographic. This negative correlation continues to be made, causing misinformation to be spread about how effective virtual reality can be.

The final, and seemingly most concerning fact, for individuals that doubt the usefulness of VR, is the big investment and connection into VR by big tech. In 2018 there seemed to be a resurgence in VR technology as big tech companies invested in virtual environments, that again resurged in 2021, with companies such as Meta and apple heavily investing as shown in figure 2. (Metinko, 2022). An article in *The New York Times* discusses how many of the big names in tech are releasing new virtual technology this year with Facebook changing its name to Meta and shipping 10 million units of the Quest 2, its virtual reality headset and Apple planning "to unveil its version of a virtual reality headset" (Chen, 2022, para. 13). The article continues to talk about how our society has started to invest in nonfungible tokens (NFTs) and other forms of

Figure 2

The rise and fall of investments in VR technology



Note. An image showing the rise and fall of investments into VR startups. (Metinko, 2022).

crypto currency as well as wealthy citizens and celebrities investing “hundreds of thousands of dollars to join a virtual yacht club” (Chen, 2022, para. 12). This shows companies continuing to capitalize on the trend to Americans shifting more digital interactions and relationships to the digital world during the pandemic. This shift causes more people to mistrust these technologies as they become more synonymous with companies and experts that large numbers of the public currently view skeptically and critically. Master and Resnik discuss how the increase in hype, which they describe as “promoting (a product) with extravagant publicity”, when exaggerated and paired with quotes form experts, captivating titles, and references to peer-reviewed articles can produce the opposite effect because of the promises being too high and the public’s already waning faith in experts and media (2013, page 322). The overhyping and cyclical rise and fall of virtual reality may be coming to an end though because even though virtual reality has not caught on commercially it is continuing to gain traction for training and education purposes by corporations and public services. *News India Times* (2021) even highlights how VR is being used in diversity training to let users “get as close as you can to experiencing the perspective of someone else” (p.18).

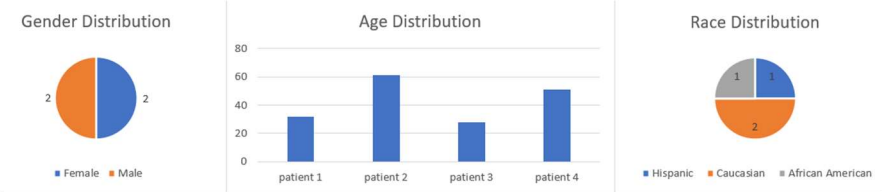
The following information was collected primarily from attending a conference given at Gilmer Hall at the University of Virginia on March 2, 2023, given by Dr. Brennan Spiegel, who has an intimate relationship with virtual reality training in the medical field as the Director of *Cedars-Sinai’s* Health Services Research and the Center for Outcomes Research and Education. Additional information on the matter was obtained from discussing the matter with David Moody, who is responsible for the integration of Virtual Reality in training Medical Students at the University of Virginia. Finally, additional data was collected from four individuals who are previous or current university’s patients to better understand their level of understanding and

comfort with this new way of training. In an earlier interview between Brennan Spiegel and Cedars-Sinai *Newsroom* (2020), he explains how virtual reality is being used not only for training but for patient care. In this interview he discusses several "hospital-wide studies on the use of virtual reality," and discusses how even though public perception of VR usually relates to games and entertainment, that when applied differently, it can be a "profound benefit to human health." His belief, and the belief of Cedars-Sinai, is that the future of virtual reality is not just medical training, but eventually "a full-service clinical operation to support the uses of virtual reality in clinical practice" for a variety of medical situations and conditions. (Cedars-Sinai *Newsroom).* He elaborates on this idea of the perception of virtual reality and its acceptance changing as it becomes more commonplace in the medical industry and believes that as time passes, and VR technology continues to integrate into the medical world, patients and staff alike will see it for the benefit it is and no one will question it being used to train individuals in any field.

