

# PROXEMICS

AUGMENTING OUR INTERACTIONS ON PUBLIC TRANSPORTATION

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Responsive Environment: Bergamo eMotion  
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## 1. INTRODUCTION

*Proxemics* - “the study of the spatial requirements of humans and the effects of population density on behavior, communication, and social interaction” (Proxemics 2016).

Edward T. Hall first coined the term as “The spatial dimension of non verbal behavior” (HALL 1963) in the journal *American Anthropologist*. Proxemics revolves around the concept of personal space, the area around a person’s body which they believe belongs to them in the moment. When this personal space is encroached upon, most people react with anxiety or discomfort (Hall 1966). But every person & culture has their own idea of personal space and reacts differently to intrusions of that space. One person may get extremely anxious and irritated as a stranger encroaches on their personal space, while another may not even take notice.

Hall noted that our sense of personal space was broken up into four zones, categorized not only by physical distance but also level of discomfort by relationship status. Hall created what he called the personal reaction bubbles (*Figure 1*), which illustrate the physical space taken up by the four zones of a person’s personal space.

### Intimate Space

This is the smallest zone surrounding and including the person’s body. This zone is meant for intimate loved ones, embracing, touching, or whispering.

### Personal Space

This zone is the second smallest, reserved from close family and friends.

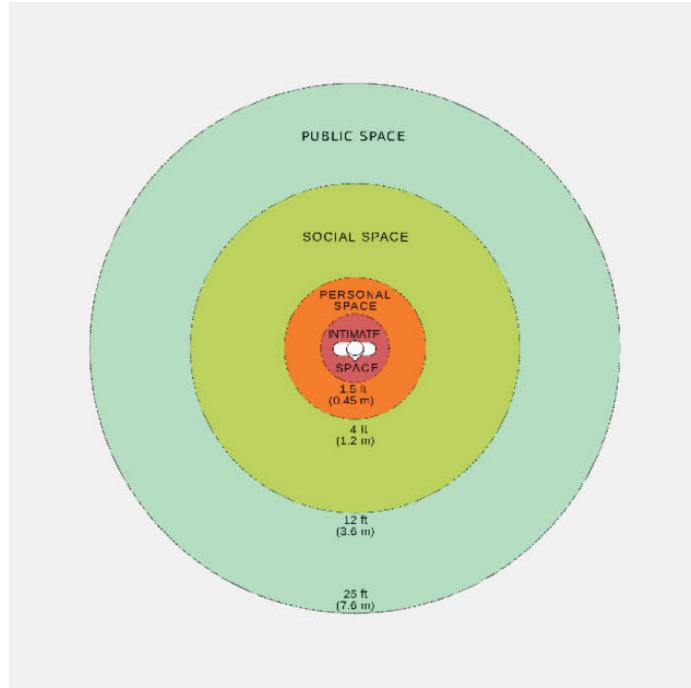
### Social Space

This zone is reserved for acquaintances and new friends – people you are willing to interact with but are not comfortable with getting too close. This may also be reserved for interacting with a small group of friends.

### Public Space

This is the largest zone, generally reserved for public speaking or other situations where a single person is speaking to a large group of people.

Although Hall tried to physically measure the radius of each zone, the size of a person’s reaction bubbles varies from person-to-person; from culture-to-culture; and from situation-to-situation. In any particular situation, a person’s reaction bubbles can be affected by a number of factors such as: kinesthetic,



*Figure 1 - Hall's personal Reaction Bubbles*

touching, visual factors, thermal factors, olfactory factors, and voice loudness (Proxemics 2016).

## 2. PRECEDENTS

Proxemics is a subject that has always been subconsciously thought of in space design. However, since this concept was coined by Edward T. Hall, a vast amount of studies have been done from the point of view of design, anthropology, physiology, marketing etc.

