Philosophical Thought Experiments in Virtual Reality

White Paper

National Endowment for the Humanities

Office of Digital Humanities

HAA-277270-21

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April 30, 2022
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1. Project Summary

The *Philosophical Thought Experiments in Virtual Reality* project was funded by a Level II Digital Humanities Advancement Grant from the National Endowment for the Humanities (NEH). The project was executed by the Virginia Philosophy Reality Lab (VPRL), an interdisciplinary team of researchers based primarily at Old Dominion University. The VPRL developed a virtual reality (VR) experience based on the “trolley problem” philosophical thought experiment that can be downloaded and experienced from anywhere on commercially available VR headsets, the Oculus Quest 2. Philosophical thought experiments are hypothetical scenarios meant to aid in analyzing complex concepts. The trolley problem presents a simple life-and-death dilemma that pits the lives of five trolley workers against the life of one worker. Users who experience the dilemma have the opportunity to reflect on some of their deepest moral commitments. By creating the dilemma in virtual reality, the VPRL sought to make the questions raised by the trolley problem broadly accessible to non-academic audiences. The aim was also to provide tools and forums for researchers and educators to gain valuable insights into popular moral thinking. It included exchanging computational and educational assets.

The project has delivered several valuable contributions:

1. The first-of-its-kind “VPRL Presents Life-and-Death Dilemmas” application for the Oculus Quest and Quest 2 headsets available for free download on Sidequest, a popular VR application platform.¹
2. An online public repository with all the application’s assets and source code for other users and researchers to use and contribute to.²
3. An easy-to-integrate real-time data logger with a cloud interface for VR-based research projects.
4. Publicly available, through the Open Science Framework³ and the VPRL’s website⁴, insights into who the users of the developed experience were and their opinions about it and reflections regarding the decisions made during the study.
5. A series of community building and knowledge dissemination activities, including presentations at professional organization meetings, VR experience beta-testing, a guest appearance on the Between Realities youtube channel, focus groups, and a widely successful workshop, concluding the project. The workshop gathered researchers and people interested in the use of VR for solving societal issues and helped foster an ongoing community between those individuals.

2. Project Origins and Goals

Although thought experiments have many uses in the study of philosophy, two primary purposes include 1) as research tools to gather evidence about how people think about philosophical concepts and 2) as educational tools to help non-academics interrogate their philosophical concepts. In developing the trolley problem thought experiment in VR, our team sought to address historical shortcomings in these two uses.

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² [https://github.com/VPRL/Virginia-Philosophy-Reality-Lab](https://github.com/VPRL/Virginia-Philosophy-Reality-Lab)
³ [https://www.vprl.org](https://www.vprl.org)
⁴ [https://osf.io/kzqmr/](https://osf.io/kzqmr/)
2.1. Problems for Empirical Studies using the Trolley Problem Thought Experiment

The trolley problem thought experiment has numerous variations. The original formulation involves a simple moral dilemma: would you pull a switch to prevent a train from killing five people but killing one person? Intuitively, many people find it acceptable to pull the switch. However, philosopher Judith Jarvis Thomson complicates the issue by asking whether it would be acceptable for a doctor to kill one patient to harvest their organs to save five other people. Intuitively, many people do not find this action acceptable. This creates the kind of puzzle thought experiments are meant to probe. Why does pulling the switch seem acceptable to many, but harvesting organs does not seem acceptable? Discussion of how to approach the Trolley Problem has arisen across diverse settings, from academic philosophy papers to popular television shows like The Good Place to programming for self-driving cars.

The philosophical problems that arise from the trolley problem rely on the assumption that it is intuitive to pull the switch but not to harvest the organs. This raises the question: do people actually think it is acceptable to pull the switch? In response, researchers use the trolley problem to uncover how people make moral decisions. We can track which aspects of a scenario are interpreted as morally relevant by providing slight manipulations to the Trolley Problem. For example, respondents are much less likely to sacrifice one person to save five lives if the sacrifice required pushing a person off a footbridge into the train's path to stop it. Another interesting finding shows that people are more willing to push an obese person than a skinny person with a large backpack. These manipulations aim to isolate the features of a situation that affect which moral decision a person makes to better model moral decision-making more generally.

Empirical research using philosophical thought experiments has significantly impacted the humanities, particularly philosophy. Prominent models such as Greene’s dual-process theory, Cushman’s dual-process theory, and Mikhail’s universal moral grammar theory use data drawn from experimental trolley problems as cornerstones. These theories address descriptive questions about how moral decisions are made and provide constraints on theories about which moral principles are best. As we understand what people think about philosophical concepts, from morality to knowledge to free will, we gain further information to be accommodated in our philosophical theories. The findings of this kind of research can also help guide public policy.

Although these studies show how people tend to make moral decisions, they are hampered by their reliance on hypothetical scenarios presented verbally or in text format. Subtle changes in the phrasing of the scenario, such as word order or whether it is described as “hypothetical” or not, have measurable impacts on the responses people give. Sitting in a lab with a researcher is not how moral decisions are usually made in real life and may limit how these findings generalize to real-life settings. We may be learning more about how people react in laboratory settings than about how people make moral decisions.

