

# EMBER

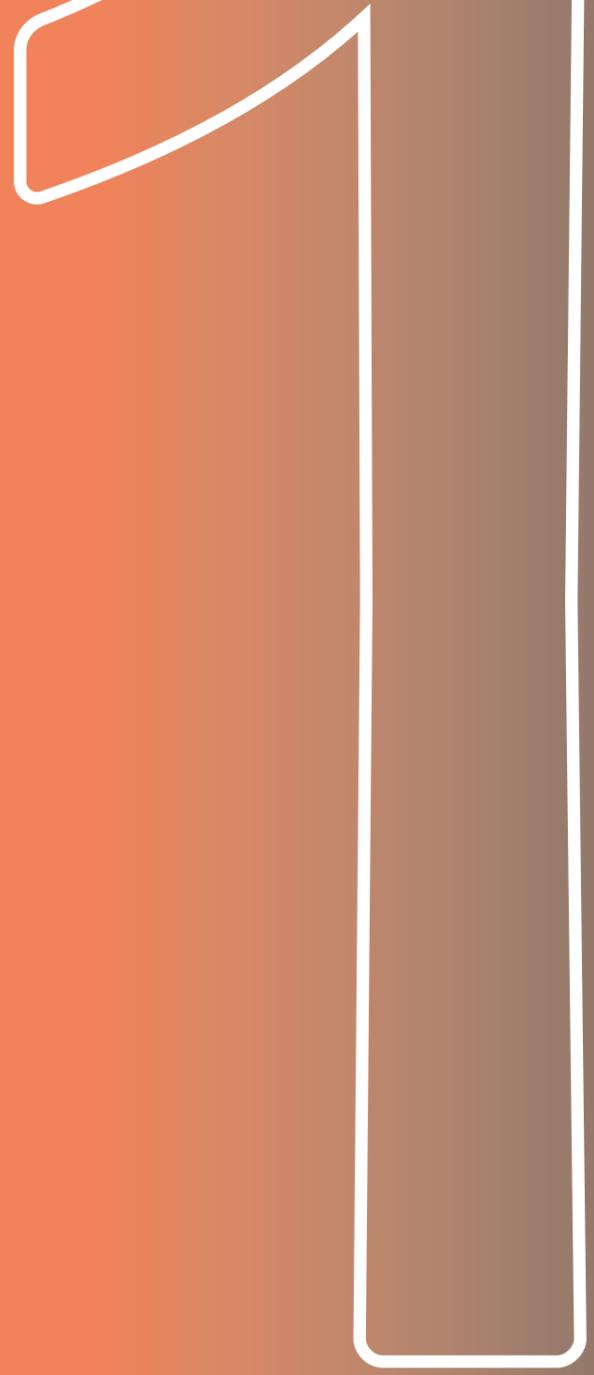
Addressing Outdoor Socialization  
in Urban Canada

Capstone  
Design Report

ALEX WHITELEY

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# INTRODUCTION

## Introduction

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The following project explored the social climate that exists in Canada's public space, identified opportunities for improving community social connection, and proposes a designed solution to the challenges of public gathering spaces. The research seeks to investigate the state of shared spaces and their contribution to community connections. Canada's major seasonal variations cause massive transformations of outdoor spaces, and so this variable is a key factor in defining and exploring the context. Community informatics is used as a lens with which to frame this vast topic and advance towards a solution proposition. Key themes in the research include variables in socialization, community social interaction, and public space.

# PROBLEM DEFINITION



## Problem Definition

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Shared outdoor spaces in urban areas are hubs of community socialization. However, these spaces can often be underused when left neglected or after having developed a negative reputation. This reluctance to congregate can be due to a lack of infrastructure, being inappropriate for the season, being perceived as unsafe, or many other possible barriers. Residents of these communities are left with an unfulfilled desire for socialization and few opportunities for public interaction. Reclaiming their spaces presents a significant opportunity in improving quality of social connection in the communities that need it the most.

## Objectives

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### General Objectives

Improve the perception and experience of underserved community spaces.

### Specific Objectives

- Allow for communities to redefine their perception of a neglected space
- Ease barriers to public space usage in the winter to increase use frequency
- Stimulate behaviours conducive to spontaneous social encounter
- Increase the inviting aspect of a public space to enable social congregation
- Support city officials in making lasting improvements to community spaces
- Reveal general trends regarding communities use and connections over shared spaces

### Methodological Objectives

- Using surveys and interviews, investigate the most significant barriers to shared space utilization
- Understand user's current perception of public space and the factors that significantly contribute
- Understand the motivations for public socialization and user's desires for their spaces

## Conclusion

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User's perception of public space is a primary object of the problem statement. The project research must thus stress the opinions, desires, and actions of existing users. Significant change to architecture and urban planning is beyond the scope of this work, and so these elements just be considered as uncontrollable factors in the research. Seasonal change is also a major uncontrollable factor, and research into this element will stress the linked changes in user's perceptions and behaviours.



# LITERATURE BACKGROUND

## Literature Background

### Public Social Behaviour in the Winter

Jeffrey Nash conducted a study in 1981 on people public behaviour through Minneapolis' harsh winter. The study revealed some key insights into how the social climate changes through the seasons. First, Nash confirms that the use of public spaces, both indoor and outdoor, is significantly reduced in the winter (1981, p.229). Second, there is a greater freedom to define the purpose of public spaces in the winter (p.238). Nash refers to this as the democratization of public space, in which the public find a newfound freedom to redefine the uses of public infrastructure (p. 238). Examples of this include large scale community phenomenon such as golf courses becoming sledding hills, as well as small behaviour changes such as standing on benches, which would not be tolerated in the summer (p. 238). Third, Nash notices displays of "festive attitude" after heavy snowfalls or extreme colds, as if the weather passing was cause for celebration (p. 234). These are important insights to building the understanding of winter behaviour. However, one aspect that this research does not address is the individual social behaviours of the residents. While it is proven that peoples frequenting of public spaces is strongly tied to weather, more emotional and individual behaviours have much more complicate relationships with weather. While general mood seems to be well related with weather (Persinger, 1980, pp. 5-10), more specific traits such as pro-sociality have no clear connection to weather variation (Vrie, 2016, p.1).