This study focuses on how design can significantly alter one's sense of personal space. We took a survey of design projects that implicitly refer to the concept of proxemics. We found that each project could be placed into

one of two categories: projects that attempt to change people's behavior by molding the environment; and projects that attempt to change people's emotional reactions to an existing environment.

### 2.1 Molding the Environment

#### City Benches

Proxemics is often thought of during the design process of many elements that surround us; the city bench could be an example of an element in the public space. The decision of segment or not each individual seat along the piece of furniture is something that directly affects to the perception of the personal space. (*Figure 2*)

## **London Bus** *Heatherwick Studio*

When asked to redesign the double-decker buses in London, the designers took every opportunity to make the bus more comfortable and inviting. The entire bus is now covered in windows, making the space feel much larger; the stairwell is no longer an isolated corridor; each seat has its own light; and colors/decor of the space was chosen to make the space more comfortable. (*Figure 2*)



## **2.2 Coping with an Existing Environment**

### **Walkman** *Sony Corporation*

In the late 1970's, Sony came out with the Walkman. This the first portable device that allowed you to bring your personal music anywhere. Being able to shut out the sounds of a busy train with your own music made people more comfortable and made it easier to ignore encroachment on your personal space. (*Figure 3*)

### **Have-A-Seat** *MIT Media Lab by Mika Igarashi, Michiel Stade and Sylvain Vriens.*

*Have-A-Seat* is a public bench that changes shape according to the number of people sitting. For instance, if there are two people on the bench, the bench makes itself wider, creating a larger gap between the two persons. (*Figure 3*)

### **Habitat** *MIT Media Lab, by Dipak Patel, Aoife Ní Mhóráin, Stefan Agamanolis.,* The installation consists of two tables in

*Figure 2 - Examples of projects that attempt to mold the environment in order to adjust human behavior and emotional reaction. (top) City Benches ; (bottom) London Bus designed by Heatherwick Studio*

remote locations. One equipped with sensors to detect the objects placed on it, and the other which contains projections of these objects. The installation is an attempt to connect two remote spaces, making the person traveling away from home more comfortable in the new space. (*Figure 3*)

### Pleated Hood, Introvert Transformation Project

*Lilian Hipolyte Mushi*

Thought as wearable art project, it consists of a mask that uses a pleated heat-sensitive material. It not only isolates the wearer from his surroundings but also changes color with his body temperature. This allows the wearer to become more comfortable in situations where his personal space may be encroached upon as well as informing those around him of his current mental state. (*Figure 3*)

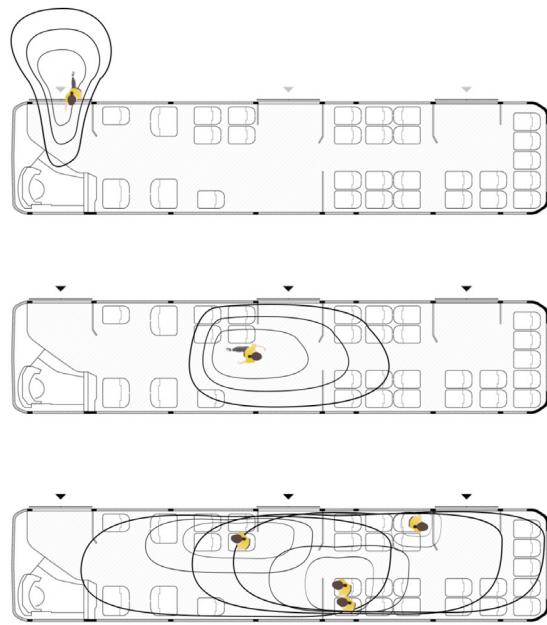
## 3. RESEARCH FRAMEWORK

This study focuses on the emotional aspect of personal space in the public sphere. Among variety of environments, the space inside the Public Transportation system is one of the most interesting and unique environments for the study of proxemics.