I interviewed four of UVA's previous patients to get their thoughts on medical virtual reality training. The patients consisted of two males and two females, and consisted of a range of age groups and ethnicities that can be seen in figure 3, but since there were only four patients and all of them were citizens close to the Charlottesville area the information gathered may be biased and should be expanded upon. The participants of these interviews were asked to rank their answers on a scale of one to five unless given another scale and were questioned about their familiarity with VR, and their

Figure 3

Distribution of interview participants by gender, age, and race



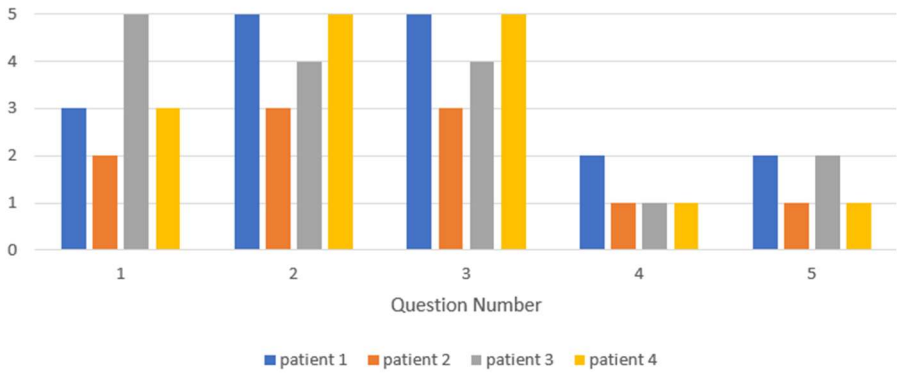
comfortability with it being used. The results of these interviews can be seen in the chart displayed in figure 4 with the question numbers correlating to the questions listed below:

1. How familiar are you with Virtual Reality?
2. How much do you trust your medical provider?
3. How comfortable would you be receiving treatment from someone who has received any amount of VR training?
4. Does VR in Social Media affect your feelings toward VR?
5. What distribution between VR training and hands on training would you find acceptable (1 being 20 % VR / 80 % Hands On, and 4 being 80 % VR / 20 % Hands On).

These interviews revealed that most people are at least somewhat familiar with virtual reality even if they have not used it themselves and show that at least most of the individuals were comfortable with some level of virtual reality training for medical professionals if these professionals also received hands on training as well. A couple of trends that were noticed from the interviews were that it did seem like male patients were much less trusting of their medical professionals, which agrees with other studies. There also seemed to be

Figure 4

Medical Training Virtual Reality Interview Responses



very little connection with social media and VR, and most of the patients seemed to have some distrust with social media and not take it, or its investments too seriously. A big revelation was that individuals trust in their medical provider seemed to correlated evenly with whether they would trust receiving some form of treatment from someone with virtual training, which forces the question of if it relates to the virtual reality aspect at all. This also correlates to the final question that is not displayed in figure 4, which is "In your opinion, what could hospitals do that would normalize this type of training and make everyone comfortable with it?" There were several different replies, which ranged from studies that show that it works and increased access, but the response from the individual who was the most skeptical about VR training was mostly about transparency.

Virtual training in the medical field has become more common in the past decade, but since it is still quite new, different social groups are still forming their opinions on the matter. Conflicting stories, studies, and ideals cause people to not trust in authorities and form opinions from their own experiences and hearsay, which can be biased and cause more work to be done to win over public perception. The negative studies that exist do illustrate that there are some legitimate concerns and there should be extra research done on these studies to guarantee that all the environments are properly setup, but there are many positive studies that illustrate the benefits as well. Public perception will continue to be swayed depending on the effectiveness of these training environments and the care received by patients who are cared for by professionals who have been trained in these environments. This does mean that as more positive studies come out, and more studies and information is released that maybe there will be some shift in perception, but it also matters that the public becomes more familiar and more trusting of the health care industry so that these biases can fade.

It is believed by many health care professionals that as VR tech continues to integrate into other parts of the health care system, and become more common use, patients will become familiar with the technology, which will help to bridge the gap that exists between these groups right now. Patients seem to be mostly positive about the idea of virtual reality being used for training, and as that training continues and more positive data continues to come release, and it becomes more common place, patients will become even more accepting just like they were about airplane pilots receiving virtual training. There does seem to be some mistrust between certain groups and their medical providers at the current time, but this does not seem to have anything to do with VR training and as everyone works to repair that relationship the trust in medical VR training may increase as well. This seems to say that the continuing growth of virtual reality training is seen as a net positive for everyone, by most members of each group involved, and hopefully this will continue to be the case as this becomes even more popular and virtual reality starts to integrate into other hospital areas.