A study by Phithakkitnukoon et al. informs us that not all social interactions are affected the same by poor weather. The study found that weak social relationships were significantly more negatively affected by weather than strong ties (Phithakkitnukoon et al., 2012, p.1). Strong relationships were also negatively affected by poor weather, only by a less severe amount. This is consistent with Nash's observation that there is less overall socialization during difficult weather (1981, p. 235).

### Mood and Sociability

The direct relationship between sociability and weather is a complicated one, however using mood as in intermediary can lead to a clearer understanding of behaviour. As previously mentioned, there is a reliable link between weather and mood (Persinger, 1980, pp. 5-10), and furthermore there is a well-researched positive connection between mood and sociability (Whelan & Zelenski, 2012, p.1).

Nonetheless, weather is an uncontrollable factor and so it's link with mood and sociability can only be used to understand the problem context. To work towards creating a solution that encourages sociability, controllable environmental factors that can influence mood need to be understood as well. One such modifiable factors

come from a study investigating the mood effects of the campfire experience. The study found that "hearth and campfires induce relaxation as part of a multisensory, absorptive, and social experience" (Dana Lynn, 2014, p.1). This research was done using only the audio and visual components of fire, and so no element of warmth was considered. This supports the ability for certain visual and auditory cues to promote positive moods, in this case relaxation.

### Built Environment and Behaviour

Design can play a role in fostering a healthy and tight-knit society. The products and services that user's interact with day-to-day can have important effects on overall behaviour. The design of objects and spaces in the public environment can have strong influences in encourage or discouraging social behaviours. Fleming et al.'s paper entitled "Social Support and the Physical Environment" outlines three key environmental variables for allowing social connections (1985). They are:

1. Opportunity for contact
2. Proximity to others
3. Appropriate space to interact

Moreover, a study exploring social interactions in connection to housing layout in Jordan highlighted the division of space as another major environmental contributor to social interaction. The study found management of open space to be an important in facilitating social relationships, and in particular the use of smaller, more confined spaces was beneficial for social interaction another (Abu-Ghazze, 1999, p.1). The author also notes that the management of these environmental variables influence the potency of the boundary between being alone and with another person (Abu-Ghazze, 1999, p.69). Poorly managed physical environment makes these two states distinct, while a well managed environment allows for small non-committal contacts which fall in an in-between state of being alone and being in a social situation.

### Social Connectedness

There are multiple factors contributing to the making of a meaningful interaction, beyond the baseline of people simply being together. A sense of belonging, affiliation (in contexts such as culture, age, gender, background), and genuine companionship are necessary when facilitating social connectedness (Lee et al., 1995, p. 232-233). These intersectional needs are often achieved through connecting individuals on at least one basis, for example, proximity or a mutual interest (Lee et al., 1995, p. 233). Social connectedness is more likely to take place, and more meaningfully, if this concept is considered upon implementation and facilitation.

Usually when discussing social interaction, the focus is on interactions made between individuals with an existing and deeper relationship. However, several

studies have now illustrated the importance of faster and shallower interactions, for example, those with strangers. These small relationships, commonly referred to as “weak ties”, have important effects on community benefits (Granovetter, 1973, p.1373). These benefits include community resilience, increased social capital, lower crime rates, and more. Additionally, transient interactions with weak ties can lead to a stronger sense of community, a greater sense of belonging and an overall elevated mood among participating individuals (Keohane, J., 2021, para. 9).

One key benefit of connecting a community with weak ties is the development of social capital. Social capital is defined as a network-based resource made from social relations between individuals and groups. This resource can give individuals access to goods, services, interactions, and other help (Witham, M., 2012, p. 441). This kind of system is observable in smaller communities like rural villages, but also in larger networks like industry technopoles (Fountain, J. E., 2021, para. 11). While this resource sometimes is often overlooked, its benefits range from greater community success and productivity to a greater sense of security and ease from participating community members (Witham, M., 2012, p. 442). This important social resource could be used as a tool to facilitate social interaction in the context of the project, or at the very least considered when designing the intended effects of the project.

### **Personal and Community Informatics**

Personal Informatics (PI) is a class of technological application practices that can consist of acquisition, visualisation, and reflection of data. This practice will serve as a lens with which the design project will be framed. This is relevant because personal information products and services present unique opportunities for establishing connections between individuals. Community informatics, which defines the practice of using personal informatics to benefit a group, is a fitting tool for the issue of post-pandemic social connectedness as it uses digital systems to achieve community goals (Gurstein, 2007, p. 11). Community informatics can leverage the social opportunities of personal informatics such as sharing personal data, tracking on someone’s behalf, and pooling of communal data (Murnane, E. L., et al., 2018, p. 127). These techniques can help the effectiveness of personal informatics tools, present new functionalities to users and increase social connectivity.

A study of the cycles of use of personal informatics systems categorized the main motivations for self-tracking as a desire to change behaviours, curiosity, and/or obtaining a record (Epstein et al., 2015, p.2). These inspirations for PI can be expanded to a social connectedness context, as an understanding of one’s relationship to their social context contributes to an understanding of oneself. (Murnane, 2018, p. 127:2-3). The current focus of personal informatics systems purely on an individual can often be negatively “ego-centric,” and personal informatics in relation to others can be useful to promote a sense of community and in turn public sociability.

## **Conclusion**

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The background research explored findings pertaining to the seasonal public socialization, mood’s effect on sociability, environmental factors in social connectedness, and community informatics.