Wide accessible virtual reality technologies provide the means to address these concerns of ecological validity. Rather than asking subjects to “Imagine yourself walking along train tracks...”, VR affords the resources to create a realistic simulation of that scenario and observe how subjects react. There is good evidence that VR simulations can tap into the same cognitive mechanisms deployed in real-life situations. For example, VR has been used effectively in phobia treatment and military training. This evidence suggests that moral decisions made in a trolley problem VR module are more likely to track how a person would act and reflect real moral decision-making processes more accurately. Studies using VR thought experiments could provide valuable and more accurate data for theorists in the humanities and beyond.
2.2. Problems for education with thought experiments

Thought experiments can also be a powerful tool for illustrating and explaining philosophical ideas. For example, **utilitarian ethics** are based on the idea that the morality of an action is derived from the consequences of the action. **Deontological ethics**, in contrast, are grounded in the idea that the morality of an action is derived from the principle upon which the action is based. Students presented with the trolley problem experience the conflict between these two approaches. A simple utilitarian ethic would suggest pulling the switch, killing one to save the five, to maximize overall happiness. Simple deontological ethics, in contrast, would abide by a principle such as “Through your action, do not intentionally harm another living creature,” and so suggest not pulling the switch. These conflicts allow students to reflect on their commitments and consider points of view that they do not currently hold.

Nevertheless, thought experiments as pedagogical tools have distinct shortcomings. Students who have trouble envisioning the imagined hypothetical scenario cannot enjoy their illustrative benefits. Furthermore, students unfamiliar with thought experiments often look for ways of “winning” the scenario, rather than engaging with it directly to see the desired conflict. For example, a student might suggest that they would pull the switch in the trolley problem but then pull the endangered person off the tracks themselves, saving all six people. This answer avoids the intended conflict in ethical theory. It does not help the student interrogate and reflect upon their commitments.

By creating immersive and realistic VR thought experiments, we can help address these pedagogical obstacles. VR thought experiments directly confront the student with the scenario without the need for difficult imaginative and hypothetical work. When students see that they are too far from the track to save the person in time, they must focus on what is available to them, which requires them to face the conflict of ethical theory to the trolley problem was meant to draw attention to.

2.3. Prior Work and Project Parameters

While VR trolley problems address concerns of ecological validity, they also present their barriers. First and foremost, access to the programming knowledge and equipment needed to produce high-quality scenarios is not available to many researchers and educators working in the humanities. For this reason, it is essential that VR thought experiments be easily accessible, usable, and adaptable. Second, until recently, VR studies required that participants be brought into a laboratory setting for extensive periods. This makes it difficult to get a large, heterogeneous study population. It also makes it challenging to use VR thought experiments for educational purposes. We wanted our VR experience to run on commercially available hardware and to be self-contained. It can be experienced without a laboratory or an in-person facilitator. Finally, given the potentially graphic nature of the content, it is important to balance realism and immersion for ecological validity with ethical concerns about the stress that may be created by asking individuals to make life-or-death decisions. The VR experience should create a believable, immersive experience that does not subject individuals to trauma more significantly than expected from an off-the-shelf videogame experience.

With these parameters in mind, the project had five outcomes:

1. Develop a shareable VR version of the trolley problem for education and research purposes that is also accessible to the broader population of VR users
2. Develop a shareable collection of assets and tools for developing thought experiments in VR to share with the community of VR minded researchers and educators
3. Run a Pilot Study using the developed resources
4. Launch an open repository to make all developed components and data publicly available
5. Begin developing an inter-institutional community around VR in the humanities
We initially began test development of a VR trolley problem experience that meets these parameters in the fall of 2019 as part of a collaboration between the Old Dominion University Department of Philosophy and Religious Studies and the Virginia Modelling, Analysis, and Simulation Center at Old Dominion University. We acquired a copy of Ramirez et al.’s VR trolley problem scenario for planning and research purposes. The development of our own VR scenario began in the spring of 2020. We applied for and won an ODU college summer research grant of $3000 in 2020. We hired an undergraduate student in May of 2020 to support the completion of the initial VR scenario prototype. The prototype was developed for the Oculus Quest headset in June 2020 using the Unity 2019.3.15f1 game engine, Microsoft Mixed Reality Toolkit (MRTK) v2.4, and MRTK-Quest v1.0. Assets for the prototype were purchased from the Unity asset store or developed independently. The prototype contained a training scenario, a moral control scenario, and a moral dilemma scenario.

We reached out to the internal review board (IRB) at ODU in August 2020 to inquire about ethics review requirements for a VR study. We received IRB approval for a pilot study in the same month.

3. Project Activities, Teams, & Participants

3.1. Prototype Refinement

Upon receiving Level-II grant funding of $85,161, work on the grant period tasks commenced. There were several difficulties in the initial allocation of funds. First, due to a late Final Report from another faculty member at ODU working on an unrelated NEH project, funds were not released until February 2021. Other projects for co-PI John Shull, the technology development lead on the project, required us to request a reallocation of funding to hire additional student developers for summer work. He took on an advisory role overseeing the work of those student developers while also continuing his role as lead developer on other aspects of the project.

