

# COMPARING PERCEPTIONS OF OCCUPANT FLOW AND SPACE FUNCTIONALITY IN VIRTUAL REALITY AND AN ACTUAL SPACE

# Overview

## 1. Background to the work

- Why we are interested
- Long-term objectives

## 2. Summary of Methodology

- How to subjects move around
- Survey approach
- Development process

## 3. Highlighting Results

- VR to actual space
- Assessing corridors
- Checking for response bias

## 4. Discussion

- Face guards
- Limitations

## 5. Next Steps

# Problem Statement

## **Long-term Research Objectives**

Better understanding of how VR can help the design review and revision process by helping to clarifying usefulness, limitations, and appropriate applications of VR.

## **Project Goals**

1. Gather perceptions of design relating to flow and functionality within a VR experience.
2. Compare the VR experience to a walkthrough of the real space.

## **Research Questions**

1. To what degree do the subjects believe VR is going to be useful as a design review tool?
2. Can subjects decipher design issues in the VR experience?

# Basic Experimental Approach

- Survey-based research
  - Use both ordinal and parametric questions
- Have subjects directly interact with the virtual environment and the actual space or full scale mockup
- Target specific design decision topics
  - E.g. occupant flow, space functionality, maintenance, desired view, etc.
- Provide opportunity for students to learn how to guide subjects through the experience

## **ASSUMPTION:**

Interacting with the actual space, in person, gives us the best understanding for design decisions about that space.

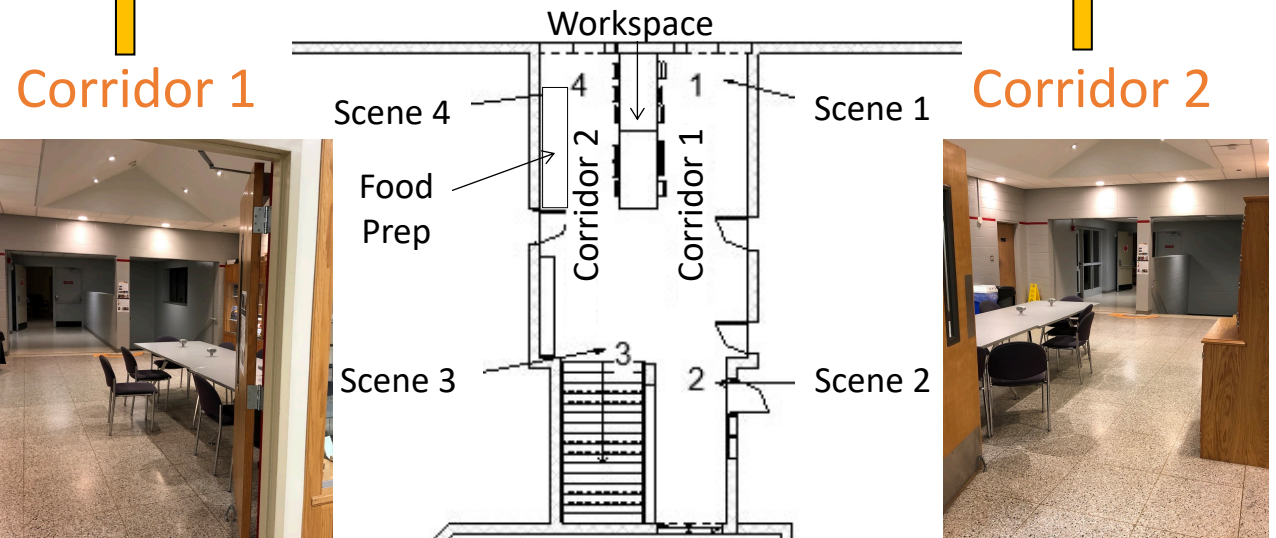
# Early Experimental Design Focal Points

- Define the space and design considerations to test
  - Chose a space that had known issues with occupant flow and functionality
- Deciding how the subjects will interact with the space
  - Freely move via joystick
  - Teleportation
  - Static points limited by tether length
- Software tools
  - Chose a game engine with easy teleportation built in
  - Revit → 3DS → Unreal Engine