To summarize some of the key insights from the background research:

- Social isolation has a negative influence on mental health.
- During uncomfortable weather conditions, people tend to interact with fewer social ties.
- Weak ties are disproportionately affected by difficult weather.
- All social interactions require the opportunity for contact, proximity to others, and appropriate space to interact.
- Small transient interactions benefit the wellbeing of all individuals who participate in them
- Social capital systems benefit communities and those that live within them.
- Community informatics can help create social interaction and social capital through sharing, cooperative tracking, and pooling of communal data.

These insights have helped develop a more thorough understanding of the problem situation and will inspire solutions going forward. Moreover, these insights have revealed opportunities that can be leveraged into key components of a solution, such as the applicability of transient interaction and community informatics. The following phase of field work will look to validate some of these insights and expand on them in a more local context.

# FIELD WORK



## Introduction

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The field work consisted of two methods of data collection: a survey and one-on-one interviews. The survey had a primarily diagnostic purpose and was used to understand the local situation and to validate that the findings from the background research were applicable in the Ottawa population. The interviews followed with the purpose of further explaining and elaborating the insights discovered in the survey.

## Objectives

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The survey was written with the goal of identifying the following research questions:

- What is the current state of socialization in Ottawa?
- What is the desire for social connection like in this population?
- What are the barriers to social connection?

To expand on the general insights from the survey, the following research questions guided the construction of the survey questions:

- What is the public perception of urban Ottawa communities?
- What is the perception of outdoor shared spaces?
- What are the motivations to socialize?
- Which barriers are most significant and why?
- How can these barriers be alleviated?

### Methodological Objectives

- Using surveys and interviews, investigate the most significant barriers to shared space utilization
- Understand user's current perception of public space and the factors that significantly contribute
- Understand the motivations for public socialization and user's desires for their spaces

## Methodology

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### Recruitment Process: Survey

The survey was targeting adult residents of major Canadian cities, most often residents of Ottawa. The survey was circulated online through social media networks, and respondents were encouraged to pass the survey on to other potential participants that fit the target demographic. However, the demographic reached was primarily between 18 and 34 years of age (see fig. 1). Results are thus representative of the young adult population and may not be applicable to different demographics.

There was a normal distribution of gender identification, with approximately 50% identifying with male or female, and a remaining 2.9% identifying as non-binary. As for community types, a large majority of respondents identified that they lived in urban areas (70.6%).

### Recruitment Process: Interview

Survey participants were asked if they were willing to participate in the interview, and the final participants were selected from these volunteers. As such, the interview participants were residents of Ottawa, and the age distribution was consistent with the survey (4 of 5 participants were 18-24, and 1 of 5 was 25-34).

### Methods and Tools

Surveys were conducted digitally using Google Forms. Interviews were conducted virtually using Zoom.

## Results

### Frequency

Respondents showed a significant decrease in socialization frequency in the winter as opposed to the summer (see fig. 2 and fig. 3). This is consistent with Nash's findings from 1981.

In the interviews, participants were asked why they tend to spend less time outside. All respondents began by saying weather was the major factor, and when asked to elaborate the two key aspects of weather they identified was cold and darkness. Additionally, they highlighted darkness' effect on their mood as a key barrier to willingness to socialize.

### Activity

Next, respondents reported prevalent use of passive spaces for socialisation in the summer. 25 of 34 respondents mentioned parks as a place they socialize during the summer, however only 9 of 32 respondents identified parks in the winter. Instead, there was a significant increase of sports/physical activities, going from 6 mentions of outdoor exercise in the summer to 17 in the winter. From this we can understand a stronger interest in passive activities in the summer (non-goal oriented), and contrarily a stronger interest in goal-oriented activities in the winter. In the interviews, participants were asked to describe their ideal winter social experience. Generally, they all described activity-based socialization, however participants stressed that the activity should not be physically demanding or technically challenging.

### Community Interaction

Additionally, respondents expressed a high interest in meeting people in their neighborhood (fig. 4) and becoming closer with the community members they already know (fig. 5). Likewise, respondents identified a high degree of openness to social interactions (fig. 6) and a positive perception of the potential for connections in their communities. During interviews participants mirrored this desire for community connections, however when asked to rank their preference between making strong ties (friends) or weak ties (acquaintances), they showed an increased interest in weak ties. This is in line with Phithakkitnukoon et al.'s finding that during poor weather weak connections are disproportionately reduced (2012, p.1). A connection can be drawn that since weak ties are scarcer during difficult weather, there is an increased desire for these interactions.

## Analysis

The fieldwork was able to validate some of the insights discovered in the background research as well as generate some unique insights. With both these streams of information, a model of interacting factors surrounding sociability and environment can be assembled (see fig. 7). This model maps the relationships between different topics of interest and represents the current understanding of the seasonal socialization situation. What can be observed from the model is the centrality of mood. There are several different factors affecting mood, and it has a direct and measurable relationship with sociability. Influencing mood thus seems to be an important method of encouraging sociability, however, should be combined with the other methods previously discovered such as well-designed spaces and emphasis on sharing.

## Conclusions

The fieldwork was able to validate the presence of an issue with certain urban Canadian community spaces and an interest from residents to have improved and more socially thriving community spaces. The key barriers that were reported throughout both interviews and surveys was the perception of spaces as "cold" and "dark". Moving forward, the project will consider these two as the primary elements of the "underserved community space" archetype.

