Depicting Places in Information Systems

Closing the Gap Between Representation and Experience

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Abstract

Places are more than just locations on a map—they are centers of meaning and lived experience that play essential roles in how people interact with and make sense of the world. Over the last three decades, as computing has grown more powerful, more ubiquitous, and more deeply entwined with society, the ways people encounter and experience places are increasingly mediated by information systems such as digital maps, information overlays, social media, augmented reality, and local guides. However, these systems are often overly reductive and simplistic in their approach to place, ignoring much of the complexity inherent in everyday experience, and treating places as not much more than locations. This is problematic when these systems are used as input for downstream decision-making processes, such as resource allocation, investment, or basic research.

In this dissertation, I present three systems that aim to close gaps between how places are represented in information systems and how they are experienced in day-to-day life.

- Livehoods demonstrates that the footprints of the urban crowd in social media can be used to produce a new kind of city neighborhood map that is flexible, dynamic, and able to evolve as neighborhoods do.
- Curated City is a social city guide that represents places of the city as not

just singular aggregations of ratings or reviews, but as multitudes of different experiences and perspectives.

- Finally, Journeys & Notes considers the the possibility of information systems acting as virtual places when the corresponding physical space lacks the qualities and affordances for place to develop.

My approach is to engage with places as complex ecosystems with myriad stakeholders in order to design systems that engage with the milieu of daily life at places. I distill my learnings from building these systems into six attributes of place that can help designers grapple with places as not just locations, but as lived spaces where the practices of daily life unfold. This work opens up new avenues for the design of location-based information systems that are more insightful and meaningful, not just for users of these systems, but for all stakeholders of places they depict, and indeed for society as a whole.

Thesis: By closing the gaps between how places are represented and how they are experienced, it is possible to design social information systems that are more insightful and meaningful to stakeholders.

Contents

For Liz and Miles.

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In My Life

There are places I'll remember
All my life, though some have changed
Some forever, not for better
Some have gone and some remain

All these places have their moments
With lovers and friends, I still can recall
Some are dead and some are living
In my life, I've loved them all

John Lennon, 1965

Anthem

Ring the bells that still can ring

Forget your perfect offering

There's a crack in everything

That's how the light gets in

Leonard Cohen, 1992

Introduction

"The buildings, neighborhoods, towns, and cities that emerge from the unfolding digital revolution will retain much of what is familiar to us today. But superimposed on these residues and remains of the past, like the newer neural structures over that old lizard brain of ours, will be a global construction of high-speed telecommunication links, smart places, and increasingly indispensable software.

The latest layer will shift the functions and values of existing urban elements, and radically remake their relationships. The resulting new urban tissues will be characterized by live/work dwellings, twenty-four-hour neighborhoods, loose-knit, far-flung configurations of electronically mediated meeting places, flexible, decentralized production, marketing and distribution systems, and electronically summoned and delivered services. This will redefine the intellectual and professional agenda of architects, urban designers, and others who care about the spaces and places in which we spend our daily lives."

William J. Mitchell, *e-Topia*, 1999 [148]

1.1 Place and Computing

Place is essential to the human experience. Most of human life is spent either at a place, or on the way to one. Reading the newspaper at the breakfast table, grabbing a coffee at the corner café, waiting for the bus to the office, meeting friends at a new restaurant, walking through the park before sunset, immigrating to a new country at the port of entry, these are but a few of mundane and extraordinary places that might enter a day in a life. It's not just the time spent in the moment that gives places their meaning; places inhabit our past as well. Vivid memories can bind themselves to our *sense of place* more viscerally than to our physical senses, perhaps because places offer a solidness that is easier to grasp in the foggy imperfection of human memory [199]. Places can also become deeply attached with feelings of community and a sense of identity for the people and groups of people who rely on them [62, 77, 107, 132, 180]. Finally, perhaps because of all of this, places are poetic [18]. Seeped with memory, emotion, and meaning, places are the subjects of powerful and moving expressions of human creativity by artists, writers, poets, photographers, and filmmakers [134, 178, 189]. Some argue that understanding place is a necessary prerequisite to understanding society [82]. And yet, despite the outsized importance of place to society, the study and practice of computing has only just begun to grasp the nature of its relationship with place.

Over the last three decades, computing systems have not only become more powerful, more ubiquitous, and more social, but they have also become more deeply intertwined with every facet of society. In one aspect of this trend, the ways people encounter, engage with, and experience places in the physical world are increasingly mediated by computational information systems such as digital maps, information overlays, social media, check-in systems, augmented reality, and social guide systems. People explore and search for directions on apps like Google Maps and Waze. They discover new experiences and places to eat with Yelp and Foursquare, and plan their vacations, excursions, and adventures with Tripadvisor and AirBnB. They find out more about their neighborhoods on sites like Nextdoor or Facebook. People communicate about and share their experiences at places with one another via social networking apps like Instagram, Snapchat, and TikTok. They travel from place to place using

on-demand taxi services, like Lyft and Uber, or bicycle sharing companies like Lime. They meet new friends and romantic partners on Tinder, OkCupid, and Meetup. These platforms operate as a middleware between human intention and experience, facilitating, recommending, curating, and crafting the way people interact with the world around them. In their roles as virtual concierges, chauffeurs, and gatekeepers to the physical, the 21st century will be one in which interactive computing systems have deep and profound impacts on places.

At the same time, there are gaps between how these systems represent place and how people experience place in their everyday lives. The most obvious such misrepresentation is when places are modeled as points in 2d space, when of course they are much more complex, both spatially and phenomenologically. More generally, information systems are often overly reductive and simplistic in their approach to place, ignoring much of the complexity inherent in everyday experience. For example:

- Many information systems treat places as a static context—merely a fixed attribute on a location, but places are dynamic and evolving ecosystems that are constantly being shaped by social, political, cultural, and natural forces.
- Many information systems depict places as singular and monolithic, but places have multitudinous identities defined by a diversity of stakeholders each with their own perspectives, objectives, and trajectories.
- Many information systems require places to have a fixed location, but places aren't always pinned down to one spot on the earth—they might be moving targets or they may have no location whatsoever.
- Many information systems treat physical places as if they're closed off and entirely separate from their digital representations, but the boundaries between physical places and their virtual depictions are increasingly blurry.

In this dissertation, I aim to close these gaps. Embracing research through design [249], I explore the design and evaluation of social information systems at the intersection of place, people, and computing. My approach is to engage with places as complex ecosystems with myriad stakeholders in order to design systems that closely mirror how people experience place in their day to day

lives. This work opens up new avenues for the design of location-based information systems that are more insightful and meaningful, not just for users of these systems, but for all stakeholders of places they depict, and indeed for society as a whole. My Northstar vision imagines systems where the sense of a place flows seamlessly between the physical world and its virtual counterparts, where location-based systems are more place-like, and where platial experiences in the virtual world would augment the physical, and visa versa. The knowledge, lessons, and insights produced in this work make significant advances towards that vision.

1.2 Thesis Statement and Research Questions

This dissertation contends that:

> By closing the gaps between how places are represented and how they are experienced, it is possible to design social information systems that are more insightful and meaningful to stakeholders.

In pursuit of this thesis, I explore the following research questions that probe the gap between how places are represented and how they are lived.

1. How can the digital traces people share through social media be used to design more dynamic and representative neighborhood maps?
2. How can we design social city guides that are more inclusive to the multiplicity of experiences people have at places than traditional rating- and review-based guides?
3. How do we represent places that are *not there*, either in the sense that they are not fixed to a single location, or they are non-places—the undifferentiated, transient, and liminal spaces that pervade modern life?

1.3 Contributions

My work demonstrates how to build more insightful and meaningful place-based information systems by representing places more like how people encounter them in their everyday lives. I explore gaps between representation and experience through the design and critical analysis of three place-based systems

System	Research Question	Representational Gaps Explored	Setting
Livehoods ICWSM 2012 [57]	How can neighborhood maps evolve as neighborhoods do?	• Places are dynamic • Places are interconnected	• Cities • Neighborhoods
Curated City CHI 2014 [55]	How can city guides represent the multiplicity of places?	• Places have many stakeholders • Places have multiple identities	• Cities • Venues
Journeys & Notes CHI 2016 [56]	How do we represent places that are not there?	• Places don't need locations • Places can be virtual or physical	• Non-places • Journeys

Table 1.1: Systems presented in this dissertation and their associated research questions.

I deployed and studied. These are described below, and summarized in Table 1.1.

1.3.1 Livehoods: Designing Dynamic Neighborhood Maps

City neighborhoods are usually represented in maps as fixed areas that neatly tile the city and rarely change from year to year. However, the reality of how people experience neighborhoods is much more nuanced and complex than this. To the people who live there and know them well, the boundaries between neighborhoods are often fuzzy and not universally agreed upon, with each neighborhood blending into the next. Neighborhoods are also constantly changing, both longitudinally as neighborhoods drift and evolve in character, identity, and boundary, but also cyclically—as the seasons change or as day turns to night, neighborhoods may be different places entirely.

While the traditional representations offer a simplification, they are also reductive of the on-the-ground reality, which can be problematic when maps are used as input for consequential decision making processes, such as resource allocation, investment, or basic research. Because of their important roles as organizational units in cities, misrepresentations in how neighborhoods appear on maps can cascade to misrepresentations in how neighborhoods are encountered, treated, provided for, and lived. Inaccurate depictions can even cause material harm to communities through the perpetuation of stereotypes or the erasure of cultural identity.

With Livehoods, I investigate the issue of boundaries in urban areas, exploring how social media analysis can produce a new kind of neighborhood map that is flexible, dynamic, and able to evolve as the neighborhoods they represent do. Viewing the "fuzziness" of neighborhood boundaries as a

fundamental aspect of them as places, we worked backwards to design a system for mapping neighborhoods that could represent them in this way. We introduce a novel clustering method and interactive visualization that uses location-tagged social media to reveal the collective activity of a city, allowing us to map city neighborhoods in ways that are much more true to how people experience them. In evaluating our approach, we spoke to dozens of neighborhood residents in semi-structured interviews, to discern how a person's individual experience of the city and its neighborhoods relate to both the discovered boundaries and the neighborhood boundaries drawn by the municipality [57]. Livehoods demonstrates that the digital footprints of location checkins offer a new perspective into the dynamism and interconnectedness of places, which inspires new, more naturalistic representations of city neighborhoods in interactive maps.

In Chapter 3, I discuss:

- The design and implementation of Livehoods, an system that analyzes over 18 million location checkins to produce a new kind of city neighborhood map that is flexible, dynamic, and able to evolve as neighborhoods do.
- The results of an extensive interview study with 27 residents of Pittsburgh to explore their perceptions of city neighborhoods, their interpretations of Livehoods, and their perspectives on the forces that are shaping their city.

1.3.2 Curated City: Capturing the Experience(s) of Place

Place rating and review apps like Yelp and Google Maps are popular ways for people to find nearby things to do in a city. Discovering new places and new urban experiences can be difficult, especially for newcomers or visitors to large cities. These digital city guides aggregate data across many individual place reviews and ratings to make it really easy for people quickly get a sense of what a place is like.

However, despite their popularity, these apps are overly reductive in the ways they actually represent the experience of place. Ratings, for example, collapse the full nuance of the experience down to a single point in a numeric scale. Place reviews suffer the opposite problem. Individual reviews are often

long and drawn out, making it difficult to distill the essense of the place down to something understandable. To counter this, review apps typically use artificial intelligence to extract summarizations of common terms, creating scannable descriptions of a place, that like ratings, offer a singular representation. However reviews are often incentivized to be be overly critical of un-generalizable things, for example a dirty fork may be a one time occurrence that spawns a horribly negative review, which can bubble up to a summary view. Furthermore, local experience is highly subjective and personal: we are each biased by our own background, experience and preferences. Both ratings and reviews seek to objectify the subjectivity of place by incentivizing users to think of places in purely absolute terms, as either "good" or "bad" experiences that can be averaged and quantified with a numeric rating or absolute review.

To break out of this mold, I introduce Curated City, a social city guide that seeks to represent places more like they are experienced. Places do not support just one experience or perspective; places contain multitudes. Although we each carry our own individual and personal sets of experiences, one of the greatest aspects of living in a city is that it is a place of shared and collective experiences. The social architecture of Curated City grants people the freedom and flexibility to express places in rich ways, fully capturing the multitudinousness of their identities. By allowing people to share and re-mix each other's personal city guides, Curated City supports the individual view, and the social, collective view of places, accentuating the commonalities across individual experiences without forcing people to make absolute characterizations of "good" and "bad" places.

In Chapter 4, I discuss:

- The design and implementation of Curated City, a social website that allows people to create and share personal guides to their city.
- The results of a 2-week long field trial involving 20 residents of Pittsburgh who documented their favorite experiences of places across the city.
- A set of nine implications for the design of social city guides that represent places as a multiplicity of individual experiences.

1.3.3 Journeys & Notes: Depicting Places That Aren't There

Most places are associated with a fixed location, however, location is neither necessary nor sufficient for place. Places can be moving targets passing from location to location as they race across the landscape, like the cab of a long haul truck or the bar car in a commuter train. They may even lack any location whatsoever—some online forums evoke feelings of place to their members, but they are entirely virtual. On the other hand, locations can lack the qualities of places too. We've all had the experience of being somewhere that feels like it's no place—airports, overpasses, highway rest stops, conference hotel rooms, bus terminals. Marc Augé calls these non-places—the undifferentiated, transient and liminal spaces that lack meaning, culture, or sociality [17]. Being at a non-place can feel disorientating and detached. Augé observes, to the detriment of public well-being, that non-places pervade post-modern life as society pushes us to spend an increasingly large fraction of our time there.

In Journeys & Notes, I ask two related questions: how can we represent places that are *nowhere* and how can we nurture a sense of place at *non-places*? I focus on designing information systems for one particularly prevalent type of non-place: the spaces that we occupy on the journeys we take, when our senses are overloaded by rapidly shifting landscapes and disoriented by inhuman-scale transportation infrastructure. Because Journeys lack a fixed location, it's not immediately obvious how to represent them in information systems. To investigate this idea, my colleagues and I designed and developed a mobile application that provides affordances for people to virtually connect with one another on their respective journeys, while encouraging them to be present and reflect on their moment in space. In this investigation we learn that in designing information systems, we need not focus only on places that are already there, but it may actually turn its attention to places that are not there, but should be. Our work highlights opportunities for how social-computing can be a force for catalyzing new categories of blended places that exist both virtually and physically [56].

In Chapter 5, I discuss:

- The design and implementation of Journeys & Notes, an Android app that creates a virtual place for people to interact while on journeys near and far.

- Two 1-week-long user studies (6 people, and 15 people) of how people adopted the system, and how their use of the system impacted their perceptions of travel and non-places.
- A large-scale field study with 9,435 participants providing insight into usage patterns, and the types of messages people write on their journeys.

1.3.4 Insights for Reasoning About Place

To facilitate the design of information systems that are more representative of place, I formalized my learnings from designing and building these systems into a six-dimensional framework for reasoning about place in design. The framework, which is described and motivated in detail in Chapter 6, consists of six distinct qualitative dimensions of places that I've distilled from the place literature in geography, anthropology, and sociology: *scale*, *transformation*, *interconnectedness*, *openness*, *"throwntogetherness"*, and *politics*. Scale reminds us that places can range from the small and personal, to the large and all encompassing. Transformation notes that places are always in a state of change. Interconnectedness describes the tangled ecosystems of links between people, fauna, flora, buildings, infrastructure, objects, ideas, actions, and other places. Openness communicates that flows of people, culture, ideas, and capital pass into and out of places, irrespective of borders [139]. "Throwntogetherness" is a neologism expressing the state of multiple people being at a place together, their trajectories might intersect, or may not, by total happenstance [140]. Finally, places are governed, both explicitly and implicitly, by power, and the politics of place denotes the manner in which power is apportioned across a place, and how different people or groups of people might be more or less favorably positioned with respect to that power.

To help apply this framework in the context of designing place-based information systems, I present a series of questions for each dimension that encourages engagement along that dimension of place in the design process. In this way, I hope to help designers to think deeply and critically about how to approach places across a broad spectrum of essential attributes, pushing them to discover a diversity of insights in advancing their design objectives. For example, some guiding questions for transformation include: How has this place

changed in the past, how is it currently changing, and how might it change in the future? What are the dominant forces that might explain these changes? How might the design artifact interact with those forces to change places in different, perhaps unexpected ways? There are no correct answers, but the process focuses the designer to incorporate insights about place that can lead to more thoughtful outcomes. Appendix B presents 18 such guiding questions to consider across the 6 dimensions of place that I've distilled from my own experiences as a system builder.

1.4 Why Place?

The idea of "place" is central to this dissertation. Although place is an intuitive concept to most, it is also ambiguously defined outside of certain professional or academic circles. In the context in which I use it here, **place**—an area of individual or collective meaning brought to life by human experience—is best understood in relation to **space**—the abstract, multi-dimensional topologies that we all pass through and exist in. Indeed, according to geographer Yi-Fu Tuan, "the ideas 'space' and 'place' require each other for definition [232, p. 6]." In his groundbreaking 1977 book *Space and Place: The Perspective of Experience*, Tuan develops a language and framework formalizing the relationship between space and place. "What begins as undifferentiated space," Tuan explains, "becomes place as we get to know it better and endow it with value [232, p. 6]." That is, place is space given meaning by human activity—the precise character of the place is defined by the nature of the activity surrounding it. Many works across geography, philosophy, anthropology, and sociology explore the space-place distinction.

The roles that places play in society for both individuals and communities is well-documented, with evidence spanning several disciplines and fields of study, including sociology, psychology, economics, urban studies, epidemiology, criminology, government, and architecture. Researchers have investigated place as a central component of public safety, health [63, 117, 121], human behavior [176, 213], urban cultural identity [179, 180, 235], economic development [110], cultural production, diseases prevention, community development [13, 37, 85, 112, 116, 240], and civic participation [160, 183]. In his narrative

about the atrophy of civic life and social capital in America, Robert Putnam sets the front lines of civic activity in America's "churches and union halls, in bowling alleys and clubrooms, around committee tables and card tables and dinner tables"—places all [183, p. 150]. For all of these reasons, designing, building, and maintaining a vibrant network of diverse places is a paramount goal of city governments, urban planners, and community organizations.

1.4.1 Space and Place in HCI

Research in Computer-Supported Collaborative Work (CSCW) and Human-Computer Interaction (HCI) has long incorporated space and place in the design of social and collaborative computing systems. Harrison and Dourish familiarized CSCW with space and place in their 1996 work, suggesting that instead of spatial metaphors, designers of collaborative groupware may in fact want to embrace place [97]. Defining space as "the opportunity" and place as "the understood reality," they argue that creating conditions for placeful interactions in virtual settings leads to more natural social experiences in collaborative systems. Reflecting on the rise of mobile computing, Dourish revisited the space-place distinction 10 years later to explore how CSCW can engage with progressive concepts of spatiality in designing mobile systems [73]. Whereas the Harrison and Dourish 1996 primarily focused on place over space, Dourish 2006 prioritizes space over place, emphasizing that space and place are co-creations of one another, both of them defined and constructed by human social processes [73]. He explores how mobile systems might change the way people encounter space, creating new kinds of spatialities, new *opportunities* for interacting in the physical world, and new concerns that designers of mobile CSCW systems should be attuned to.

The focus on space over place in Dourish 2006 was motivated by the inherent spatiality of mobile computing. From maps and navigation to transportation and tourism—mobile technologies change how we think about and get around in the world, creating *opportunities* for new kinds of social practices that augment the production of space. As Dourish puts it: "Introducing technology into these settings does not simply create new opportunities for sociality (the creation of places), rather it transforms the opportunities for understanding the structure of those settings (developing

spatialities) [73]." While this may have been true in 2006 when social computing was in its infancy, in 2022, we can no longer say that computing does not create new opportunities for sociality.

In the decade and a half since Dourish 2006, computing has become even more mobile, even more social, and even more deeply entwined with society, including with the *understood realities* of place. This calls for a re-evaluation, then, of the relationships between space, place, and technology, with a renewed focus on place over space, especially on how technologies are representing places and how places are experienced. This insight is one of the main forces that motivates my research.

1.5 Document Organization

The remainder of this document is laid out as follows. In Chapter 2, I provide a brief introduction to place for computer scientists and interaction designers, and lay out some background and related work, highlighting the role of place in computational information systems. Chapters 3–5 present case studies of the systems I've built, and lessons I've learned about building place-based information systems. In Chapter 6, I discuss some thoughts on design strategies for building place-based systems. And in Chapter 7, I share final thoughts about closing the gaps between representation and experience of place and how my research has produced new insights and meaning at places; I also point to areas where future research is needed.

Background

2.1 Place: A Working Definition

What are we talking about when we talk about place? This is a curious question. One the one hand, 'place' is universal—most of our lives are spent either at a place or on our way to one, and so we understand them innately. On the other hand, 'place' plays a number of roles in several disciplines of study, including geography, philosophy, architecture, economics, anthropology, sociology, and increasingly, computing. Because its meaning is so "wrapped in common sense," as Cresswell notes, place is both familiar and easy to understand, but also "more slippery as the subject of a book [61, p. 6]," or in this case a dissertation. To help ground the reminder of this work, what follows is a concise exploration of some foundational ideas about place.

2.1.1 Space versus Place

In defining *place*, it is helpful to consider it in relation to *space*—the physical expanse we all move through and exist in. Relative to place, space is commonly described as *abstract*, *relational*, *geometric*, *uniform*, or even *empty*. Cresswell notes, space has been seen as "a realm without meaning—as a 'fact of life' which, like time, produces the basic coordinates of human life [61, p. 16]." A part of space may be called place if it becomes meaningful to people. Precisely how this meaning is created varies, emerging from a plethora of human activity, such as the naming, building, occupying, or depicting of portions of space.

This characterization of space as mainly abstract is relatively uncontroversial, though de Certeau, Lefebvre, Dourish and others have explored socially produced space [38, 73, 131]. On the other hand, there are multiple ways to think about place in relation to space. Agnew suggests two perspectives: "the first is a geometric conception of place as a mere part of space and the second is a phenomenological understanding of a place as a distinctive coming together in space [10]." The difference between these two views, according to Agnew, is quite like the difference between having an address and living at that address. Place as having an address is "definable entirely in relation to a singular spatial metric (latitude and longitude, elevation, etc.) or other spatial grid defined by putatively non-spatial processes (core-periphery, city-hinterland, administrative regions, etc.)." Whereas viewing place as occupying an address, one is forced to make sense of both the seemingly limitless variability of lived-experiences people have at places as well as "the impact that being somewhere has on the constitution of the processes in question [10]."

The latter phenomenological perspective was developed by humanist geographers in the 1970s, particularly by Yi-Fu Tuan and Edward Relph. Tuan describes how a space becomes a place through the lens of getting to know a neighborhood:

> A neighborhood is at first a confusion of images to the new resident; it is blurred space "out there." Learning to know the neighborhood requires the identification of a significant localities, such as street corners and architectural landmarks within the neighborhood space. [232, p. 18]

To Tuan, what starts out as abstract space gradually comes into focus through experience. And then "when space feels thoroughly familiar to us, it has become place [232, p. 73]."

To phenomenologists, human experience flows from place, first and foremost—"To be human is to be in place [61, p. 38]." Quoting Relph, Cresswell describes the philosophical grounding of the humanist perspective:

> The basic meaning of place, its essence, does not therefore come from locations, nor from the trivial functions that places serve, nor from the community that occupies it, nor from superficial or

> mundane experiences…The essence of place lies in the largely unselfconscious intentionality that defines places as profound centers of human existence [Relph 188, p. 43 quoted in Cresswell 61, p. 38].

Here, Relph is essentially saying that human consciousness constructs a series of relations between the self and the world, and those relations are necessarily set in place [61, p. 38].

In the humanist view, place can emerge from space through human experience, as is the case in Tuan's depiction of getting to know a new neighborhood. But place can also creates space around it, much like a bridge constructed over a landscape [102]. The bridge—a place—creates opportunity and possibility for movement, exploration, and encounter, which are the antecedents of space [61, p 28].

Finally, we may also view space and place as ends of a spectrum, rather than binary absolutes. As Cresswell puts it, "the continuum which has place at one end and space at the other is simultaneously a continuum linking experience and abstraction. [61, p. 37]."

2.1.2 Defining Place: Three Dimensions

Returning to the task of defining place, Agnew posits a multipart definition that captures much of the above nuance [10]:

- **Place as location**: "a site in space where an activity or object is located" in relation to other places, like a city or settlement, or other systems of places.
- **Place as locale**: "settings where everyday-life activities take place," especially social activities, like offices, homes, restaurants, vehicles.
- **Place as sense of place**: settings with a "unique community, landscape, and moral order," where there is emotional attachment and a sense of "belonging."

These dimensions of place are simultaneously *attributes* that specific places might have, as well as different analytical *lenses* through which we can begin understand the world in different ways.

Agnew's dimensions add color to my goal of representing places more as

they are lived. When places do appear in information systems, they are typically depicted as locations, named points or portions of space. In my research, I seek to design information systems to representing places as locales with a sense of place.

2.1.3 Avoiding Sentimentality of Place

It is easy to fall into the trap of being overly sentimental or nostalgic when approaching the subject of place. This is perhaps because places are more often associated with the past than the present or the future [140]. Rooted in history and culture, places commonly enter the popular consciousness as something to be preserved and protected from the influence of outside forces seeking to change them. While this viewpoint can be a rallying cry for preserving community identity, it has also been deployed with disastrous consequences as a weapon of exclusion, subjugation, and even extermination aimed at those with less power or status.

The sentimentalist view is also ignorant to a spectrum of experiences people have at place beyond those of positive emotional affect. There are places of fear, places of shame, places of tragedy, places of struggle, and places of mourning [61, 233]. The same place can even present itself differently to different people. To many, "*home*" is a place of shelter, safety, and tranquility. However, to others "*home*" is a place of fear, pain, and abuse.

2.1.4 A Global Sense of Place

The humanist conception of place as something that you get to know if you spend enough time there can be problematic. It defines place as something more associated with the past than the present or future. Agnew compares this perspective of place to "stepping into a Thomas Kinkade painting and enjoying the unself-conscious sociability of a world long since lost [10]." Not only can this perspective lead to overly sentimentalist understandings, but it is incongruent with the increasingly globalized world, where local places are influenced by global flows of people, culture, and capital. In the context of globalism, the humanist perspective seems reactionary, even exclusionary.

This led geographer Doreen Massey (and others) to develop a global sense of

place that is open, dynamic, and progressive. "Instead then, of thinking of places as areas with boundaries around," and that are defined by experience, Massey writes, "they can be imagined as articulated moments in networks of social relations and understandings, but where a larger proportion of those relations, experiences and understandings are constructed on a far larger scale than what we happen to define for that moment as the place itself, whether that be a street, or a region or even a continent [139]." In contrast to the humanist place, which has a singular identity that people get to know with experience, the global sense of place supports multiple simultaneous identities that can be encountered from different perspectives. Massey describes how this global sense of place might be developed:

> There seems to be…a number of ways in which a progressive concept of place might be developed. First of all it is absolutely not static. If places can be conceptualized in terms of the social relations in which they tie together, then it is also the case that these interactions themselves are not motionless things, frozen in time. They are processes.
>
> Second, they do not have boundaries…Do not have single unique identities; they are full of internal conflicts…none of this denies place nor the importance of the uniqueness of place. The specificity of place is continually reproduced…There is the specificity of place which derives from the fact that each place is the focus of a distinct mixture of wider and more local social relations. [139]

Many gaps in digital representation stem from out-of-date conceptualizations of places as enshrined locales rooted in the past, for example the notion that places like neighborhoods have fixed boundaries, or that a corner cafe has a single identity captured by an online review.

2.2 Place in HCI

In Chapter 1, I discuss Harrison and Dourish's seminal work exploring the space-place distinction in collaborative system design, particularly in relation to spatial metaphors in user interfaces such as collaborative virtual reality systems, operating systems with graphical desktops, and communication platforms

[73, 97]. They argue that place may be a more effective metaphor than space for collaborative interactions, as place emphasizes connectedness, distinction, and sociality rather than the undifferentiated dimensionality of space. My call for a renewed focus on place builds on the legacy of this work, though from a different perspective. Instead of highlighting the importance of place metaphors in virtual collaborative systems, my focus is on the how we can better represent the phenomenological aspects of physical places in virtual settings.

In this section, I position my research on representing places along side related and overlapping areas of HCI were place has emerged as a relevant factor, including Ubiquitous Computing, Social Computing, Geographic Human-Computer Interaction, and Urban Computing.

2.2.1 Place in Ubiquitous Computing

Around the time Harrison and Dourish were exploring space and place as a metaphors in computing, computing had begun to move through space and infiltrate place. This section reviews connections between place and Ubiquitous Computing research [238].