# Space Layout

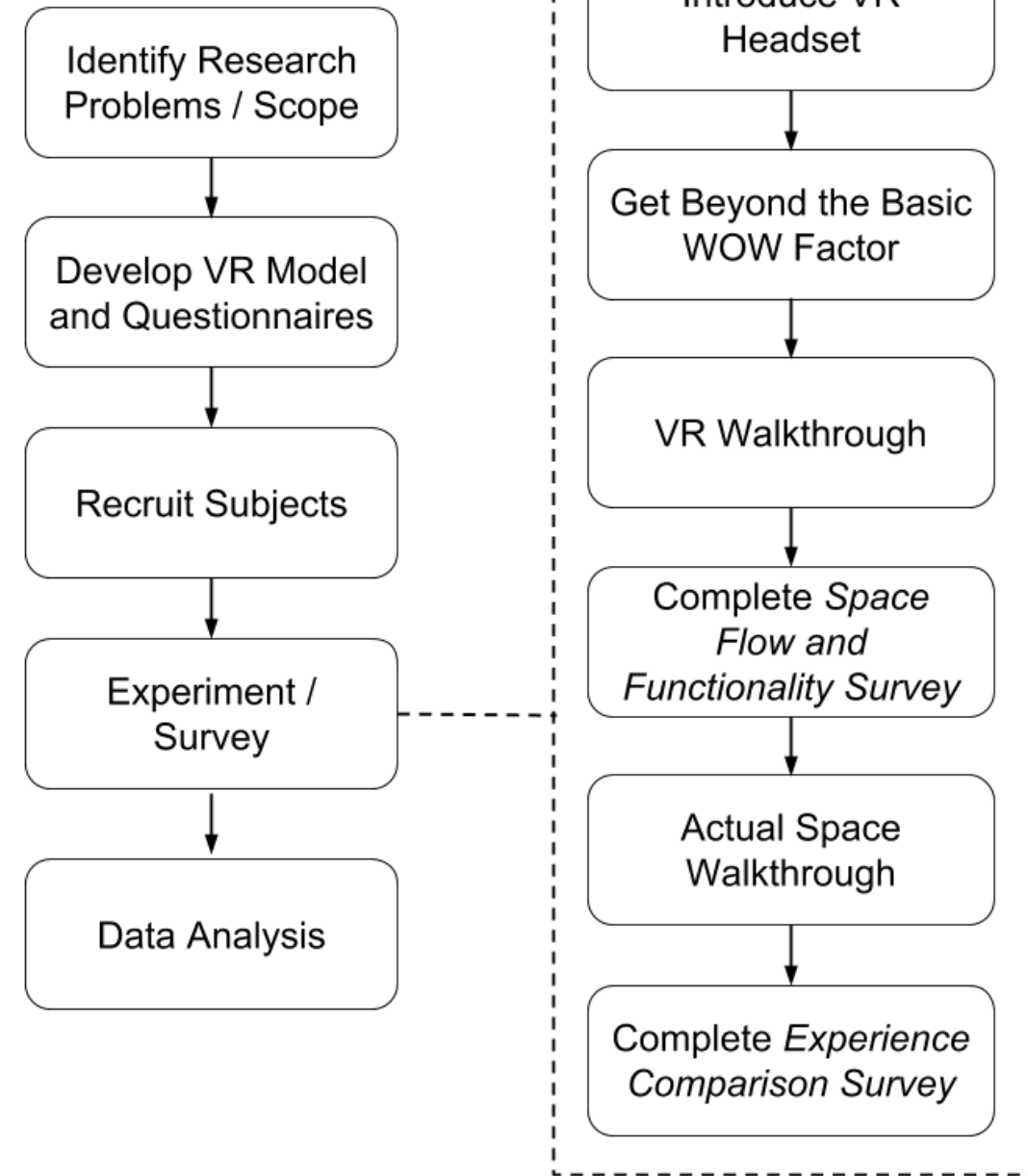
- Corridor 1
- Corridor 2
- Workspace
- Food preparation
- Mail drop