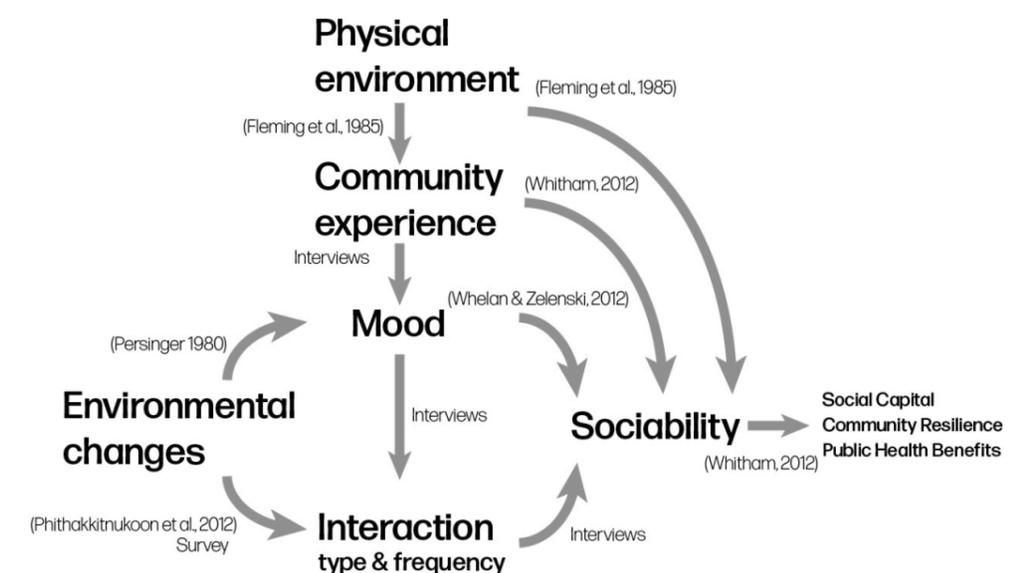


Figure 7. Model of Environmental Change and Sociability

# CONCEPTUALIZATION

## Introduction

With the insights from the background research and the fieldwork, a tentative solution concept can be developed. Three key takeaways from this research synthesis that will go on to inform the design brief are:

1. **Mood** is central in the theoretical model and thus focus on mood and its derivatives is an effective method at addressing sociability.
2. **Weak ties** are the most affected by seasonal changes. Pandemic fears and social cues are often cited as major barriers to small interactions.
3. **Sharing** was identified as a fundamental contributor to weak ties, and community informatics can leverage data sharing for this purpose.

These three concepts represent an evolution in the understanding of the problem context, and inform the approach taken in the conceptualization and ideation phases.

### Personal Informatics Aspect

Personal informatics can be utilised in multiple ways in the solution. The conceptualisation will begin by searching to actively reflect data on site, however it is also productive to utilise data that has been synthesised after a significant collection time. This second method would reveal more general trends and is explored further in later stages of ideation. For both methods, privacy remains an important factor due to the public nature of the project. The data gathered should remain anonymous and general, so impersonal variables such as traffic and interaction frequency are likely the most appropriate.

## Concept Direction

The following three requirements were established to define the direction of concept exploration. They are informed from the previous research but will continue to be validated through concept iteration and user testing.

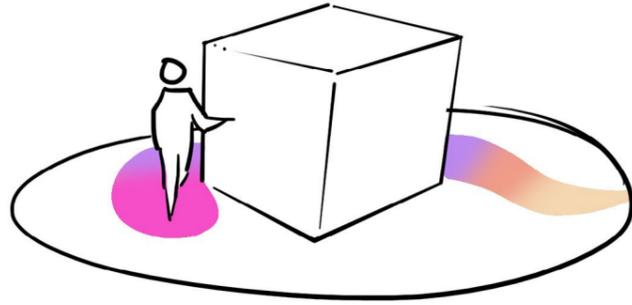
**Dialogue Interaction:** Participation with the system was targeting the “dialogue” level of interaction (see below).

**Decentralised System:** In order to allow for strangers to share an interaction in public, it is essential to conserve their personal space. Decentralising the interaction allows for participants to co-interact without compromising their personal space bubbles.

**Active Reflective Data:** Among the many methods of leveraging community data, active reflective displays community information on-site to stimulate reflection while present in the interaction.



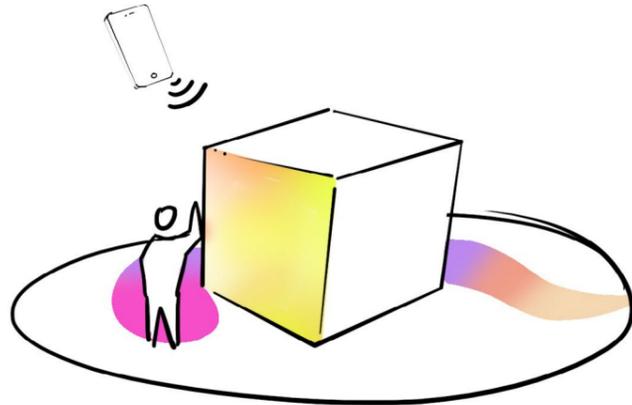
1) User 1 interacts with the device in a public space by walking around it



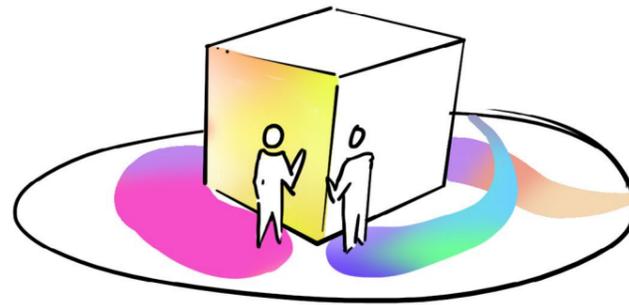
2) User 2 can see that someone is interacting and provides an interaction



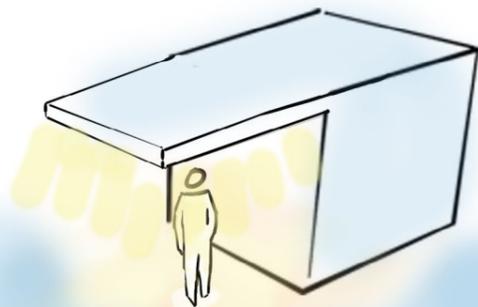
3) User 1 can see User 2's interaction



4) Many users can interact with the device together



\* The device provides some relief from the wind, snow/rain, and darkness



## Brief

A solution should allow for dialogue between users interacting with a decentralised system retrofitted into an urban community space. This system should actively display anonymous community data to stimulate on-site reflection of active users.