Context-Aware Computing

As computers became smaller, more connected, and more ubiquitous , researchers began to explore opportunities and implications for context-aware computing. Context-aware computing imagines devices and software that sense, understand, and react to the user's current state in intelligent and intuitive ways [8, 201]. From the early days, the ability to naturally respond, and adapt to changes in place has been a core scenario of context-awareness. For example, Abowd et al. define *context* as any information that can be used to "characterize the situation of an entity," where an entity is a "person, place, or object that is considered relevant to the interaction between a user and an application [8, 69]." The wide-scale availability of location sensors on mobile devices allowed "place" to be inferred from location and gave rise to location-aware computing as a specific area of interest in context sensing [103]. Hazas et al. motivate this scenario:

> Simply knowing that a person is "at home," "in my office," or "in my car" is often sufficient for applications to carry out

> predetermined actions in a given situation, such as turning off a cell phone's ringer during a film or concert. In these cases, the person's relationship or interaction with a place is more important than the physical location [99].

Location-aware applications have been studied in a number of different research scenarios [22, 44], including navigation [9, 47], way-finding [136, 151], and tourism [7, 46, 153], many of which are now commonplace mainstream technologies. For example, Cyberguide is a location and position aware tour guide built for hand-held devices that anticipates the answers to tourists' questions depending on their location [7]. Asthana et al. explored a context aware shopping assistant that shoppers as they move through a shopping center [15]. Researchers have also developed location aware field guides that help ecologists [165, 166] and archeologists [195] catalog their discoveries in the field.

Here the underlying vision is of applications that can sense the places where they are used, and respond and adapt themselves appropriately to the context. In practice, location-aware applications do not respond to place as *a sense of place that*, rather they incorporate place in the form of a named or categorized locations. For example, this might be done through the use of geofencing, where specific areas on a map (places) are partitioned off then assigned names and categories, either automatically or by the user. Or this could be done through sensing the proximity to a known reference location, such as a WiFi access point or a bluetooth beacon.

Developing applications that can respond to place as a sense of place rather than as just a location will require new understandings, new underlying models, and new approaches to context. Some research has begun along these lines. For example, Taylor et al. report on a year-long field study exploring the relationships and conceptualizations between a local community of place and data collected about that place [221]. My research contributes to these goals by shedding light on how to represent places more as they are experienced.

Participatory Sensing

The mass proliferation of sensor-rich mobile devices has opened up new research avenues for observing, studying, and understanding places by leveraging the collective data gathering capabilities of geographically distributed people. Often

called participatory sensing or crowd sensing, these systems gather and aggregate detailed data about locations that would otherwise be difficult to collect, enabling rich and novel representations of places.

For example, research has explored how participatory sensing can reveal insights about cities, for example in leveraging geotagged photos to automatically construct construct a travel itineraries [65, 124], using geotagged Tweets to construct a guide to automatically build a guide to city neighborhoods [220], or by using location data to identify and recommend social events people in a city might be interested in [184]. Froehlich et al. analyze 13 weeks of usage data from a city-wide bicycle sharing deployment, revealing insights about collective activity patterns across city neighborhoods [87]. Vaish et al. introduced Twitch Crowdsourcing, an app that took over a phone's unlock screen to inject light-weight crowdsourcing tasks, some of which were location-based, such as how crowded a place is, what activities can people do there,and what the acceptable attire is like [236]. Zimmerman et al. developed a system to generate real-time predictions of bus arrival times given the analysis of GPS traces from commuters [250].

These participatory sensing systems are able to gather fine-grained social data that reveal how people move through, and in some cases, interact with places. My research provides insights and guidance for how such rich data can be channeled to build systems that are more placeful.

Location Tracking and Privacy

This dissertation considers a likely future where we are surrounded by devices that are sensing ever more intimate aspects of our behaviors, our environments, and our urban lives. The proliferation of location-based services allows third parties access to sensitive consumer location data, often times unbeknownst to the end user [27, 113]. Such practices raise a number of privacy concerns, and inspired research programs to better understand and enhance location privacy.

For example, researchers have explored designing algorithms that guarantee a sufficiently level of aggregation so as not to reveal an individual's identity [154, 219], or building systems that help developers and end users control and manage their location privacy [25, 105, 197, 229]. Work has also been done to understanding and modeling what aspects of their location people are

comfortable sharing, with whom they want to share it, under what conditions, and at what levels of aggregation an anonymity [31, 227]. These are extremely difficult problems to address, only made more difficult by the constantly moving targets of advancing technology, changing public policy, and evolving social norms. While this dissertation does not directly address the challenges of privacy, exploring ways to form deeper representations of places potentially opens up new directions for understanding location sharing preferences of users [227].

2.2.2 Place in Social Computing

Place and location strongly influence how people socialize and interact with each other in the physical world. Smart-phone location tracking capabilities open the door to creating new kinds of social applications enable place and location to influence how people interact in virtual settings as well. In the process, Social Computing research has emerged to explore the interactions between place and these new kinds of social applications.

Checkins and Social Location-Sharing

Location sharing applications are the most basic example of a location-based social network (LBSN): the phone tracks a user's location as they move around, and it allows them to share this information in real-time with chosen social connections, as a kind of communicative context. In *continuous location sharing systems*, the user's location is constantly tracked in the background, regardless of what activity they are doing on their phone. A common scenario might involve a spouse or partner wanting to communicate their commute home to a significant other. On the surface, these systems are not directly about place. However, when their data are collected and analyzed in aggregate, they reveal a view of population flows through places like cities and neighborhoods, and can be used to infer structure, relationships, and power dynamics inherent to a place. For example, Cranshaw et al. analyzed data from a location sharing system to reveal contextual attributes about places, such as how busy they are, and how predictable are their visitation patterns [59]. Early research has also explored using these kinds of location tracking systems for suggesting new social connections [59, 248] in digital social networks, providing early evidence for the

digitization of some of the traditional functions of place.

In contrast to continuous location sharing, *checkin systems* are more explicitly place-based, as people typically either search for a place or confirm their presence at a place in order to perform a checkin, and broadcast it to their connections. Foursquare is the most popular app designed explicitly for location checkins, but there are numerous other popular apps where checkins are a secondary activity users can perform along side of other activities, adding a location to a photo or social media post, or sharing a location with a dating app to find matches nearby. Research has shown that people perform checkins for a variety of reasons, including information discovery, tracking their important moments, as well as curating their presentation of self and other more performative factors in location sharing [53, 133].

Because checkins are tied not just to a location, but to a point of interest, or a locale, they are often associated with additional meta-data about the place. For example, Foursquare venues have a venue name, category, and user generated content such as photographs. Research has looked into how this rich, annotated checkin data at places can be used to extract novel insights about places and the people who visit them. Scellato et al used the categories of the places two people checkin to together infer whether or not they know each other [200]. Cranshaw and Yano constructed topic models over place categories from checkin data to infer latent categories over neighborhoods [60]. These works demonstrate the potential for location-based social networking as both a source of fine-grained social data about places, but also as model for developing virtual spaces that augment the social life of a physical place.

2.2.3 Geographic Human-Computer Interaction

There is a growing body of work that addresses the important role geography plays within HCI. These works of GeoHCI [100] can be broadly categorized into two types: research into how to build systems with prominent geographic features, and works that explore or analyze the various underlying geographic facets of computing systems using the tools of geography [222, 224, 225]. In seeking to engage more deeply with the experience of place in digital representations, my research spans both types of GeoHCI.

Mapping and Navigation

Some of the earliest geographic computing research was in support of building usable mapping and navigation, first for the web, and then for location-aware mobile devices. My research is most influenced by newer works in this space that strive to map more than just the objective physical reality, and turn more towards mapping peoples subjective experiences of place. Such works take inspiration from psychogeography, which studies how the physical environment impacts the behaviors, experiences, and emotions of people [52].

Often, works in this area employ methods from crowdsourcing and social computing to aggregate many individual experiences across space to better understand the geographic and demographic facets of peoples' experiences at a larger scale. Researchers have used this approach to map peoples' emotions [66, 157], their sensory perceptions like sound [204] and smell [187], and peoples' experiences [21, 96]. Project Sidewalk uses combines crowdsourcing with Google Street View to map areas of city streets that are inaccessible for people with mobility impairments, for example by identifying sidewalks without a curb cut [96, 198]. Fox et al. take a critical approach to mapping, creating typographic maps of neighborhoods of a city using data from platforms such as Yelp and Zillow, in order to highlight political dimensions of place-based technologies [84]. My research extends these efforts in a few ways. In addition to exploring new areas of experiential mapping, such as mapping how people perceive their neighborhoods and how they experience their city, my work also engages with questions around how these experiences come to define the sense of place, and conversely, how technologies that map urban experiences might actually change or impact the very places they seek to map.

Another aspect of psychogeography that has been explored in HCI are mental maps, which are collections of peoples' biased perceptions of the contours of the physical environment [137]. Mental maps can be used to study how qualities of the urban built environment impact how people experience a city. More recently within HCI, mental maps have begun to influence research on location-based services and the mobile and social web. Bentley et al. used hand-drawn paper maps to explore how checkin systems such as Foursquare, are influencing peoples' perceptions of place [26], and Quercia et al. developed a

crowd sourced approach to mental mapping that used Google Street images to investigate Lynch's hypotheses about imaginability on a large scale [185]. My work similarly draws from the mental mapping literature in forming a methodological basis for my investigations.

Beyond simply mapping these psychogeographic signals, research has also looked into how these signals can be used for context aware navigation [151] and to help people get from place to place along routes that are more expressive than simple shortest-distance paths. Systems have been built or proposed that route people along the most beautiful path [43], the quietest or happiest path [186], the path that is most serendipitous [67, 120, 226, 247], the safest [209], the most familiar [168], or a path personalized to the individual [40] . Extending this idea to multi-stop routes, social-media-based route finding can be used to build travel itineraries that are driven by the wisdom of the crowd [65, 124]. Although, I do not explicitly explore the the topic of navigation, my work contributes to this area in two ways. First, I explore systems that envision a data infrastructure that could enable a kind of place-aware routing that is more knowledgable about people's experience of place than traditional routing. Second, I explore the concept of building digital tools that can nurture online communities anchored around the routes people take, effectively creating digital places that augment physical non-places.

Geospatial Peer Production

Online mapping and the associated challenge of constructing and maintain massive geospatial data sets inspired large-scale, collaborative mapping projects, like GeoWiki, Open Street Map (OSM), and other kinds of geospatial peer production communities [86, 93]. Research has shown that the accuracy of OSM, and other volunteered geographic information (VGI), on the whole, stands up to the accuracy of other sources of ground [81, 93], but such data often exhibit geographic biases with some areas benefiting from better coverage and accuracy than others, for example on along the rural/urban divide [101, 114] or along other sociodemographic dimensions. Research has suggested that people who are located close to an area may produce more accurate contributions about that area than those who are more distant to where they contribute [114], however, recent work has proposed that other distance metrics

beyond geographic proximity may be equally valid proxies for accuracy [223]. Other researcher have studied participatory mapping and VGI in specific contexts, such as crisis mapping and disaster response [90, 143, 212, 237], or street and sidewalk wheelchair accessibility [96, 175]. This research adds to this body of work by exploring how to build and incentivize communities to crowdsource the experiential attributes of places.

2.2.4 Urban Computing

Urban computing has its roots in the study of ubiquitous computing (ubicomp) and the "disappearing computer." This vision was perhaps best voiced by one of the field's founders, Mark Weiser, who said that computers should strive to "weave themselves into the fabric of everyday life until they are indistinguishable from it [238]." As computing devices began to get smaller, more mobile, and more seeped into the environment, researchers started to examine the implications of computing as it spreads into different physical settings, including imagining ubicomp for the urban landscape [167]. Some early works in this field took a playful perspective, exploring how the unique social dynamics of the urban environment can be used as design elements for applications [92, 119, 167, 171, 206, 241]. For example, Paulos and Goodman created a mobile device called Jabberwocky, a mobile device that allows that explores the concept of the "familiar stranger [146]," people we regularly encounter in urban environments but do not know [168].

There are a number of recent works that look at how to effectively engage the urban crowd to offer technologically mediated grass roots solutions to urban problems. Paulos et al. [172] explore the concept of an ambient display that could highlight a person's urban score, and indicator that captures their relationship with their city. There is also a growing area of research that empowers people, especially those living in dense environments like cities, to take a participatory approach to sensing their environment [126–128, 170]. For example Kuznetsov et al. gave people mobile sensors to measure air quality that could be distributed and attached by participants to various fixed locations in the city [126].

In recent years there have been a number of works focused on understanding urban areas by harnessing vast amounts of human activity data that are

increasingly becoming available in urban areas. Zheng et al. explored how sensor equipped taxi-cabs could be used to generate data source depicting the "pulse" of the city. Using this rich source of data, they identify traffic engineering flaws in the city's layout that potentially lead to high congestion. Chon et al. develop a social crowd sourcing system that combines various signals, including sound and image sending, in order to characterize the category of a place [48]. Similarly, Yuan et al. use properties of visitation patterns a region sensed through mobile phones and and other meta-data about to try to discern the region's functional category [243]. Lathia et al. use data from subway rides in London to model urban mobility as a way to measure well being across different city neighborhoods [129]. Similarly, Froehlich et al. use data from cycling trips in a city-wide system for bicycle rentals to understand large scale mobility patterns and the "pulse" of the city [87].

In some ways, building applications that can understand a city through computational methods is related to context awareness, which aims to build applications that can sense and adapt to a changing environment [72, 201]. There is a rich and deep literation in ubiquitous computing in applications that use context, in particular location aware applications such as location sharing systems. Data from location sharing systems have been a valuable source of insight about the physical world and the relationships between online online and offline interactions [59], large scale urban dynamics [39, 60, 159, 246] and the effects location technologies have over people's behavior [53, 133].

Livehoods: Representing Neighborhoods

In this chapter, I delve into one particular kind of place—the urban neighborhood. When they're shown on maps, neighborhoods are traditionally represented as static, bounded areas that completely tile the city. Here, I argue that such conventional representations are not place-centered, as they don't accurately reflect the dynamics of how neighborhoods are lived and experienced. Further, I introduce a new method for representing neighborhoods that leverages location-based user-generated content to reveal the collective spatial activity patterns of a city's inhabitants. This new approach reconceptualizes of the idea of a neighborhood, moving away from preordained areas delineated by rigid boundaries, towards new spatial concepts—which we call Livehoods—that are more a dynamic, fluid, and place-centered.

Much of this work was done in collaboration with Raz Schwartz, Jason Hong, and Norman Sadeh, originally appearing in ICWSM 2012 [57] where it received a BEST PAPER AWARD, with additional thoughts and ideas from works I presented at workshops in 2010 [60] with Tae Yano and in 2013 [54] as well as some previously unpublished work. The technologies presented in this chapter have been patented under U.S. Patents #10,713,672 and #9,846,887 [58].

3.1 Introduction: Neighborhoods and Maps

Most people intuitively grasp the *idea* of "neighborhood" just from spending time in cities exploring their different parts. However, defining "neighborhood" precisely and specifying with certainty where a given neighborhood is located can be much more challenging. Even long-time city dwellers may be uncertain where one neighborhood starts and another ends, or they may struggle to recount the blocks and micro-neighborhoods that make up parts of a city they know well. This is because neighborhoods are "fuzzy" kinds of places, forged from the many repeated collisions, struggles, and spatial negotiations that unfold over many years of people living closely together.

What we can say for certain is that neighborhoods are distinct, named parts of a city and there is a shared understanding among groups of residents about these different parts and their respective names. However, both of these two basic pillars are themselves "fuzzy" concepts. To start, neighborhoods may be distinct from one another, but what exactly makes them distinct? Do different neighborhoods have different attributes? If so, what attributes define a neighborhood? Or is the distinction more arbitrary, like random borders drawn on a city map? There are no set answers to these questions, and there are no set rules defining precisely how one neighborhood differs from another. There is also fuzziness in the shared understanding people have about neighborhoods. It is true in order for a neighborhood to exist, there must be some common agreement among people of its existence, however, that agreement is hardly ever universal. Neighborhoods are contested areas. Different people and groups of people perceive places differently based on their subjective personal experiences and there may be considerable disagreement about an area's name and boundaries. This contestation is a familiar part of the "throwntogetherness" and spatial politics of city life [140]. In short, "fuzziness" itself is a defining quality of neighborhoods.

However, the vagaries of the experience of neighborhoods are at odds with how they are typically represented formally in maps, both the digital and analog kinds. Neighborhood maps codify the informal and approximate nature of neighborhoods into concrete and definitive artifacts. This codification often begins in city-planning departments, where officials aggregate disparate streams

of data about the demography and geography of an area in order to make formal determinations about neighborhood boundaries. These "official" maps typically present neighborhoods as tidy and well-defined areas that neatly tile a city's extents. This cartographic precision leaves little room for ambiguity or nuance. In short, neighborhood maps are anything but "fuzzy."

Traditional neighborhood maps are paragons of user-centered design, but they fall short as representations of place. The typical goal of a neighborhood map is not to capture the nuances of neighborhoods as places; rather, it is to communicate definitive areas of the city efficiently and with certainty to end users of the map—usually people with navigational or commercial needs. Whether or not these navigationally-oriented neighborhood maps succeed at their user-centered objective has little to do with how accurately they represent neighborhoods as places. For one, fixed neighborhood maps are stagnant, monolithic, and may portray old and partial realities, whereas neighborhoods themselves are dynamic, multi-faceted, and constantly in a state of transformation.

This gap between the ambiguity of lived-experiences and the precision of cartography is problematic and can be harmful to people, places, and communities. As Jane Jacob notes "often borders are thought of as passive objects, or matter-of-factly just as edges. However, a border exerts an active influence [112]." Maps and the borders drawn on them influence the many spatial decisions people and organizations make on a daily basis, like where to buy a house or open a business, or how public goods and services are apportioned. The cartographic misrepresentation of a place can at best make communities feel like they are not properly recognized or represented by outsiders, or at worst like they don't really exist.

> A neighborhood label, once affixed, has real consequences, Suttles points out. For outsiders it reduces decision-making to more manageable terms. Instead o dealing with the variegated reality of numerous city streets, the resident can form a set of attitudes about a limited number of social categories and act accordingly. Thus a mother will instruct her child to stay out of Harlem, or a judge that a boy who lives in Riverdale is probably acceptable for her daughter.

> Newcomers may be attracted or repelled by areas defined with a high or low prestige label. For those who live within it, the neighborhood defines areas relatively free of intruders, identifies where prospects of status insult, and simplifies innumerable daily decisions dealing with spatial activities. Thus the mental map of neighborhoods is not superfluous cognitive baggages, but performs important psychological and social functions. [144]

In this chapter, I introduce a novel approach to mapping neighborhoods that is more representative of them as places than traditional maps. This new approach algorithmically models the areas of a city as a dynamic and evolving set of spatial clusters derived from people's movement patterns through the city on a large scale. Using geospatially tagged social media data from hundreds of thousands of people, I introduce an method for algorithmically mapping distinct geographic areas, depicting a snap-shot of the ever-changing activity patterns of a city and its people. Contrary to traditional neighborhood maps that are stagnant and portray old realities, our clusters reflect current collective activity patterns of people in the city, thus revealing the dynamic nature of local urban areas, exposing their individual characters, and highlighting various forces that form the urban habitat. This model takes into into account both the *spatial proximity* between venues as well as their *social proximity* which I derive from the distribution place visitation patterns in the city. The underlying hypothesis is that the "character" of an urban area is defined not just by the places found there, but also by the people that choose to make that area part of their daily life. I call the areas this method produces *Livehoods* to reflect the dynamic nature of activity patterns in the lives of city inhabitants.

To evaluate our approach, in Section 3.4, I present interviews from 27 residents of Pittsburgh, which show the ways in which Livehoods clusters are representative of people's mental maps [147] of the city. In addition to validating the Livehoods, these interviews shed light on the various forces that shape the city and the ways in which Livehoods untangle them. Finally, in Section **??**, I use the six-part framework from Chapter 6 to analyze the place-centeredness of neighborhood mapping. While the results suggest that Livehoods are more place-centered than traditional neighborhood maps, they also reveal gaps where even Livehoods are not fully representative of

neighborhoods, pointing to future work in place-centered mapping. In addition, this analysis also brings to the surface various benefits of place-centered neighborhood mapping for cities and the people who live in them. Neighborhood maps that are place-centered lead to spatial systems and services that are better aligned to communities and their needs.

3.2 Background

The forces that shape the dynamics of a city are multifarious and complex. Cultural perceptions, economic factors, municipal borders, demography, geography, and resources—all shape and constrain the texture and character of local urban life. It can be extremely difficult to convey these intricacies to an outsider; one may call them well-kept secrets, sometimes only even partially known to the locals. When outsiders, such as researchers, journalists, or city planners, do want to learn about a city, it often requires hundreds of hours of observation and interviews. And although such methods offer a way to gather deep insights about certain aspects of city life, they simply do not scale, and so can ever only uncover a partial image of the inner workings of the city.

This work is informed by and contributes to research studying the dynamics, structure, and character of a city on a large scale. Our approach is fundamentally data-driven. Given geospatial social media data from hundreds of thousands of people, we developed an algorithm that maps the distinct geographic areas of the city depicting a snap-shot of the ever-changing activity patterns of its people. This has been made possible by the rapid proliferation of smartphones over the last two decades, and the subsequent emergence of location-based services and applications.

Location-based social networks such as Foursquare have created new means for online interactions based on the physical location of their users. In these systems, users can "checkin" to a location by selecting it from a list of named nearby venues. Their checkin is then broadcast to other users of the system. Around the time this research was conducted, Foursquare announced they had 15 million registered users on the platform, and over 1 billion checkins [83]. Although our technique is agnostic to the particular source of such data, foursquare is appealing because it is the first such service to gain a wide user

base. This success is due in part to the mix of uses and services that the system provides for its users, as foursquare has many built-in mechanisms that actively encourage users to check-in.

Our methodology for comparing the fabric of the urban environment with the results of our clustering algorithm is grounded in several earlier works in urban studies and urban design. Such works investigate the structure and function of cities [137] as well as people's perception of their local surroundings [111, 218], the importance of social interactions for the creation of the local character [146, 161, 182]. Such studies often require long time spans and extended resources to discover meaningful results.[1]

As data from location sharing systems are becoming increasingly available for researchers to analyze, there have been a number of recent results from social science, computer science, and machine learning that are finding new ways to extract various insights on relations between online and offline interactions [59, 91], large scale urban dynamics [39, 60, 159] and the effects location technologies have over people's behavior [53, 133, 202]. This work also aligns with the ideas offered by Wellman, who notes that the move towards flexible, mobile, fragmented social systems results in the weakening of traditional boundaries such as neighborhoods [239]. These studies research how users' activities in the physical places translate and effect the virtual sphere and in return how the virtual sphere represents physical interactions.

3.3 Livehoods Clustering Methods

Here, I provide the high-level motivation and intuition behind the methods we used to produce the Livehoods clusters in our ICWSM work. For full technical details of our approach, refer to Appendix A.

3.3.1 Foursquare Checkin Data

In this work, our view into the collective footprints of city dwellers is based on geosocial media checkins we collected from Foursquare between 2010 and 2011.

[1] For example, in the 1970s, William Whyte collected thousands of hours of video to study social interactions in the city's public places [240] while Stanley Milgram deployed an army of graduate students to document New Yorkers in their daily routines [146].

In its most minimal form, a checkin is a three-tuple consisting of a *user*, a *location*, and a *time*. However, the checkin often contains additional information beyond coordinates on a map, including various meta-data about the place the user visited, including its name, address, hours of operation, and sometimes even a description of the place. When such data are included about the location, the encapsulated location entity described by the data is typically called a point of interest or a *venue*. Although our technique is agnostic to the particular source of checkin data, we used Foursquare data for our analysis. Foursquare was ideal for our needs because of its wide appeal and relative availability of user-contributed data. It was the first geosocial network to gain wide appeal, due in part to its unique blend of gamification features that encourage users to regularly checkin to venues with their locations [133]. While, Foursquare checkins are not publicly available by default, users can elect to share their checkins publicly to a broader audience on their Twitter timeline. Developers looking to gather checkin information can do so in two steps: (1) first they'd gather publicly shared checkin Tweets using Twitter's public APIs to extract the corresponding Foursquare checkin IDs from the Tweet body, and (2) then, using the checkin IDs, they'd pull up Foursquare meta-data using Foursquare's checkin API. If the queried checkin was indeed shared on a public Twitter timeline, Foursquare's API grants the developer access to this information. Otherwise, it returns an access control error.[2]

I constructed a corpus of 18 million Foursquare checkins by combining data from two sources: approximately 11 million Foursquare checkins gathered in 2010 by Chen et al. [45], and our own dataset of 7 million checkins that I collected by crawling Twitter between June and December of 2011. Both datasets used were constructed using the Twitter public timeline search API in the manner described above, and thus represent a potentially biased subsample of all public checkin Tweets [150], which themselves are a biased subsample of all Foursquare checkins. For each of our 18 million checkins, our data consists of the user ID, the time stamp, the latitude and longitude, the name of the venue, and the category of the place from Foursquare's place category ontology, e.g.,

[2]Note, both Foursquare's and Twitter's API policies have changed several times since this research was conducted, and the procedures I've described for accessing checkin data may no longer be valid. See their respective developer terms of service for details.

College & University::College Bookstore or *Food::Taqueria*.

3.3.2 Measuring a "Social" Distance Between Venues

Our objective is to identify areas of community through collective mobility. The general guiding principle that we adhere to is that if two nearby venues are frequented by many of the same people, we want them to be clustered together in the same Livehood. To achieve this goal, we take a graph-based approach to clustering, where nodes of the graph are checkin venues and the edge weight between venues represents the strength of relationship between them. A clustering of the graph is a partition of its nodes so that the total weight of the interpartition edges is minimized (and the intrapartition edge weights are maximized). Although the general graph clustering optimization problem is NP-hard, there are many heuristics that perform well in specific instances [80]. In a graph clustering paradigm, achieving our desired end goal amounts to designing the structure of the graph and the weights of its edges in a manner that encodes our guiding principles for Livehoods. That is, we need to design a graph where the weight of an edge between two nodes measures the similarity of the set of people that visits the corresponding venues. Deriving such a metric using checkin data is relatively straightforward.

Suppose that V is a set of n_V Foursquare venues, U is a set of n_U Foursquare users, and C is a set of n_C checkins of users in U to venues in V. Ignoring the temporal aspects, each venue $v \in V$ can be represented by the "bag of checkins" to v. More specifically, let c_v be an n_U dimensional vector where the u^{th} component of c_v is the number of times user u checked in to venue v. Under this representation, we can define the *social similarity* $s(i,j)$ to be the cosine similarity between vectors c_i and c_j. That is, $s(i,j) = \frac{c_i \cdot c_j}{||c_i||\ ||c_j||}$.

While we could use this social distance to derive a clustering of the venues in a city, where edges between venue i and j are weighted proportional to $s(i,j)$, by it self, it would not produce the kinds of clusters we're aiming for. This is because, most cities have a handful of landmarks that are visited by practically everyone else in the city. For example, landmarks like train stations, airports, major monuments, and shopping centers attract a huge percentage of the population, and thus will typically be mostly similar to one another. If we cluster venues using only the social similarity metric, the clusters are likely to

be geospatially non-contiguous, their shapes warped by these long distance similarities.

To achieve the clustering we have in mind, we need to constrain the clusters to be geospatially contiguous in addition to socially well connected, blending this social distance with geographic distance. To do this, we take an approach where geographically distant edges get zeroed out in weight, and geographically proximal edges have weights by their social similarity.

Let $d(i,j)$ be the geographic distance between venues $i,j \in V$. We compute an $n_V \times n_V$ adjacency matrix $\mathcal{A} = (a_{i,j})_{i,j=1,\ldots,n_V}$ on the venues as follows. First, for a given venue v, we let $N_m(v)$ be the m closest venues to v according to the $d(v,\cdot)$ for some parameter m. Then we let

$$a_{i,j} = \begin{cases} s(i,j) + \alpha & \text{if } j \in N_m(i) \text{ or } i \in N_m(j) \\ 0 & \text{otherwise} \end{cases}$$

where α is a small constant that prevents degenerate venues from having no connections to any others.

3.3.3 Clustering

With the graph constructed in this manner, we use a spectral clustering to discovery local urban areas. Spectral clustering uses properties of the eigenvectors of the Graph Laplacian of a data similarity matrix in order to remap the data into a space that is better suited for separating groups of dissimilar data points. The popularity of the approach is due to both the quality of the clusters it produces and the simplicity of implementation. Spectral methods for data clustering are a well studied [135, 205] and are popular in practice due to the quality of the clusters that are often produced and the simplicity of implementation. For more details of the clustering algorithm used in this work, see Appendix A.