Four scenes for subjects to view



# Notes about the Workflow

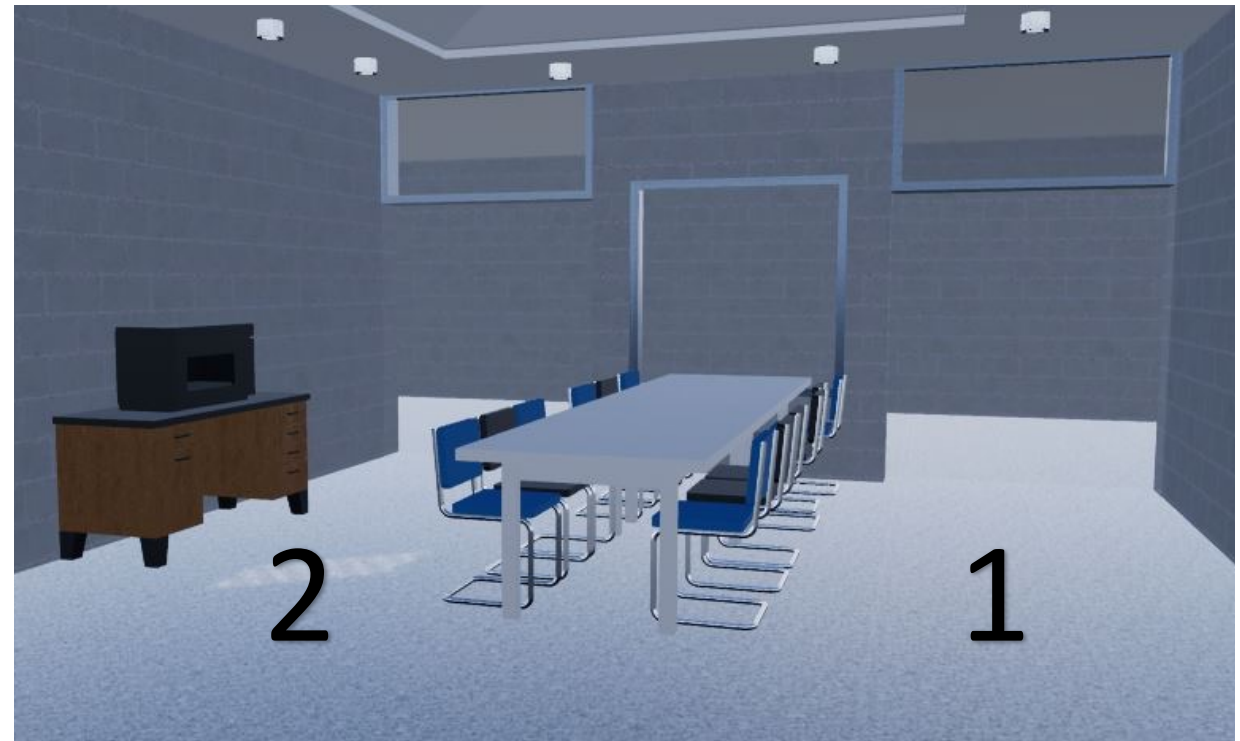
- Steps considered
  - Subject height adjustments
  - Free walkthrough
  - Repeated surveys (VR vs Actual)
  - Formal question validation processes
- Data Analysis
  - Basic descriptive statistics
  - Ordinal statistics using Mann-Whitney U test