We initially planned to begin data collection using the already developed prototype in March of 2021 using the VR experience prototype and IRB approval already secured. However, data collection did not begin until July 2021. Based on helpful feedback from the NEH, we decided to do a beta-test of the prototype to make refinements so that the pilot study would utilize a VR experience closer to the final experience at the close of the grant period. Co-PI John Shull and his team handled all coding and development work, with consultation from co-PIs Andrew Kissel and Krzysztof Rechowicz. We are grateful to the NEH for this helpful suggestion, as substantial changes were made to the experience after the beta test, highlighted below. A video of a playthrough of the experience is available on our Youtube channel.  

3.1.1. Specifying Unspecified Details

One of the primary difficulties we initially faced in the beta test was the need to specify under-specified details from the original trolley problem. For example, the original trolley problem does not fully determine why there were people on the tracks whose lives were in danger. Furthermore, it was not clear why the user would be near train tracks in the first place. Unlike abstract, verbally presented thought experiments, VR thought experiments must address these questions. It quickly became clear from our beta test that, in the absence of a facilitator on hand to answer these questions, our VR experience would have to go to greater lengths to specify these details.

5 https://www.youtube.com/watch?v=MoGW3ySNRag&t=2s
One clear example of this is the “Push” scenario of the trolley problem. In the Push scenario, users must decide whether to do nothing, allow five workers on train tracks to be killed by a trolley, or push a single person into the train's path to stop it. This scenario raised a host of questions for our beta-testers. Many of them did not even realize that pushing the person into the path of the trolley was an option. And those that understood that they could push the person found the idea that hitting a single person would stop an entire train to be unrealistic.

The problems were further complicated by the desire to increase the ecological validity of the study. To increase the ecological validity of the study, we sought to increase perspectival fidelity, the degree to which a simulation accurately represents the subjective point-of-view of human observers. We made design decisions such as using all diegetic sounds, removing heads-up display overlays to convey information to the user, and having the entire experience occur in a first-person perspective. These choices, however, made it more challenging to convey affordances in the environment to the user. We ultimately decided to have an in-world train engineer explain a “brake system” to the user through a loudspeaker. The brake system involves pushing a water barrel onto the tracks to create a short-circuit in the electric tracks, bringing the trolley to a stop. The engineer then says, “Honestly, you could push anything filled with water onto the tracks and the train will stop. Like a water balloon. Or even a person.” We conveyed the option of pushing a person onto the tracks to stop the train plausibly without explicitly telling the user to push a person while also retaining perspectival fidelity.

3.1.2. Accessibility
The VR experience was created using principles of accessible design, an effort spearheaded by Krzysztof Rechowicz, while also pursuing goals of ecological validity and perspectival fidelity. In many cases, these goals pulled in opposing directions. For example, the color scheme for console interfaces was selected to reach a larger audience with visual impairments, despite not reflecting standard colors for these interfaces. In other cases, both goals were more easily satisfied. For example, the experience uses a CC-TV to convey information about the track's state and for closed captioning of the audio instructions from the train engineer. This allows us to retain perspectival fidelity while making the experience more accessible for deaf and hard-of-hearing users.

Beta-testers helped identify several ways in which the prototype could be more accessible. For example, the prototype used a large hand crank switch system. The switch had to be pulled through an entire 45 degrees of motion before it would change the track the trolley was on. The hand crank proved challenging to use, particularly for individuals who had to remain seated during the experience. To make the experience more accessible, we replace the hand crank with a button press.

3.1.3. Readability
In addition to accessibility issues, beat-testers also identified several ways in which the experience could be made more readable for users. By readable, we mean the experience should make it clear to users what can and cannot be interacted with and what is expected of their interactions at any given point in the experience.

In the pursuit of ecological validity, we made several design decisions meant to emphasize perspectival fidelity. At the same time, we sought to minimize the potential adverse effects of making difficult moral decisions on users. For example, while it is necessary to show the user the stakes by revealing the workers trapped on the tracks, it is not required to display the actual deaths of the individuals. To control when and what users see, we set the experience at night and used a screen with various security cameras. Users could swap between the cameras to see multiple positions of the track. When workers are killed, we could have the electrical systems flicker at a crucial point. In the dark,
without the aid of the security cameras, we could control the violence the user would be exposed to without sacrificing perspectival fidelity. Or so we thought.

The problem with the complex camera systems and low lighting made the experience extremely difficult to read. Beta-testers were not sure which security camera they were viewing at any given point, making it unclear to them whose lives were threatened by the trolley at any given point. The low lighting, while attractive, made it difficult to make out shapes at a distance. Finally, the placement of the user within the scene meant they needed to turn their bodies 180 degrees to see all relevant aspects of the scene.

As a result of this feedback, we made massive changes to the layout of the prototype. Lighting was increased, and the security camera screen was replaced with a CC-TV that provided simple visual information about which track was currently active. The track was laid out in a completely new way, placing both tracks in front of the user. This allowed them to look to the left to see the oncoming trolley easily and to the right to see all workers on both tracks while still being in a position to push a person onto the tracks for the “Push” condition.

3.1.4. Completing the “VPRL Presents Life and Death Dilemmas” experience

Laying out each scenario in response to beta-tester feedback and making the experience accessible and readable led to more significant differences between individual scenarios than initially expected. Due to these substantial changes to the prototype, we ultimately decided to focus on two Trolley Problem scenarios: the original “Switch” condition and the “Push” condition. All of these changes were completed by July 2021. An extension was requested for IRB approval and granted at the beginning of July, acknowledging relevant differences to the experience. The pilot study was launched on Sidequest the same month under the title “VPRL Presents Life and Death Dilemmas.”