Public Transportation is unusual in the fact that we willingly accept the encroachment of our personal space by complete strangers; and we willingly encroach on the space of others. In any other situation this might be the cause for an awkward confrontation. But because, as a society, we're familiar with the rules of public transportation, we repress our feelings of anger and discomfort. This repres-



*Figure 3 - Examples of projects that attempt to change one's emotional reactions to existing environments. (top - bottom) Sony Walkman; Have-A-Seat; Habitat; Pleated Hoot, Introvert Transformation Project*



*Figure 4 - Depictions of bus riders' proxemic volumes. (top) A passenger walking on the bus; (middle) a passenger in the middle of the bus; (bottom) multiple passengers riding the bus.*

sion of our instinctual emotions often leads to an intense sense of anxiety.

People cope with this anxiety in a number of ways. For instance, one might ride subway with headphones blasting music and their eyes glued to their phone, while another might try to make himself more comfortable by sparking up a conversation with his neighbor. It seems that most make (an often subconscious) choice between separation (ignoring those around you) and fusion (interacting with those around you). What most don't realize is that their actions, the actions of one out of many in the confined space, affects the rest of the space both directly and indirectly. For instance, if a bus passenger is speaking loudly on his, the other passengers are forced to passively take part in his private conversation.

### How can we alter one's perception of personal space?

Through the study of our precedents, we found that each project took the approach of either molding the environment to prevent unwanted emotions or by creating interventions that allow us to cope with an existing environment through either fusion or separation. We felt that both approaches take an important stance on proxemics but they're not enough. That's why we're proposing an approach that combines these two stances by redesigning the interior of the bus and incorporating an interactive light installation throughout the floor and seating.

## 4. PROPOSAL

### 4.1 Interactive Light Installation

The system we're imaging consists of an array of LED lights embedded into the floor and seating; and a motion sensing device such as Microsoft's Xbox Kinect; and microphones spread throughout the bus.

#### LED Lights

The array of LEDs is used to project an abstract representation of each passenger's proxemic volume. As each passenger cohabits on a bus, their volume continues to follow them similar to the way a shadow follows its caster at high noon.

#### Motion Sensor (Kinect)

The motion sensor is used to track each passenger on the bus. This doesn't just include their physical location in space but it is also used to interpret:

- Body language - a closed off posture means you're less willing to interact with others and are imposing less on others;

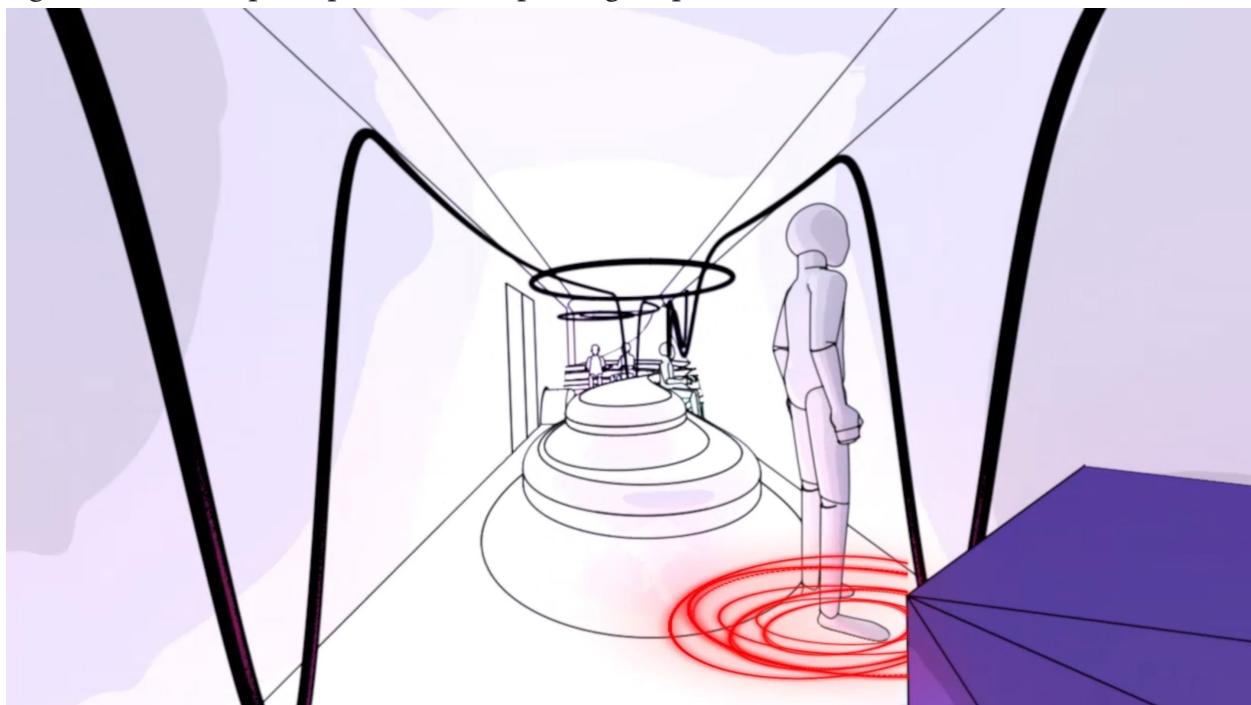
while an open posture can mean the opposite.