## Storyboard

The storyboard makes many generalisations and simplifications, but the essence of the solution is to make connections over a shared spatial experience. User 1 and User 2 can bond over a pleasant but non-committal anonymous interaction. If User 2 has visited the physical space previously and is aware of the experience, the information that User 1 is currently there incites a reflection on User 2's own experience. The act of interacting with a physically located device also induces proximity to other users and can provide opportunities for sharing small connections with others using the device.

## Conclusion

The next steps for this project will rely on clarifying these simplifications made in the storyboard. What is essential about this storyboard is it shows a first attempt at consolidating the elements of dialogue, decentralised interaction, and active data into a scenario. The next phase of ideation will consist of increasingly precise scenarios that will help to validate or change these elements, as well as potentially introducing new elements.

As mentioned in the background research, co-design has been shown to be an effective method of defining well adapted solutions for the public space. As it stands, the solution will be publicly accessible and so will be a public good rather than a private good. For this reason, it is especially important to consider the input of potential users, as public goods can be imposing on a community if they are not well suited for their context.

# IDEATION



## Introduction

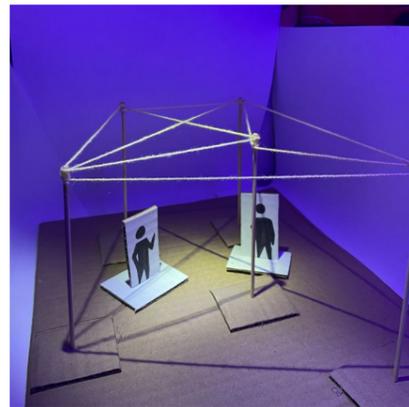
The previously shown storyboard shows the desired interaction in broad strokes. The two key factors that compose the solution are the simple, non-committal, pleasant spatial interaction, and the community-based synthesis of in-situ data. The concept evolution used scenario propositions to probe different methods of integrating the aforementioned key factors.



Network Scenario

## Early Ideation

To kick off the first round of ideation, early scenarios that included the aforementioned design parameters were conceived. The concepts were undeveloped in terms of feasibility, but integrated communal dialogue interaction, decentralised systems, and active reflective data.



Network Prototype

### Network:

The network scenario was chosen as the most appropriate concept and was prototyped with a scale model to allow users to engage with the scenario. The scale model was supported with a scale model "puppet" to represent the user, a flashlight that was used to simulate the lighting effect in the "Wizard of Oz" style, renderings to further elaborate the aesthetic aspect, and an example community was described to provide context.

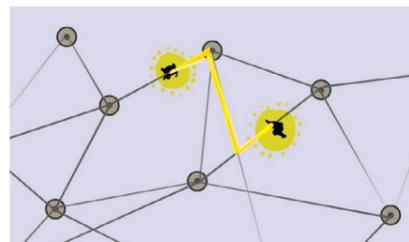
After a first round of tests, some insights were integrated in the prototype and another round of testing was conducted. This phase of testing resulted in the conclusions:

#### Play needs to be integrated

- The passive style of engagement was appreciated, but did not fit users who were willing to engage with the installation deeper

#### Design should support the "lingerer"

- This scenario supported "passer-by" users but had little value for users that would linger in the space. The solution should encourage lingering in the space, and subsequently congregating, in order to promote community connections and change perceptions of space.



Network Interaction

## Concept Development

### Community Campfire:

This scenario integrated decentralised physical play and communal collaboration. User tests validated these additions, but new problems appeared. Most importantly, this concept was no longer adaptable for the seasons, as snow cover would likely render this installation useless.

This iteration brought forward the metaphor of a communal campfire, which was intended to bring a story to the interaction so users can more readily understand the installation. The campfire metaphor was used because of potential that was identified in the background research and because the fieldwork identified perception of "cold" and "darkness" to be key barriers.

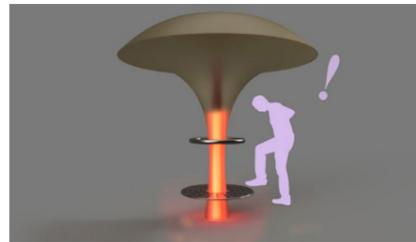


Community Campfire Scenario

### Ablaze:

The next direction made some compromises to address the flaws of the previous concept. Sacrificing the decentralisation of the interaction allowed for the touch points to be protected from the elements with a parasol-like form.

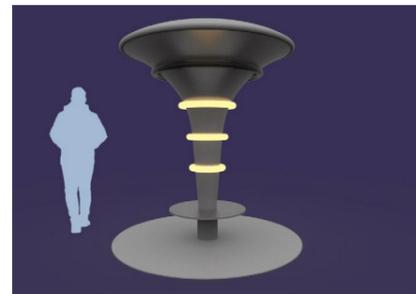
The "pump" interaction which was originally conceived for the campfire scenario was translated to this scenario with little change. A mechanical prototype of this interaction was constructed to test the interaction experience with users. These tests uncovered unexpected issues with the "pump" interaction, provoking a redesign of the interaction.



Ablaze Concept

### Ablaze v.2:

To address some of these concerns, a second version was conceptualised. This concept incorporated two modes of interaction, physical and touchless, to involve more users. This proof-of-concept helped validate the need for two layers of interaction, but the issues of mechanical complexity and personal space remained.