The name “VPRL” refers to the Virginia Philosophical Reality Lab, an interdisciplinary coalition of educators and researchers based primarily in Virginia that explores philosophical issues through extended reality (XR) technologies. While the group’s core is at Old Dominion University, as we began to make connections with stakeholders (both academic and non-academic), it became clear that we needed to think more in terms of an overarching coalition. As a result, we founded the VPRL to provide more cohesive messaging and a unified entry point for newcomers to participate in our ongoing work. In retrospect, this branding move should have occurred before the beginning of the grant period.

Upon completion of the experience, during data collection, we engaged an interdisciplinary focus group of humanities-based academics working in or interested in working in VR. The goal was to present our experience as a potential tool for their research and classrooms. The list of participants and graphical summaries of the findings of the focus group can be seen in Appendix A. In general, the group was impressed by our solutions to the difficulties of translating the trolley problem into a VR space. They were excited about the potential to gather data from users at home. They were particularly excited that our experience allows the collection of audio data to hear reflections on the experience, as well as the RUDE logger described below. All participants agreed that going forward, they are primarily interested in reducing the cost and technological barrier to deploying VR in the classroom and would like to see more work devoted to social experiences in VR rather than solo experiences. The VPRL has included this feedback in our plans for developing more philosophical thought experiments in VR. Overall, the focus group was an excellent opportunity to engage in cross institutional discussions about how to effectively use VR in humanities-based projects.

3.2. Pilot Study

The pilot study occurred from July 2021 through December 2021. Due to the IRB extension approval, we decided to collect data over a longer period than initially planned. The primary means for recruiting participants to the study was advertising on the Sidequest storefront. We also advertised in online forums on Reddit and Facebook, devoted to philosophy, virtual reality, or both. Finally, we advertised through word of mouth. We have been successful in attracting visitors to our Sidequest page. As of April 2022, over 2000 people have visited the page, and nearly 300 have downloaded the experience.

One of the unique features of this pilot study is that it allows individuals to contribute data and experience the trolley problem without needing to come into a laboratory setting. As mentioned earlier, this helps address worries about ecological validity. However, it is also a useful means for gathering data in light of the ongoing COVID pandemic, since data collection is contactless. Going forward, our approach, documented on our Github page, offers a valuable way to gather VR data and disseminate philosophical ideas at a distance.

In the initial stages of the study, there was a very large drop-off between downloads of the experience and playthroughs to completion. One of the significant “friction points” in the process was that, per IRB regulations, participants were required to complete an informed consent form and a demographics survey at a third-party site, Qualtrics, to receive a code that unlocked the downloaded experience. Many users would reach the code authentication point in the experience and stop. We submitted a revision request with IRB to address this friction point to move the informed consent process into the VR experience itself. We also incentivized the completion of the experience by raffling off Steam gift cards to users. As a result of these efforts, we completed the pilot study with 33 data points. This data has been anonymized and made available on our Open Science Framework page as per the project goals.

One of the difficulties we faced during the pilot study was the constant advances and changes in the software and technology we were working on. In October 2020, for example, Meta (formerly Facebook) announced that a Facebook account would be required to use the Oculus Quest 2 headset on which the experience runs. This hurt the number of users on Sidequest and likely negatively affected our study population during the pilot study. Furthermore, Oculus announced App Lab in early 2021, a way for experimental experiences like ours to be downloaded directly onto Quest headsets without the need for third-party software like Sidequest. One of the significant barriers to using Sidequest is that users must open a developer account with Oculus and connect their quest to a computer to add apps. This process is not intensive, and Sidequest has a vibrant community. Still, it tends to cater to niche VR hobbyists more than the broader public. Unfortunately, application requirements for App Lab are much more stringent than Sidequest. Submission to App Lab for approval would have put the project considerably behind schedule. For this reason, we elected to remain with Sidequest for the pilot study but have plans to submit for App Lab approval as part of continuing work on the project.

3.3. Additional Asset Creation

While the pilot study was being run, co-PIs John Shull, Krzysztof Rechowicz, and Andrew Kissel assembled a team of ODU students and faculty to develop additional assets for the community of VR humanities researchers and educators. These assets fall into three broad categories: 1) Art assets, 2) the RUDE data logger, and 3) additional Github and Unity support assets.