- Proximity to other passengers - your proxemic influence on another person becomes more apparent the closer you are to that person.
- Velocity - A person in motion is more likely to gain the attention, wanted or unwanted, of others in the same space when compared to a person sitting still.
- Interactions with other passengers - When conversing with another passenger, your two proxemic volumes begin to grow larger and overlap.

#### Microphones

Sound is an important factor to emotional response of a proxemic interaction. For instance, when speaking to someone in a whisper, you're inviting them into your personal space and those around you are less likely to hear. On the contrary, if you screaming loudly on the phone would make it certain that others on the bus could hear you.

*Figure 5 - An example depiction of one passenger's proxemic volume*



## Possible Interaction

To give a better understanding of the interactions, I'm going to walk you through a possible scenario in our imagined bus.

You walk onto the bus and greet the bus driver. You notice strange orange lights glowing and changing shape underneath a person standing at the front, waiting for his stop.

He doesn't seem to care.

You look down and see a similar, but blue, glowing light projected from the floor underneath you. Even though you're barely walking, it's constantly in motion, changing shape and form but always underneath you, almost as if it has become your shadow.

This light is your 'proxemic volume', the amount of space the bus perceives as belonging to you, being influenced by your presence.

As you walk down the corridor your volume begins to grow & shrink, blurring your volume with others as you pass them.

You sit, look out the window and keep to yourself. Your volume slows and shrinks down to a size that just barely encompasses your entire body.

You notice your friend, with a red volume of his own, standing on the other side of the bus and you invite him to sit next to you.

As he sits down next to you, both of your volumes begin to grow. They appear as if they're blending together.

You start talking about the lights and explain how you're not really sure what they mean. The two of you extoll a hearty laugh.

Your volumes grow even larger.

The divide between the two volumes is no longer visible. The two distinct entities continue to appear as if they're permeating from their owner but they now morph and extend as one.

The more enthusiastic your conversation becomes, the larger the volume grows, consuming the volumes of those around you.

Others on the bus begin to take notice and conversations about the lights start happening everywhere on the bus. Their volumes blending and blurring together, both creating and revealing the transition from strangers to acquaintances; melting away the anxiety of the usual bus ride.

## 4.2 Molded Space

In order to pursue the type of interaction explained above, we found that the actual arrangement of the space in a bus constraint the user to experiment the commuting journey in two type of spaces: a row of seats or just standing in the central area of the bus. We had the idea to re-imaging a space that will be more compliant with the type of diversity of situations that occurring in a bus and, at the same time, a space that would allow to display more freely the interactive component of the installation.