3.3.4 Related clusters

We also develop a way to compare different Livehood clusters based on the similarity of users that visit them. Again we use a cosine similarity measure for this, but aggregated at the cluster level. For each cluster $\mathcal{A}_i$, we represent it as

an n_U dimensional vector $c_{\mathcal{A}_i}$, where each component u is the number of checkins users u had to *any venue* in $\mathcal{A}_i$. We compute the similarity between all pairs of clusters as $s(\mathcal{A}_i, \mathcal{A}_j) = \frac{c_{\mathcal{A}_i} \cdot c_{\mathcal{A}_j}}{||c_{\mathcal{A}_i}|| \; ||c_{\mathcal{A}_j}||}$.

3.3.5 Livehoods.org

We built an interactive website at http://livehoods.org that visualizes the Livehood clusters of several cities on a map, allowing users to explore various checkin and venue statistics for each Livehood, and the structure of related Livehoods.

3.4 Pittsburgh: A Case Study

To explore these ideas further, I present a case study of Pittsburgh and its neighborhoods. While the choice of city was mainly one of convenience, Pittsburgh happens to be an ideal setting for investigating neighborhoods for several reasons, including its geography, its culture, and its socioeconomic history.

Pittsburgh is set at the confluence of three rivers—the Allegheny meanders from the northeast to join forces with the Monongahela, which flows in from the southeast, to form the Ohio River on its westward journey to the Mississippi. It was these three rivers that drew Generals George Washington and John Forbes to build their outpost, Fort Pitt, here in the French & Indian War of 1758, and it was these three rivers that drew titans of industry to build their empires of steel, coal, aluminum, and glass in the 19th century, propelling Pittsburgh on its meteoric rise to the forefront of the industrial revolution in America [228].

Over the last several decades, Pittsburgh has seen its population decline by more than half, driven by the collapse of the steel industry and a rapid decline in manufacturing in the United States [228]. From it's peak in 1950, more than 700,000 people lived in Pittsburgh, making it the 12th largest city in the United States at the time. Today, just over 300,000 people call Pittsburgh home [32].

While its industrial past still colors the modern day landscape and culture, the Pittsburgh of today is in the midsts of a renaissance of sorts, as it seeks to find its post-industrial identity. The steel mills and factories of the last century

have been replaced by technology companies, healthcare conglomerates, world-class research universities [125]. One can bear witness to this cultural inflection by taking a walk through one of the 92 neighborhoods (Fig 3.1), nestled among the many rivers, hills, and valleys of Pittsburgh's intricate geography. While many of these neighborhoods were once de facto "company towns," providing housing to the employees of the nearby factories or mills [228], they are now ground-zero for the city's culture re-invention, boasting a burgeoning restaurant scene, well-supported artist communities, and a healthy services industry [125].

This city, in the midst of dramatic social, cultural, and economic change, is the setting for this case study.

3.4.1 Generating the Livehoods Clusters of Pittsburgh

To create the Livehoods clusters for a given city, one must first extract all that city's checkin data from the larger multi-city corpus. In this work, I use a bounding-box to filter out the content of interest, which I generously drew to contain the metropolitan area. While filtering with shape-files for municipal borders would have been more precise, this extra precision was not critical, and even not ideal for our use case. First, since the goal is to study how collective activity patterns interact with and potentially bleed across municipal boundaries at the neighborhood level, adding hard boundaries at the municipality level would be antithetical to our primary objective. Second, checkin data at the periphery of the city tends to get quite sparse, both in terms of geographic density of venues, and in terms of volume of checkin content. Because of this, clusters at the periphery of the city tend to be imprecise. Since our main unit of study are neighborhoods within the city's core of the neighborhood, the practical differences between filtering with a shape-file, versus filtering within a bounding-box are moot in our use case.

For Pittsburgh, I chose the bounding box defined by the southwest and northeast latitude/longitude corners, (40.36, -80.10), and (40.51, -79.85) respectively. In this region, our data contained 42,787 checkins of 3,840 users at 5,349 venues. These data were clustered with the Algorithm 1. Parameter selection was done in an iterative manner. I first choose starting parameters that seemed practically meaningful, given my domain knowledge of the city, and

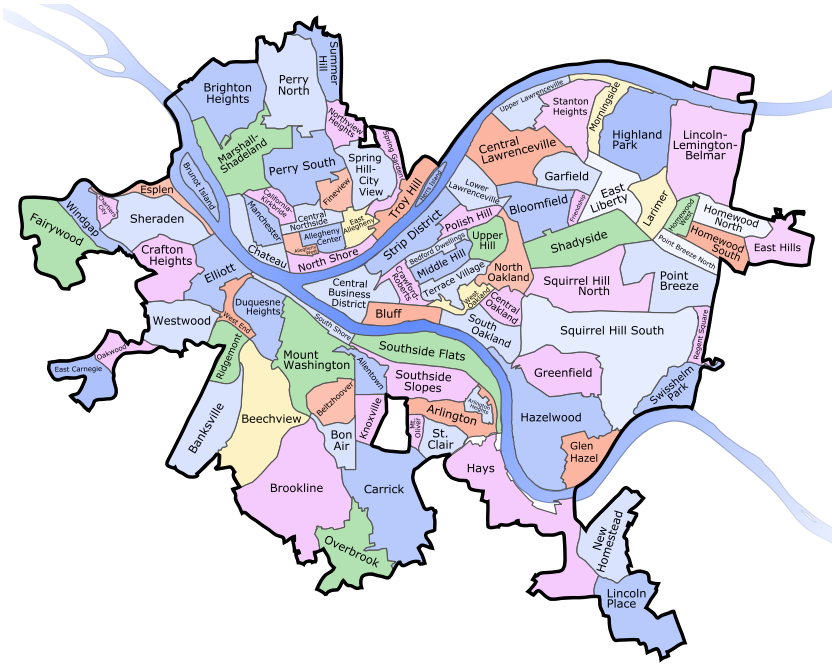

Figure 3.1: The neighborhoods of Pittsburgh, modified from A. Somerville [211] based on maps published by the city.

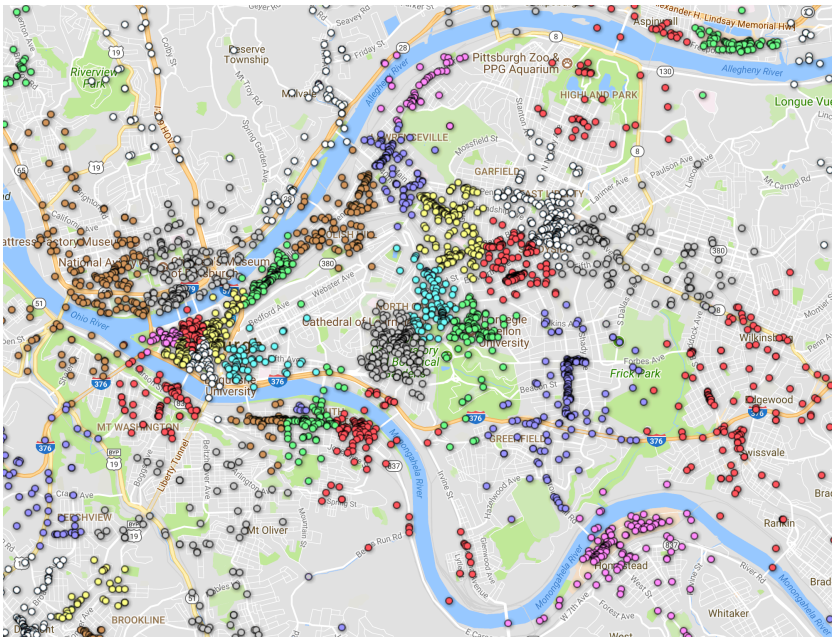

Figure 3.2: The Pittsburgh Livehoods clusters. Contiguous, samely-colored venue dots are clustered together.

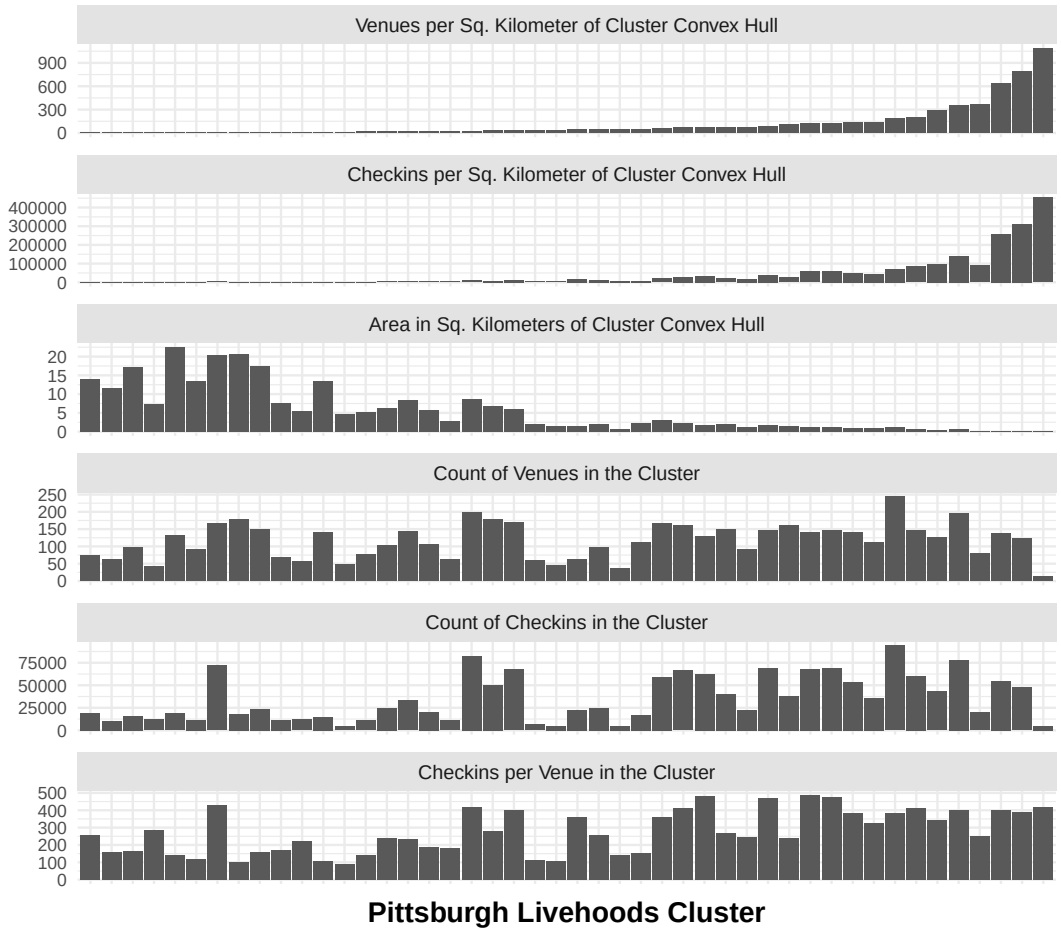

Figure 3.3: Statistics on the composition of the 46 Pittsburgh Livehoods clusters discussed in this case study. The area of the convex hull of the clusters was measured in square kilometers. The horizontal axis of all six plots represents all 46 clusters, sorted according to the density of venues in the convex hull area (the first plot), so that tracing down vertically in the same position across all six plots, shows six sample statistics for one cluster.

the approximate number of clusters I expected the city to have. I then varied these parameters slightly from the starting point, and visually inspected the results in collaboration with Raz Schwartz, to get a sense of quality. The main criteria we used to select a final parameter setting was the average geographic area of the clusters that were produced. We were biased towards selecting a clustering that we felt was "neighborhood-sized." While this was a subjective measure, in practice, within a feasible target range for the parameter settings, the clusters did not vary drastically much.

I settled on the parameters: $m = 10$, $\alpha = 0.01$, $k_{min} = 30$, $k_{max} = 45$, and $\tau = 0.4$, which partitioned the city into 46 Livehoods clusters. Figure 3.2 shows a map view of the clusters in this region, and Figure 3.3 shows high level statistics about the cluster composition. Clusters contained between 12 and 245 venues, with a mean of 116.3, median of 124.5, and a standard deviation of 50.5. Measuring the area of their convex hulls, the clusters varied in geographic size considerably (min: 0.01 km², max: 22.6 km², median: 2.22 km², mean: 5.58 km², standard deviation: 6.25 km²), with the geographically smaller clusters typically located within the urban core, and the geographically smaller clusters in the exurban perimeter. Reinforcing this trend, as illustrated in Figure 3.3, clusters with a larger geographic area did not contain proportionally more venues, and so were considerably more sparse than the geographically smaller clusters within the urban core. Indeed, the Pearson's product-moment correlation between geographic area and number of venues measured 0.12, with a 95% confidence-interval of (-0.18, 0.39), showing no evidence of any positive relation.

3.4.2 Evaluation: Gathering Perspectives

For decades, researchers of urban environments have used mental mapping techniques to study cities. A mental map is an encoding of a person's perceptions and biases with respect to the spatial landscape they inhabit, shaped by their memories, past experiences, and other individual biases. A common method for externalizing a person's mental map is to ask them to produce, from memory, a hand-drawn map of a familiar region of the city as they narrate their process and point out any particular areas of interest. While these maps may not be geographically accurate or true to scale, their distortions are just as valuable as their areas of precision, as areas of certainty and

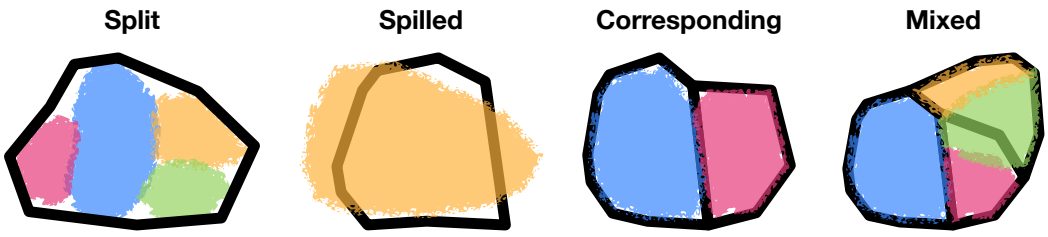

Figure 3.4: Illustrations of the *split*, *spilled*, *corresponding* patterns, and an illustration of a *mixture* of the three. Black lines indicate municipal boundaries. Colored areas indicate Livehoods clusters.

uncertainty tell a story of the person's experiences with the city.

This approach was introduced by Kevin Lynch to study how the built environment impacts peoples' interpretations and mental representations of space and how the many individual mental maps of residents converge into a collective image of the city [137]. Arguably, Lynch's method is more place-centered than it is human-centered— while he was concerned with collecting and analyzing data about the human experience of a city, his focus throughout is squarely on the places of a city, using the data he collected from people to build up an understanding of how places shape human experiences and visa versa. It is telling that Lynch's main findings—paths, edges, districts, nodes, and landmarks, the five building blocks of peoples' mental maps of a city—speak to properties of places, rather than attributes of the people he interviewed or of the urban experiences they shared. Having such a place-centered perspective likely came naturally to Lynch, coming from the world of architecture and urban design, however, it is much less common to see place-centered methods in HCI and IxD. Lynch's method has been adopted by psychologists, urban designers, geographers and other researchers to provide grounded measurements of peoples' subjective perceptions of their everyday urban landscape [75, 89, 146, 210, 234].

Inspired by these mental mapping methods, my colleagues and I took a similar place-centered approach to evaluating the Livehoods clusters. Between Nov. 17th and Dec. 17th, 2011 we conducted interviews with 27 residents of Pittsburgh to explore how their individual mental maps of the city intersect and interact with both official municipal neighborhood boundaries and with the cluster boundaries that we discovered. Our goal in these sessions was both to

validate and lend interpretation to the clusters discovered by our algorithm. To accomplish this, we developed an interview protocol that explored the similarities and differences between our clusters and the official municipal neighborhood boundaries. We focused on three *dispersion patterns* that explore the intersection between Livehoods and municipal borders: (1) *split*—when a municipal neighborhood contains more than one Livehood, (2) *spilled*—when a Livehood cluster spills over the boundaries of a municipal border, and (3) *corresponding*—when the Livehood cluster and the municipal borders coincide (see Figure 3.4). We use the areas of the city where each of these patterns are realized as place-centered topics of focus in our interviews, as we tease apart the different local dynamics that contribute to the experience of neighborhoods.

Recruitment and Participants

To recruit volunteers, we contacted a number of organizers of online social media forums with a neighborhood-focused mission, such as the "Friends of Shadyside" Facebook group [2], which is dedicated to patrons and residents of the Shadyside neighborhood of Pittsburgh. We asked these organizations to share a link to our recruitment webpage with their constituents, which provided a high level overview of our study goals and asked people to come out in support of their neighborhood to participate. People were asked to contact us directly to sign up for the study. To qualify for participation, we required that people be at least 18 years of age and they must have lived in their neighborhood for at least one year.

Of our 27 interviewees 22 were people who responded to the recruitment posting. There were 12 females and 10 males among this group, and they represented a wide age range (mean age: 35, min: 23, max: 62, and standard deviation: 11) and had diverse educational backgrounds (1 had completed high school, 2 had some college, 10 had bachelor's degrees, 2 had some graduate school, and 7 had master's degrees). Any names of these 22 recruited participants that appear in this work are pseudonymous. With their permission, we use the names of the remaining 5 participants, who were local subject matter experts with whom we specifically requested interviews: a senior planner from the Pittsburgh Office of City Planning, an independent real-estate developer, and three partners of a large local real estate development firm.

Unlike the typical approach taken in human-centered design, our participants are not drawn from some technology specific model of a likely user. Rather, we've selected people with familiarity or expertise on a broad cross-section of many of the city's neighborhoods. Furthermore, by selecting participants who are associated with a neighborhood group, we have intentionally biased towards people who have demonstrated as least some level of civic participation by their group membership, with the hopes of drawing out more vivid expressions of elements of neighborhoods.

Livehoods Interview Protocol

The interviews were conducted by me and Raz Schwartz, my principle collaborator on this work. To create a casual scene for discussion and allow us and the participants to better connect around the city's places and neighborhoods, we met up with each person in a local cafés in their own neighborhoods. The interviews took approximately approximately 60-90 minutes and people were compensated $10 for their time.

The semi-structured interviews with the participants began with a discussion of their backgrounds in relation their neighborhood. First, we asked the subjects to describe their background, focusing on what neighborhood they live in, how long have they lived there, why they decided to move there, and where they moved from. Next, we asked them to describe "the character" of their neighborhood, including areas of interest, and the types of people that live and visit there. These questions were intentionally left broad and open ended, to allow the participant to characterize the places in the way that is most meaningful to them. We then asked them to list other Pittsburgh neighborhoods that they frequently visit.

Then, without giving specific instructions, we showed them a map of Pittsburgh, and asked them to draw the boundaries of their neighborhood over it. This offered a way to anchor the subsequent interview, and let us explore the differences among the participants' mental perceptions of the area, the municipal neighborhood borders, and the Livehood clusters. It also let us validate any *corresponding* patterns between Livehoods and municipal boundaries. Next, we asked the participants whether there are places within the area that they drew where there is a "shift in feel" of the neighborhood. If so,

we asked them to mark them on the drawing. This allowed us to validate any *split* patterns between the Livehoods and the municipal borders. If they were very familiar with any other neighborhoods, we asked them to repeat this for these neighborhoods. Next we showed a website with an interactive map that had the municipal neighborhood boundaries overlaid on top of it, and we asked them for any comments. To explore any *spilled* patterns, Looking at this map, we then asked if there were neighborhoods where the "borders might be shifting or in flux."

After that, we showed the them a map of the Livehoods clusters, initially explaining that the map shows different "areas of the city" based on an algorithm that looks at "trends of where people go." The participants were asked to study the map and then to give their feedback. Later, we revealed how the algorithm works, including how we obtained the data. Finally, we showed the participants the "related areas" feature of the website for the areas of the city we discussed, exploring interesting areas that were either mentioned previously in the interview or were of particular interest. Our protocol was designed so that we were not leading the subject, and we made sure to stress that we were looking for them to be critical of any errors or of anything that they found unclear or confusing in the maps.

3.4.3 Shadyside and East Liberty: A Story of Transition

In the fall of 2002, a Whole Foods Market opened in Pittsburgh directly on the border of two very distinct neighborhoods—East Liberty to the north and Shadyside to the south, separated by train tracks and a public busway.

East Liberty, once the third-largest retail center in Pennsylvania with both a vibrant commercial center and a tight-knit residential community, was the victim of failed urban renewal projects of the 1960s that led to its near-demise in the 1970s and 1980s. In an effort to compete with the national sentiment of deurbanization that was thriving at that time, developers at the time demolished blocks of houses and businesses to make way for large one-story retail buildings, high-rise public housing projects, and a one-way perimeter road encircling the business district. The result of the failed project was an exodus of both people and resources that led to high crime rates and urban decay [163].

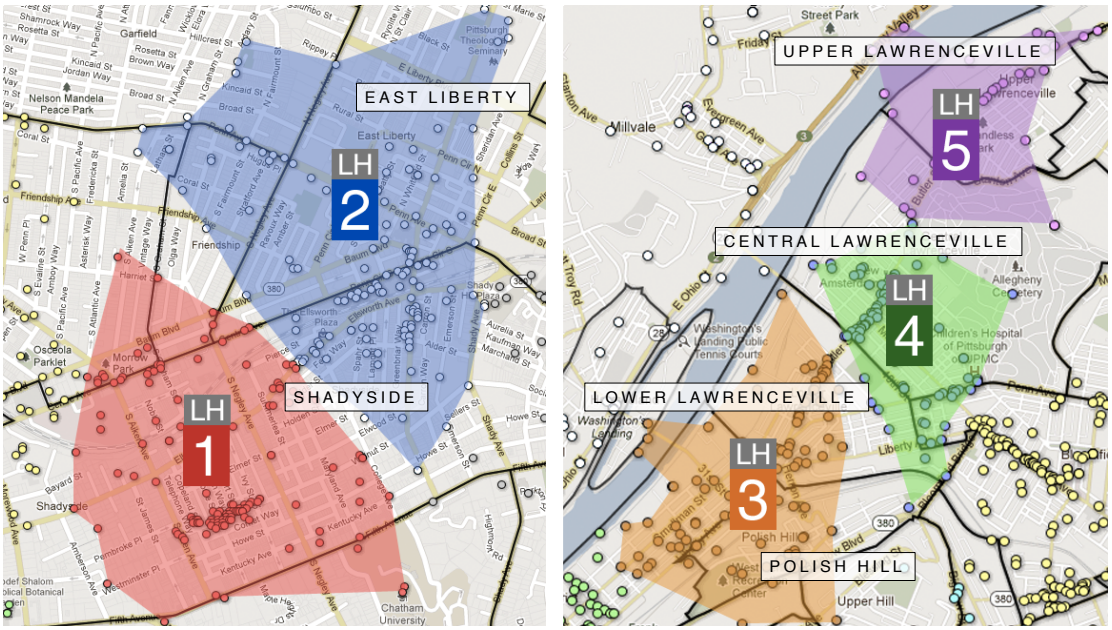

Figure 3.5: The municipal borders (black) and Livehoods for Shadyside/East Liberty (Left) and Lawrenceville/Polish Hill (Right). This image originally appears in Cranshaw et al. 2012 [57].

On literally the other side of the tracks is Shadyside, one of the most coveted neighborhoods, with vibrant shopping, and nice houses on tree-lined streets. Described by "The insider's guide to Pittsburgh" as the Georgetown of Pittsburgh, it is one of the most acclaimed and desired neighborhoods in the city, often characterized as an expensive, ane even posh neighborhood. Shadyside has three main business districts. Walnut Street, which is on the western end, is perceived by many as a metonym for the neighborhood of Shadyside as it is the home of high-end national chain stores, an Apple Store, and several expensive restaurants. On the eastern end of Shadyside is Ellsworth Ave, and Highland Ave. There are also have many nicer restaurants on these streets, but contrary to Walnut, the shopping is mostly local and independent businesses here. There are vintage clothing shops, locally owned boutiques, and several antique stores on Highland and Ellsworth.

Our participants described the two neighboring neighborhoods as a study in contrast. East Liberty is predominantly black; Shady Side, predominantly white. East Liberty is lower-income; Shadyside is where wealthier people live. For many years, there was little connective tissue between the two neighborhoods. As several of our interviewees who identified more closely to Shadyside noted,

there was nothing to do in East Liberty other thank to "look for trouble." On the other hand, East Liberty residents felt that they are not welcome in Shadyside, with its "BMWs owners" and high-end stores.

Then came East Side[3] that shifted the balance of power. Local residents address the change to the opening of a Whole Foods Market in the fall of 2002. The grocery store was situated on Centre Avenue, directly on the line of conflict between East Liberty to the north and Shadyside to the south. In a course of 9 years since the opening day of the store, the area it inhabits has massively transformed and consequently affected patterns of behavior of both local residents and visitors.

Our algorithm discovered two Livehoods in this region. In Figure 3.5 (Left), LH1 is almost completely contained within Shadyside and encompasses Walnut Street (one of three Shadyside business districts), and the western end of Shadyside, which is mostly residential. On the other hand, LH2 *spilled* across the boundary between East Liberty and Shadyside, containing all of East Liberty and the Whole Foods, in addition to Shadyside's two other business districts (Ellsworth and Highland) and the eastern residential end of Shadyside.

Two main notions emerged from our interviews that support the way our algorithm clustered this area. First, the high-end national stores of Walnut Street draw an entirely different demographic than the locally owned independent shops of Highland and Ellsworth, supporting the *split* between the eastern end of Shadyside and the western end. Second, the recent developments of East Side, are actively blending the distinction between Shadyside and East Liberty, by connecting the business districts in both neighborhoods, supporting the *spilled* pattern in the region.

Kelley, a 29 year old resident of Shadyside, explained the difference between Walnut and Ellsworth:

> When you go to Walnut Street, that's where I often see an older demographic. You will see women and men above the age of 50

[3]East Side is the brand name for the development of a 14 acres starch situated on the border between the neighborhoods of East Liberty and Shadyside. The development was orchestrated by The Mosites Company, a local real estate development firm managed by Steve Mosites, Mark Minnerly and Susan Bicket, in collaboration with the East Liberty Development Inc., a community development corporation that supports the revitalization of the East Liberty.

> walking around with shopping bags. I don't see that demographic on Ellsworth ever shopping around... So I would say that's a big difference. You are going to see older, straight, richer people on Walnut and you are going to see much younger, more indie looking people on Ellsworth.

The distinction Kelley made between the two areas repeated in many of our interviews with Shadyside residents. In addition to the different demographics visiting the commercial districts, several of our participants noted that the housing stock on each end is different. In the area surrounding Walnut Street one can find large self-owned, well-maintained family houses while on the eastern part, there is much more rental housing, primarily marketed towards students, and young professionals.

The grouping of the eastern portion of Shadyside with East Liberty in LH2 was also supported by many of our participants. For Kelley and many others that live in eastern Shadyside, socializing and using resources in the developed area of East Side feels more natural. As Erin, a 24 year old graphic designer, notes:

> That makes sense to me because I think at one point it was more walled off and this was poor [East Liberty] and this was wealthy [Shadyside] and now there are nice places in East Liberty and there's some more diversity in this area so they are becoming more the same. And I do think Shadyside is almost shrinking and you only do have a few streets that are really that wealthy and bougie any more.

Just like in our interview with Erin, the blurring of the borders between Shadyside and East Liberty appeared time and time again. Overall, 85% of the interviewees named this area when they were asked the open ended question: "Can you think the neighborhood borders are shifting or in flux anywhere around the city?" For Shadyside residents the East Side development is a natural extension of their neighborhood while for East Liberty people it is clearly part of their territory.

Although we received a great deal of support for our cluster, the mapping was perceived as controversial for several interviewees, mostly older residents of

the area. For them, the developments in East Liberty did not blur the lines between the two neighborhoods but rather created neutral grounds where both groups meet. As Donna, a 62 year old resident of East Liberty said in regard to the East Side development: "it doesn't bring us together. It's a place where both sides feel comfortable with." The role of the Whole Foods as a melting pot was also emphasized in our interview with the Mosites company. According to them, in addition to serving the wealthy residents of Shadyside, this specific Whole Foods location has one of the largest food stamps customers population of all the stores in their system which is attributed mainly to East Liberty residents.

3.4.4 Lawrenceville and Polish Hill: Geography and Identity

Lawrenceville, one of Pittsburgh's largest neighborhoods, had been going through massive changes and development in recent years. Our interviewees were conflicted about the cohesiveness of the area. For some, it is one big neighborhood encompassing more than 20 blocks whereas others notice distinct subsections carrying different characteristics.

The city itself subdivides Lawrenceville into three different municipal neighborhoods: Upper Lawrenceville, Central Lawrenceville, and Lower Lawrenceville. And although these areas are all connected by Butler street, the character of each of them is different. As Daniel, a 43 year old resident of Lawrenceville, explains:

> The look isn't different, but the vibe and the feel are very different. Middle Lawrenceville from 40th until the cemetery that is where the first people were moving in and fixing up the area... And then, Lower Lawrenceville, is kind of picking up right now and then Upper Lawrenceville it's been like the really rough area with gangs and drugs.