3.3.1. Art Assets

VMASC lead project scientist and artist Bratislav Cvijetic led a team of three ODU undergraduates to develop art assets to create further VR thought experiments. The first undergraduate, Ryan Kearney, was hired as a part-time student worker. The other two undergraduates, Riley Johnson and Christian
Lamm, worked for class credit. All three students were taken from the newly created Game Design, Development, and Criticism program. This three-way collaboration between Philosophy & Religious Studies, VMASC, and Game Design programs at ODU highlights the interdisciplinary approach that has been central to the project from the start. The students had the opportunity to work on modeling assets for an in-progress project, and the project benefited from their alternative thinking and vision. The team worked from May 2021 to November 2021, developing 3D model assets for a train station, track, and buildings and a wide variety of worker models. This last asset is particularly useful, as previous studies suggest that the demographics of the individuals whose lives are endangered is morally salient. In addition to the 3D models, the team developed high-quality shaders to increase the perspectival fidelity of the experience. These assets were created under a Free Art License, allowing others to copy, distribute, and transform them for use in their humanities VR experiences.7

3.3.2. RUDE Logger
The Research Unity Data Extractor (RUDE) is a dynamic logging system that reads and prints out events within a Unity scene. When the RUDE package is attached to a VR scene in Unity, researchers and educators can pull back data in real-time based on what the user does in the VR scene. The Capabilities Lab handled development on RUDE at VMASC. Lead project scientist Alex Nielsen oversaw the project. The RUDE system was completed by Brandon Feldhaus, Joel Stokes, and Patrick Ball in consultation with PI Andrew Kissel. Work on the logger occurred between August 2021 and December 2021, with final commits completed in the first month of 2022.

The RUDE logger has extensive documentation as well as a tutorial video. Furthermore, it can be attached to Unity projects developed for any hardware, making it an extremely versatile tool for researchers and educators. The RUDE logger can be accessed on the VPRL Github page and its separate Github repository.8 Development on this component of the project was an excellent example of cross departmental synergy. The Capabilities Lab has already been able to use the RUDE logger on other projects, showing it to be a versatile tool that satisfies the needs of researchers and educators outside of the immediate project.

3.3.3. Additional Github and Unity Assets
Additional assets for Unity were necessary to make contributions to the project easier for members not on the original team. Co-PI John Shull completed this work. These assets include spline systems for NPC movement through the environment, documentation for the Github repository, promotional videos, initial components for a WebGL version of the experience, and more. The goal is to transition the project to an entirely open source project that allows users and contributors to continue to benefit from the work we did during the grant period.

4. Project Outcomes

Five core outcomes resulted from this project.
1. A collection of high-quality VR trolley problem scenarios entitled “VPRL presents Life and Death Dilemmas” to be used by researchers, educators, and the general public. As stated earlier, the scope of these scenarios is smaller than initially planned due to our efforts to make the experiences more viable as a research and education tool outlined in the activities section above. The experience runs

7 https://github.com/VPRL/Virginia-Philosophy-Reality-Lab/tree/main/Unity3D/VPRL_Art/Assets
8 https://github.com/vmasc-capabilities-lab/RUDE
on the Oculus Quest 2, as well as PC-based head-mounted displays. It can be downloaded directly from our Github page, as well as on our Sidequest page. One version is set up for data collection, while the other is for educational purposes only and does not collect data.

2. The second outcome is a complete data set, open and accessible to the public, drawn from an initial online research project using the VR scenarios. This data includes quantitative information on event occurrences and head and hand tracking data and qualitative responses from participants. None of the data includes personal identifying information.

3. The third outcome is an online Github repository that also serves as a forum for sharing VR scenarios and data sets and those based on the trolley problem resulting from this project. Github also allows for bug reporting and support to continually improve the quality of the scenarios. This approach provides philosophers, researchers, educators, and the general public access to high-quality VR scenarios that can be tailored for their specific needs. It also creates a forum for the public discussion and distribution of other thought experiments created in VR. In addition, the VPRL has developed a forward-facing website to facilitate ongoing collaborations and VR philosophy development work across institutions.

4. Fourth, PIs gave several conference presentations throughout the project. The talks promoted the research of the project and developed a growing community of likeminded researchers, educators, and enthusiasts, while also providing useful feedback for PIs on the continued development of the project to meet the needs of those working in diverse fields. These talks include: (i) "Engaging with the Trolley Problem: Designing a VR Experience at ODU," High Impact Practices XR Workshop (Invited), October 2020 (Andrew Kissel, pre-award). This talk was part of a week-long workshop to discuss adopting VR technologies in the classroom across disciplines. (ii) “Killing and Letting Die in VR” Southwest Popular/ American Culture Association (Refereed), February 2021 (John Shull and Andrew Kissel) This talk engaged game studies scholars about the use of VR and gaming technologies for humanities-based research. (iii) “Philosophical Thought Experiments in Virtual Reality” Pacific American Philosophical Association Meeting (Refereed), April 2021. (Andrew Kissel). This talk was part of a panel to explore the use of philosophical thought experiments in VR with an interdisciplinary audience. Attendees included noted philosopher David Chalmers, and helped develop relationships with philosophers that would later contribute to the project’s focus group and data pools.

In addition to these academic presentations, the VPRL hosted a virtual workshop at the conclusion of the grant period to present the project and its findings and to discuss difficulties in developing VR thought experiments for humanities-based research. The workshop, which was open to the public, was entitled "Exploring the Humanities through Virtual (and other) Realities" and was held on December 10th, 2021. It represented the culmination of development and community building efforts undertaken throughout the year. It included presenters from Old Dominion University, Lindenwood University, and Virginia Tech, as well as over 30 other attendees. The keynote speaker for the workshop was Kent Bye, a well known personality in cutting edge VR work. His presentation, “Process Philosophy & VR: The Foundations of Experiential Design” helped to connect the academic work of the project with the more general audience of VR enthusiasts. The centerpiece of the workshop was a panel discussion and Q&A that focused on uses of VR to create embodied experiences, and the shortcomings of that approach.