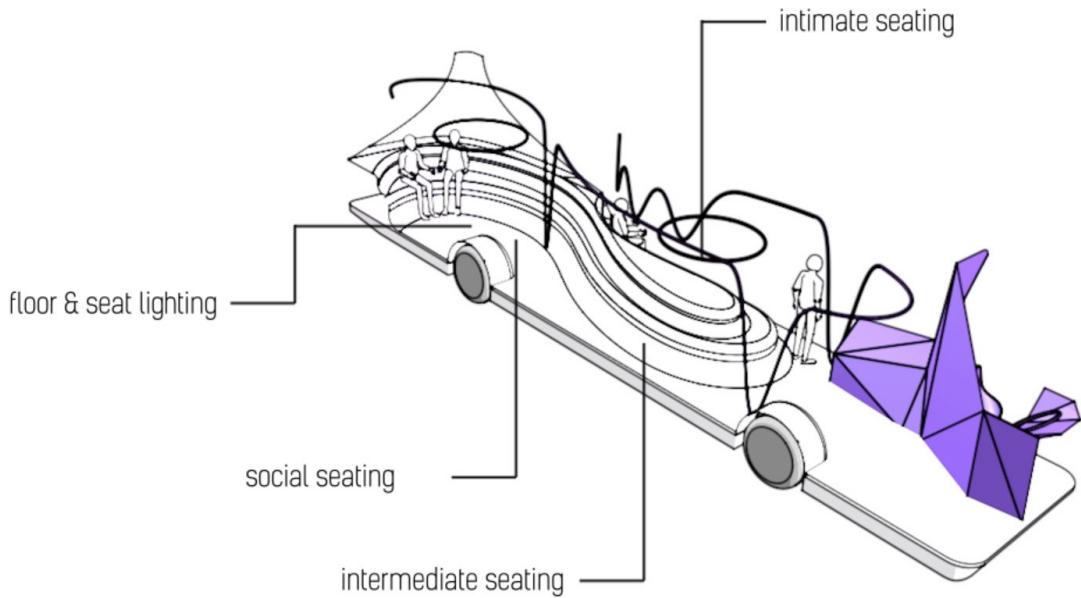
Then, the intervention consists on a single surface that extends along the bus and it bends up to create the seating space. By doing this operation, we understood that the space that is generated should encourage certain situations. For example, in one area of the bus, the form of the bench allows for a 'concave' space where, like in a plaza, people could tend to socialize more. In contrast, in other area the bench creates a smaller space

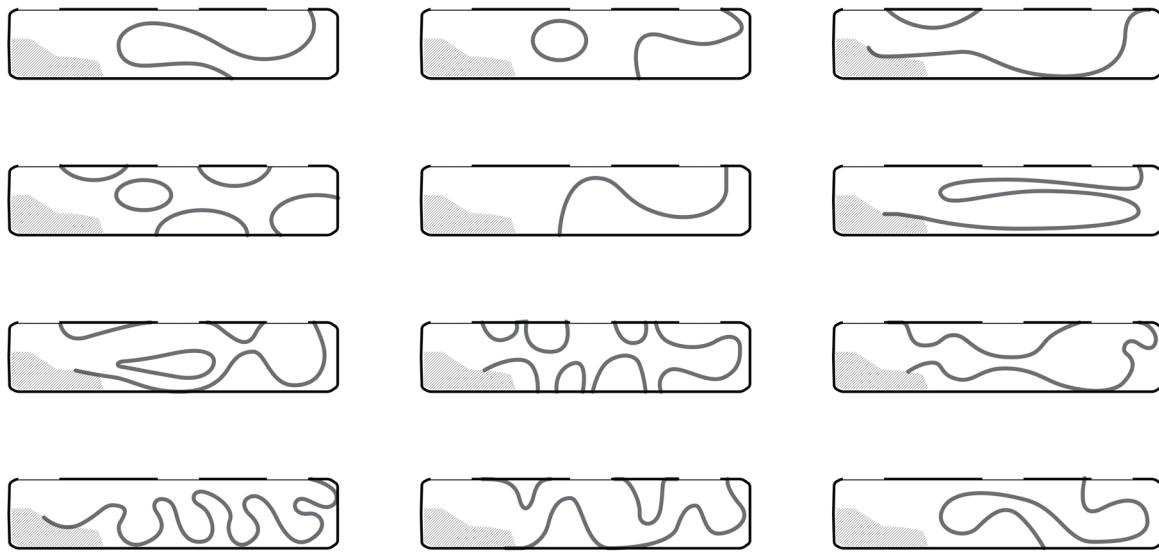
closer to the window; in this case, it would be an appropriate place for people that would have the need for being more separated, they may be having even more relation to the outdoor space rather than inside the bus. Last, the part of the bench located in the center of the bus would be an intermediate situation, a place where the person sitting could have an overview of the entire space but also being isolated from the persons sitting next to him as the 'convex' shape of bench will tend to isolating by rotating their field of vision. (*Figure 6*)