# Survey Summary

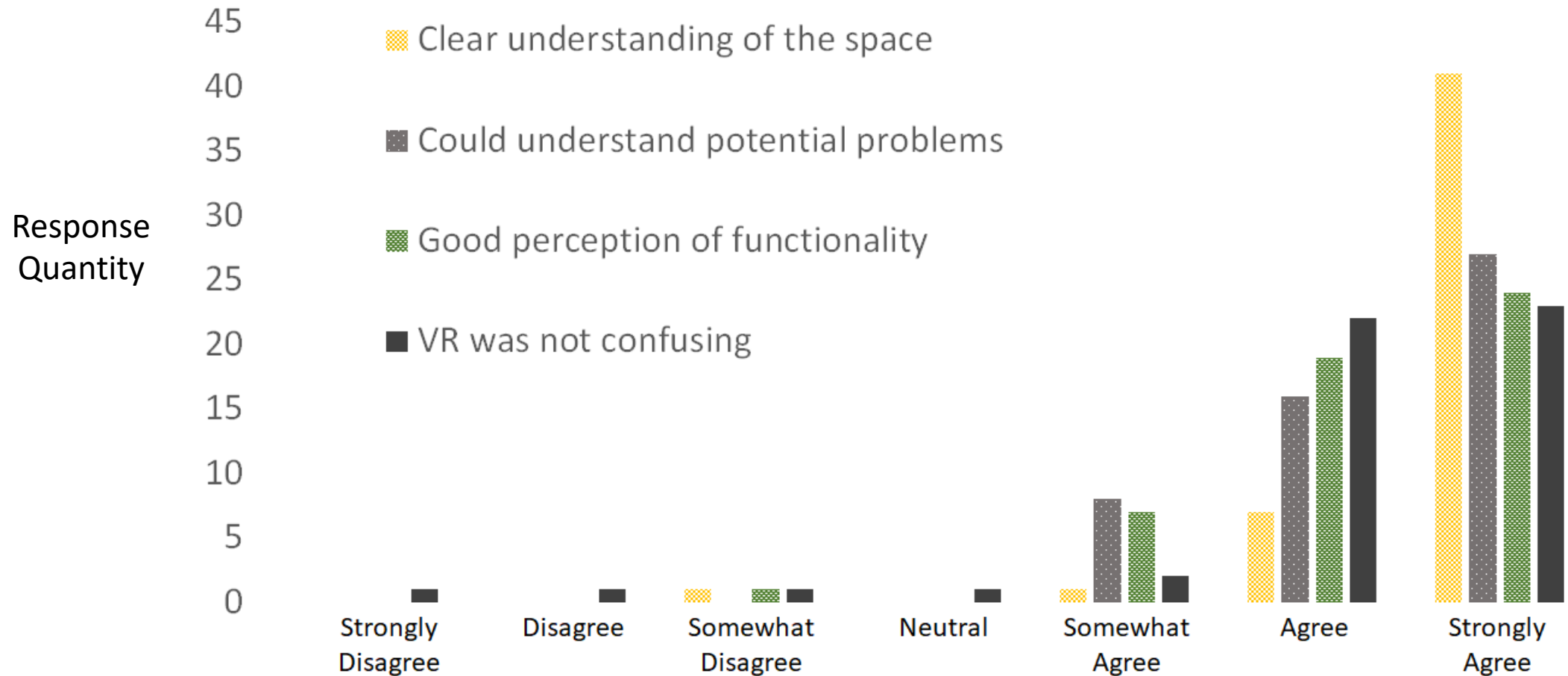
- **Overall design effectiveness** for occupant flow and space functionality (Q3 and Q6)
- **Occupant flow** potential (Q4 and Q7)
- **Obstruction** potential (Q5 and Q8)
- Overall occupant flow capacity (Q9);
- Workspace design (Q10);
- **Electrical outlet placement** (Q11);
- Food prep station design and placement (Q12).

