# Liminal Spaces and the Uncanny Valley:
## An Interdisciplinary Virtual Reality and Psychology Experimental Research Design

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# INTRODUCTION: Does the organization of an otherwise known public space cause users to feel unsettling feelings?

Developments in virtual reality (VR) technology and tools like the experimental design framework UXF provides a way to prototype, design, and implement psychology experiments. We use a case study experiment to show the feasibility of virtual reality technologies in creating psychological experimental design environments. We show that through the use of video game engines such as Unity and a research pitch design process from psychology students, virtual reality can be an effective tool to prototype psychology research designs. The background for our research problem comes from the understanding of liminal spaces which is often associated with spaces that cause some sort of discomfort or unease (Mauro, 2021).
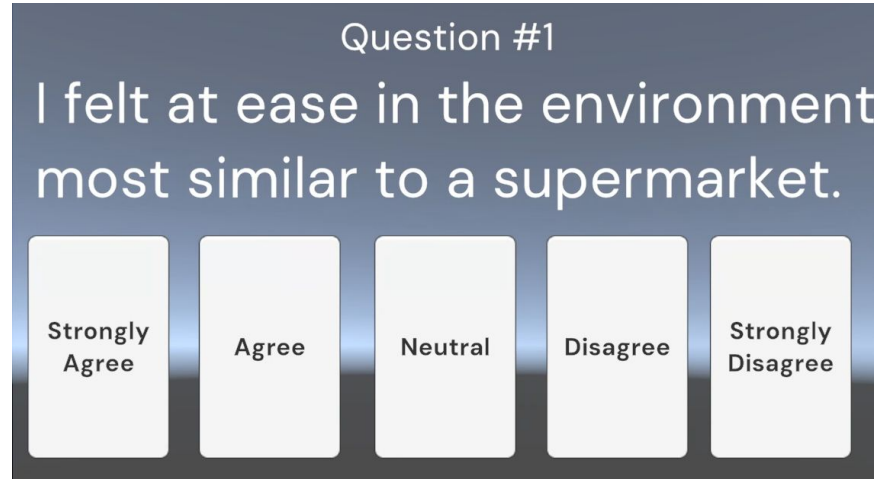
# FRAMEWORK: Project Architecture
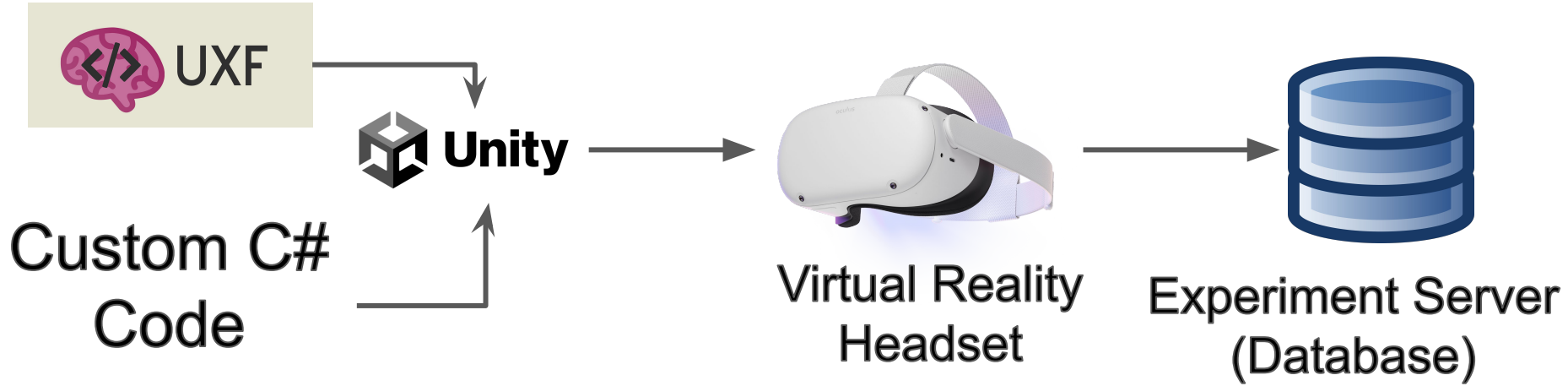


Experiments are built with an framework that allows for precise data collection such as UXF (Unity Experiment Framework) and combined with custom code alongside the Unity Game engine to create a VR application that runs on a Meta Quest 2 virtual reality headset. At experiment start, the headset randomly sorts the participant into experimental/control. The headset communicates with a experiment server that allows for data collection to be saved to a database.

# FRAMEWORK: Liminal Spaces + Quantitative Results



**CONTROL**



**EXPERIMENTAL**

By turning common environments into a liminal space–often associated with spaces that cause some sort of discomfort or unease (Mauro, 2021)–unease can be measured quantitatively with the amount of time someone spends in a room before moving onto the next room, and with the qualitative results of a post-experiment survey.

# FRAMEWORK: Psychological experimental design w/ questionnaires



Psychological questionnaires in response to virtual reality experiences have shed insight on how virtual reality can be used as a tool in psychological experimental design (Nijland et al., 2021).

# FINDINGS: Methodology + Theory

Our methods included gathering a sample from the Psychology class at P2P, only allowing 18 year-olds that have a signed informed consent for easier data gathering. Gathering data utilized a built in timer that would measure the time each subject would spend in each settings, in addition to a survey at the end that measured the users comfortability at a 0-4 scale. In theory, those who experienced the settings intended to cause uncomfortability (liminal spaces) should reflect a lower time and lower comfortability score on the survey.