10 https://osf.io/kzqmr/
11 https://github.com/VPRL/Virginia-Philosophy-Reality-Lab
12 https://github.com/VPRL/Virginia-Philosophy-Reality-Lab/issues/new/choose
13 https://www.vprl.org
conversation laid the groundwork for future discussions and collaborations between the represented institutions, as well as the general public. A video of the workshop has been uploaded to our Youtube page. The workshop materials are viewable in Appendix B.

Co-PIs on the project also engaged non-academic audiences directly in a variety of ways to build a sustainable community around philosophical work in virtual reality. For example, Krzysztof Rechowicz, John Shull, and Andrew Kissel presented early work at a virtual Science Pub talk in March 2021. The talk, entitled “Murder on the VR Express,” was hosted on Zoom and invited the local community to see our ongoing work and ask questions. The talk had over 70 attendees, with virtual participants visiting from around the world. Interviews with Daily Nous and Philosophie, a French magazine that shares philosophical news with the general public. Co-PIs John Shull and Andrew Kissel also went on the popular podcast “Between Realities” to discuss philosophical issues in virtual reality and to promote “VPRL Presents Life and Death Dilemmas.”

Finally, the project helped develop and contribute to an ongoing community of VR researchers, educators, and the general public through its efforts. The previously mentioned workshop contributed to this developing community. Furthermore, through work on this project, the VPRL has developed an ongoing relationship with the EthicsLab at Central Washington University, which now uses the “VPRL Presents Life and Death Dilemmas” VR experience as part of their programming. Thanks to contacts made through this project, scholars at ODU, Santa Clara University, the University of Arizona, and Keele University have begun collaboration on an edited collection through Routledge Press on philosophical issues arising in virtual reality. Co-PIs Andrew Kissel, Krzysztof Rechowicz, and John Shull are currently working on a paper on the pilot study’s findings for publication in a special issue of Sociétés on the social impact of virtual reality.

5. Project Evaluation and Impact
We evaluated the success of our project at several stages throughout the course of the grant, both formally and informally. The first stage was the beta-testing of our pilot experience, which was the basis of many of the changes and additional work that we took on during the grant period. Beta testers complimented the experience, particularly the accessibility options, but also criticized it for being difficult to read. This feedback became the basis for numerous design changes. Here is a small sample of some of the feedback we received:

- “Great work with error proofing, UI, and ensuring accessibility. There are several things that I look for in a successful VR experience from a design and HCI perspective and your work checks many boxes of mine.”
- “I found the overall experience confusing and difficult to parse. Some of this may have been user error due to my first time using an oculus quest. However, throughout, I found it difficult to

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14 https://www.youtube.com/channel/UCT7SW-DCEgsONWaLctsvkA
18 https://www.youtube.com/watch?v=lgcV9qby00&t=1375s
19 https://www.mdpi.com/journal/societies/special_issues/Society_VR
23 https://github.com/VPRL/Virginia-Philosophy-Reality-Lab/issues/44
understand what was happening in each scenario due to poor visibility of the general area and understanding the location of the tracks and the workers.  

- “I found it difficult to push and pull the lever. When pushing the lever sometimes, it would come back.”

On the basis of this kind of feedback, we made multiple changes to the experience (outlined in the Activities section above). These changes were largely successful. Using audio recordings and a post-experience test, we received feedback from participants in the pilot study. During the course of the pilot study, Tancy Vandecar-Burdin and Wendi Wilson-John at ODU’s Social Science research center provided ongoing analysis of the success of the study, as per the grant requirements. Co-PI Krzysztof Rechowicz was in charge of the analysis of the results of the pilot study. These results are summarized in Appendix C. The findings of the post-experience test were encouraging, though there is also more work to be done. The audio recordings indicated that many of the participants in the pilot study did experience a moral dilemma when deciding what to do when confronted with the trolley problem. This was one of the primary goals of the pilot study, to create a realistic experience of a moral dilemma. Below are two excerpts from these recordings where participants explained why they made the choice that they made.

- “I debated based on the amount of people. It’s either letting five die or killing one, but as a robot, I figured action and inaction, I don’t know how to explain this. By letting those five die is also an action. So, if I could save five or kill one, it’s just, I’d rather one person die than five people die.”

- “In this particular case, I had two options. If I left it at the default, five individuals would be killed. If I switched it to the spur and divert the tram or trolley, only one individual would be killed, and the reasoning is that the welfare related to the five lives outweighs the welfare related to the one life.”

Despite these successes, there were also indications that, for some participants, their choice was accidental or was made with the knowledge that the experience was not real. This suggests that we fell short of our goal of creating a virtually real experience for some users. However, this suggests areas for further research.

We also received valuable feedback from the focus group, which included educators interested in using VR from the University of Arizona, Santa Clara University, Virginia Tech, Lindenwood University, Central Washington University, and Keele University. This focus group expressed interest in the VPRL’s goals of community driven, Open Source models for sharing resources within the virtual humanities for education and research purposes. They also expressed interest in the experimental data sharing frameworks embodied in the VPRL’s approach, utilizing the Open Science Framework.