Our algorithm found similar divisions, breaking the area into three Livehoods with boundaries closely *corresponding* to those of the municipal map (see Figure 3.5 Right). The border between LH3 and LH4 was situated exactly on the 40th St. Bridge, the border between Lower and Cental Lawerenceville. The division between LH4 and LH5 was placed on 48th street, three blocks

away from the municipal border between Central an Upper Lawrenceville on 51st street.

We found strong evidence from our interviews supporting the Livehood clusters based on factors such as property values, crime rates, business types, and general feel. As Claudia, a 54 year old journalist, notes:

> I think middle [Central] Lawrenceville is the most desirable or well rooted. Where the better housing stock is. LH3 is definitely newer. LH5 pretty much was left alone... There are parking lots and convenience stores around 40th that when you hit those you think 'I have left something behind.' And then you are in another part of Lawrencevile because you passed a bridge and there's not a lot of connective tissue at some of these intersections.

Several of the interviewees did not agree with the separation of Lower and Central Lawrenceville. For them, the separation is arbitrary and it is based mainly on local businesses' interests. Since Lawrenceville was perceived as a dangerous area, a group of business owners in Lower Lawrenceville decided to brand the area as "LoLa" and market it as a stand alone destination for unique shops and restaurants.

Another point of interest is in the *spilling* of Lower Lawrenceville into the adjacent neighborhood of Polish Hill in LH3. At first glance, this grouping seems odd and not feasible. Polish Hill is a very small neighborhood that is separated from Lower Lawrenceville by train tracks and a bus way in addition to geographic barrier of being located on an hill. But this grouping seemed natural to Roger, a 47 year old resident of Polish Hill who said:

> I think it's pretty accurate... I think that's how some of our residents identify with Lower Lawrenceville because of their activities and their perception. Where they go to for entertainment, where they go for food, where they go because they enjoy the walk.

The connection the algorithm discovered between these two areas went both ways. As Jessica (a LH3 resident) explains "there are some places in Polish Hill we hang out a lot that feel more like our neighborhood."

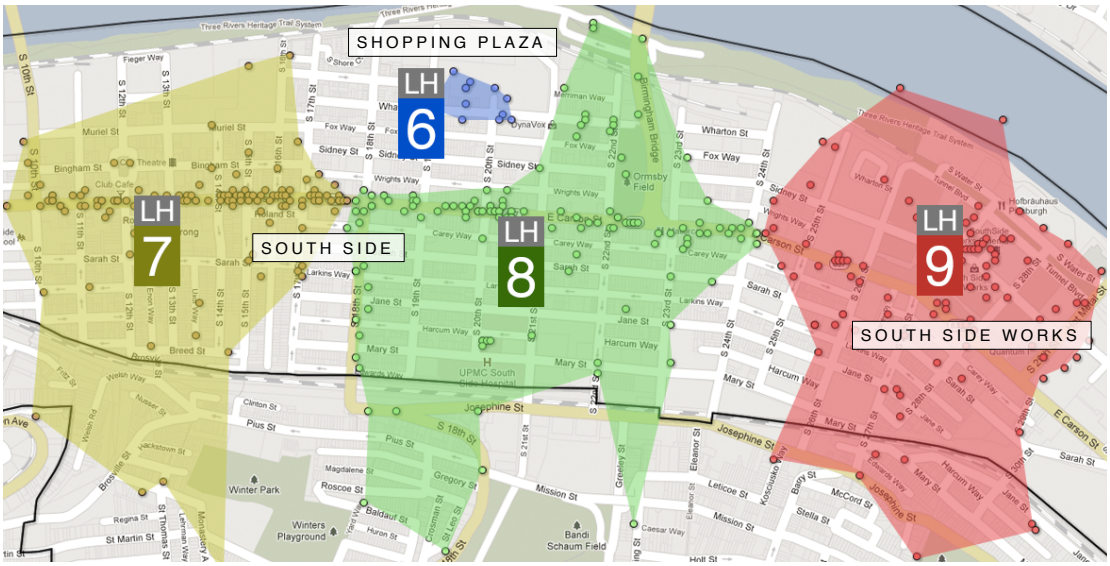

Figure 3.6: The municipal borders (in black) and Livehoods for South Side. This image originally appears in Cranshaw et al. 2012 [57].

3.4.5 The South Side: Density, Safety and Access

The South Side Flats neighborhood of Pittsburgh lies along the southern border of the Monongahela River. The main business district in the South Side is along Carson Street, which is one of the top destinations for nightlife in the city, as it has a high density of bars and restaurants. Moreover, occupying a large area on the eastern end of the neighborhood, there is a recently built mixed-use development called South Side Works consisting of an open air shopping mall with national vendors, several office buildings, and luxury condos, and stretches the Liberty Bridge in the east up beyond the Hot Metal Bridge to the west.

Our clustering algorithm *split* South Side Flats into four Livehoods (see Figure 3.6). LH7 is the area along Carson between Liberty Bridge and 18th Street, LH8 is the area between 18th and 24th Street, and LH9 is the area east of 24th Street. The fourth area, LH6 is a shopping plaza north of LH8. The union of these four regions *corresponds* very closely with the municipal boundaries of that region, indicating that the spatial patterns of the venues in the South Side Flats and the activity patterns of the people visiting them are well aligned with municipal definitions.

In our interviews, we found strong support of the Livehoods clustering for South Side. Particularly strong was the evidence supporting the *split* between

the western part of South Side Flats (LH6, LH7 and LH8), and the eastern portion around South Side Works (LH9). We asked every subject who was familiar with South Side to indicate any places where they notice a "shift in feel," and nearly all participants indicated that South Side Works, which begins just to the east of the Birmingham Bridge, is distinctly different from the rest of South Side Flats.

When we showed the municipal borders of South Side to Ashley, a 25 year old who works at a local radio station, she was surprised, commenting "Oh! So that is just all one big neighborhood. I would have definitely thought there is a division near the Birmingham [Bridge]." Later, when we showed the Livehoods mapping and asked her about the boundary between LH8 and LH9, she exclaimed:

> Ha! Yes! See, here is my division! Yay! Thank you algorithm! ...I definitely feel where the South Side Works and all of that is, is a very different feel.

This "different feel" around South Side Works was identified by many of the subjects. Sara, a 30 year old video game designer who lives and works in South Side describes South Side Works as "more up-scale" and having "more chains" than the western part of South Side, which she describes as having more "individual stores." Mark Minnerly remarked, after being shown the Livehoods mapping, that the grouping of LH9 was "totally intuitive" since it is comprised of mostly "national tenants." Kara, a 28 year old recruitment coordinator, described LH9 as a "totally different thing" compared to the rest of South Side. South Side Flats also has a much higher density of bars on its western end (LH7 and LH8) than there is near South Side Works (LH9). One manifestation of this is that there is less foot traffic, especially at night, on the eastern end of Carson.

Although nearly everyone understood and could explain the differences between LH8 and LH9, there was less agreement about whether the *split* between LH7 and LH8 was valid. For instance, Sara mentioned that the difference between LH8 and LH9 made sense to her, but she did not know the difference between LH7 and LH8. On the other hand, Kara, who has lived both on the western end of Carson (LH7) and on the more eastern parts (LH8) noted that it feels "a bit more isolated" around 23rd making her feel "less safe." She

elaborated:

> Whenever I was living down on 15th Street [LH7] I had to worry about drunk people following me home, but on 23rd [LH8] I need to worry about people trying to mug you... so it's different. It's not something I had anticipated, but there is a distinct difference between the two areas of the South Side.

As Kara notes, although the difference is not very prominent, the division by the algorithm displays a subtle difference that can be attributed to the type of people and business in each of these parts.

Moreover, those that did notice a shift between LH7 and LH8 described the street as being narrower and the buildings closer together in LH7. Zach, who is a 30 year old technology consultant and who used to be a cab driver in Pittsburgh explained "from an urban standpoint it is a lot tighter on the western part once you get west of 17th or 18th [LH7]." The added density of bars and restaurants west of 18th makes LH7 more appealing to those visiting it for the nightlife, especially for Dusquesne University students, who can walk across the 10th Street Bridge to LH7. This translates to the outsider influence on LH7 that can be observed by looking at it's related Livehoods. LH7 was strongly related to LH8 and LH9, but was also related to the Livehood of Dusquesne University (un-shown). Notably, LH7 was not strongly related to the nearby LH6, which contains the only grocery store in South Side. This is in contrast to LH8, which did have a strong relation to the grocery store, indicating that LH7 was more influenced by outsiders than LH8.

LH6 has a completely different story to it. This area contains the only grocery store (Giant Eagle) in South Side. The Giant Eagle is located in a medium sized strip-mall that attracts a demographic that, as noted by our subjects, is distinct from the rest of South Side. As Sara explains:

> There is this interesting mix of people there I don't see walking around the neighborhood. I think they are coming to the Giant Eagle from lower income neighborhoods...I always assumed they came from up the hill.

Kara also expressed the same sentiment. When asked who it is that visits LH6, she said that it is "people that live up on the slopes maybe even towards

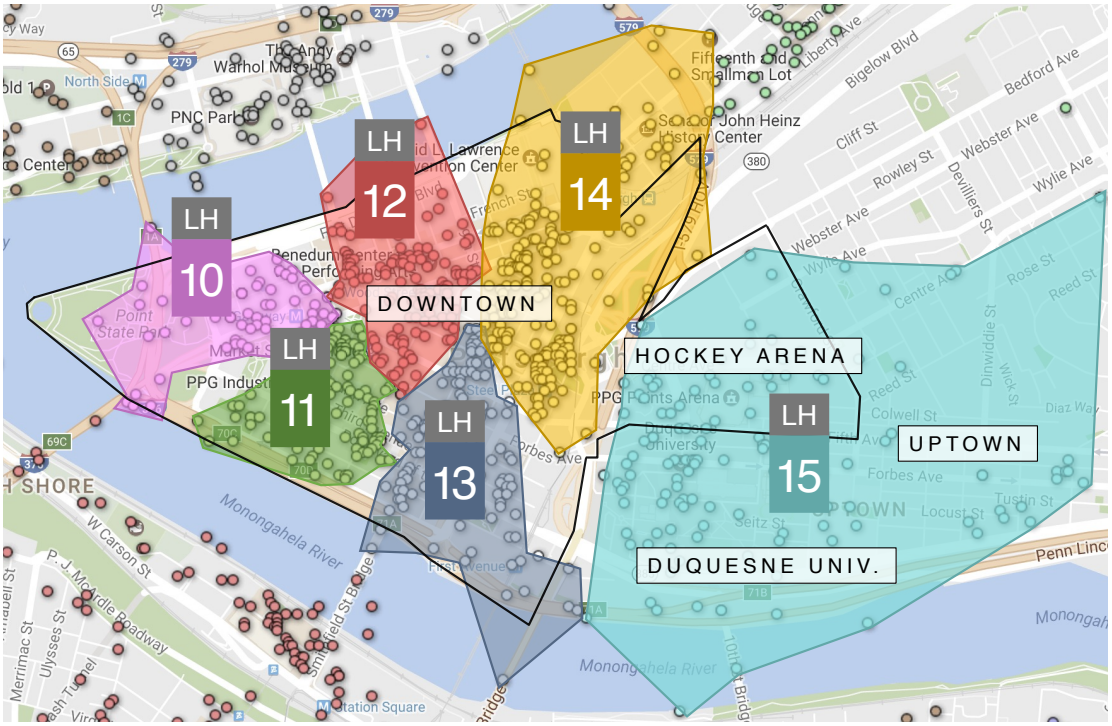

Figure 3.7: The municipal borders (black) and Livehoods for Downtown Pittsburgh.

Carrick," which is another municipality to the south. The related Livehoods for LH6 verified their assumptions, showing a wide area spanning several communities in the hills to the south. That such a wide area was strongly related to such a small shopping center reveals the distinct lack of resources in these communities, some of which are significantly poorer that the South Side, and many don't have a grocery store of their own.

3.4.6 Downtown: Regions of Differing Functions

Downtown Pittsburgh is a small triangular area that's bordered on the north, south and west by the confluence of the Allegheny River and the Monongahela River, and on the east by an interstate highway and by Duquesne University, sitting atop a large hill. Like most downtown areas, Downtown Pittsburgh has the highest density of buildings in the city, including most of the city's high-rise office buildings, several educational institutes, government offices, apartment buildings, theaters, cultural institutions, and hotels.

While the municipal boundaries suggest that Downtown Pittsburgh is one

monolithic neighborhood, we see from Figure 3.7 that the Livehoods tell a more complex story. Our method divides the Downtown area across six Livehoods, in a *mixed* pattern; the core Downtown triangle exhibits a *split* pattern across five Livehoods (LH10 - LH14), while LH14 and LH15 *spill* across the eastern borders of the city's official boundaries.

In the case of LH14, the Livehoods extend beyond the official northeast border between Downtown and the Strip District, extending several blocks east all the way to the highway. This is precisely where Kyle, who lives and works downtown, would have placed the border. As he describes (prior to us showing him the Livehoods map), "the Strip, once you get pass a certain point I don't feel it goes as far as it does here [pointing to the municipal boundary between Downtown and the Strip District]. … it's really a dead zone. I would consider downtown to go to the overpass. I would move that border back." Kyle's observation highlights a dynamic we've seen numerous times in analyzing Livehoods data: urban highways create strong psychological borders that influence peoples' movements throughout the city.

LH15, on the other hand, clusters the eastern downtown appendage containing the Consol Energy Center hockey arena with the nearby areas of Duquesne University and Uptown, rather than with any of the core Livehoods inside the triangle. Deborah expressed surprise that hockey arena is considered part of Downtown, given the area's historical roots as a residential neighborhood as part of the Hill District.

> I see they consider the Igloo as part of downtown because when they put the Consol that was a city deal.[4] It exits as parking right now. But this historically has been residential…The people there were also salty about the way that the Igloo ended up in The Hill because that was a move of "urban renewal." That area has always been The Hill, they just wiped it out and stuck that Igloo there. They wiped off a 5-10 block area. It was a mix of residential and small businesses.

The expansion of LH15 into Uptown and the Hill District may be vestigial remnants of neighborhoods long past, as Deborah recounts, or it may reflect

[4]The Igloo is a nickname for the Consol Energy Center, the arena where the Pittsburgh Penguins play ice hockey.

modern day functional usage patterns of the area, as hockey patrons park their cars and visit the nearby bars and restaurants of LH15 prior to games, rather than venturing into the denser and less car-friendly areas of Downtown proper.

Within the triangle, the five *split* Livehoods of LH10-LH14 reveal that even within a central business districts dominated by towering skyscrapers, shared areas of collective identity emerge. Kyle attributed the differences among the five downtown Livehoods to a combination of lunch-going behaviors of people who commute downtown to work, and differences in the function of the different downtown regions. He notes that, LH12 is the theater district, which attracts people visiting downtown for cultural events. With ample parking and restaurants to accommodate the theatre crowd, LH12 offers a one-stop-shop for people visiting for a night on the town. "The red [LH12] are theater-goers. Parking garages are very close in their location around the theaters, restaurants are set around the theaters too. So I think people park in there, they are going to eat there, they go to see a show and then they are leaving." He also points out other functional differences among the five Livehoods: LH11 contains Point Park University and Market Square, the main shopping area downtown, and while LH13 and LH14 are both contain office buildings where people work during the day, LH14 is the core business district and LH13 is the government center, containing city hall, the county courthouse and several other large municipal buildings. After we described the clustering algorithm to him, Kyle was pleased to note that the Livehoods mapping revealed folk boundaries that he and his coworkers had previously discussed:

> It's funny, we actually talked about this at work, Smithfield St [approximately the dividing line between LH11-LH12 and LH13-LH14]. We have always said that's a dividing line in town. If you work on this side of town [pointing to LH13 and LH14] you don't go below Smithfield St, and if you work on this side of town [pointing to LH10, LH11, and LH12] you don't go above Smithfield St, and it's pretty close. It's pretty much mapped in here. So you proved it!

This anecdote illustrates the social processes by which socially constructed boundaries are reinforced; lines that start as internal divisions in peoples individual mental maps are codified and given meaning through social

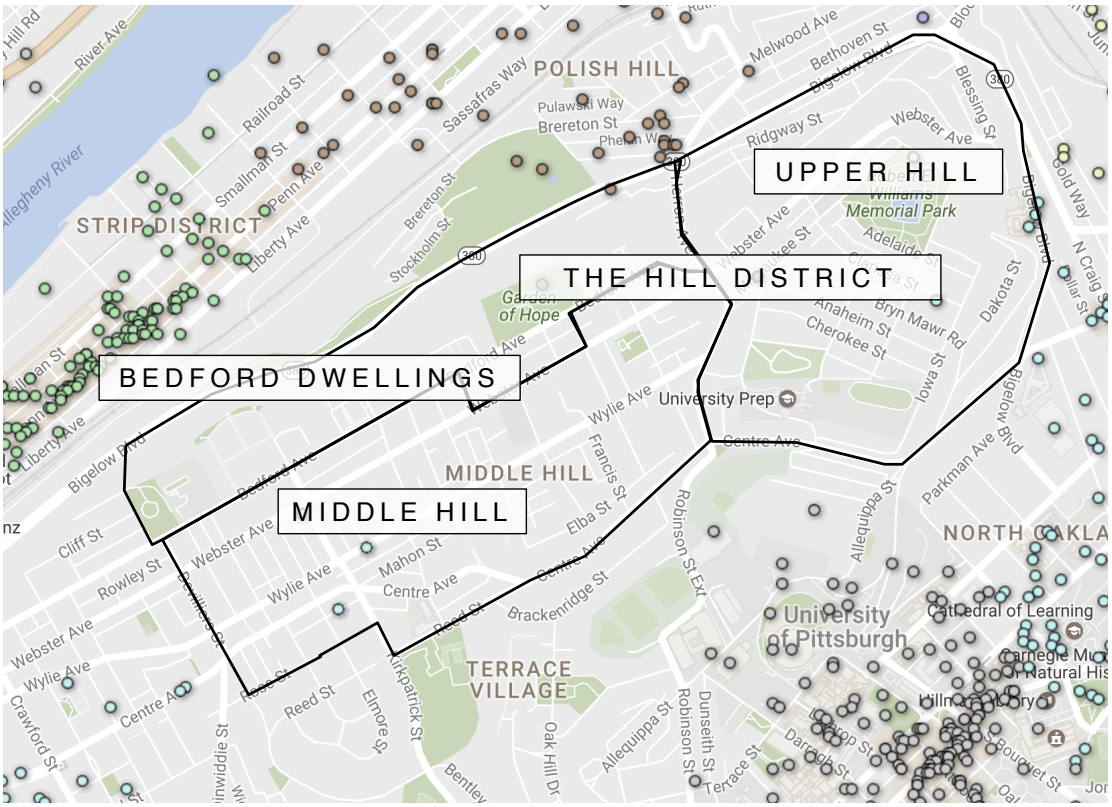

Figure 3.8: The municipal borders of the neighborhoods in the Hill District.

interactions.

3.4.7 The Hill District: Data Bias and the Digital Divide

The Hill District is a centrally located, predominantly black neighborhood with a rich and tumultuous history famously documented in the plays of August Wilson. Following the demolition of huge swaths of the neighborhood to make way for a hockey stadium in 1958, it is now one of Pittsburgh's poorest areas with 40 percent of the residents living below the poverty level. Although a number of civic organizations have plans to revive the area and return it to its heydays of the 1930-50s, it is currently regarded by many of Pittsburgh residents as a place to avoid.

In the Livehoods mapping, the Hill District simply did not exist (see Figure 3.8). Instead the mapping showed a big gap in the middle of the city where the neighborhood should be. While the areas immediately surrounding the Hill District were represented by the different Livehoods, the Hill District's

only representation on our map was its lack of presence. In this way, the Hill District doesn't align with any of our dispersion patterns—or perhaps it matches a fourth pattern we hadn't anticipated, called *missing*.

We presented the Livehoods mapping to Deborah, an unemployed Journalist, that lives in the Hill District and asked for her reaction. She said:

> That's a lot of open spaces... It looks like if you were to look around here (pointing to the hill district - RS) it is like there is a plague.

Deborah identified all the other Livehoods that were surrounding the Hill District and at first felt that the lack of representation was due to the lack of interesting destinations in that area. After briefing her about the way the algorithm works and the data it is based on she said:

> That means there is more Internet use in these other areas outside of the hill. This is basically a visualization of the digital divide.

For Deborah the mapping presented a known fact to her referring to the lack of smartphones ownership in the Hill District. In a way, the Hill District was mapped through its lack of mapping.

These results lay bare the potential for how maps derived from biased data might cause harm to people and communities, in amplifying an existing digital divide.

3.5 Forces That Shape Neighborhoods

In this work we present a clustering model for mapping a city based on the collective behaviors of its residents. By analyzing patterns of people's movements through the city, our approach offers a way to visualize and investigate the on-the-ground dynamics, structure, and character of a city on a large scale. Assuming that both people and places define the character of an area, our results portray a dynamic, almost live, view of the social flows of people throughout the different parts of a city–the Livehoods.

We identify three dispersion patterns that describe the relationship between city neighborhoods and Livehoods: *split*, *spilled* and *corresponding*. Based on our interviews, we find different local dynamics that each of the patterns could possibly represent. *Split* patterns often show the different demographics or

different functions that operate in a certain area. *Spilled* patterns typically reveal areas that are in transition, or borders that are in flux. Finally, *corresponding* patterns indicate the strong influence municipal borders and geography have over local social interactions. In the following section we will examine some of the factors that shape the city and show how they translate to our mapping and dispersion patterns.

3.5.1 Municipal Neighborhoods Borders

Contrary to the strict and largely fixed neighborhood borders set by the city government, Livehoods are dynamic, and evolve as people's behaviors change. City neighborhoods borders predominately serve as a way to make order in the chaos of the urban ecosystem. As Justin Miller, a senior planner in Pittsburgh City Planning office explains:

> I need things organized because we have a functional role here...We have to allocate resources and there are a lot of dollars attached to those boundaries...in a lot of the cases, one side of the street is going to qualify for CDBG and the other side is not.[5]

These arbitrary borders, set by the city urban planners based on census tracts and geographic landmarks such as roads and bridges, play an important role in the allocation of resources and the planning of local development. But as can be seen from our results, these borders only partially represent the different areas of the city.

In several cases, the Livehoods boundaries *corresponded* perfectly with the municipal borders indicating the strong role that neighborhoods do play in shaping people's activity (e.g. between LH3 and LH4 at 40th Street). However, in some cases, Livehoods *spilled* across the borders between two or more neighborhoods. For example we can see LH2, which *spilled* across the border between East Liberty and Shadyside. In this case, the crossover indicated a shift in peoples' behaviors and perceptions of that area, due to a concerted effort of developers to blur the lines between what were once two very different neighborhoods. In other cases, a single neighborhood may be *split* into several Livehoods. As we saw with LH6, LH7, LH8, and LH9, each had their own

[5] A program of the US government that provides Community Development Block Grants to local communities in need.

character as defined by the demographic mix of local residents and visitors.

3.5.2 Demographics

In our interviews, we found strong evidence that the demographics of the residents and visitors of an area often played a strong role in explaining the divisions between Livehoods. As mentioned above, South Side was *split* by the algorithm into 4 different Livehoods. Our interviewees characterized each of these differently based on the type of people who visit them. For example, LH9 was described as a newly developed area harboring national chain stores in contrast to the more local, mostly night-life oriented area of LH7–each attracting different demographics.

In addition, the lack of both users and venues data for certain areas provides another way of tracing its demographics. For example, The Hill District, one of Pittsburgh's poorest neighborhoods did not appear at all in the mapping although it occupies a large area in the heart of the city. The area, that is mainly inhabited by low income, predominately black residents, lacks any representation in our mapping thus implying a the low rate of smartphone usage, and providing a possible depiction of the digital divide.

3.5.3 Development and Resources

Economic development can affect the character of an area. The *spilled* mapping of LH2 captured the social effects the developments of East Side had over the neighboring areas of East Liberty and Shadyside. By visualizing the flow of people between the two once conflicting areas, the algorithm identifies the implications that the economic development had for residents and visitors of the place.

Similarly, the resources (or lack there of) provided by a region has a strong influence on the people that visit it, and hence its resulting character. The *split* area of LH6 in the South Side, which serves as a grocery shopping hub for the communities south of Pittsburgh highlights the distinct single-purpose of that area, and therefore distinguishes it from the surrounding Livehoods.

3.5.4 Geography and Architecture

The flow of people through the streets of a certain area is shaped by the geography and the architecture of the place. We discovered that Livehoods can reveal this influence and the effects it has over people's visiting patterns. For example, the algorithm created a division between LH7 and LH8 in South Side. This division was unclear to some participants, but others noticed the subtle change in building density on either side of the division. This subtle change effects the kinds of businesses that are on either side, and in turn effects the behavior of people visiting these areas.

3.6 Conclusions and Future Work

In this chapter, I explore how to make neighborhood maps more place-centered by representing them, not as static and monolithic boundaries that tile a city, but as dynamic and flexible areas that can reshape themselves to represent the day-to-day realities of neighborhood. To explore this idea, I introduced Livehoods, an approach to modeling, representing, and studying neighborhoods that leverages real-time digital footprints of city dwellers to develop more flexible representations of neighborhoods. Our case study exploring peoples perceptions of Livehoods in Pittsburgh provides strong evidence that the regions our algorithms identify are meaningful representations of collective urban activity at a hyper-local scale, offering a more dynamic and more place-centered depiction of the city as its being lived in the moment.

This work has several limitations and biases that are important to address. First, by aggregating the behaviors of many people, the algorithm itself may be prone towards a "majority" bias consequently misrepresenting or hiding behaviors in the minority. There are also several biases inherent in the methodology and type of data we use in this work. Moreover, our data are based on a limited sample of checkins shared on Twitter and are therefore biased towards the types of places that people typically want to publicly share. The demographic of Foursquare users, which is usually characterized as young professionals in the ages between 25 and 35, owners of smartphones and urban residents can also influence our results. Tuning the clusters is non-trivial and may lead to experimenter bias which joins the possible "confirmation bias" of

the interviewees. This mapping might also contribute to local segregation and create a “geo-fencing” effect that will perpetuate separation between demographics.

Curated City: Representing the Experience(s) of Place

> *Cities are places of work, consumption, circulation, play, creativity, excitement, boredom. They gather, mix, separate, conceal, display. They support unimaginably diverse social practices. They juxtapose nature, people, things, and the built environment in any number of ways.*
>
> —Amin and Thrift, 2002 [12, p. 3]

In this chapter, I present an accounting of our design of Curated City, a social and collaborative online city guide that strives to represent the multiplicity of experiences of life in a city. Curated City balances the richness of individual expression with the wisdom of the crowds, allowing people to chronicle their favorite place-based experiences in their own personal guide to the city's neighborhoods, while immersing them in a process of social curation that simultaneously spurs their creativity while allowing popular experiences to bubble up to the surface.

The research in this chapter was published CHI 2014, in collaboration with Kurt Luther, Patrick Gage Kelley, and Norman Sadeh [55] .

4.1 Introduction: The Experience of Place in Cities

"Every citizen has had long associations with some part of his city, and his image is soaked in memories and meanings."

(Kevin Lynch, The Image of the City [137])

We are, each of us, profoundly affected by the experiences we have at the places we visit. This is especially true in cities, where number of potential activities one could engage in at any given moment vastly outnumbers what is possible for a single person to experience. Whether it be enjoying the familiar atmosphere at a favorite pub, taking a leisurely walk through the park, or discovering a new band at an open mic night, our rich and personal local experiences color how we perceive and interact with the people and places around us. The coalescence of these individual experiences imbues each resident with their own unique conception of the city, formed over years of association with places, rooted in habit, and influenced by culture, socio-economics, geography, and history. As we discussed in Chapters **??** and 3, this unique and subjective representation of the city created in the minds of each city-dweller is often called their *mental map* or their *image of the city* [137].

Researchers have long studied how mental maps can be used as a way to probe peoples' perceptions of the built environment [137], and to delve deeper into the cognitive processes that govern city life [**?**]. Recently, in the context of the mobile and social web, mental maps have been explored as a framework for analyzing and improving the richness of the location-based services and online city guides [26, 185], which have traditionally presented a dull, biased, and sanitized view of the places in a city. In the typical user scenarios, online city guides are designed to incentivize user-generated content, most commonly in the form of *venue ratings* or *venue reviews*, that describes and evaluates the city and its places and experiences.

Both ratings and reviews have strengths and limitations. Speaking first to their respective strengths, reviews are helpful in that they allow people to be maximally expressive of their personal experience at the venue. In reviews,

people are free to highlight what they liked and what they didn't like in as much detail as they see fit. This level of detail is also helpful to people who are consuming the reviews, allowing people make decisions about how others' experiences align with their own nuanced preferences.