This component is not thought as an ultimate design solution, but more as a strategy for the interior arrangement of the bus. The spaces that any arrangement would eventually create are part of a design reasoning that is inevitable to be associated with specific

cultural values; consequently, the strategy allows the space for multiple design iterations that could represent more accurately another way of thinking the proxemics space. (*Figure 7*)

*Figure 6 - A diagram of the proposed bus layout*





*Figure 7 - Illustrations of other potential bus layouts*

## 5. PROTOTYPE

To represent the interior of the bus inside of Gund Hall we created a minimal stage set consisting only of the elements necessary to evoke a bus. As you can see in *Figure 8*, we created the outline of the bus's shape with white tape, blocking off areas for the driver's booth and the four wheels. We arranged the seats in such a way as to evoke the shape described in the framework section, and wrapped a subsection in fabric. The area wrapped in fabric is meant to be the 'rendered' area.

A projector, a computer, and a Kinect sensor are placed directly in front of the fabric surface. A C# application uses the Kinect to track people as they exist in the 'active area', the area covered in fabric. An abstraction of their proxemic volume is projected underneath them onto the fabric.

The following applications are programmed into the C# application: (*Figures 11-13*)

1. Simply being in the space – every person always has a proxemics volume. Without any other interaction, a small volume is projected underneath.
2. Walking & hand motion – the faster you move, the larger your volume grows and the faster it morphs & blends.
3. Being next to a person/interacting with them – the two (or more) volumes will begin to grow towards each other and spread outward. The individual shapes blur & blend with one another. The center of each person's volume is visible underneath them but the larger volume now belongs to the group.