# FINDINGS: Results

At the end of experimentation, it was observed that on average, subjects that went through the liminal spaces ended up staying in those spaces longer than those in the control environments (*Table 2*). However, it is important to note that comfortability was lower in the experimentation group than the control group (in the Library and Classroom settings) (*Table 1*). Overall, it was discovered that while comfortability did decrease in liminal spaces, more time was spent in these spaces which contradicts part of the theoretical results.

# FINDINGS: Tables

| | Control Group | Experimental Group |
|---|---|---|
| **Average Store Survey** | 1.4 | 1.6875 |
| **Average Class Survey** | 1.8 | 1.6875 |
| **Average Library Survey** | 2.6 | 1.8125 |

*Table 1: Survey Scores*

| | Control Group | Experimental Group |
|---|---|---|
| **Average Store Time** | 35.3 | 35.375 |
| **Average Class Time** | 29.4 | 31.6875 |
| **Average Library Time** | 16.2 | 30.25 |

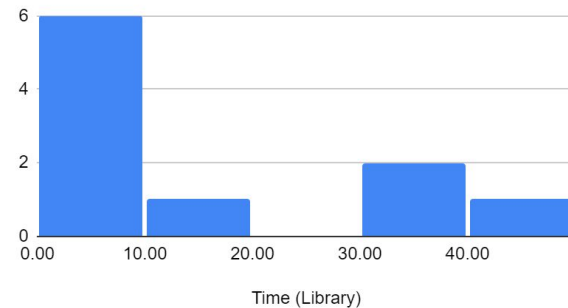*Table 2: Time Spent in Each Environment (measured in seconds)*

# FINDINGS: Graphs
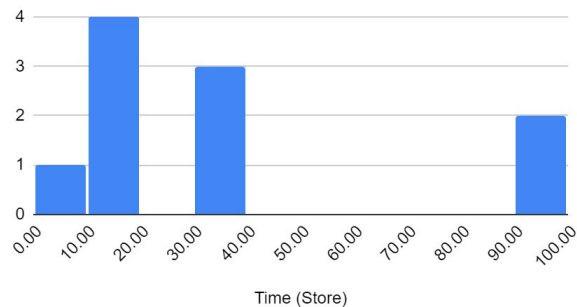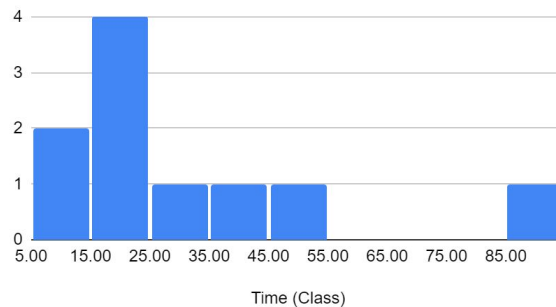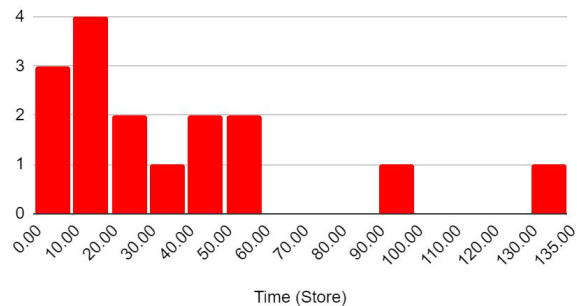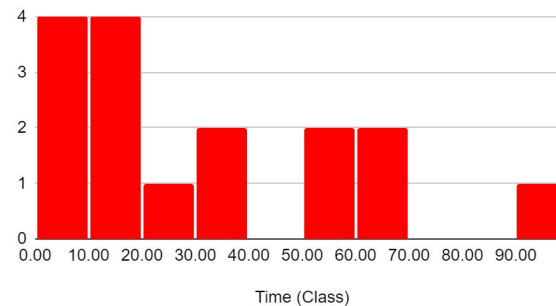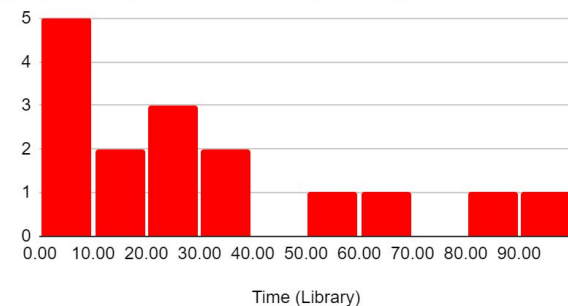
# CONCLUSIONS: General + Limitations

In the context of our research question, our data reflected interesting points, most notably that in liminal spaces, comfortability decreased while time spent increased. This was most likely due to increased intractability/curiosity which diverted the attention of the subjects from moving on to the next room. While it proved the uncomfortability that liminal spaces are meant to create, it poses the idea that in spite being in a space that causes a negative feeling to occur, people are willing/more likely to explore their surroundings. However, since this was done in a virtual environment, it is unknown whether these results would translate one-to-one to real life as these experiments were conducted in a normal space. As well, the virtual environments themselves were not created in a way that perfectly reflected reality, so there could be some disconnect there as well.

# CONCLUSIONS: Problems + Applications

In addition, there was a problem with transition scenes during the first wave of experimentation so some data was lost as well as time for experimentation. Outside of the experiment, the idea of utilizing virtual reality outside of entertainment purposes could allow more widespread use of the technology for various psychological experiments as a way to replicate human behavior. The use of VR is already used in forms of exposure therapy, as a cheaper means to be able to treat those with PTSD. As well, the concept of liminal spaces could aid in the creation of various spaces for people returning to in-person workspaces after the COVID pandemic: creating spaces that people would feel comfortable in.

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