Ratings, on the other hand, are helpful for the opposite reason. While they offer minimal expressiveness, they present an efficient way for a person to quickly assess the quality of their experience at a place and share it with others. From the perspective of those consuming these ratings, it's similarly easy to quickly get a sense of the quality of an experience, given the average ratings an experience has received.

Despite these positives, both ratings and reviews in online city guides can have a number of problems stemming from misaligned incentives and interaction design flaws. For example, it's not uncommon to see people write long and sometimes overly detailed reviews, which can be costly for a consumer to read through and process. The reviews themselves can be overly critical of un-generalizable things, for example a dirty fork may be an one time occurrence that spawns a horribly negative review that may keep people away. There's also a significant amount of redundancy, and duplicated work in local reviews, which is both wasted effort on the part of the reviewer, and a missed opportunity for identifying review commonalities [88]. Furthermore, because of the immense power that these websites command in terms of generating (or not generating) foot traffic, business are frightened of un-justified negative reviews, which they are sometimes left powerless to correct.

Ratings can also have critical problems. While ratings can help asses quality, their lack of expressiveness projects the full variability of local experience onto an arbitrary numeric scale that can be interpreted differently by different people. Ratings often tend to be bi-modal in distribution, an artifact of a sampling bias towards the extreme ends of the spectrum where people are disproportionately motivated to leave a rating when they either love a place and want to give it 5 stars or the hate it and give it 1. Such biases can significantly skew ratings, making it difficult to discriminate between experiences with similar average ratings, yet very different rating distributions. Finally, having a uniform rating system induces comparisons between incomparable things, for example a

Michelin rated restaurant and a fast food restaurant might both end up with 4.5 stars on average, but they're clearly quite different experiences.

While places may support a diverse range of perspectives and experiences, ratings and review systems tend to conceal this diversity by framing the quality of an experience at a place in a black and white, thumbs-up or thumbs-down manner, leaving little room the shades of gray of alternative experiences or minority opinions. These systems are also often biased towards experiences that are inherently commercial, such as restaurants, bars and other local businesses, while many of the most vibrant and vital places in a city are non-commercial. These dynamics induce a competitiveness in online ratings that can at times feel toxic, needlessly creating a zero-sum landscape of winners or losers. There are many unintended consequences and secondary impacts to rating and review sites, as local businesses report being feeling as if they are being held hostage by their scores on these websites, and try to over optimize their business practices in order to change their scores—decisions that may or may not align with improving them as places.

In this work, I design social city guide aligns better with people's mental maps of the city. Although mental maps are unique to each individual, they are also inherently social, reflecting one slice of the shared urban experience. Lynch called the commonalities across a collection of mental maps the city's *public image* [137]. Public images reflect the shared local and cultural knowledge of the populous, facilitating coordination and cohesion between individuals and the environment. Harnessing this collective wisdom presents enormous opportunities for building online local services that are more faithful to the urban experience in endeavors such as local search, travel and tourism, transit, online social networking, and local news. One challenge in realizing this vision lies in externalizing mental images of the city in a manner that is scaleable to millions of people while capturing the richness of their personal perceptions. Once collected, this information must be aligned and aggregated in a manner that captures usable public images of the city.

It is in this gap between the scalability and the fidelity to personal experience where our work makes a contribution. We introduce Curated City, a website that explores collaborative and social mechanisms for producing

scalable, yet expressive mental map externalizations. Users of Curated City are tasked with producing a personal guide to their city by chronicling the experiences and Instagram photos that best express the places that they care about. To highlight the overlaps between individual mental maps, users' guides are visible to one another and are networked via their common places and shared experiences, allowing the city's public image to emerge through social curation. Users' guides are also visible to one another, and are networked via their common places and shared experiences, highlighting the overlaps between their individual mental maps, and allowing the city's public image to emerge through social curation.

In this chapter, I describe the design of Curated City, and the results of a two week field trial in which 20 residents of Pittsburgh were asked to login and add content to their personal guides every day. By combining interviews, and an exploratory analysis of site usage data, we use this deployment as a technological probe [108] to uncover some of the successes and stumbles of possible system designs for assisting denizens in curating their city. The results of our efforts are synthesized into a set of insights that designers can incorporate into future place-based urban and social technological systems.

4.2 Background

A mental map is simply a person's biased internal image of a large area of space, encompassing all their local knowledge, and formed through the totality of their experiences and perceptions of the environment. This knowledge can be spatial, but can also be sensory, experiential, cultural, personal, or emotional. Mental maps were introduced by Kevin Lynch in his groundbreaking 1960 work, *The Image of the City* [137]. Lynch's objective was to formally study qualities of how the urban built environment were perceived by the city's populous. Doing so required a formal methodology for externalizing peoples' mental images of the city. He developed a detailed protocol that asked people to describe their city, to provide a hand-drawn sketch of its main features, and to detail various routes they frequently took, including discussions of any perceptions and even any emotions they might have felt at points along the way. Lynch collected dozens of these mental maps, and then formed a representation of the city's public

image by aggregating the individual maps along a fixed set of elements of the urban form: paths, edges, districts, nodes, and landmarks. Following Lynch's seminal work, the methodologies he employed have appeared prominently in other research areas,[1] including social psychology [145**?**], geography [230], cognitive psychology [104, 234], and artificial intelligence [123].

More recently, mental maps have begun to influence research in human-computer interaction, especially relating to location-based services, and the mobile and social web. Bentley et al. replicated Milgram's study protocol to see how modern technologies, including checkin systems such as Foursquare, are influencing peoples' perceptions of place [26]. Researchers have also begun to explore ways of scaling this process up technologically. Quercia et al. built and studied a crowd sourcing system that utilized Google Street images to investigate Lynch's hypotheses about imaginability on a large scale [185]. Cranshaw et al. examined whether social media can be used as an externalization of people's mental maps; Livehoods used Foursquare checkins to produce a "public image" of a city's neighborhoods [57].

Curated City's use of mental maps is more subtle than these works. Rather than revisiting past research questions in the context of modern technology, we use the mental maps as a theoretical framework around which we designed a social curation system to highlight the public's experiences of the city.

There is a long history of work exploring computing technology and the city [106, 168], or more broadly technology and local communities [95, 190, 239]. In offering a system that both studies and influences people's attachment to place, and their relationship with their city and its neighborhoods, our work makes contributions to these areas as well.

Our work also ties into the social computing and creative online collaboration literature. In designing Curated City, we were inspired by work investigating remixing in collaborative systems, such as Scratch [149], ccMixter [42], and Reaktor [51]. By allowing users to re-share elements of another user's guide, Curated City also provides affordances for remixing, such as buttons for quick re-sharing and automatic attribution [149]. Unlike these

[1]Similar concepts have appeared in the literature under various names, including *image of the city*, *mental map*, *cognitive map*, and *psychological map*, each having slightly different connotations. We use the term *mental map* referring to Lynch's formulation [137].

other systems, the content being shared on Curated City centers on lived experiences rather than multimedia.

4.3 Curated City System Design

Building a personal city guide is a challenging task—the creator must assemble from their long history of urban interactions, those places and experiences that they feel are noteworthy enough to mention. Some urban experiences might be easily recalled, for example ones that happened recently or that occupy a prominent role in the creator's life. Still others might be difficult to bring to the mind's surface without some external stimulus. Indeed, the role of the interviewer is crucial to Lynch's protocol. In order to ensure that nothing is missed, the subject's perceptions of the city must be continually probed through free association, in order to explore and discover relevant findings that even the subject may not have been fully cognizant of.

Curated City is a social website that allows people to create and share their own city guide, allowing other people to explore their favorite parts of a city, neighborhood by neighborhood. There are two main challenges that Curated City attempts to address. The first challenge is one of *externalization*: making external a person's mental image of the city. The second challenge is one of *aggregation*: combining the many individual images into a public image of the city.

In designing Curated City that is more representative of how people actually experience places, our process was deliberately structured to explore the range of possibilities for how a social city guide might address these two challenges. Throughout we've taken efforts to build on design patterns that support externalizing and aggregating people's mental maps across a diverse range of perspectives and experiences of place, encouraging people to build city guides that may showcase alternative experiences or minority opinions.

The Curated City user experience is divided into two primary components: the *Feed View* and the *Guide View*. To lessen the burden associated with externalization, the Feed View shows a list of experiences shared by all users of the system. In this way, as users observe and are inspired by the work of others, they can free associate, and even reuse others' content, serving in many ways, as

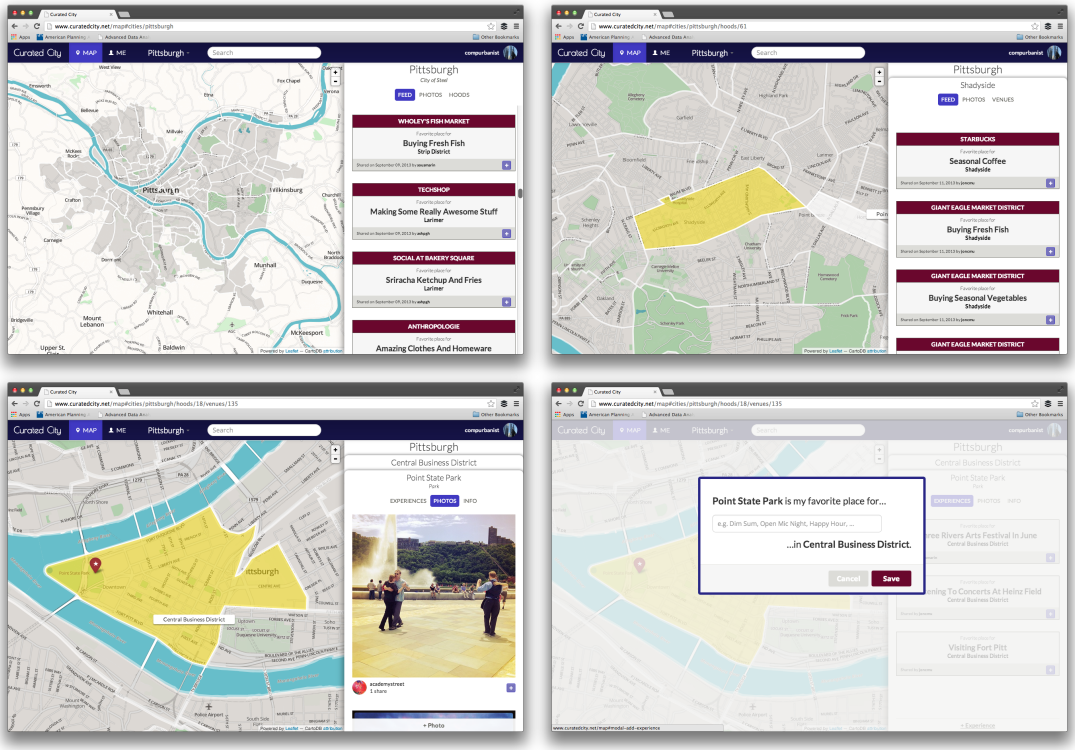

Figure 4.1: Three screenshots of the *Feed View* of Curated City and a screenshot showing the *Add Experiences* modal view (bottom-right). Users can explore a feed of content at the city-wide level (top-left), neighborhood-wide level (top right), and venue-wide level (bottom-left). Once a venue is selected, users can add experiences or photos to that venue by clicking a *Share* button. Detailed views of the Feed View and the Add Experiences modal can be seen in Figure 4.2 and Figure 4.3 respectively.

a proxy for the interviewer in Lynch's protocol. Additionally, as I will discuss below, the design of the prompt for collecting experience text was introduced to focus the range of possible user inputs, simplifying the creative process, while still allowing users to share highly expressive sentiments. By nudging this experience text to be short and focused, we also hoped to increase the chance for overlapping experiences, creating the opportunity for aggregation through social curation. Finally, making each component of a person's own individual user guide reusable, we are are implicitly encouraging users to aggregate the experiences they have in common through remixing.

4.3.1 The Feed View

Figure 4.1 shows a screenshot of the Feed View, which is the main way people discover new content from other people about parts of the city. When a user selects a geographic place of interest, the Feed View displays a user-curated feed of experiences at these places.

To hone in on a geography of interest, users may either search or browse the places of the city. In the navigation bar at the top of screen is a search input, which allows people to search for *neighborhoods*, *venues*, and *experiences*. As users start to type their search query, they are assisted with a auto-complete typeahead[2] showing matching neighborhoods, venues, and experiences, with a visual treatment to distinguish the three entity types. Although some users may find this search useful when they are looking for something specific, the overall design ethos emphasizes browsing over searching to prioritize discovery by serendipity. On the left side of the Feed View is an interactive map of the city's neighborhoods, which serves as a navigation interface letting users click on and select a neighborhood, while also providing geographic context as to which neighborhood or venue is currently selected.

Based on the user's selection, on the right side of the Feed View is an information feed of recently posted content about the currently selected city, neighborhood, or venue. The top-left, top-right, and bottom-left of Figure 4.1 shows examples of this feed at the city, neighborhood, and venue levels respectively. Note, as users drill in to deeper levels of specificity in the

[2]https://twitter.github.io/typeahead.js/

geographic hierarchy, the respective feeds are stacked like cards on top of each other. Figure 4.2 shows a detailed view of the photos and experiences feeds for a neighborhood and a venue.

At each level of the geographic hierarchy, the feeds have three distinct *pages* that filter the type of content displayed in the feed. Users select a page using a pill-menu appearing at the top of the feed panel. The city, neighborhood, and venue feed types all have one page for *experiences* and another for *photos*. The third page is distinct across the three levels. The city feed has a page that lists the *neighborhoods* in that city, while the neighborhood feed lists all the *venues* in the selected neighborhood—both cases provide yet another navigational method for drilling into different geographies. Venue feed types have a page for *venue information*, which displays some meta-data about the venue, including its name, address, and place category.

When users are browsing the experiences or photos of a venue, there there is a button at the bottom of the feed to add either a photo or an experience to that venue. Clicking this triggers a modal popup that guides the user through the process of adding a photo or an experience to that venue (see the bottom right of Figure 4.1).

4.3.2 Creating and Sharing Content

Our design allows for people to create and share two types of content, **Photos** and **Experiences**. As a user creates content, two things happen. First, we automatically generate an entry in the user's guide, properly inserting the content with the associated neighborhood and venue. Second, the content is shared in the appropriate public information feeds for the whole city, the neighborhood, and the venue, with an attribution link pointing back to the user's guide page.

Photos can be imported to a venue or neighborhood from a user's Instagram account, which is also used for authentication. When a user clicks the "add photo" button, we query the Instagram API to search for photos that they have previously posted in the geographic vicinity, displaying them in a scrollable grid menu inside a popup window. Users add photos to their city guide by selecting them from this menu.

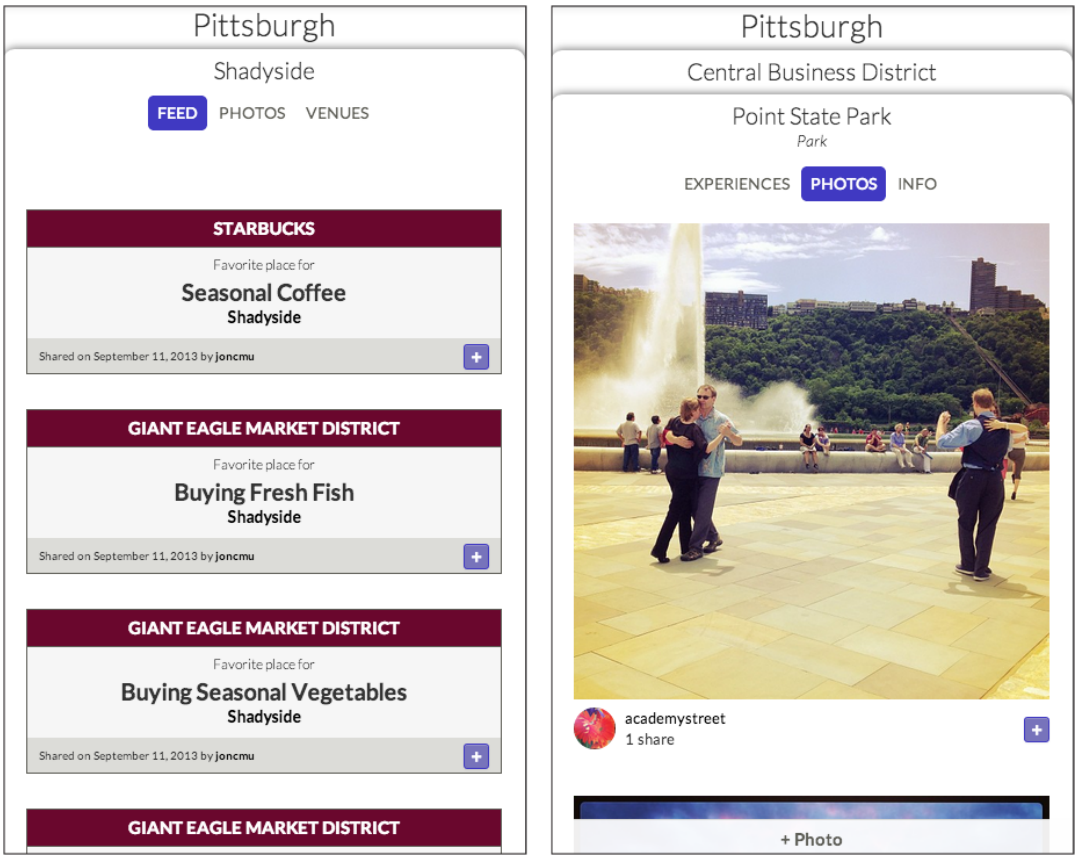

Figure 4.2: A detailed look at the content in the *Feed View*. Users can select a city, a neighborhood in that city, or a specific venue in a neighborhood and see a feed of content (images and experiences) that people have shared about the region that they selected. Each piece of content has a *plus* button that allows users to implicitly endorse a piece of content another user has created by adding it to their own city guide.

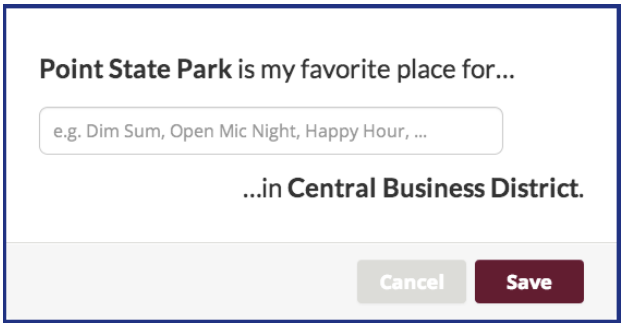

Figure 4.3: A detailed view of the *Add Experiences* input modal. When users seek to add an experience at a venue, they are asked to answer the prompt: "[Venue Name] is my favorite place for _____ in [Neighborhood Name]."

While photos offer a straightforward way to add rich visual depictions of places, **experiences** are actually the core design element of Curated City. Experiences are short snippets of text that users can add to describe a venue. Clicking the "add experience" button triggers a modal popup asks the user to complete the prompt: *[Venue Name] is my favorite place for ___ in [Neighborhood Name].* We list these short fill-in-the-blank responses along side venues to highlight their unique and notable experiences.

The design for this prompt is deceptively simple. While the basic interaction is straightforward and the question is easy to answer, there are several subtle yet important design elements packed into this short prompt. While allowing for a completely free text response encourages people to be creative and expressive with their responses, the madlibesque scaffolding of the prompt text focuses this creativity, nudging the user towards descriptions that are thoughtful, personal, and placeful. For example, by asking what aspects about a venue are their "favorite," we are explicitly nudging people towards making positive statements about places. The word "favorite" also implicitly invokes a comparison between this venue and other venues, however we limit the scope of that comparison to be "in the neighborhood." This limited scope not only makes it easier for the user to answer the prompt, but it also limits the sense of competition among venues. It's perfectly acceptable for a person to have multiple "favorite" pizza shops in different neighborhoods across the city, for example. Finally, while the short length of the response (which is limited to 50 characters) might dampen creativity, it encourages reusability. With many users in a city contributing short textual answers to the same prompt and to the same set of venues, it is be much more likely for multiple people to have the same responses, and so it will be much more likely to aggregate along common experiences. If many people share the same opinions and experiences about a place, this adds weight to their responses. This design element highlights the fact that cities are places that balance both individual and collective experiences.

4.3.3 The Guide View

Users of Curated City create their own personal *city guide*, which serves also as their user profile that others can browse and take inspiration from. Figure 4.4

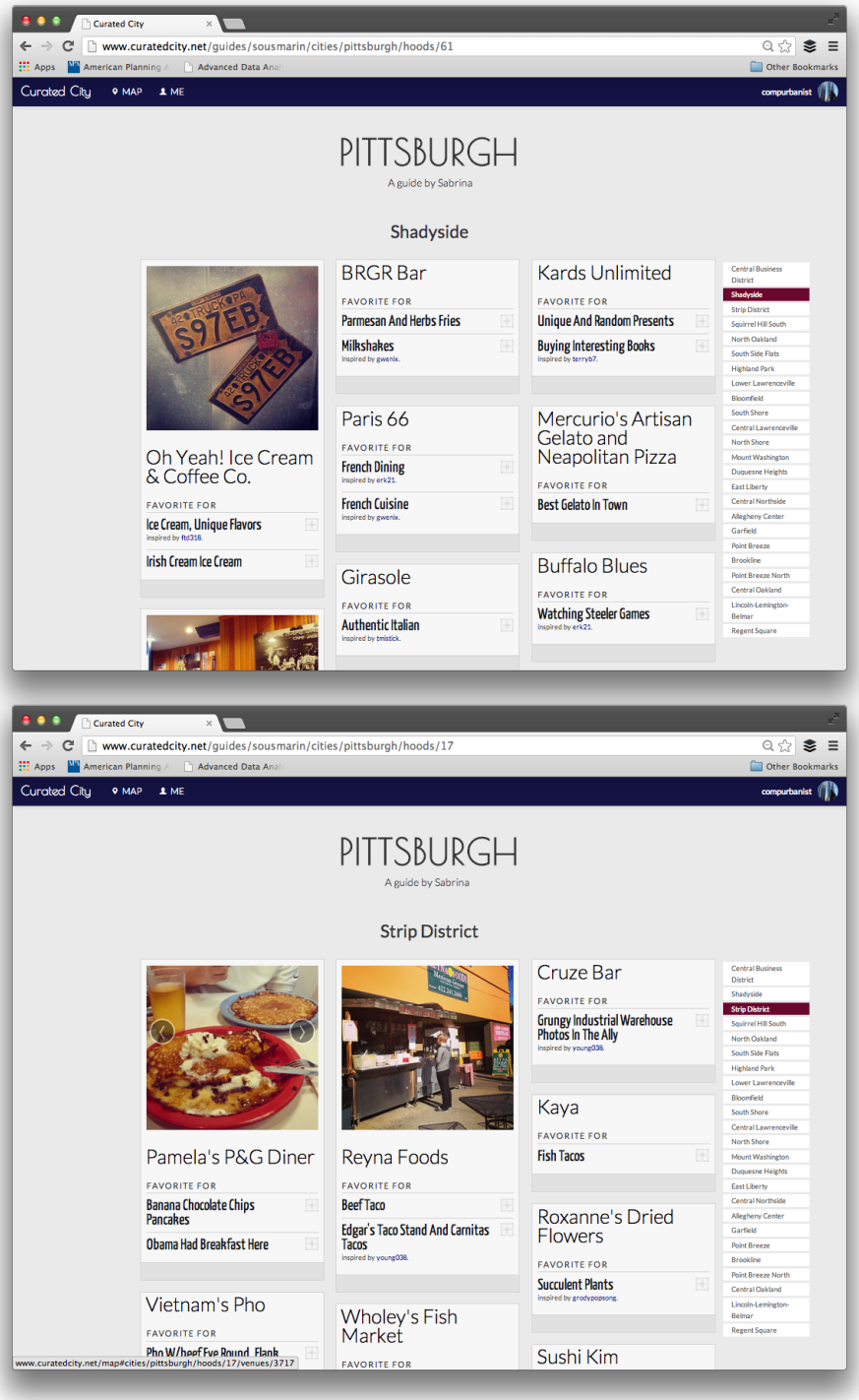

Figure 4.4: Two screenshots of a user's *Guide View*. The top shows photos and experiences in the Shadyside neighborhood and the bottom shows the Strip District.

shows two screenshots of a guide to Pittsburgh created by a Curated City user. On the right hand side is a navigation menu of the different neighborhoods where the user has contributed content. When a user selects a neighborhood, the main screen to the left changes to display a guide to the users's favorite venues and experiences in that neighborhood. The top of Figure 4.4 shows the user's favorite experience in the Shadyside neighborhood, while the bottom shows her favorites from the Strip District.

Each neighborhood guide displays a grid of information cards, with one card for each each venue in the neighborhood the user has added content about. If the user imported any photos to a venue, they will appear at the top of the venue card, with a carousel navigation to allow for scrolling, if there is more than on photo at a venue. Similarly, if they user imports any experience to their guide, they will appear in a list below the picture, under a heading that says "*Favorite For*." Each experience in this list has a "plus" button for others to remix and import that experience to their own guides. Conversely, if any of the user's experiences were remixed from another user's guide, the experience will appear along side some attribution text that says "*Inspired by [username of content creator]*."

4.3.4 Remixing

In addition to adding content of their own, while browsing other users' content ether in the information feeds or on others' guides, a user can click the "plus" buttons on this content to re-share it on their own personal guides, giving attribution with a link back to the creator. In this way, the guides in Curated City are "remixable;" one person's guide can be a composition of both original creative content and snippets pulled from other people's guides.

There are a two intended advantages to remixing. First, remixing alleviates the cold start problem by making it easier for people to quickly build up a guide. As new users browse other people's content, they can quickly import experiences that they share to their own guide. Remixing is also intended as a curatorial mechanism.

In closing the gap between representation and experience, just as places are both individual and collective, Curated City supports both a personal view of

the urban experience as well as a socially constructed one. Much like how Lynch's collective image of the city emerges from individual mental maps, in Curated City, collective experiences emerge through the social curation of individual experiences. The more users remix experiences of others that they themselves have also experienced, a collective image of the city can comes into focus from these commonalities.

4.3.5 Neighborhoods, Venues, and Geographic Organization

Neighborhoods are a primary unit of organization in a city; their names and boundaries are socially constructed entities, and so naturally neighborhoods play a crucial role in defining the city's public image. This is in strict contrast to the role that neighborhoods play in location-based services, which often rely heavily on latitude and longitude as the central unit of location orientation, and use neighborhoods, if at all, as secondary descriptive data attributes. We wanted to design a system where neighborhoods play as central an organizational role in the application experience as they do in the real-world urban experience. By designing Curated City around neighborhoods, our intention was to better align the application experience with people's mental maps, and to similarly allow for social curation to emerge around the common language that is the city's neighborhoods.

Curated City separates Pittsburgh into its 90 distinct neighborhoods as defined by the City of Pittsburgh, whose polygonal boundaries are overlaid on the map view. Each neighborhood was pre-loaded with a list of venues located there, which were determined in advance from Foursquare venue data. We launched the site with 6198 venues distributed across the neighborhoods. Neighborhoods could be selected in one of three ways: by clicking on the neighborhood in the map view, by the searching the neighborhood's name in a search field located in the top navigation bar, or by browsing a list of neighborhood names in the city-wide information feed. Venues could similarly be selected through the same search field, and by browsing for them in the city- or neighborhood-wide information feeds. Although venues could not be selected through the map view, once selected, a venue's location was displayed with a marker on the map and its neighborhood was highlighted, to give proper geographic context.

4.4 Study Design

Recruitment was done via three channels. We distributed flyers to busy spots on and around the Carnegie Mellon University and the University of Pittsburgh campuses. We also posted an advertisement on Craigslist, and we asked several Pittsburgh businesses and neighborhood groups to share our recruitment material on their Facebook and Twitter profiles. Participants needed to be Instagram users with a public and active Instagram account, they needed to be at least 18 years old, currently live in Pittsburgh, and have lived there for at least one year. This recruitment and study protocol was reviewed and approved for the inclusion of human subjects by our university's Institutional Review Board.

4.4.1 Participant Demographics

Our 20 recruited participants were nearly evenly distributed across gender identity; 9 were male, and 11 were female. Most participants tended to be in their mid 20s to early 30, with a mean age of 28.2, a median of 26.5, and a standard deviation of 6.4. Our oldest participant was 60, and our youngest was 18. The mean number of years living in Pittsburgh was 10.6, with a median of 5 and a standard deviation of 12.1.

4.4.2 Study Design and Required Tasks

We designed the two week study to serve as a technological probe, immersing the participants in the social experience we created, so that we could gather their thoughts and insights, and foster a richer discussion about creating a guide with Curated City. The assigned tasks were intended to be as minimal as possible, while still encouraging participants to be engaged with the service, and with each other for a meaningful amount of time. Participants were required to login to the system every day, and contribute at least three experiences per day to their guides (either by creating a new experience, or by re-sharing someone else's experience). We did not require them to share any photos over the course of the study. If participants fell behind or forgot to login, they were sent a reminder email to add more experiences. Additionally, every 48 hours, all participants were sent a digest email that linked to the most active user guides

and most active neighborhoods over the past 48 hours. This served as a positive reinforcement and motivational incentive to login and add content. Participants were paid $20 for completing the study. And as an added incentive, we asked them at the end of the study to vote for who they thought made the best Pittsburgh guide. The winner received an additional $50.