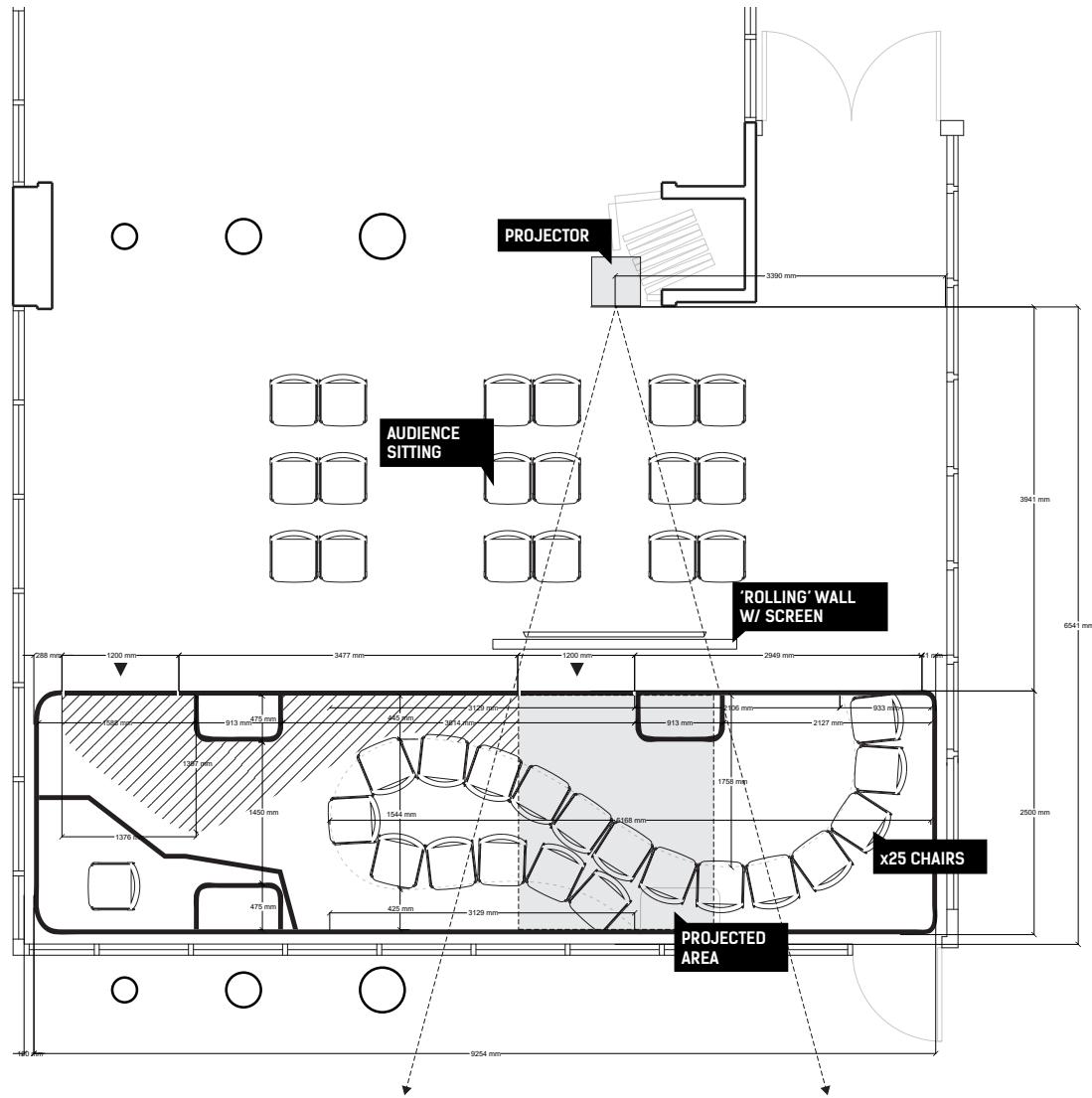


Figure 8 - The set design for our prototype in Gund Hall



*Figure 9 - A picture of the chair layout*



*Figure 10 - A picture of the 'rendered' area of the stage set*



Figure 11 - A picture of a single person walking through the prototype stage



Figure 12 - A picture of two people interacting on the prototype stage



Figure 13 - A picture of two people interacting and one not on the prototype stage



Figure 14 - A picture of one person sitting in the 'isolated' area

## 6. CONCLUSION

Whether we accept it, or not, our emotions are directly related to those around us. This becomes even more prevalent in the public sphere, especially on public transportation. On a daily basis, we willingly accept strangers encroaching on our personal space. This acceptance means the repression of emotions such as anger and annoyance, that in any other situation would lead to an awkward confrontation. This repression leads to a form of anxiety that only exists as a byproduct of our public transportation system. This installation hopes to relieve this artificial tension, exposing our effect on those around us, and putting us at ease by creating a whimsical situation where strangers become acquaintances, relieving the tension and anxiety created by the preexisting system.

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