Ablaze v.2 Concept

## Conclusions

Through the series of iterations and scenarios, the final project elements were refined. Elaborating off what was originally cemented in the research phase, the elements necessary for the final design were:

1. Project is **accessible** (temporary, low-cost, simple installation)
2. Project is **adaptable**
  - a. Physical changes (temperature, season)
  - b. Behavioural changes (passive vs active interaction)
  - c. Spatial changes (location, traffic flow)
3. Project sparks **sharing** of activity/experience (see Dialogue interaction)
4. Project encourages **congregation**
5. Project enables **playful interaction**
6. Project reveals broad data-based **community trends**



*Final Concept Interaction Prototype*



*Final Concept Form Iteration*



*Ablaze Interaction Prototype*



*Final Concept Scenario*



# FINAL CONCEPT

## What:

Ember is a modular system for transforming public spaces and discovering data-driven community insights. Ember is composed of interactive structures that can be temporarily deployed in community spaces such as parks, plazas, or courtyards. For a period of 6 to 10 weeks, the structures use built-in sensors to create an interactive environment of shimmering lights. Once the system has left the space, the anonymous usage data is made public to reveal community trends that can inform future government decisions.

## Why:

On a community scale, temporarily integrating lighting and play into a community space gives residents the opportunity to redefine their relationship with the space. In the macro perspective, accumulating community data through a variety of locations and times establishes a basis of understanding for shared space usage and community needs. City officials and other stakeholders (for example, local business owners) can see community trends and make informed decisions based on real data.

## How:

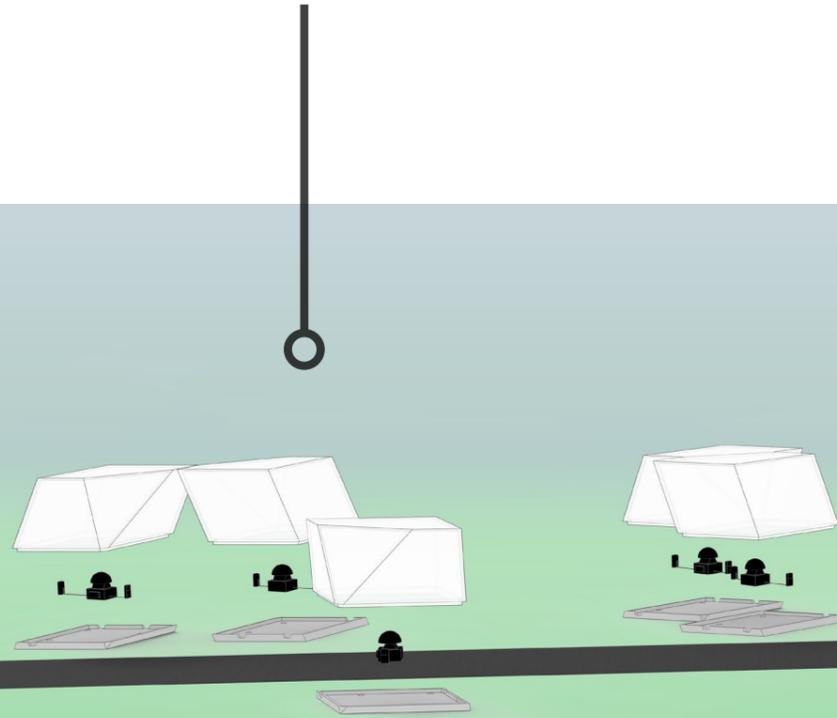
The IR sensors detect user movement in the space and nearby Embers glow brighter. This touchless interaction allows the installation to extend meaningful experiences to users who are only briefly passing through the space. Using a simple internal microphone, impacts from steps, jumps, and knocks on the surface of the Ember are detected and provoke an animated "shimmer" to propagate through the nearby Embers.

The Ember units record the number of IR sensor readings and playful interactions detected every 15 minutes. The synthesis of this simple data can reveal a community space's most active times of day, days of the week, most high traffic areas, and more. With multiple sampled communities throughout the year, the resulting database becomes increasingly rich. City officials can enhance their understanding of the city at a community level, and make more informed funding, planning, and development decisions.