4.5 Findings

At the end of the two week trial, we invited the 15 most active participants to visit for a 30 minute interview, 11 of whom were able to attended. The goal of these interviews was to gather a more complete understanding of the range of possible user experiences, so that we might clarify the design landscape for building socially curated city guides. In these discussions, we focused on the creative process that participants engaged in as they developed their Pittsburgh guides, honing our attention to issues of collaboration, inspiration, the role of neighborhoods, intended audience, the types of experiences participants added, their desires for exploration, and their sense of community or civic pride.

4.5.1 The Process

With such an intricate multi-layered task, it would be natural to expect significant variation in the process that participants took in creating their city guides. Here we describe some of the common and uncommon procedures participants went through as they engaged with Curated City.

When participants were getting started, it was common for them begin with their intimately familiar venues, often ones in their home neighborhoods. For example, Jordan, a 27-year-old administrative assistant, and 9-year resident of Pittsburgh said that "I tried to start with venues that are closer to where I live, venues that are in my neighborhood that I frequent often, including the reasons why I go there." Or, take the case of Danny, a 24-year-old clerk and intern, and 6-year resident of Pittsburgh, who said "I mostly stuck with places that I knew, because in the two weeks, I didn't travel anywhere new, so I just stuck to those places." As they got more comfortable with the process, and as they began to see more of what others were adding, participants began to branch out from their most familiar places to see what they recognized in other neighborhoods.

A Sample of Shared Experiences	
Food & Drinks	• Moo Yang • Hungarian Food • Mystery Pig Part Concoctions • Drinks With A View • Duck Cannoli • Mile-High Meatloaf • Dirty Chai Latte • Brunch by the Park • Street Tacos
City Life	• Finding a Random Party • People Watching at its Best • Watching Kids Running Around the Fountain • Views of Market Square • Reflecting on Life at Night • To Get Out of the City Without Leaving
Sports, Culture, & Leisure	• Kayaking in the City • Late Night Basketball • Student Art Shows • Watching Pitt Basketball • Picnic Spot • Watching the Plays of Oscar Wilde • "Silver Clouds"
Natural and Scenic	• Walking Along the River • Dogwoods in the Spring • Beautiful Houses • Sunset Views • Pretty Photo-Ops • Watching the Sunset
Shopping & Commerce	• Succulent Plants • Vintage Apparel • Upstairs Patio • Decor • Ambiance • Affordable Fashion

Table 4.1: A sample of interesting experiences shared by our participants.

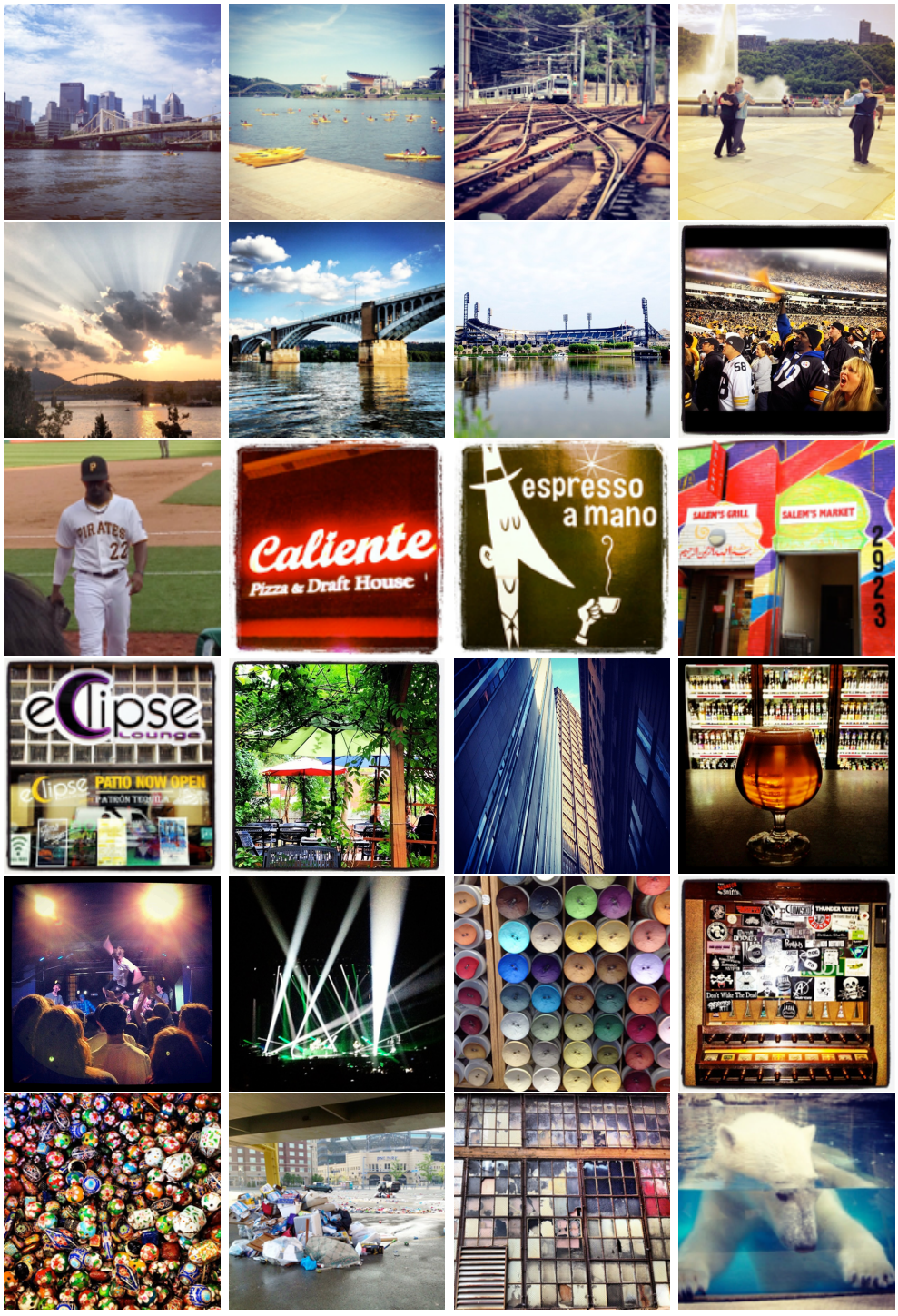

Figure 4.5: Some images shared by people.

Danny, a 24-year-old clerk and intern, and 6-year resident of Pittsburgh said "a lot of time I was looking at what was available in the [neighborhood venue lists], and seeing what I recognized, and seeing which places I go to a lot, or was really special. I would pick a neighborhood that I was familiar with, then I would scroll through the venues to the ones that stood out."

Some participants took a much more formal approach than others. For example, Jane, a 28-year-old non-profit program coordinator, and a 5-year resident of Pittsburgh, took a uniquely thorough approach to making her city guide. Before even adding anything to Curated City, Jane created a Google Document where she made a numbered list of all the places she could think of, and for each of these, she briefly described what she found interesting and what she liked about each. Then she went through her computer photo library and annotated the list with whether or not she already had a photo of the venue. If she encountered any interesting photos on her computer that were not yet on Instagram, she would import them to her Instagram library. Over the course of the two weeks, she made an attempt to visit and photograph the venues on her list with missing photos. Although Jane's approach was definitely more engaged than others, for her this wasn't much out of the ordinary. She enjoys photography as a hobby, and maintains a blog about her travels. As she says, "I take pictures of stuff, food, restaurants, places, and I keep a blog on and off. So it's easy for me, because I do it anyway."

Another more formal approach was taken by Nora, a 40-year-old technical support engineer, and life-long resident of Pittsburgh. Nora described three ways she typically went about adding to her guide. In addition to the common methods of listing her favorite and familiar places, and of generally browsing the website and seeing what came to mind, her third (and primary) approach was Instagram-driven. She uses Instagram frequently to document the places she goes in the city. As she describes: "[when] I was somewhere I wanted to take an Instagram photo, I wouldn't really publish it to Facebook and Twitter like I normally do, but I'd put my own hashtag of *#curatedcity* on it, and then *#bestwhatever*." Later when she was home, she would use these hashtags to remind her of the things she wanted to add to Curated City.

4.5.2 Types of Venue Experiences

One of the unique design ideas that Curated City explored was the use of short free-text input to express urban experiences. So that we could explore the range of experiences that people share, we purposely gave them very little guidance beyond the input-field prompt. We didn't make any suggestions as to what kinds of experiences they should document, and we didn't correct them if we felt their experiences deviated from any intended use. In this section we explore participants perceptions about the kinds of experiences they personally submitted and of those they observed others adding.

General Versus Specific Experiences

The experiences that people created over the two weeks differed greatly in terms of specificity. Some people added highly general experiences that were impersonal and described common activities avaiable at many distinct venues. Examples of these more general experiences included: *yoga*, *indian food*, *brunch*, *dessert*, *phó*, *curry*, *pizza*, *scotch*, *pad thai*, *tacos*, and *burgers*. Others added experiences at the other end of the spectrum that were highly specific, for example experiences that were uniquely available at only one or few venues such as specialty menu items, or personal anecdotes about a place. Examples of these more specific experiences included: *late night basketball*, *taking a walk in the evening*, *dog friendly ice cream*, *dogwoods in the spring*, *the pastrami headwich*, *spiced pumpkin and pear soup*, *cold brewed coffee*, *an outside date*, *hungover breakfast*, *succulent plants*, and *"Silver Clouds."*

We asked participants to comment on the distinctions and differing roles of specific versus general experiences. Since they took less creative effort, some participants found general experiences less interesting (both to create and to read) than personal or specific experiences, especially when the experience description was very similar to either the name, or the category of the venue (e.g. "favorite pizza" when the venue is a pizzeria). Jane, who preferred sharing specific experiences, describes her frustration reading general experiences shared by others:

> Lots of people just said "cocktail" or "pizza" or something that is already in the store's name. Why would I want to know or read this? …Tell me specifically what I should get, or what that

> restaurant is famous for, or if I go to a place, what time should I go to see what?

To Jane, specific experiences were more useful, since she felt they better characterized what is unique about a place, and why others might want to visit it. Valerie shared the same sentiment, saying "specific makes it more fun. It gives it more personality." She also felt that being the first person to share something interesting and specific about a place gives a person "bragging rights" to that experience.

Yet, some users preferred sharing more general experiences, feeling them more useful as an index or a search term for people are looking for places to go. Nora, who is a longtime user of the social bookmarking site Delicious, viewed adding experiences as a form of venue tagging, saying "these are tags, they're a way to quickly access information." She characterized the experiences she added as "buzz words," short, general descriptors of what it is she likes about a place. She and her husband go out frequently to many places throughout the city, so for her, "tagging" with general experiences was a natural way to organize her favorite places, so that her guide would be most useful to her, and to her out of town friends.

Some people saw both sides of the issue, seeing value in both specific and general experiences. Jordan for example felt that "both aspects can be really helpful." She felt that specific experiences are more helpful to people already familiar with an area that might need detailed advice about where to go, but she felt that people that are new to an area might need more general experiences to find what they need.

These insights highlight the critical roles that *both* general and specific experiences play, and the importance of having a system that cultivates the sharing of each. Whether they preferred sharing general or specific experiences, participants appreciated that could freely express themselves. As Christy said, "I thought it was good that you could put whatever you wanted. I know a lot of things sometimes limit what you can say about a place. I thought it was nice that you could say either a specific menu item, or more general things."

Positive Versus Negative Experiences

Participants were strongly enthusiastic about creating guides with only positive "favorite" experiences. A number of advantages to this approach came up in the interviews. For many people, they found it simplified the process of making a guide, by getting them to focus on something specific, or as Danny describes it "you had to really think what in particular is that you like so much about it. …it makes you concentrate solely on what makes it good."

Several participants contrasted the positive-centric experiences of Curated City, with the sometimes very negative reviews of systems such as Yelp. Jordan, for example says, in contrast to Yelp, where "there's a lot of negative feedback," she liked "the idea of people going in search of a positive experience." Valerie, who is a social media consultant for local businesses, mentioned how worried businesses are about getting negative feedback on social media. She said, "I think it's nice to have a website that encourages people to write positive things. It's kind of like, if you don't have anything nice to say, then don't use it at all."

Prompting participants to describe their *favorite* experiences didn't mean negative experiences had no role to play. A few people wished the website let them express a negative opinion. Sandy, for example said "there were definitely places I don't like. …I would have wanted to in general say what my experience was like."

Some people didn't want to change the prompt, but wanted to use it sarcastically to express negative experiences in a humorous or "snarky" way. For example, one participant wanted to add a "best place to get shot" experience to a popular nightclub in Pittsburgh's Strip District. She said she only resisted because she was part of a "serious" study, saying "I was tempted. If it wasn't a study, I would have." One participant did actually use experiences in a sarcastic way on a few occasions over the two weeks. For example, he added favorite "worst smelling dumpster in the city" to a popular sushi restaurant in the South Side. When asked to comment on these these sarcastic experiences, participants reacted positively, generally seeing sarcasm as a perfectly legitimate, if not fun, use of the website.

4.5.3 Collaborative and Social Factors

Although users of Curated City each developed their own personal city guides, the process they engaged in while developing them was inherently social, designed to facilitate both direct and indirect collaboration among users. In this section we explore some of the insights shared by our participants about these collaborative and social factors.

The Activity Feed

The primary way participants encountered the social elements of Curated City was through the activity feed. As they browsed a venue, a neighborhood, or the city as a whole, the activity feed showed all experiences added by others to the selected area, arranged in reverse chronological order. By bringing to the surface commonalities in their experiences, and in the neighborhoods and venues that they frequent, the activity feed provided the links that networked the participants' mental maps, facilitating their social externalization.

The feed was designed to be a jumping off point, sparking ideas for where to browse next or what content to add next. This often happened directly, for example, when a person browsed to the explicitly linked user guide, venue page, or neighborhood page associated with the shared experience. But just as often the jumping off was more indirect—seeing a shared experience in the feed often jogged a person's memory of a related experience or venue, often meaningful only to the participant. As Sandy, a 23-year-old concierge, and life-long resident of Pittsburgh said, "I enjoyed looking at that stuff. I mostly like to see what other people were thinking, sometimes it sparks things in my head too."

Some, like Jane, used it every time they logged in, reading every experience people added:

> I just scrolled down to the last time I logged in, and went through what people added. …I look at the venue first. If it's a place I've heard about that sounds interesting to me, I look at what the experience is.

Others, like Jordan used it more organically, as a way to see what venues and experiences were getting attention:

> I liked to work off of what other people were saying or to gauge my

> ideas from their experiences. Like Fuel and Fuddle for example. I saw that it was getting attention, it's a popular place to go, so I wanted to share what I like about it, after disagreeing what someone else had said, so I could kind of balance it out.

In addition to working as a source for social inspiration, the feed also functioned as a way to get acclimated to the system, by seeing what others were doing. As Nora told us "I did like seeing what some of the other people did, because it gave me a framework for what I should do at the beginning."

Although most found the feed useful, some participants reported aspects of the feed that were lacking. Several participants would have preferred that the feed be more visual, integrating the photo-sharing activity with the experience sharing. Also, many expressed the desire to be able to "follow" others, so that they could have more control over what appears in their feed, or as Jane put it to "screen out those that put up boring guides."

Re-sharing the Content of Others

Most users did engage in some re-sharing, though their opinions and explanations for why they re-shared (or didn't) varied. Re-sharing was seen by participants as a way to "fill in" their guides, making them more complete by leveraging other people's content that they valued or supported. Most of the time this was in the context of agreeing with another person's favorite experience and wanting to express the same experience on their own guide. However, some participants noted they occasionally used the re-share as a bookmark, by adding an experience to their guide that they'd heard about and are interested in, but haven't yet tried. This suggests that there might be a need for separate user actions on an experience.

Some described re-sharing as a way to gather support for a particular experience at a venue. As Danny expressed,

> I think it [re-sharing] bolsters a certain area's reputation. If one person suggests it, and another agrees with it, like "yeah it is a good place for that," it sort of adds a sense of community, that it's being vouched for.

Others noted that this reputation might be useful for local-search, to help decide between venues that offer the same experiences. For example, Nora

thought the brevity of experiences helps to focus people's efforts and quickly gather agreement or disagreement about the experience: "if you get a lot of people saying similar things about a venue, that tells you more about it than the 15-paragraph Yelp review."

Participants generally liked that guides would link back to the original experience creator on re-shares, viewing it as a way both to give proper attribution for someone's effort, and as a way to discern status. As Valerie put it, the attributions speak to "who is influential in the network."

However, not all participants were in favor of re-sharing. Some enjoyed the creative process of coming up with their own experience, and viewed re-sharing as "cheating." Others viewed *not* re-sharing as a fun challenge; if someone had already written an experience that was close to what they wanted to add, they enjoyed coming up with interesting variations rather than re-sharing. Still others didn't re-share because they wanted to retain "ownership" of their experiences. Such reactions are similar to those observed in the study of re-mixing in creative collaboration [149].

Sources of Inspiration

Participants were often inspired by the content they browsed from other users. We can think of this as an indirect form of creative collaboration; although they were not directly working together on the task, their final creative products were influenced by one another. A person would see an experience shared at a venue, and something about it would "spark" them to share an experience of their own. This might simply be a natural variation of the inspirational content, for example they might favor a different venue in the same neighborhood for the same experience. Other times the venue might spark them to think of another similar venue (either nearby, or similar in category) that they wanted to add. Still other times, it might lead them to add content that is not related in any clear or obvious way, a free association that only they understand.

Civic Pride and Collaboration for the Common Good

Several participants reported feeling a sense of civic pride as they described their favorite Pittsburgh places. Their pride for their city and for the places that they visited influenced the final guide that they made. This sense of pride

was best expressed by Valerie:

> When you're from Pittsburgh, and you're born and raised, it's very important what places you think are the best at certain things. Especially if you're from Squirrel Hill, its very important which pizza shop you think has the best pizza, so you want to claim that as strongly as you can, because it gives you a social circle you're going to be part of for the rest of your life.

Valerie's quote underscores how she used her guide to shape her presentation of self with respect to civic pride. Other participants rewarded venues and neighborhoods that they associated with positive experiences. Christy talked about "rewarding places that I like for being good places" by adding them to her guide. For example, she mentioned including a particular Hungarian restaurant because "nobody knows about this place and it's really great."

Similarly, some participants described the process as a form of collaboration for the common good. Although they each were building their own uniquely personal guides, for some there was a sense of contributing these personal experiences to a collective "public image" of the city—a view of Pittsburgh as seen by its residents. Danny described this feeling as "filling out the city by people who live there."

4.5.4 Audience

When we asked participants to create a personal guide of the city, we did not indicate whom the guide should be for. Yet, most participants independently arrived at an audience for their guides, which shaped the types of experiences and photos they chose to include or leave out. These audiences fell into four categories of roughly decreasing familiarity: self, friends, locals, and tourists. Most participants had a primary audience in mind, but a few, like Jordan and Jane, felt that an ideal guide would speak to multiple groups.

Some participants viewed themselves as the target audience for their guides. For them, the guides represented a form of personal journaling, helping them record and reflect on where they've been and how they felt about it. This echoes the "personal tracking" motivations other scholars have identified for

checking in to venues using applications like Foursquare [133].

Most participants, however, had broader audiences in mind. Friends were perhaps the most commonly mentioned audience, but usually friends from out of town who were visiting Pittsburgh and wanted to know what to do. Jane built her guide around the question, "If my friends are touring Pittsburgh, where would I take them to?" Jordan likewise designed her guide for visiting friends. She described how this exercise clarified her mental map so that she could spontaneously make suggestions:

> I have people come in from out of town, and instead of being like "Oh I don't know, where should we go?" The indecisive approach comes up a lot, and I like to know where to go when someone says, "Oh, I'm kind of in the mood for this thing," then I know what the best place is. And now that I've done this, I have sort of a log in my head.

Nora took this idea further, viewing her guide as a way to externalize her mental map so that she could share it with others and even remove herself from the equation. She said, "I'd love to have a guide that I can share with people... I do want to be able to say, 'Just look here; find stuff this way."

Other participants designed their guides for a more general audience. But even without specific people in mind, they were able to circumscribe which types of content would be valued by imagining themselves in those roles. For example, Christy selected the experiences in her guide based on what "people like me" were likely to enjoy. Jordan, whose audience included locals, sought to highlight more obscure experiences in popular venues. She said:

> I find that many people, when going out to restaurants, tend to stick with a staple menu item—Pad Thai, for example—and I like that I was encouraged to share a unique favorite; in the hope of expanding others' comfort zones.

Danny, whose audience included tourists, excluded chain businesses from his guide in favor of locally owned venues, which he felt tourists were more likely to appreciate: "What's the point of a curator if you're just going to go to McDonald's or the places you're already familiar with?"

Finally, Valerie imagined putting together guides for specific events with

highly specialized audiences, such as family members and friends visiting the city for a wedding, or conference attendees descending upon Pittsburgh and wanting to "venture out of their hotel lobby."

4.5.5 Photos

Photos played a central role in the Curated City experience for many of our participants. Since we required all participants to be Instagram users prior to the study, their affinity for photography was not surprising, but we did not expect photos would feature so prominently into participants' guides. In fact, our study did not require participants to add any photos whatsoever. Yet, with few exceptions, guides were adorned with a variety of colorful photos depicting storefronts, meals, social gatherings, and other relevant images. When we asked about this, many participants' eyes lit up, and they extolled the value of photos:

> I just really like pictures. I'm more interested in a visual experience sometimes than I am in reading about things. So the more pictures the better in my opinion. I like to get an idea, even with restaurants, what the layout of the restaurant is, or what the food is like, or what the ambience is. (Christy)

> Pictures tell me more about a place. I can see the ambience of it, or if the picture happened to be the topic that the person's experience is about, then it tells me more about it, or in general, pictures grab my attention. (Jane)

As Christy and Jane suggest, much of the value of photos lies in their ability to convey information about a venue — its ambiance, the people who go there, the quality of the products and services — in rich detail without writing walls of text. But there were also benefits unique to Curated City. Because experiences were also designed to be concise, they paired well with photos, and the more talented photographers in our participant pool took advantage of this interplay when crafting their guides.

As described above, Jane took an unusually comprehensive approach to illustrating her guide, systematically adding existing photos from her Instagram library and then making an effort to take new ones to fill in the gaps. Most participants focused on adding photos they had already taken, but an active

subset made an effort to take new photos while they were out. Sometimes participants were influenced by what photos had (or had not) been added by others. For example, Nora initially added very specific photos to her guide referring to particular experiences. As she grew to realize many venues and neighborhoods lacked more basic images, such as building facades or interior views, she "got more general with the photos, to just get a picture of the space," which she thought users would find more helpful.

4.5.6 The Role of Neighborhoods

City neighborhoods played a central role in the design of Curated City. In this section, we highlight some of the neighborhood related observations shared by participants in the interviews.

Neighborhoods as an Index for Navigation

In Curated City, neighborhoods played a significant role as an interface for accessing the website's content. In order to get to a venue, users could use the search bar, but often they didn't have a particular venue in mind first, and would instead click on a neighborhood they were familiar with to browse the venues that were there. Christy describes this process, "A lot of times I wasn't looking for anyplace in particular, I just clicked on a neighborhood and thought 'do I know anything here?'" Such indexing was also helpful with respect to the neighborhood activity feed, as a window into what other people are doing in the neighborhood.

Some participants thought neighborhoods were a natural structure to use for navigation in Curated City, because they reflect how people typically move about the city. Christy comments on this aspect, "[this is] how I would use it in terms of looking for things. …I would know generally where I'm going and I would use it to look for things in that general neighborhood while I'm there." Danny thought this would be especially useful to people who might be new to the city, noting for example that new students coming to a university might want to know what places are in their college neighborhood. Jane thought indexing content by neighborhoods was useful "because people are usually active in only a few neighborhoods most of the time." Similarly, Nora felt "it's really useful to do things by neighborhood," because Pittsburgh has such

distinct, and geographically separate neighborhoods, making it " hard to get from one neighborhood to another."

Neighborhood-based navigation also made it easier for some participants to add content. Danny describes this: "I like how it was local to a region, so you didn't have to think in *all* of Pittsburgh, if I had to go for *one* place for sushi …, I like that way better." Neighborhoods also allowed multiple favorites for the same experience but in different neighborhoods, easing content creation by allowing for the re-use of experiences.

As a Small City or a Community

Neighborhoods also came up in the interviews in terms of how they related to sense of community. Sandy described neighborhoods as being self-contained units: "I feel like a neighborhood is a small city, and there is so much to do in each one." There was a feeling that adding content in a way that strengthens the perception of the neighborhood, also strengthens the sense of community there.

Valerie, as an employee of the Shadyside neighborhood chamber of commerce, often thinks about neighborhoods, and how they are defined and perceived. She spoke at length about how positive it was that Curated City used municipal neighborhood boundaries to define where venues are located, as opposed to how developers might market their location. Bakery Square is a new development in Pittsburgh located at the border of three neighborhoods, but as Valerie describes, people's perceptions of neighborhoods can be complex (see e.g. [57]):

> People are very sensitive about it. So Bakery Square Part I is in Larimer, and if you look at your guide, that's where it is. But Bakery Square Part II is in Shadyside, and that's where it is. But everyone is like "Bakery Square is in East Liberty," whereas *none* of Bakery Square is in East Liberty at all. …I think that everyone in Pittsburgh should see this map.

Valerie continues, describing how people in the community can be sensitive when real-estate companies will market a development in a way that doesn't give proper attribution to the neighborhood where it's located.

Experience	# Shares	# Users	# Venues
Sunday Brunch	11	8	7
Beer Selection	8	3	6
Pizza	8	6	5
Milkshakes	6	5	4
People Watching	5	3	3
Authentic Italian	5	5	2
Cheap And Unhealthy Food	5	4	2
Happy Hour	4	4	3
Craft Beers	4	4	3
Thai Food	4	2	3
A Walk Along The River	4	3	2
Outdoor Dining	4	4	2
French Cuisine	4	4	2
Fried Chicken	4	3	2
Scotch	4	3	1
Feeling Like You're At Hogwarts	4	4	1
Espresso	4	4	1
Succulent Plants	4	4	1
River Views	4	4	1
Concerts	4	4	1
Peaceful Walks	4	4	1
Best Ice Cream In Town	4	4	1

Table 4.2: The top 10 experiences ordered by number of experience shares.

> People take pride in their community, people put a lot of effort into making their community better places. A lot of people really do stay rooted in their neighborhood for a very long time. All these new developments are really great, but there's a lot of people who are really hurt by how they are configured or how they are attributed.

She feels a neighborhood-centric guide like Curated City could help strengthen the sense of community in neighborhoods by highlighting the things that people pride about them.

4.6 Site Usage

Over the study period, the 20 participants contributed 1264 experience shares (259 of which were re-shares), of 932 unique experiences, at 565 venues. The mean number of experience shares per user was 63.2, with median 60, and

Venue	# Exp Shares	# Exps	# Users
Schenley Park	23	16	8
Hofbräuhaus Pittsburgh	19	9	8
PNC Park	17	11	11
Point State Park	16	10	7
Cathedral of Learning	13	8	7
Trader Joe's	13	9	9
Piper's Pub	12	6	5
Pittsburgh Vintage Grand Prix	11	8	2
Heinz Field	9	7	6
Eat 'n Park	9	8	3

Table 4.3: The top 10 venues ordered by number of experience shares.

standard deviation of 34.4. The top 5 experiences by total number of shares were: *sunday brunch* (11 shares, 8 users, 7 venues), *beer selection* (8 shares, 3 users, 6 venues), *pizza* (8 shares, 6 users, 5 venues), *milkshakes* (6 shares, 5 users, 4 venues), and *people watching* (5 shares, 3 users, 3 venues).

To get a sense of how geographically clustered the participation was, we can look at experience distributions across neighborhoods. Per user, the mean number of neighborhoods in which participants had experiences was 14.0, with a median of 12, and a standard deviation of 5.3. We can also look at what percentage of a participant's experiences were inside their home neighborhood. The mean percentage of within home neighborhood experience shares was 19.1%, with a median of 14.4%, a range between 0 and 66.6%, and a standard deviation of 14.4. The top neighborhoods participants contributed experience shares to were Squirrel Hill South (140), Shadyside (139), South Side Flats (125), Strip District (108), and North Oakland (94). Table 4.3 shows the top venues ordered by number of experience shares at these venues.

Table 4.2 shows the top experiences ordered by total number of shares of the experience. Also shown are the number of users that shared the experience, and the number of venues at which the experience was shown. Note that many of these top experiences were shared at multiple venues, indicating a range of places where one could find this experience. This lends support for the possibility of using experiences in the context of a local search.