Finally, we used a post-workshop survey to evaluate the success of the “Exploring the Humanities through Virtual (and other) Realities” end of year workshop. We made the survey available via a QR code at the end of the presentation. Full results can be found in Appendix D. Although only a small number of attendees responded to the survey, all five responding participants strongly agreed that the workshop had interesting presentations, that they would attend another workshop on exploring the humanities in VR, and they would recommend the workshop to others. Four of the five respondents agreed or strongly agreed that the workshop increased their interest in pursuing humanities using virtual reality technologies.

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6. Project Continuation and Long-Term Impact

The VPRL plans to continue work on this project in several forms. First, as the project has been made open source and open access, it plans to continue to make updates to the experiences on Github and solicit additions from the open source community. In the short term, these additions include had to add height adjustment, options for sitting and standing, menu options for different hands, a process to include text for speech/audio, and themes tied to colors that were set up as default for those who have levels of color blindness. Second, we plan to extend our community building to high school students and other non-professional academics. We have developed a working relationship with the Norfolk Public Library to bring the experience to underserved communities without access to VR headsets. The goal is to develop a framework for introducing the public between the ages of 13 and 18 to philosophical ideas through VR programming in non-traditional settings. In the long term, we plan to use this initial community outreach work with NPL to develop grant proposals for level III NEH funding or an Advanced Informal STEM learning grant through the National Science Foundation. Third, we plan to develop more philosophical thought experiments in VR, focusing on more social experiences as requested by collaborators. One of the effective ways we found for collaborating was to create synergistic relationships with groups in a wide variety of disciplines. For example, our undergraduate developers were drawn from ODU’s Video Game Studies, Design, and Development program. They gained skills and experience, as well as portfolio projects, to use towards their major while working on this project. Going forward, we will continue to exploit this kind of synergy, as seen with our ongoing collaboration with the EthicsLab at Central Washington University.
Appendix A: Focus Group Participants and Outcomes

Joseph Steineger  Lindenwood University
Erick Ramirez  Santa Clara University
David Schwan  Central Washington University
Bryan Carter  University of Arizona
Kathryn Francis  Keele University
Alice Fox  Virginia Tech

FOCUS GROUP OUTCOMES

VMASC’s Capabilities Laboratory (CapLab) provided VRPL support for a small focus group with seven subjects across the Humanities to explore the market value of the VRPL products and organizational mission.

This focus group explored drivers, dynamics, and dimensions of the products in order to better understand how to move the VRPL program forward in the coming year.

We have broken this out into three areas of concern:

- **PAIN POINTS** utilizing VR in education
- **CORE INTERESTS** within the community
- **FUTURE TOPICS** of operational interest

PAIN POINTS

Most felt communicating value to institutional and disciplinary leaders is a challenge due to steep learning curves & frequent confusion over cost responsibility.

Investment in educational VR is limited by a lack of unified user experiences, as well as insufficient IT support resources for VR labs and equipment purchases.

Content availability and structure creates extra challenges, a strong focus on single player experiences reduces impact while the cost of custom assets is prohibitive. Users also would like more powerful examples outside of moral dilemma contexts.

FOCUS GROUP OUTCOMES

CORE INTERESTS

Participants are most excited to use and share unique experiences across disciplines which would allow for social decision making in the future.

Within the VRPL mission, the focus group most valued the goal of creating community-driven Open Source models for sharing resources within the Virtual Humanities, for both education and research purposes.

Users stated a profound need for experimental data sharing frameworks, integration with biometrics & sensors, and sharing of game engine assets & tools for IRIS data collection and publication.

FUTURE CONVERSATIONS

The need for onboarding, retention, and community management plans was reiterated frequently, meanwhile, formal approaches to collaborative scholarly production could be explored/encouraged.

Participants encouraged VRPL to explore how it can drive development skills for Virtual Humanities while also creating shared spaces for live, open source distribution of assets, tools, experiences, scholarship, and support.

Finally, subjects encouraged the VRPL to engage less-integrated scholars, like entry-level educators and researchers, to better understand VRPL’s disciplinary and scholarly value propositions for early-career practitioners.
Appendix B: Workshop Materials

**Exploring the Humanities through Virtual (and other) Realities**

Zoom Virtual Conference Link: https://tinyurl.com/4humanitiesVR

December 10, 12pm – 3:30 pm ET
Questions? Contact: vprealitylab@odu.edu

**12 pm – 1 pm: Murder on the VR Express: Thought Experiments in VR**

In this session, the Virginia Philosophy Reality Lab (VPRL) will present their work to develop VR thought experiments based on the trolley problem. It will highlight the obstacles they encountered and share how other educators can use tools developed by the VPRL to create their own thought experiments.

**1:15- 2:15 pm: Panel Discussion- “Affordances and Pitfalls for Humanities in VR”**

In this session, panel speakers will share their experiences exploring humanities-based questions using virtual reality (and other) technologies, considering both the problems and benefits that might arise. Each speaker will provide 10 minutes, before having an open discussion with the audience.