Use parallel sets of questions for the two corridors

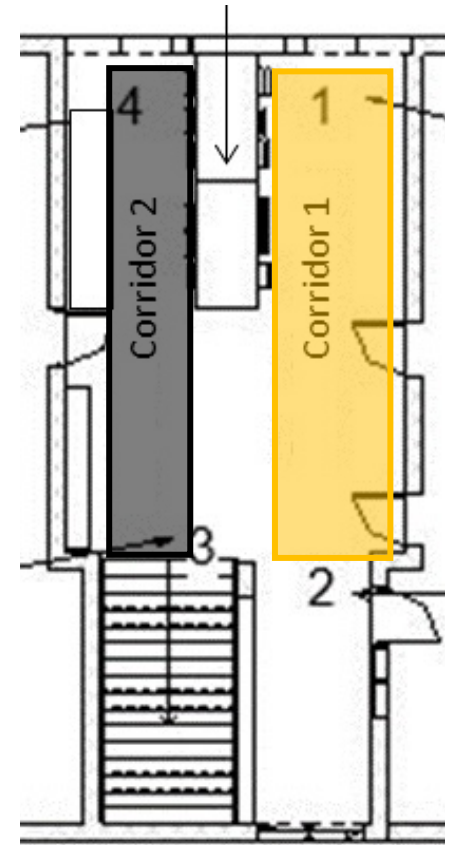
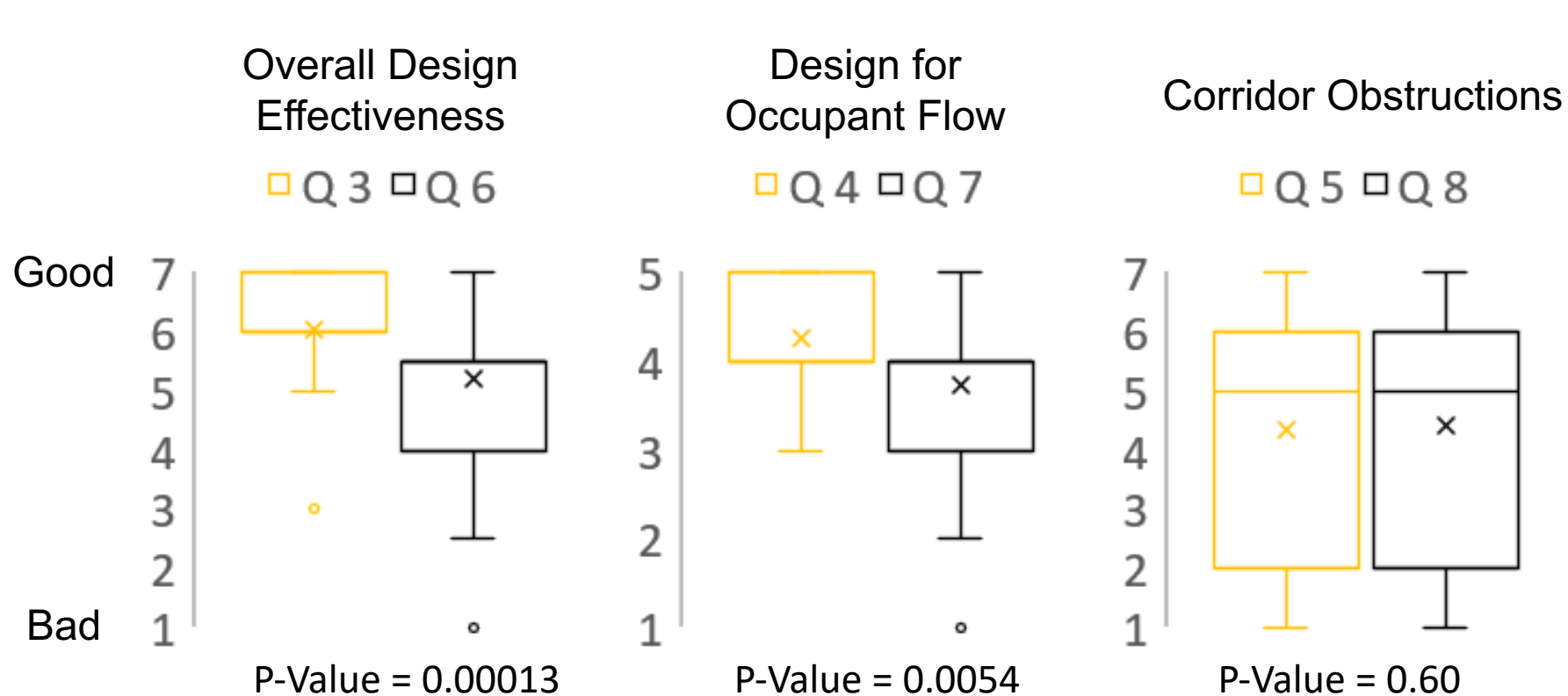