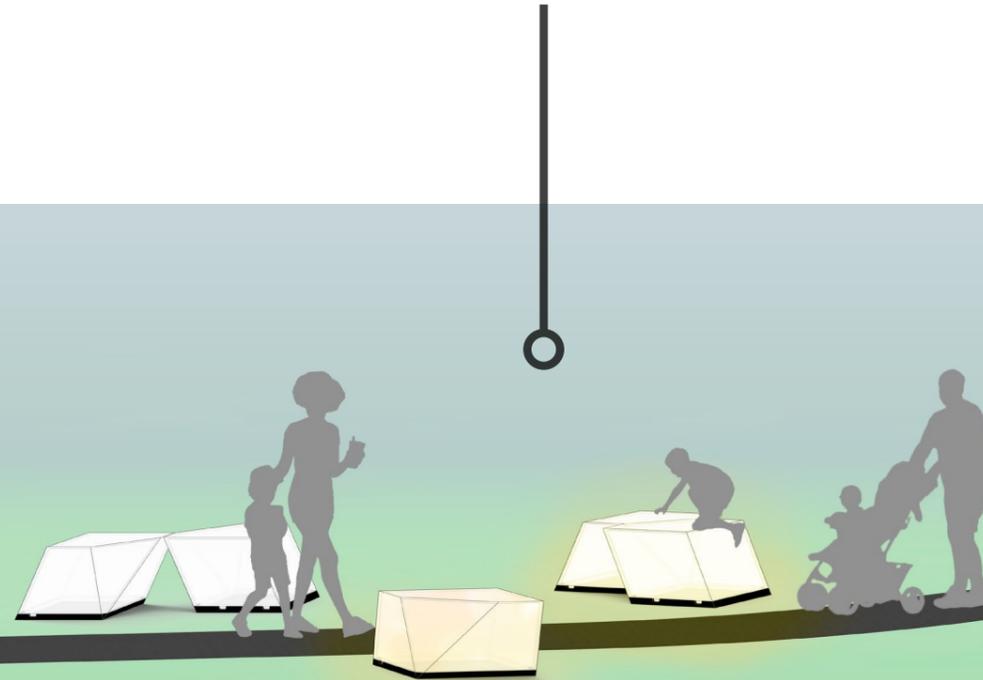


# Journey Map

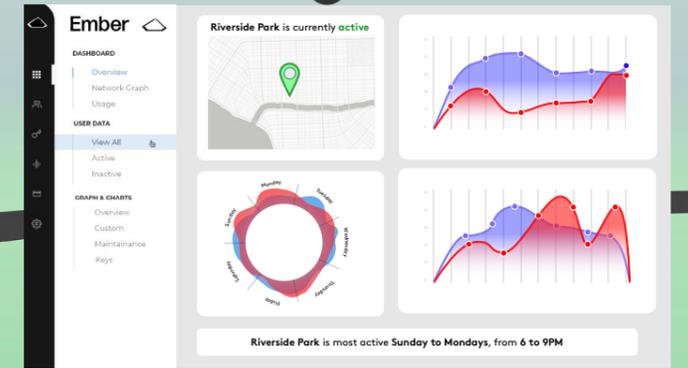
*Installed On-Site*



*Community Use*



*Data Reflection*



# Design Rationale

## Form

Simplified and cost-effective manufacture  
Modularity allows for various arrangements and masses from a single form allows for greater adaptability to different contexts

## IR Sensors

Proximity interaction is low commitment and engaging for the "passer-by" user. Infrared sensors are ideal for this touchless interaction as they can be shielded from the elements inside the plastic shell.

## Glow

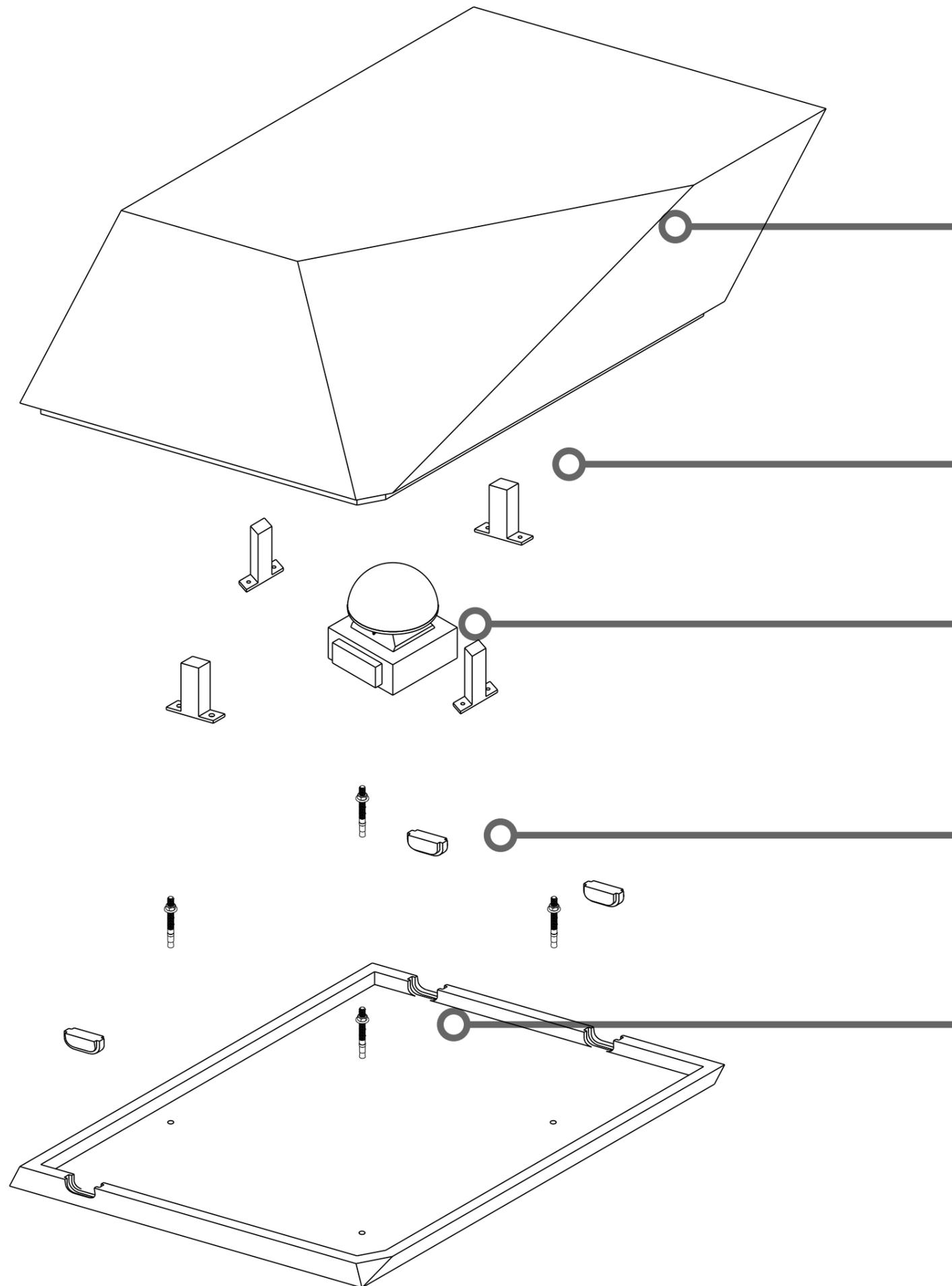
Warm glow makes these sculptures inviting points of outdoor congregation, and connects with a wide variety of users. The fire-like animation addresses the perceptions of "cold" and "darkness".