Dr. Saikou Diallo, Virginia Modeling, Analysis, and Simulation Center, Old Dominion University
Dr. James Hutson, Art History and Visual Culture, Lindenwood University
Dr. Ashley Shew, Department of Science, Technology, and Society, Virginia Tech

**2:30- 3:30 pm: Keynote- “Process Philosophy & VR: The Foundations of Experiential Design”**

As Voices of VR Podcast host Kent Bye has conducted over 1600 oral history interviews since May 2014, he has been of the frontlines of innovation & experimentation with the medium of virtual reality. Moving from passive 2D media to more immersive and participatory 3D has required a shift from linear production process to more iterative, experiential design practices. Bye argues that the shift towards experiential design, embodied cognition, and contextually-aware design is reflected in a similar philosophical shift from substance metaphysics to process-relational metaphysics as described by Alfred North Whitehead’s Process Philosophy, Epperson & Zafiris’ Relational Realist Quantum Ontology, and Kastner’s Transactional Interpretation of Quantum Mechanics. Whitehead’s mereological approach of whole & parts also helps emphasize contextual dimensions that are normally collapsed through the lens of reductive materialism. This talk will provide a tour through some foundational philosophical concepts that have helped Bye form a series of sensemaking frameworks that includes a pluralistic synthesis of Process Philosophy, Feminist Philosophy, Indigenous Philosophy, Chinese Philosophy, Ancient Philosophy, Media Theory, as well as modern neuroscience.

*This workshop is made possible in part by a grant from the National Endowment for the Humanities.*
Appendix C: Pilot Study Data (Compiled and analyzed by Krzysztof Rechowicz)

- Participants showed a high level ofなかの changes, expected, given demographic trends in the household owners.
- Generally greater variation in age and education background than previous studies.
- Francis et al., 2017
- Biologically et al., 2012

Study Outcome

- Study Outcome

Post-experience Survey

<table>
<thead>
<tr>
<th>Question</th>
<th>College Group</th>
<th>Non-College Group</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>Question_1</td>
<td>0.05</td>
<td>0.03</td>
<td>0.12</td>
</tr>
<tr>
<td>Question_2</td>
<td>0.04</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>Question_3</td>
<td>0.06</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Question_4</td>
<td>0.07</td>
<td>0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Question_5</td>
<td>0.08</td>
<td>0.06</td>
<td>0.11</td>
</tr>
<tr>
<td>Question_6</td>
<td>0.09</td>
<td>0.07</td>
<td>0.13</td>
</tr>
</tbody>
</table>

- People who felt a variety of emotions (Q4) believed that their emotional reaction was appropriate (Q3).
- People who felt a variety of emotions (Q4) experienced moral dilemma (Q7).
- It was difficult to decide (Q11) for people who felt they were in moral dilemma (Q9).
Appendix D:

Virginia Philosophy Reality Lab Workshop Survey Results

Five (5) participants completed the post-workshop survey. All five indicated that they would be at least somewhat likely to use the Life and Death Trolley Problems module. Four of the five indicated that they would be at least somewhat likely to use the VPRL-developed tools to create their own thought experiments in virtual reality. Three respondents indicated that they would very likely contribute data to the VPRL Open Science Framework page and will use data on the VPRL Open Science framework.

<table>
<thead>
<tr>
<th>Please indicate if you would be very likely, somewhat likely, neutral, not very likely or not at all likely to do the following:</th>
<th>Very Likely</th>
<th>Somewhat Likely</th>
<th>Neutral</th>
<th>Not Very Likely</th>
<th>Not at all Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>I will use the Virginia Philosophy Reality Lab (VPRL) Life and Death Trolley Problems module.</td>
<td>40.0% (2)</td>
<td>60% (3)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>I will use the VPRL developed tools to create my own thought experiments in virtual reality.</td>
<td>20.0% (1)</td>
<td>60.0% (3)</td>
<td>20.0% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>I will contribute data to the VPRL Open Science Framework page.</td>
<td>60.0% (3)</td>
<td>0.0% (0)</td>
<td>40.0% (2)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>I will use data on the VPRL Open Science Framework page.</td>
<td>60.0% (3)</td>
<td>0.0% (0)</td>
<td>40.0% (2)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
</tbody>
</table>

All five responding participants strongly agreed that the workshop had interesting presentations, that they would attend another workshop on exploring the humanities in VR, and they would recommend the workshop to others. Four of the five respondents agreed or strongly agreed that the workshop increased their interest in pursuing humanities using virtual reality technologies.
<table>
<thead>
<tr>
<th>Please indicate if you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the following statements:</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The “Exploring Humanities through VR” workshop had interesting presentations.</td>
<td>100.0% (5)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>The “Exploring Humanities through VR” workshop increased my interest in pursuing humanities using virtual reality technologies.</td>
<td>60.0% (3)</td>
<td>20.0% (1)</td>
<td>20.0% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>I would recommend this workshop to others.</td>
<td>100.0% (5)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>I would attend another workshop on exploring the humanities in VR.</td>
<td>100.0% (5)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
</tbody>
</table>

Participants were asked how the event can be improved for future participants and the comments largely focused on the technical aspects of the event. Respondents recommended ensuring the Zoom room is private to avoid Zoom bombing as well as clarifying the roles presenters play to ensure that a variety of viewpoints can be examined. In order to avoid Zoom bombing a respondent recommended there be a pre-registration for the event to avoid making the link available to people who have not registered. Lastly, it was recommended that a sound, video and connection check be completed prior to the event. One respondent also commented “great work, really interesting!”.