Although participants were not required to share any photos as part of the

Venue	# Photo Shares	# Users
Schenley Park	52	5
PNC Park	20	7
Point State Park	15	4
Heinz Field	14	7
Cathedral of Learning	14	4
The Bagel Factory	13	1
Bakery Square	12	4
Carnegie Mellon University	10	3
Pittsburgh Zoo & PPG Aquarium	6	4
Eat 'n Park	6	2

Table 4.4: The top 10 venues ordered by number of photo shares.

study, in most cases they enthusiastically embraced the photo sharing functionality of Curated City. Participants shared 482 photos total, each sharing between 1 and 129 photos, with a mean of 26.7, median of 15, and standard deviation of 31.8.

4.7 Design Recommendations

There are numerous complex decisions a person must make in order to outwardly express their personal image of the city. Whether they do so consciously or not, they must decide on who their intended audience is; who they expect will be reading their guide will color almost every other decision they makes throughout the process. They must also decide which, among all the venues they have been to, will appear in their guide, and how to best express the experiences that are special to them about these places. This often means striking the right balance between general and specific, between personal and impersonal, between informative and entertaining, and between sincere and sarcastic. We present a series of design recommendations to benefit future designers of social systems that support urban or local curation.

Utilize neighborhoods. Since they are already used so organically by city-dweller's for navigation, orientation, and wayfinding, neighborhoods offer a natural framework for indexing information such as experiences and photos within a city. Despite playing such an important role in the daily lives of city denizens, they are often an afterthought in most location-based services.

Putting neighborhoods at the forefront of the design will align the system design better with the participants internal mental map, and produce more expressive externalizations. It will also lead to a public image of the city that helps to strengthen existing historical communities.

Focus on the positive. Local review sites such as Yelp let users leave negative and positive reviews about a place. This encourages people to be critics rather than curators. By focusing on the positive aspects of the city, designers can eliminate the noise from the data while boosting the signal. Stop encouraging people to say negative things, and set them free to express the things they truly care about.

Design socially generated "jumping off points." Creating a city guide is an involved process; knowing where to start and how to express what is important to a person can be difficult. Designing socially generated avenues for free association will allow a person to see others' content and be reminded of things that she wants to add. Mechanisms such as the activity feed add serendipity and encourage creativity and branching out. People find unexpected users, places, and experiences, and each of these is another potential jumping off point for free association to related venues or experiences.

Restrict the universe of possibilities. It can be daunting to list your favorite places in the entire city. People may have many favorites that do similar things, but do them slightly differently. How does one choose? By restricting the scope of favorite experiences to neighborhoods, it frees the creator from having to choose. It also helps people that might be looking for a place to go, especially if they know in advance what neighborhood they want to visit, they can see what experiences in that neighborhood the community has added.

Motivate the general and the specific. General experiences, and specific experiences both have important roles to play, and a well designed system should engineer incentives for both. General experiences are better for searching, indexing, and building up reputations for a place, while specific experiences help add character, entertainment value, and they help people make decisions when they're already familiar with a place. Encouraging a diversity of experience types will increase social activity, and add value. Adding social

mechanisms such as a 'favorite' in addition to a 're-share' might improve diversity. Engineering notifications for such interactions is important to strengthen the social incentives.

Nudge newcomers to start with what they know. Encourage people to get started with places they're most familiar with. As they get more comfortable with the system, they will naturally branch out.

Design for civic pride. People can feel strong emotions about their city and the places within it. Design the system to let people effectively express these feelings, and show off their civic pride. The system should foster a feeling of creating city guides for the common good by focusing on neighborhoods and positive experiences

Reward higher quality content with social status. Make profile pages public by default, and give proper attribution when content is re-shared. Rewarding creativity lets people "claim ownership" of interesting experiences that they add. Allow users to follow people whose opinion they admire.

Humor and sarcasm are important. Although one might expect the system to be used in a certain way, people always find a way to use it in funny, unanticipated, and entertaining ways. Free-text experiences allow people to be personal, sarcastic, and humorous in their descriptions. This keeps people entertained, engaged, and motivated to express more about the city.

Support visual experiences. Photos are attention grabbing, emotional, and highly expressive of the experience of place. In building a system for externalizing mental maps, photos are essential. If possible, design and engineer ways to link photos to experiences, and allow photo with captions. Make interfaces such as activity feeds more visual.

Journeys & Notes: Representing Places That Are Not There

"If space is rather a simultaneity of stories-so-far, then places are collections of those stories, articulations within the wider power-geometries of space. Their character will be a product of these intersections within that wider setting, and of what is made of them. And, too, of the non-meetings-up, the disconnections and the relations not established, the exclusions. All this contributes to the specificity of place.

To travel between places is to move between collections of trajectories and to reinsert yourself in the ones to which you relate. [...] Places not as points or areas on maps, but as integrations of space and time; as *spatio-temporal events*.

This is an understanding of place—as open ('a global sense of place'), as woven together out of ongoing stories, as a moment within power-geometries, as a particular constellation within the wider topographies of space, and as in a process, as unfinished business...."

Doreen Massey, *For Space*, 2005 [140, p. 130]

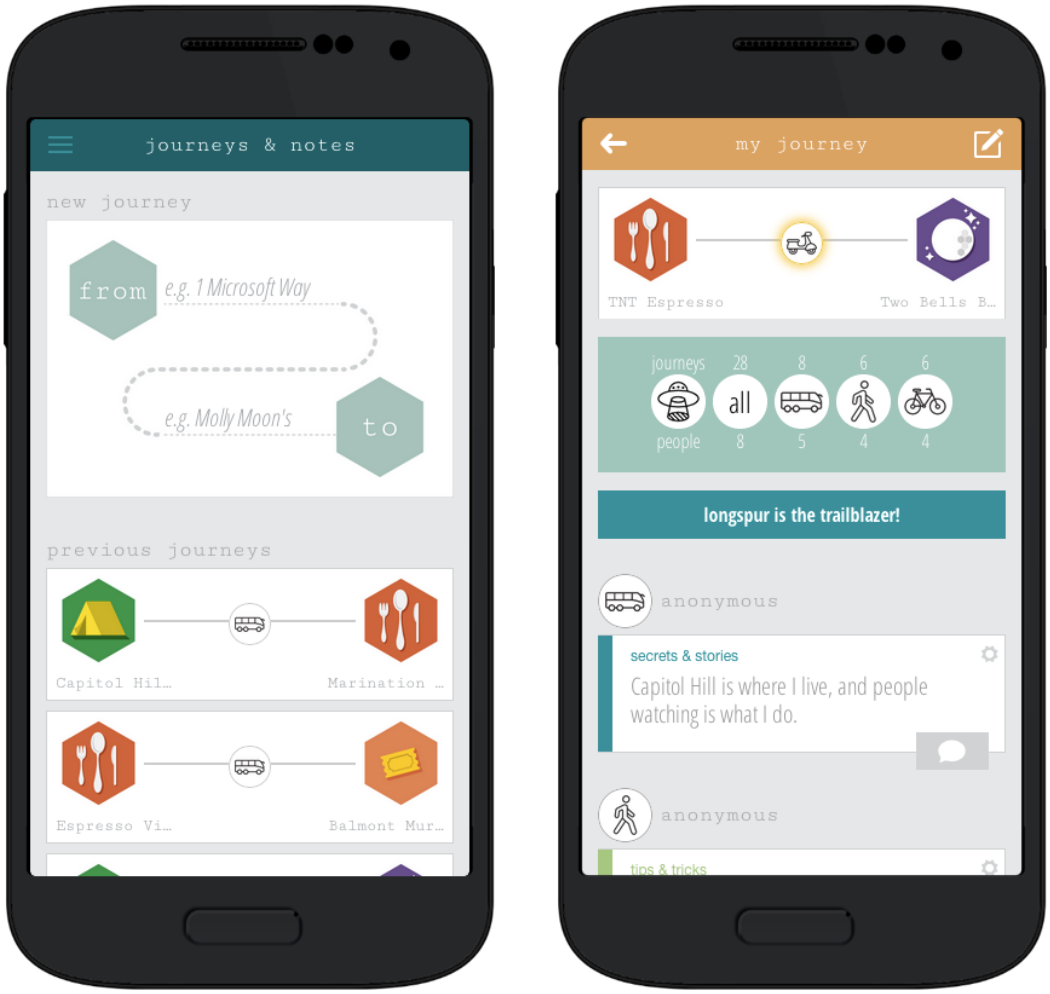

Figure 5.1: (Left) The *Home* screen. Here users can review their history, add a new journey, and checkin to a previous journey. (Right) The *Journey* screen. Once a user has checked-in to a journey, they can see stats about past visitors and interact with notes that others have left behind.

5.1 Introduction

The distinction between *space* and *place* has long provided an important theoretical framework for guiding the critical study and design of social computing systems, mobile location-based services, and online communities [74, 98]. Spaces are best thought of as purely abstract—they are bounded or unbounded geographic areas or domains without any specific cultural significance. Places, on the other hand, are spaces that are imbued with a history, human social context, and cultural meaning [10, 19, 78, 131, 232]. By

understanding the processes that turn a space into a place, one is empowered with conceptual tools for understanding how to develop successful online communities and collaborative systems.

However, it is also important to understand the characteristics of *non-places* in the physical world: those physical spaces "which cannot be defined as relational, or historical, or concerned with identity [16]." In his 1995 treatise on the subject, anthropologist Marc Augé argues that the cultural and technological forces of modernity are pushing us to spend increasingly more of our time in non-places, describing a world where "people are born in the clinic and die in a hospital, where transit points and temporary abodes are proliferating under luxurious or inhuman conditions (hotel chains and squats, holiday clubs and refugee camps, shanty towns threatened with demolition or doomed to festering longevity); where a dense network of means of transport which are also inhabited spaces is developing; where the habitué of supermarkets, slot machines, and credit cards communicates wordlessly, through gestures, with an abstract, unmediated commerce [16]."

By understanding non-places and the impact technology has on their production, we can hope future technologies will mitigate or reverse the societal trends that Augé describes. This work aims to take a step in that direction.

We are motivated by the question of how location-based social computing can enhance the meaning, symbolization, and cultural relations experienced at physical non-places. We ask, how can place-making efforts in the digital world augment the experience at physical non-places?

To examine these questions through design, we draw our focus on what Augé calls the "archetype of non-place," the spaces occupied by the traveler [16]. As Augé describes "the plurality of places" that the traveler passes through creates a "discontinuity between the spectator-traveler and the landscape he is contemplating or rushing through," preventing the him (or her) from perceiving this landscape as a place, and "from being fully present in it [16]." Journeys taken by travelers often start and end at non-places (for example at bus terminals, airports, or subway stations), and are played out on the place-less fields of modern transport-infrastructure (in cars stuck in highway traffic, in cramped airplanes, or packed train cars), touching the daily lives of billions of

individuals.

The main contributions of this work are:

- The design and implementation of Journeys & Notes, an Android app that lets people checkin to their journeys.
- Two 1-week-long user studies (6 people, and 15 people) of how people adopted the system, and how their use of the system impacted their perceptions of travel and non-places.
- A large-scale field study on 9,435 participants providing insight into usage patterns, and the types of messages people write on their journeys.

5.2 Background and Related Work

Checkin apps emerged around 2003 to enable a virtual social experience anchored around physical places [**?**]. These apps allow users to broadcast their presence at venues, that is, the places they go to. Venues include restaurants, bars, offices, apartment buildings, homes, museums, parks, movie theatres, shops, and cafés. Dodgeball, GoWalla, Foursquare and now Swarm are some of the apps that embodied this concept of checking-in to a venue. More recently, Facebook has adopted this as a feature that people can use to attach a location to their posts.

Designers of social computing technologies have grappled with the concept of places for quite some time. In 1996, Harrison and Dourish [98] argued for the importance in distinguishing between "places" and "spaces," with a special emphasis on the virtual. Ten years later, Dourish [74] restates these concepts in the context of spatial technologies.

Places often create communities around them [161, 182]. Place checkin apps have begun to leverage and augment these venue-based communities [141, 203]. Conversely, non-places are not typically conceptualized as vibrant spaces where communities take root. However, we have observed instances where online communities anchored at non-places have shown signs of emergence.

Previous work has explored the design of technologies to connect people with one another while riding public transportation. For instance, researchers

developed Trainroulette, an app to promote "situated in-train social interaction between passengers" [34]. The researchers found that people were interested in knowing who shares the rides with them, but wanted to do it semi-anonymously (exposing only certain aspects of their identity). Similarly, Belloni and colleagues [24] explored the use of mobile technologies in "transitional spaces." Their work focused on the design of a location-based friend finder that displays any of the user's friends that are in the same subway train. The researchers found that users wanted the ability to "invisibly" log in to the system. This need for identity opaqueness inspired the design of our app's identity system.

Other work has looked at designing applications to increase social engagement with the physical world. Rosner et al. designed an application that let people convert free form doodles to sharable walking routes on maps [191]. Cranshaw et al. designed an online community of people documenting their experiences at places through sharable city guides [55]. Overall, a meta-analysis of pervasive technology and public transport [33] proposed the development of applications that not facilitate only more efficient journeys, but also more enjoyable ones that people look forward to. This is what we set out to do.

5.3 Scenario-Based Design for Non-Places

Our investigation of non-places as an unexplored domain in social computing began with an informal survey of how existing social computing systems and apps are being used or re-purposed for use in non-places. In surveying this landscape, we considered all-purpose social networks such as Facebook, checkin apps like Foursquare, fitness apps like Strava, tracking apps such as Moves, travel apps such as TripAdvisor, and commuting apps such as Waze. As we considered each technology, we thought about how the features and usage scenarios of these existing services might be adapted by the non-place traveler, perhaps to help foster a disappearing sense of community, or to augment a transient space with virtual experiences of place.

Inspired by formal design methodologies such scenario-based design [35, 36, 158, 193] and persona-based design [29, 41, 181], we synthesized our findings into a set of four scenarios that we felt represent broad yet diverse archetypes of the non-place traveler, while speaking to the opportunities,

challenges, and implications of life in non-places. Here we highlight how these scenarios helped inform our design process, offering a lens through which we can empathize with the lives, emotions, and social computing needs of a non-place traveler.

5.3.1 The Everyday Commuter

Whether they travel by car, by bus, by train, by bike, or by foot, the one thing most everyday commuters have in common is the regularity of their trips. Especially in larger urban cores, this often translates to either time spent in the car stuck in traffic, or sharing the same bus or train with many of the same familiar strangers they see each day.

Recently, apps such as Waze [207] have successfully harnessed the excess capacity of people's free time during peak commuting hours by using people's smartphones to crowd-sourcing traffic conditions. Although its goal is utilitarian, Waze built an online mobile social community around commuting drivers stuck together in traffic, all just trying to find a way around. This shows how social computing can be designed with the needs of the everyday commuter in mind.

5.3.2 The Frequent Flyer

Red-eye to London. Dinner at an airport bar in Istanbul. Just enough time for a coffee before the early flight to Fez. The frequent flyer knows airports. There are no familiar strangers in the airport, only familiar types – the business traveler, the retiree, the honeymooning couple, the college student returning home, the jet-setting socialite – the frequent flyer can spot them all with barely a glance.

Airports are among the most highly checked-in-to venue types in Foursquare and Facebook. Sometimes, flyers checkin on departure to let friends know they'll be out of town. Others checkin to boast about the interesting places they're traveling to. Checking-in upon arrival in an unfamiliar place offers the opportunity for serendipitously bumping into nearby social connections. A Facebook group called Airport Tango[1] has over 8,000 members. Whenever a

[1] https://www.facebook.com/groups/348726108583892/

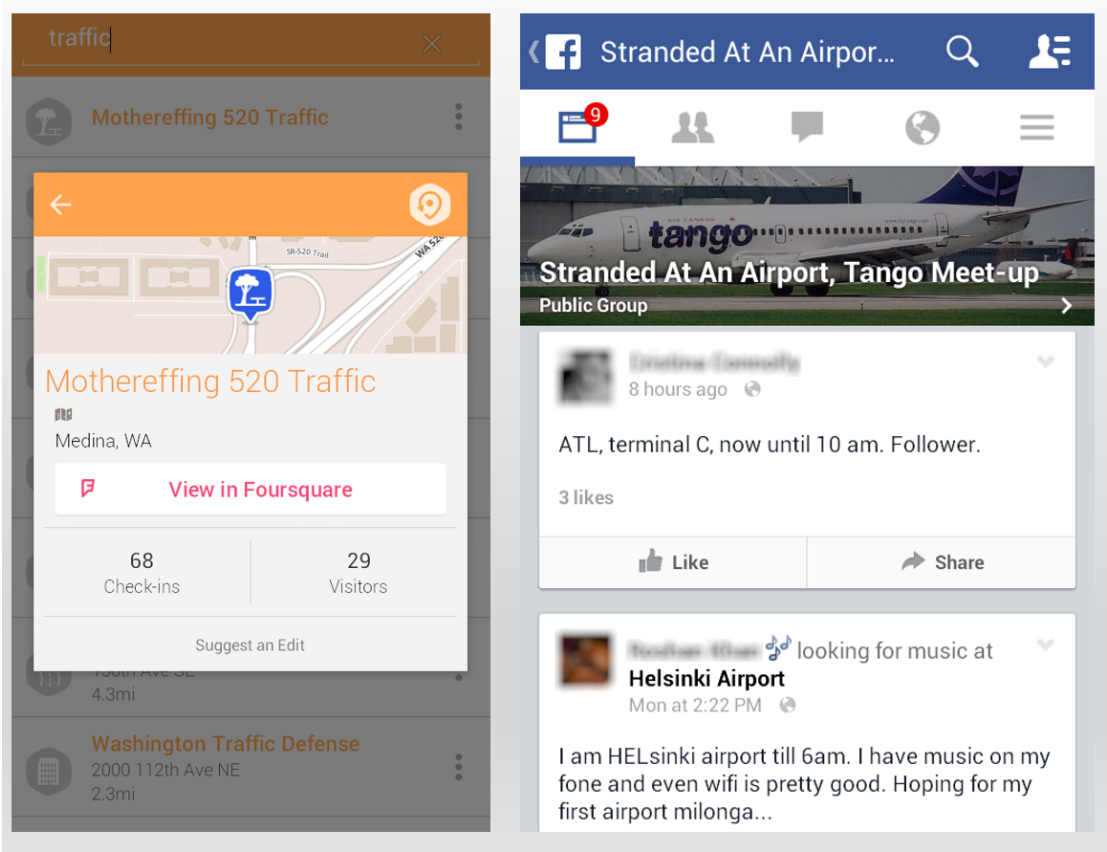

Figure 5.2: (Left) Swarm venue for a recurring traffic jam in a highway.(Right) Facebook group for meeting tango dancers at airports.

group member has some layover time in an airport, they post to the group looking to connect with other members so they can dance the Tango while they wait for their flights (see Figure 5.2 Right). Similarly, Foursquare users often create fake venues to check in while stuck in traffic jams (see Figure 5.2 Left). Checkin apps and other forms of social computing are regularly being used by travelers to make airports a little more social.

5.3.3 The Quantified Traveller

Counting – a cousin to logging, tracking, following, and recording – requires extreme consideration and attention to detail. The quantified traveler might count calories, steps, rides, smiles, records, sodas, hellos, sighs, words spoken, liters drunk, grams consumed, emails sent, texts sent, etc. – you know, the

things that prove useful when compiling the annual report.

The quantified-self movement seeks to empower individuals with increased capabilities for tracking and expressing their personal activities. Some of the initial commercial successes in this space have been glorified step counters, allowing people to estimate how much they walk in a given day. Recent quantified-self applications are starting analyze the trips people take. For example, Strava is a smartphone app for competitive bicyclists and runners that tracks their routes and times [49]. It goes well beyond simple GPS path tracking, however, implementing a leaderboard that shows the best recorded times on all road segments. Moves is another quantified-self smartphone application that builds a beautiful visual journal of the users' activities by automatically identify the venues that they stop at and the modes of transit used to take them between venues.

5.3.4 The Journaling Traveller

The journaling traveler documents the details they feel are often overlooked, carrying their stories with them – on fronts of notebooks, side pockets, marking events on calendars. Documenting the world as they see it drives the Journaling traveler to write at length about how their neighborhood is changing, about the gentleman who walks the park every morning at 7:19am, and about the most recent paint change on the sushi restaurant next door.

Documenting journeys is an age-old tradition. One of the earliest travelogues recorded is the one by the Greek geographer Pausanias from second century A.D. Today, the explosion of social media applications has motivated people to document every aspect of their lives, and journeys are not an exception. People document them with photos on Instagram, or by writing long and detailed notes on Yelp or TripAdvisor about their journeys. Journaling-specific mobile applications like Day One have millions of people using them diligently every day. All of this shows the desire both for journaling travels and for mobile apps to do so.

5.4 Journeys & Notes System Design

In this section we describe the key elements of the Journeys & Notes system design. We link specific designs and components to the various facets of social life in non-places that motivated them, often using our four scenarios as a connecting point of reference.

5.4.1 Overview

Journeys & Notes extends the concept of a checkin [53**?**] beyond fixed-point venues, allowing users to checkin to the *journeys* they take. By specifying the endpoints of their journey and their mode of travel, users unlock a virtual social experience where they interact with other travelers also on the journey, discover notes that others travelers have left along the way, and they can leave behind their own notes for others to find.

The app is comprised of two main screens: the *Home* screen, and the *Journey* screen. From the home screen (see Figure 5.1 Left), there are four possible actions that the user might take: (1) they can checkin to a new journey; (2) they can review their previous journeys, possibly checking-in to one of them; (3) they can return to see details of their current journey; and (4) they can review statistics about all their journeys by mode of transit (see Figure 5.1 Right).

When the users tap the "new journey" area, they are prompted to specify the origin, destination, and mode of transit to complete their journey checkin. When checking-in to a previous journey, the user is only required to specify the mode of transit (see Figure 5.5 Left). Previous journeys are presented on the Home screen as a visual list of cards for each journey, depicting the origin, destination, and summary statistics about past mode-of-transit choices on that journey. If a user is currently checked-in to a journey, they will see "current journey" section on the home screen, with a card depicting the details of the journey they're checked into. In all cases, these actions take the users to the *Journey* screen for their current journey.

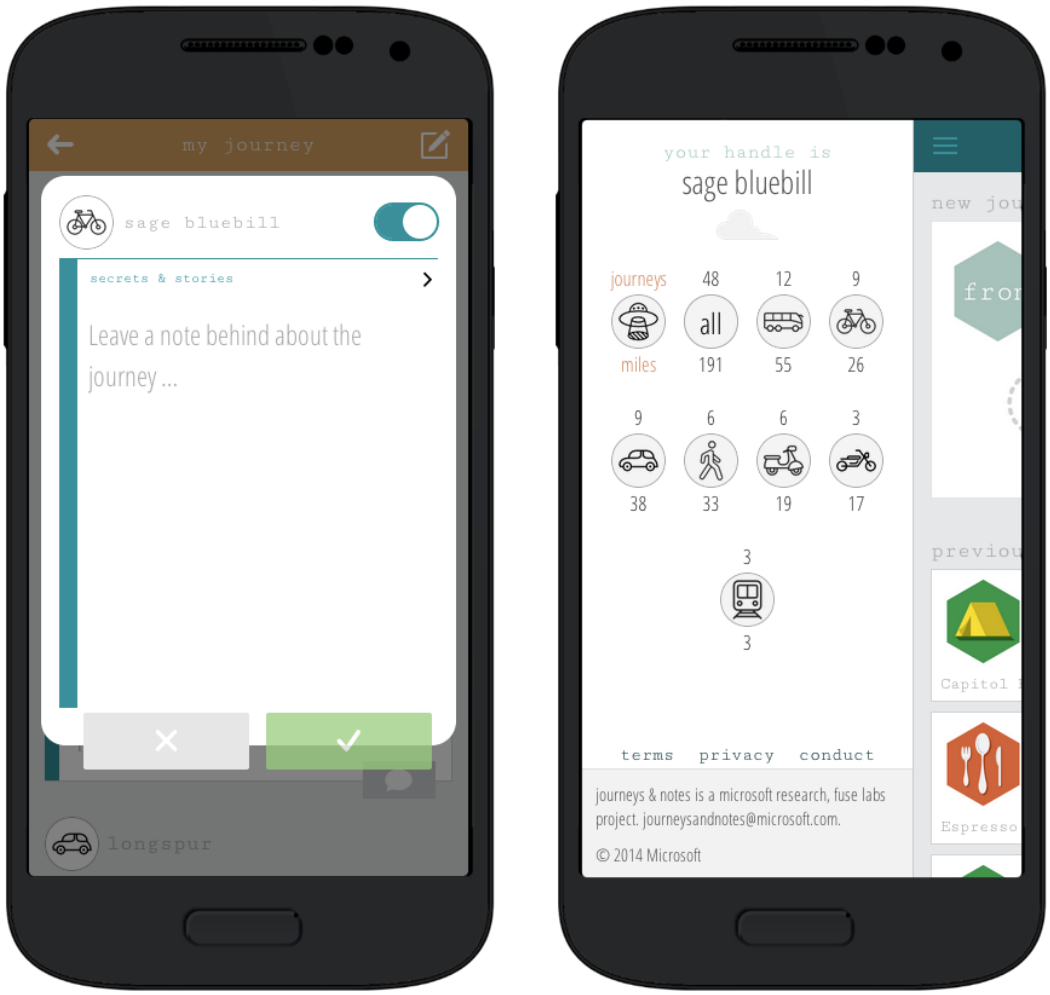

Figure 5.3: (Left) The *Notes* view. Users can leave a note behind on their journey for others to see. (Right) The *Stats* view. Users can see summary stats of all the journeys they have taken, grouped by mode of transit.

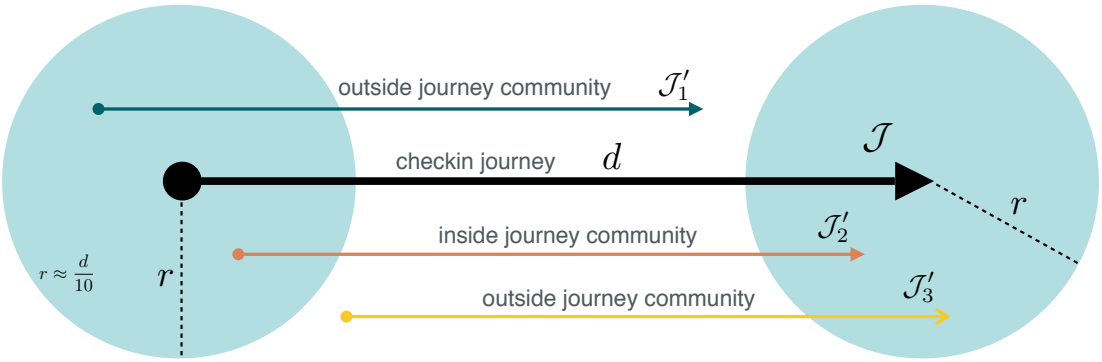

Figure 5.4: Nearby journeys are bundled together to create a community. $\mathcal{J}$ is the checkin journey of distance d, which defines a community radius of $r \approx \frac{d}{10}$. Only notes $\mathcal{J}'_2$ are visible to $\mathcal{J}$, because $\mathcal{J}'_2$ starts within r of $\mathcal{J}$ and ends within r of $\mathcal{J}$.

5.4.2 Journeys

A *journey* is fully specified by its *endpoints* – the origin and destination of the user's trip. In the system, endpoints are literally points on the map (latitude and longitude coordinates), so that two users will be on identical journeys if they start at the same location and finish at the same location, independent of the paths they take while en-route. The user provides their journey endpoints in a text field by specifying either a *venue* (e.g. a named points of interest, like "The Statue of Liberty") or street addresses. The system geolocates the user's input, resolving the endpoints to a coordinate by referencing the Foursquare API (for venues) and the Bing API (for addresses). To enable ease of free text input on a mobile device, as the user types their endpoints the system generates "typeahead" auto-suggestions of nearby venues and addresses based on the current device location [14].

5.4.3 Journey Checkins

The central experience of Journeys & Notes is the *journey checkin*, the process by which users expresses their presence on a particular journey. To checkin to a journey, a user must give their origin and destination (determining which journey they are on), and they must choose their mode of travel from a menu of travel icons (See Figure 5.5 Left).

When a user checks-in to a journey, they are taken to the Journey screen, where they are greeted by a randomized "welcome" message that we crafted to

reinforce the user checkin behavior, and adding variety, playfulness, and gamification aspects to the user experience. We designed three types of welcome messages. The first type shows high level statistics about the journey, including any notable milestones, how many times the user has travelled the journey, and how many other people have travelled on the journey too. The second message type presents a travel-related haiku for the user's enjoyment. The third type shows "fun facts" about the journey (for example how long would it take a bird to travel the whole distance). In later sections, we will delve into the design and motivation for showing these messages. Figure 5.6 (Right) shows one example of the welcome screen.