REFERENCES

Bijker, W. E., Hughes, T. P., & Pinch, T. J. (1984) The social construction of technological systems. Zeitschrift für Wissenschaftsforschung, 2, 39-52

Blazauskas, T., & Gudoniene D. (2020). Virtual reality and augmented reality in educational programs. In Daniela, L. (Eds.) *New Perspectives on Virtual and Augmented Reality: Finding New Ways to Teach in a Transformed Learning Environment* (pp.82-94). New York, NY: Routledge

Brown, D. (2021, March 26). Diversity training steps into the future with virtual reality. *News India Times*, 52(12), 18 - 17.

Bowditch, J., & Williams, E. R. (2021). *The Power of Virtual Reality Cinema for Healthcare Training: A Collaborative Guide for Medical Experts and Media Professionals*. Milton: Productivity Press.

Carlson, B. (2009). Virtual Reality SCOT model. [Figure 1]. Class handout (Unpublished). School of Engineering and Applied Science, University of Virginia. Charlottesville, VA.

Cedars-Sinai (2020, October 14). *Newsroom.* Virtual Reality as Medicihttps://www.cedars-sinai.org/newsroom/virtual-reality-as-medicine-an-interview-with-brennan-spiegel-md/ne: An Interview with Brennan Spiegel, MD. Retrieved April 1, 2023, from

Chen, B. X. (2022, January 6). New Tech's Familiar Look. *The New York Times*, 171(59295), B1 - 1.

Edwards, B. (2018). The wacky world of VR in the 80s and 90s. *PCMag.* Retrieved July 28, 2022, from https://www.pcmag.com/news/the-wacky-world-of-vr-in-the-80s-and-90s

Immerse. (2020, January 14). *The Use of Virtual Reality Environments for Medical Training.* Retrieved February 10, 2023, from https://immerse.io/2020/01/14/the-use-of-virtual-reality-environments-for-medical-

training/#:~:text=VR%20is%20so%20effective%20in%20a%20health-care%20training,revisit%20modules%20to%20improve%20their%20skills%20and%20scores.

Keller S., Park H., Cunningham M., Fouladian J., Chen M., & Spiegel B. (2017, December 19). Public perceptions regarding use of virtual reality in health care: a social media content analysis using facebook. *Journal of Medical Internet Research*. Retrieved February 10, 2023, from https://doi.org/10.2196/jmir.7467

Master, Z., & Resnik, D. (2013, June 1). Hype and Public Trust in Science. *Science & Engineering Ethics*, 19(2), 321 - 335.

Marshall, C. (2014, May 18). 12 technologies that scared the world senseless. *Techradar.* Retrieved March 2, 2023, from https://www.techradar.com/news/world-of-tech/12-technologies-that-scared-the-world-senseless-1249053

Metinko, C. (2022, January 21). The rising and falling of investments in VR technology. [Figure 2]. VR/AR investments increase just as Metaverse talk heats up-but that may not be the only reason. *Crunchbase News*. Retrieved August 5, 2022, from https://news.crunchbase.com/startups/metaverse-augmented-reality-virtual-reality-investment/

Swagger (2020, October, 21). Three reasons why virtual reality failed we investigate some of the reasons why VR hasn't caught on as it was predicted to. *Swagger.* Retrieved February, 10, 2023, from https://www.swaggermagazine.com/casino/3-reasons-why-virtual-reality-failed-we-investigate-some-of-the-reasons-why-vr-hasnt-caught-on-as-it-was-predicted-to/

Towers-Clark, C. (2021, February 19). Medicine and mindfulness: how VR training is helping healthcare through the pandemic. *Forbes.* Retrieved February 10, 2023, from https://www.forbes.com/sites/charlestowersclark/2021/02/19/medicine--mindfulness-how-vr-training-is-helping-healthcare-through-the-pandemic/?sh=10c8045458b9

Vaghela KR, Trockels A, Lee J, & Akhtar K (2022, April 1). Is the virtual reality fundamentals of arthroscopic surgery training program a valid platform for resident arthroscopy training?. Clinical Orthopaedics and Related Research, 480(4), 807 - 806. Retrieved from https://doi.org/10.1097/CORR.0000000000002064