# VR to Walkthrough Experience Comparison



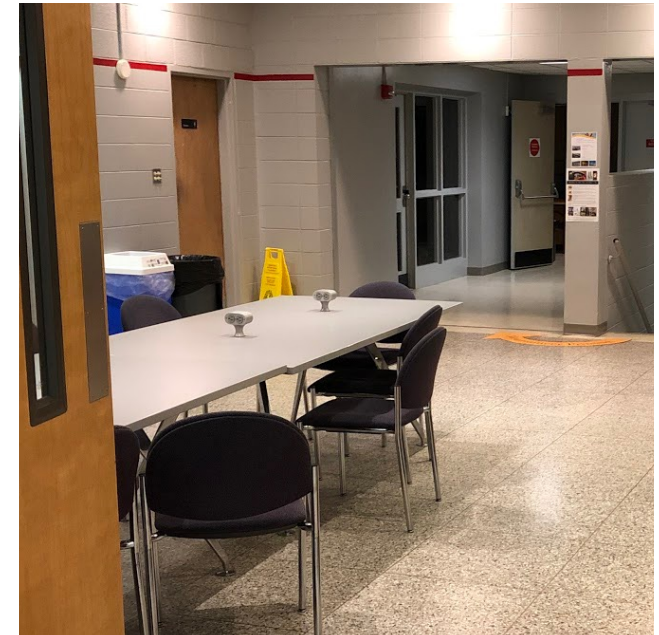
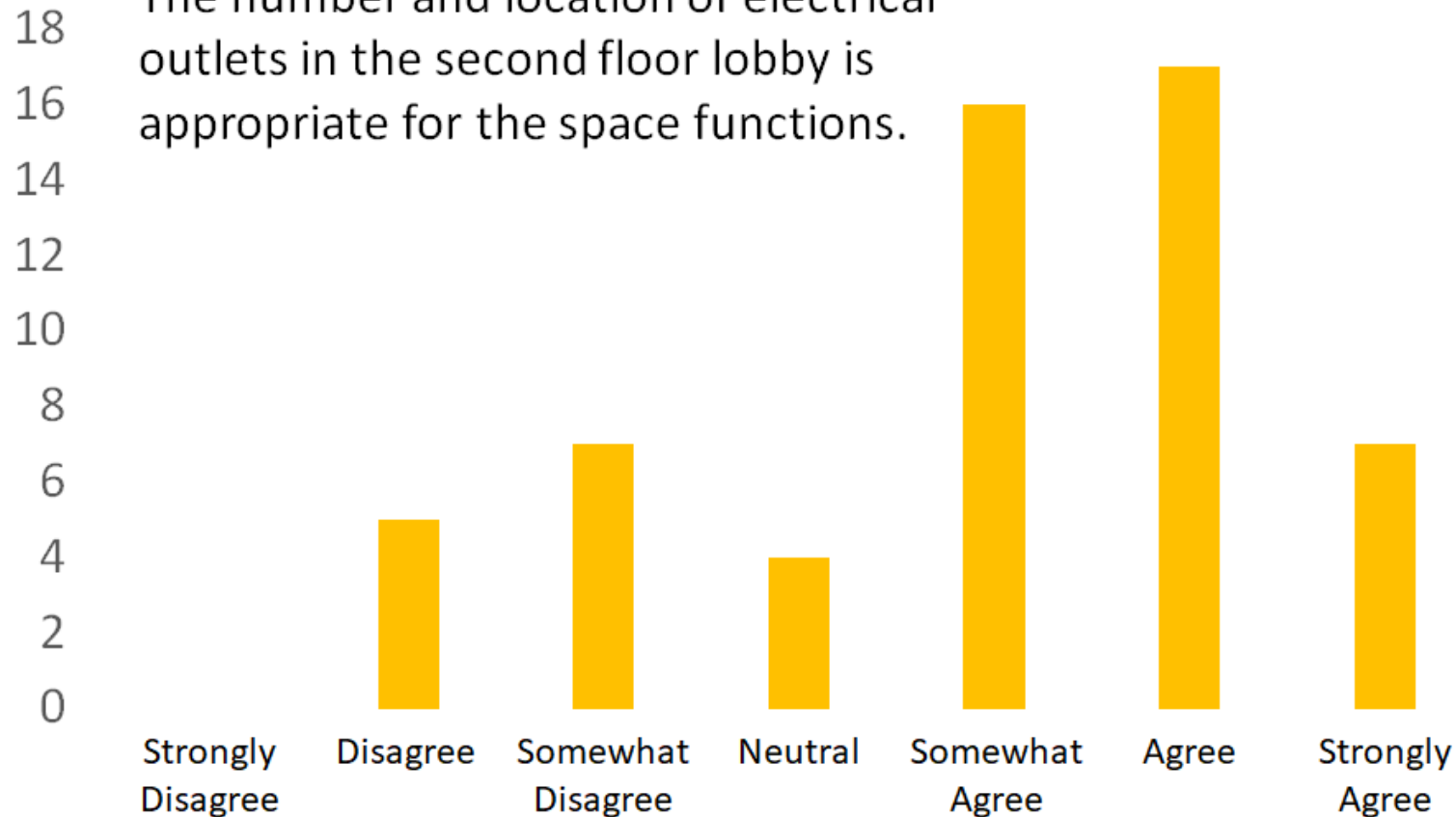
# Assessing Flow and Function



# Responses about Electrical Outlets as a Bias Check

## Statement

The number and location of electrical outlets in the second floor lobby is appropriate for the space functions.



# Face Guard Observation

- Usage during study split nearly half and half
- No significant difference between responses from the two groups.
- P-Values for null hypothesis all greater 0.4



# Limitations

- **Bias**—Subjects were familiar with the space, so the flow and functionality results are inconclusive. However, comparison questions should still hold.
- **Students vs Broader Population**—We hope that students of Building Science will be an appropriate sample population, but a thorough study is needed to compare general student perceptions to the broader population.
- **Space Selection**—Originally chosen due to electrical chords blocking corridors, but the space was altered to fix the issue before the study could be conducted.

# Next Steps

- Dive deeper into how the scale of the scenes and items in the scene may impact design review and revisions.
- Incorporate more thorough experimental design practices as we gain a better sense of metrics like Effect Size.
- Begin conducting design review charrettes with students, teaching them how to navigate a client through the experience.