## Microphone

Reacting to physical engagements (sit, kick, jump) promotes play and pleasant interaction without including fussy mechanical components

## Base

The base is designed to facilitate quick and easy assembly and disassembly. Removable plugs allow for optimal routing of power and data cables depending on the arrangement of the site. The use of anchors to secure the base make installation simple and unintrusive.



CAPSTONE

## Conclusion

### Next Steps

While reasonably developed, the Ember concept remains in the exploratory phase. The next steps to progress the design would involve some concrete development in terms of manufacturing, ergonomics, branding, etc. Moreover, in-situ testing could yield unique insights that have not been achieved with user testing and scenario building. Users in public spaces may have unique perspective that can only be learned through the installation of an in-context prototype.

### Ember

The beginning problem statement addresses a very broad and confounding issue; that of systematic social issues that affect many undefined public spaces. Because of this, the solution was challenged with being appropriate for a context that is variable and constantly changing. Nevertheless, the final solution does adhere to the original purpose of improving outdoor community spaces through a range of scenarios, from different locations, seasons, and times. The most successful element of the Ember concept is its ability to address the issues on both the community and city levels. The two solutions intertwine the motivations of my two key groups of stakeholders: local residents and city officials. The combination of these two approaches results in a final solution that is greater than the sum of its parts.



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# Appendix

Figure 1. Age Demographic

Indicate your age  
34 responses

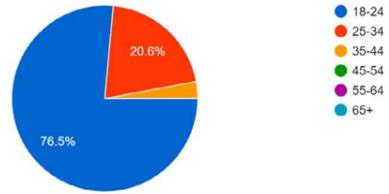


Figure 2. Summer Outdoor Socialization Frequency

In the summer months, how often do you socialize outdoors (ex: with friends, acquaintances, family members outside your household)

34 responses

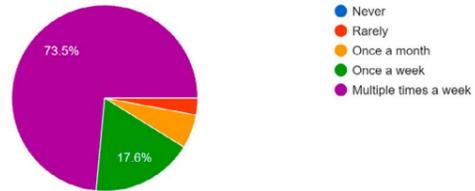


Figure 3. Winter Outdoor Socialization Frequency

In the winter months, how often do you socialize outdoors (ex: with friends, acquaintances, family members outside your household)

33 responses

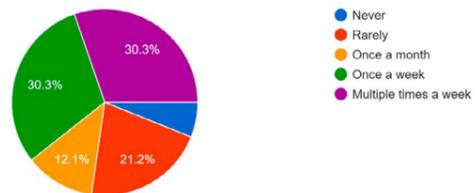


Figure 4. Desire to Meet Community Members (1- strongly disagree, 5-strongly agree)

I would like to meet more people in my community  
34 responses

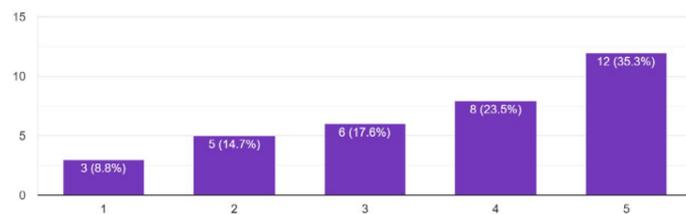


Figure 5. Desire to Strengthen Connections (1- strongly disagree, 5-strongly agree)

I would like to be closer with the people I currently know in my community  
34 responses

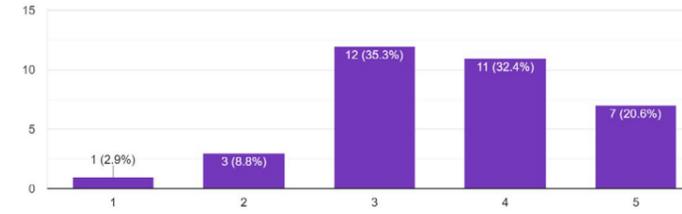


Figure 6. Openness to Conversation in Public (1-Not Open, 5-Very Open)

When I am outdoors in my community:  
34 responses

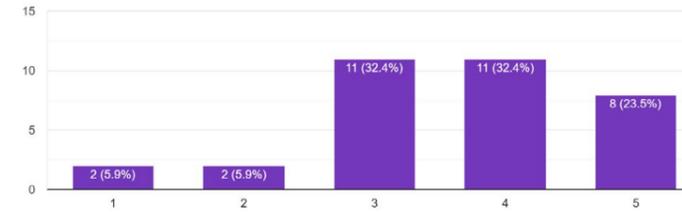
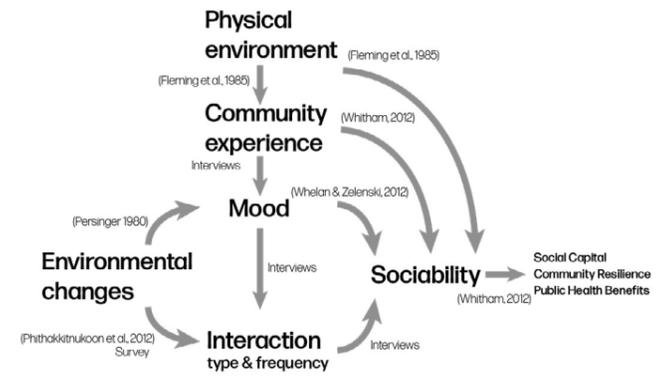


Figure 7. Model of Environmental Change and Sociability





**Carleton**  
**University**

Industrial  
Design