Journey Community

The Journey page is a forum that asynchronously connects users on similar journeys, allowing people to leave behind notes for their fellow travelers to read, and to read and respond to the notes left behind by others. These notes are only visible when a user is on that journey, creating an explicit bond between the virtual content of the journey, and the physical journey itself.

This design augments the space of the traveler with a persistent community, complete with affordances to interact with this community outside of the physical realities of the non-place. This design is one of the most direct vehicles by which we hope to impact the experience of non-places.

Each checkin journey defines its own forum members based on the journey endpoints. Roughly speaking, all other journeys that start *near* the checkin journey's origin, and end *near* its destination are bundled together to define the journey's forum. We scale this bundling so that the longer a distance covered by the checkin journey (as the crow flies), the wider the community of bundled journeys. Specifically, if the checkin journey $\mathcal{J} = (a, b)$ travels from point a to point b and is distance d, we define the community radius $r = (d/c)$ to be a constant fraction of the distance for some $c > 1$. As d varies, we further restrict r so that it has fixed minimum and maximum values α and β. Then the community of journeys bundled with checkin journey $\mathcal{J}$ is $C(\mathcal{J}) = \{\mathcal{J}' = (a', b') : d(a, a') \leq r \text{ and } d(b, b') \leq r\}$. In our implementation we set c to 10, α to 100 yards, and β to 30 miles. That is, $\mathcal{J}$ is bundled with other journeys that start within a radius equal to 1/10th of its distance and end

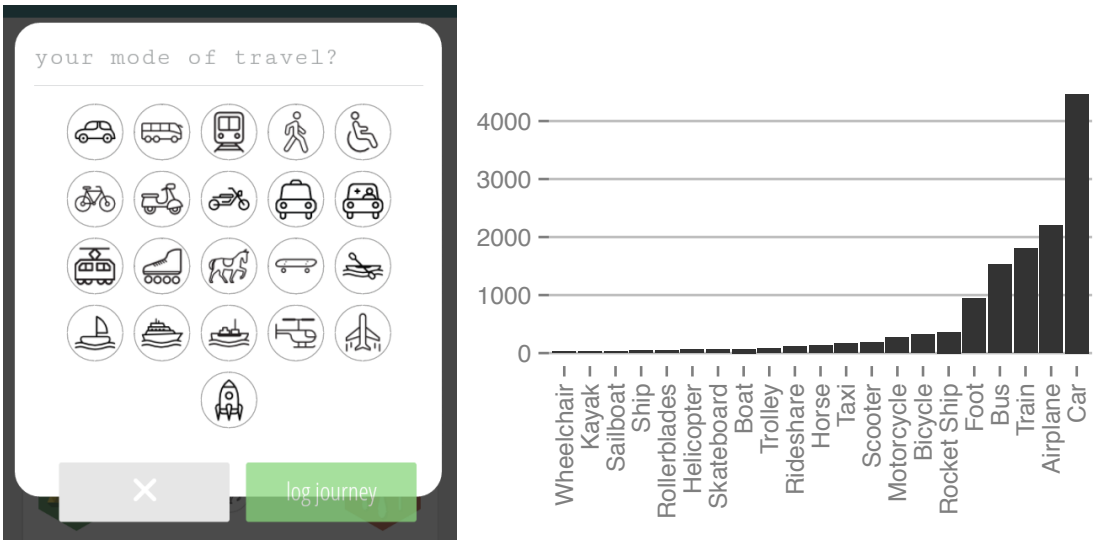

Figure 5.5: (Left) Supported modes of travel. (Right) The number of journey checkins by transit mode observed during the field deployment. Cars (34%), Airplanes (17%), Trains (14%), Buses (12%), and Pedestrians (7%) comprise the majority of checkins.

within 1/10th of its distance (with an additional minimum radius constraint of 100 yards and maximum radius of 30 miles). This is outlined with an example in Figure 5.4.

Having a community radius that scales with the length of the journey allows Journeys & Notes to be equally useful for the long distance business trips, where you would want to encompass the entire cites or each end, and for the many intra-city adventures of the everyday commuter, where radius should capture just a block or a neighborhood. Traveling over longer distances, say from New York to San Francisco, one would want to be grouped with other travelers that start anywhere in the New York region, and end anywhere in the San Francisco region. Similarly, if one is traveling between two neighborhoods within the same city, one would want a much more localized community. All of this happens invisibly in the user experience: when they checkin to a journey, they simply see their fellow travelers on similar journeys.

Mode of Travel

Asking users to select the mode of travel in order to checkin to a journey serves three very different purposes. First, by forcing travelers to think of their mode of transportation as not just a means to the end of their journey, but as a

critical part of their identity in the online community (their avatar), we are turning role of the mode of travel on its head, from something that encourages individuality and disorientation in the physical world, to symbol that breeds sociality and presence in the online community.

Second, their mode of travel provides an important piece of contextual information that can be used to help foster online community growth. To surface this information, we use the mode of travel icon as the user's avatar in the journey forum. This increases travelers' awareness of other possible modes of travel to get where they are going; for example, drivers become more aware of the cycling community that exists along their commute. It also encourages communities to form within a given mode of travel; for example, bus riders can quickly scan posts from other bus avatars and identify with other bus riders' travelling experience.

Finally, data about how people get to where they are going is extremely valuable civic data that could be used to better inform city transit planning. Collecting these data at a large scale is very difficult for cities and organizations. Developing a scalable approach for approximating or modelling transportation patterns within a city could lead to significant civic innovations.

5.4.4 Notes

Leaving notes on a journey is relatively straightforward. Simply tapping a "compose" button opens up a note builder popover window, which guides users to constructing their notes. Notes are plain text and are restricted to 250 characters. The compose view is shown in Figure 5.6. The author has the option to categorize the note with one of five categories: *Notes & Visitors*, *Secrets & Stories*, *Love & Hate*, *Missed Connections*, and *Tips & Tricks*. By scaffolding the compose window with note topic sections, our goal is to gently focus the discussion, so that people are not turned away by the cold start problem of a blank page with no inspiration for what to write.

Notes appear in the Journey page in a feed displayed in reverse chronological order. Different categories receive different color treatments, allowing for visual information filtering when browsing the feed. When a note in the feed is tapped, it opens up a detail view for that note, which displays any

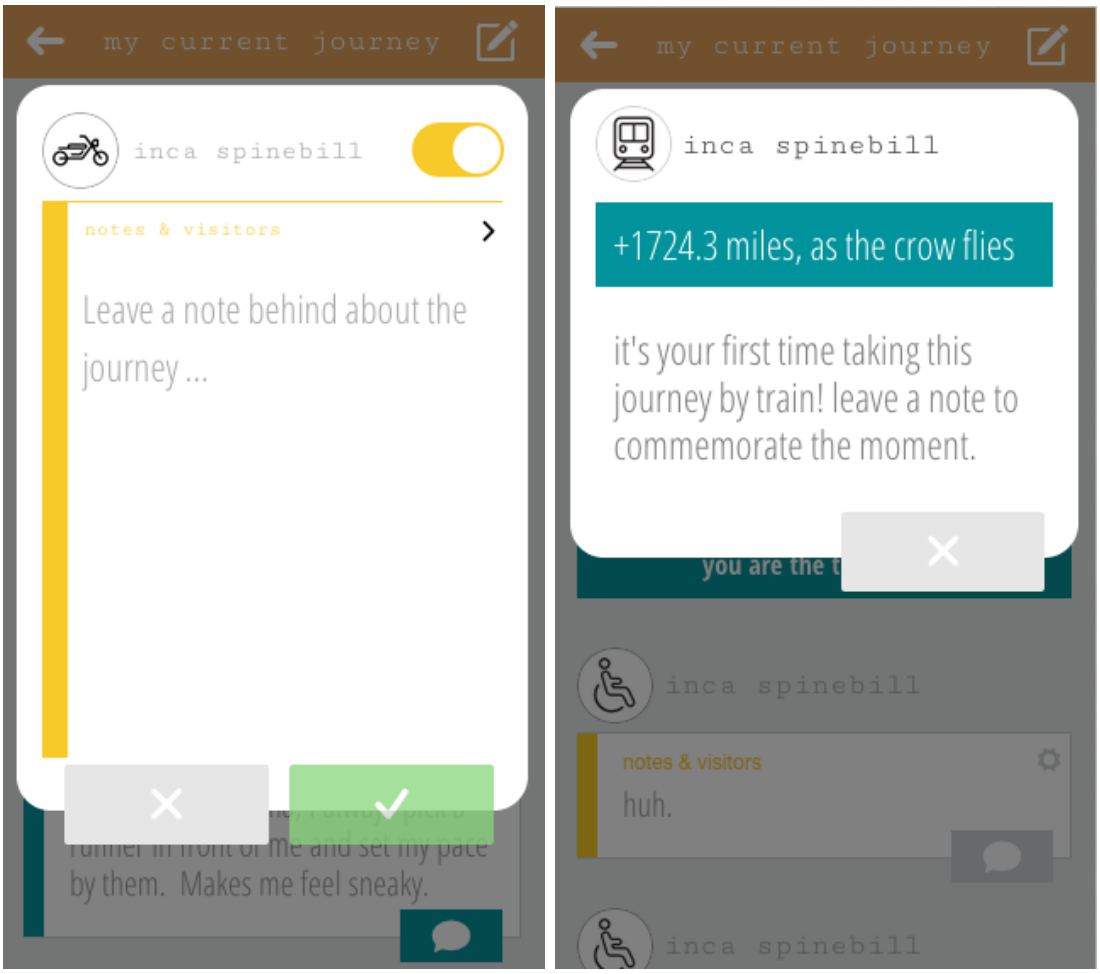

Figure 5.6: (Left) The note *compose* window. Tapping the toggle in the top right switches between anonymity and pseudonymity. Tapping the sub-header will step through the five different note sections. (Right) A *welcome* pop-up appears immediately after a user checks-in to a journey.

comments that have been left, and exposes an interface for composing a comment on the selected note.

Note are not only the primary means by which people interact with their fellow travelers (by reading the notes of others, and leaving comments behind), but simply by virtue of being asked to write about it, notes encourage the traveler to be mindful of the journey, and create a sense of history and culture from the previous travelers.

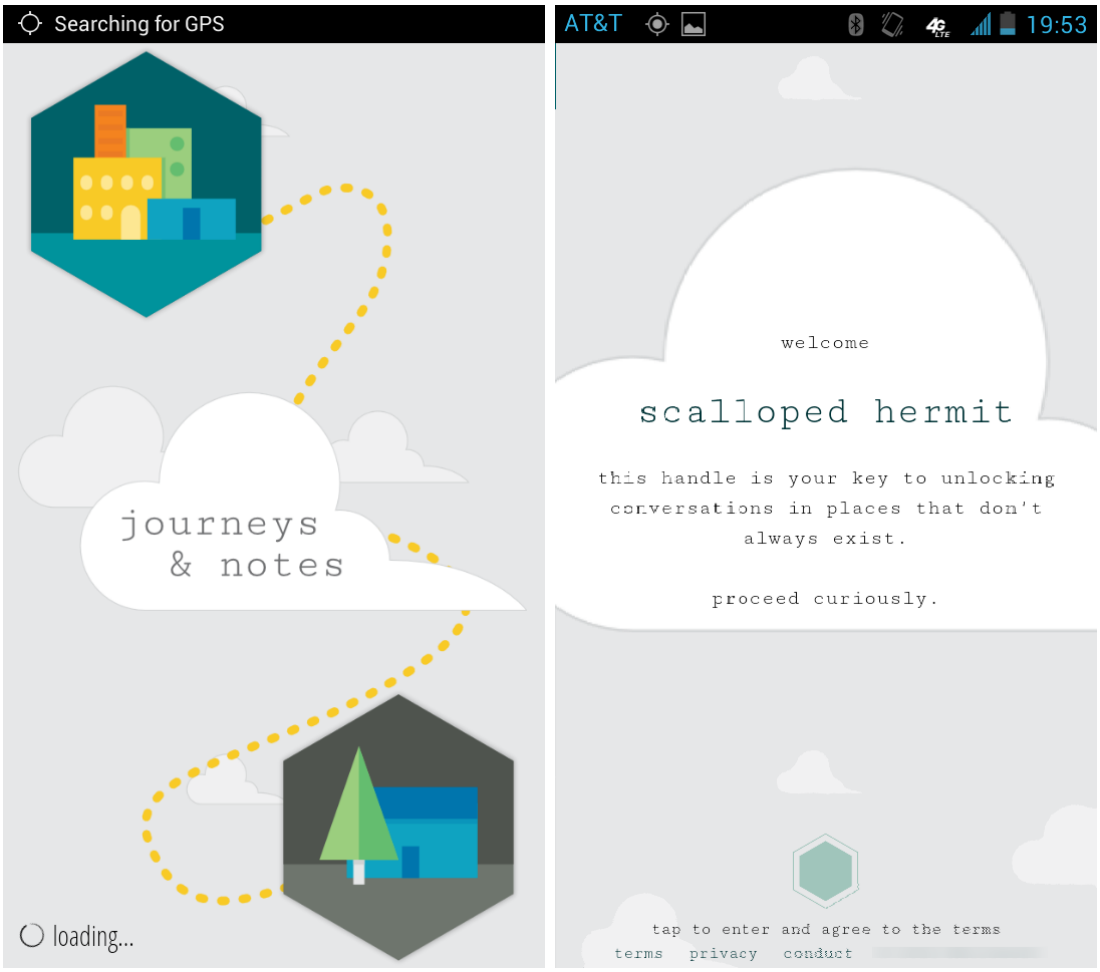

Figure 5.7: (Left) Journeys & Notes loading screen. (Right) A random pseudonym given to a first time user.

5.4.5 Pseudonymity and Anonymity

There are three defining aspects of our design around user profiles and identity: (1) users are given random system-assigned usernames, or *pseudonyms*, the first time they use Journeys & Notes; (2) pseudonyms are persistent, they cannot be changed, and they are visible on all the notes they leave behind; and (3) when users are composing a note, they can decide (with the switch of a radio button) to make the note completely anonymous, thereby not associating that note with their pseudonym.

Our pseudonyms are derived from naming schemes developed for bird species common names. Although there are only about 10,000 species of birds

[5], we developed a method for creating a suitably large name-space of pseudonyms that *sound like* bird names, but may not be, by expanding on typical structure used in naming strategies. Each species common name must feature the common name of the family (e.g. sparrow, wren, warbler). However, the family name is typically modified by (1) attributes describing the physical characteristics (e.g. yellow-rumped cacique); (2) geographic terms denoting where the bird can be found (e.g. the Eurasian nuthatch); or (3) landscapes or habitats where the bird roosts (e.g. mountain pygmy owl). By taking the Cartesian product of the constituent sets of descriptors in each of these three cases, we created a name space of well over a million possibly fake but convincing bird common names (e.g. scarlet crested wren). We felt having bird names as pseudonyms was a whimsical and playful design that might appeal to users like the journaling traveler, who sees beauty in the simple things around her. Figure 5.7 illustrates the new user on-boarding screens, highlighting the pseudonym assignment.

Much of our thinking about identity and anonymity was influenced by the needs and experiences of the city-dwelling public transit enthusiast, such as the everyday commuter scenario. Many who live in large cities have high regard for the anonymity that comes with city life, a somewhat paradoxical byproduct of sharing a small physical area with a great many people [111]. They also value the structure and regularity of the daily commute – in particular the familiar strangers, those faces in the crowd that they recognize and who may even occupy a significant portion of their lives, yet whom they have never had any deep interactions with.

Stanley Milgram was one of the first to write about the role of familiar strangers in urban milieu. He describes the phenomenon as a distinct category of relationship, providing support and value, and also requiring maintenance in the same way that family, friends, or colleagues do [147]. Like Paulos and Goodman's Jabberwocky [169], our design of Journeys & Notes does not attempt to alter existing familiar stranger norms or relationships. Rather, we hope to accentuate familiar strangers by building technology that enables new interactions and experiences that highlight their unique role in urban life.

Specifically, our decision to use assigned pseudonyms was intended to

preserve urban anonymity. For the everyday commuters who regularly share close quarters with many of the same fellow travelers every day on their bus, train, or shuttle commutes, we believe it is important to maintain the same feelings of anonymity in the application as is experienced in the physical world. Our use of persistent random pseudonyms, in contrast to pseudonyms that are refreshed with each new post [130], allows users to maintain familiar stranger relationships in the application by noticing and following the posts of familiar pseudonyms that they might recognize from journeys past.

5.4.6 Quantified-Self and Gamification

Just as place based checkin applications use self-quantification and gamification as motivating forces that drive usage [53, 245**?**], we believe there are similar opportunities for non-place based checkins. First, inspired by a similar feature Foursquare used to have, we give people the title of "trailblazer" when they are the first to checkin to a journey that no one else has checked-in to before. Our goal is to encourage people to explore new journeys for themselves and for the system as a whole. Furthermore, inspired by the examples we described in our scenario like Waze and Strava, we decided to incorporate journey-based statistics about the user. We surface these statistics to the user in a summary panel on the Journey page. We first maintain simple counts for the number of times the user has taken each trip. Additionally, we maintain counts for the number of times the user has checked-in with each mode of transit, both in total and for each journey. We also measure cumulative miles traveled (as the crow flies) for each mode of transit, again both in total and for each journey. The total cumulative mode of transit stats is displayed on the user profile page, see Figure 5.3 (Right).

5.4.7 Design Aesthetics and Poetic Elements

The idea of leaving a digital note behind on a journey evokes feelings of hiding a message in a bottle and tossing it out to sea — the action itself is poetic — writing a message not knowing who, if anyone, will ever see it. From the visual design language of the application, to the use of bird names as pseudonyms, to the natural imagery scattered throughout, we've tried to imbue much of the poetics of this moment into the look, feel, and voice of the application. These

poetic elements encourage travelers to be mindful and present in their surroundings, perhaps nudging them to notice aspects about the journey that they otherwise might have missed.

The most overt invocation of poetics in our design was our use of haikus to welcome users to a journey and priming them, to think about the type of content they might leave behind as notes. We hired three creative writers on oDesk[2] to produce haikus exploring the core concept of the app: the journey through non-places. Each writer composed 15 haikus, three haikus inspired by each of the five note sections.

Here is one inspired by *Missed Connections*:

> Motor hum, grease smell
>
> and there you are again, but
>
> long, the road between

Seeded Content

We also hired a number of writers who were familiar with a number of major metropolitan areas of the United States to seed the app with pre-existing 896 notes as one way to bootstrap engagement. We asked the writers to write notes for common journeys of people in those metro areas. Below is an example of a note written by one of these writers:

> "Every day during my lunch break I take a run from the bottom of Boston street up the hill and I draw a chalk line to see where I am after 10 minutes. I'm inching my way up, guys, anyone wanna race?"

5.4.8 Implementation

Journeys & Notes is implemented as a client (Android application) and server (REST API), where the server's role is exclusively to persist the actions of the user to a remote datastore, facilitating sharing and interaction across multiple distributed clients. The datastore is implemented with a spatially enabled PostGIS/PostgreSQL database, allowing for efficient execution of queries with spatial joins. Our REST API is implemented in Python with the Flask

[2] http://odesk.com

framework. We will not go into any further details about the system architecture.

5.5 User Studies

We conducted two rounds of small scale user studies of individuals who used Journeys & Notes for one week with a total of 21 participants. In study 1, we recruited 6 participants from the Seattle area through TaskRabbit[3]. We conducted an hour long, in-person pre-study interview with each participant, to get a sense of their normal everyday transportation patterns, how they got around the city, and what they typically perceive as they travel. After this discussion we gave them an overview of how to use Journeys & Notes. They were asked to use Journeys & Notes for one week, to checkin on each journey they take, and to leave 3 notes behind on their journeys per day. After this week, we conducted another in-person, 1 hour long post-study interview. In study 2, we recruited 15 people from the Seattle area through Craigslist[4] to use Journeys & Notes for one week with the same usage requirements of study 1 participants. In this round, however, our evaluation was through two online surveys (pre- and post-study), featuring several free response questions about their experience.

Our goal was two-fold. First, we wanted to better understand the landscape of how people conceptualized the journeys they take and people they encounter along the way. Second, we wanted them to use Journeys & Notes for a week, so we could get a high level understanding of which aspects of the system people seemed to respond most to, and which were features were not as robust. The version of the app that we tested in these trials was more primitive than the one described above. It did not have as many quantified-self features that counted trips and mileage. We transcribed the interviews and identified common themes and important insights that emerged, which we synthesize in the discussion below.

[3] http://taskrabbit.com
[4] http://craigslist.org

5.5.1 Anonymity and Other People

Because the content was sparse and geographically siloed across the city, participants had limited contact with others in the study, however there was some. One participant remarked laughing at posts he found from other people: "Some of the missed connections are really funny. There was one guy that lost his blue velvet jacket somewhere up there [laughter]... he was looking for it. He lost it on a bet. That was hilarious!" Although most people did not post anything fully anonymously, some of those who came into contact with others' posts seemed more thoughtful about using fully anonymous postings, often when saying things that they didn't want attributed to their pseudonym. One participant posted all of her content anonymously. She was a regular bus rider, and was concerned about people identifying patterns in her posts and being able to guess her real identity, so she decided to be entirely anonymous.

5.5.2 Reflection, Curiosity, and Exploration

By far the most common theme we heard from participants was that Journeys & Notes made them more reflective in different ways. For example, one person felt having the transit icons so closely associated with his identity made him question his transportation choices: "I think I would try to bike more instead of drive. That was the powerful thing for me with the app since I didn't have any other contact [with others]. It really forced me to consider how I travel and if it was really necessary. I really liked it for that reason." Another participant felt that getting into the habit of writing while on a journey made him more aware of his commute and the world around him: "I can only use my experience, but I think anyone who wants to actively be more aware of their commute would enjoy this. It allows reflection on a part of the day that is often dismissed as a necessary evil best ignored." Similarly, another felt that, "Writers and thinkers would love it. It's a great way to be expressive. It might clue you in on things you had no idea about." This is particularly encouraging feedback in support of the journaling scenario for non-place based social applications.

Another participant felt the app piqued her curiosity: "the app just made me curious. It made me want to explore and look for people in the area. I really wanted to have a conversation with someone!" Similarly, someone else said:

"When I did get to read other's posts I felt some sense of connection — like hey, other people are going through here and are sharing their experience. I liked the opportunity to pick up little secrets about places." She continued: "Each time I logged in, I felt thoughtful and more conscious of my surroundings (except for having my head in my phone). But when I wasn't looking down, I was more aware of my surroundings because I wanted to write descriptively."

In response to seeing the haikus, another participant said: "I did notice the Haikus! I liked them. They seemed to inspire me more than anything. They build up this idea that just around the corner I might meet someone unexpected."

5.5.3 Public Transport

We heard from several participants that they felt the app was most useful for public transportation (and not driving, or walking, or biking). For example, one woman said: "I think the app is most useful for public transport, didn't log any trips I took by car or foot." This was echoed by several others. If we were designing the app from scratch, we would reconsider the decision to make it a general purpose transit app. We will expand more on this this feedback in the discussion section.

5.5.4 Limitations

Of course, not all participants enjoyed Journeys & Notes. Some were just too busy with other things they valued more to give it much time: "In transit, especially taking transit, I had other things I needed to pay attention to like not missing my stop and being alert to what was going on around me. I also don't like having my face buried in my phone on the bus because I think people do it to relieve social anxiety or out of boredom. I like being able to people watch- or gasp- even strike up a non-digitized exchange with someone."

Others just didn't feel connected to what it was trying to achieve, and felt systems like Facebook are more complete: "At 53, I found nothing too interesting in it. You have Facebook and a few other things out there, so people check in there, though not me. I can see the benefit for entertainment of strangers commenting on stuff written by me, but since I was just outside

Seattle, I saw no comments from anyone."

Another thought it was too buggy to enjoy: "Why would anyone use it if this is what it is? What does it add to a trip? It is fiddly in alpha and doesn't look up addresses, and is yet populated with a lot of user content, so no, I'd not use it as it lives now."

5.5.5 Feature Requests

One of the features that we had planned to add, but were not able to finish before these studies, was a statistics and tracking feature about journeys (e.g. quantified-self). Interestingly, this was something that was specifically requested: "Also, I think a cool feature to add would be distance and time measurements. Maybe the app keeps track of how long the journey takes the user, or the user can add that information in. This would give others on the same trip more information hence why they use the app in the first place! Also adding a distance counter could be cool and easy, especially since the locations are already in the database." This feedback motivated us to complete this exact feature in time for our release in the app store.

5.6 Large Scale Field Deployment

The app was publicly released in the Google Play store on October 22, 2014. Between then and September 20, 2015, there were 20,323 installations resulting in 23,697 user registrations (we purposefully do not maintain user identity across re-installs, resulting in duplicate registrations). During this time 9,435 people performed a total of 12,904 journey checkins on 11,337 unique journeys. While most of these users performed just one journey checkin, there were 2,121 people with more than one checkin during this period, some with considerably more, with a maximum of 50 checkins by one user observed. As one would expect, most journeys were relatively short with a long tail of very long journeys: the median distance was 54 kilometers (33 miles) and the mean distance was 1296 kilometers (805 miles).

We can also see how these journeys are distributed across different modes of transit (Figure 5.5 Right). While most people embarked on journeys on traditional modes of transit (Car, Airplane, Bus, Train, and Walking account for

84% of checkins), people did engage with our more playful and atypical modes of transit. We observed 58 people take journeys by skateboard, 125 people checked-in with a horse, 21 travelled by wheelchair, and 363 by the fantastical rocket-ship.

5.6.1 Analysis of Contributed Notes

Along with those checkins, 1,989 users wrote 2,777 notes on their journeys, and 203 replies to existing notes. As one might expect, most of these notes were left in the default, Notes & Visitors section (2,300 or 90%). Some users also ventured from the default section and left their posts in Tips & Tricks (122 or 5%), Love & Hate (51 or 2%), Secrets & Stories (45 or 2%), or Missed Connections (16 or 1%).

To explore how these 2,777 posts contributed to the "sense of place" of the journey, we asked 5 annotators to categorize each post along five dimensions: (1) is the post poetic? (2) is it factual? (3) is it personal or intimate? (4) is it about memories of a past journey? and (5) is it about the present moment in this journey? We additionally wanted to identify posts that expressed the essence of the four personas that were critical to our design. We asked the annotators to also make judgements about whether the post author was (6) an everyday commuter, (7) a frequent flyer, (8) a quantified traveler, or (9) a journaling traveler. In this way, annotators labeled the data across 9 categories, and they could tag each post with any, all, or none of these categories. Table 5.1 shows a summary of number of post tagged in each category, including Fliess' Kappa scores for the annotations. Fliess' κ scores are computed, and in some cases indicate low agreement, perhaps reflecting the subjectivity of the task. We show approximate counts of each category type, by counting when at least two annotators agree on a labelling. Most posts were about the current journey (816), and the most exemplified scenarios were the Everyday Commuter (443) and the Journaling Traveller (373).

Below are some examples of notes written by users that exemplify the scenarios above. We only show posts from each category if at least two of the four annotators agreed the post belonged in that category.

Category	κ	Number of posts
Poetic	0.41	77
Factual	0.22	536
Intimate	0.01	15
About Past Journey	0.06	46
About Current Journey	0.16	816
Everyday Commuter	0.21	443
Frequent Flyer	0.09	76
Quantified Traveller	0.02	25
Journaling Traveller	0.06	373

Table 5.1: A summary of post labels given by five annotators, where κ is the Fleiss' measure of inter-rater reliability, and the number of posts counts when at least two annotators agree.

Poetic

"From the shelter of my bus stop I watched the mist hug the walls of the building. Everything seemed to be wrapped in drops."

"I leave one train, only to get upon another. Exactly the same."

"The train is empty. Seats creak. The guard approaches silently. Gliding like he has done for years. I have no ticket to show him. I am not here."

Factual

"Grab a taxi or the BTS to the Victory Monument. From there head to the north-east side of the roundabout (you'll see all the minbuses) and speak to the women there. It should cost 60 Baht to the centre of Ayutthaya."

"Take a diversion via Brecon on the A470... Great change from heads of the valley."

"During the weekday, is easier to get coach ticket from the terminal bersepadu selatan (TBS), southern bound bus terminal."

"Find and play the piano at the airport. Relaxing."

Intimate

"I'm going to meet the love of my life for the first time, and if it doesn't work out I doubt I'll ever have the strength or will to overcome it. This is, regardless, a day of incredible happiness and growth. Optimism, more than anything."

About a Past Journey

"It is my second time back to TO after leaving it in 2005. This time marks as a special trip in memory of my one decade since graduated from U of T."

"Did this travel in 2007 and didn't regret it."

"My journey from the Philippines to the USA was years ago. I migrated here with my family with hopes of a better future and life."

About the Current Journey

"The coffee is cheap and plentiful, and I'm on my way to Mexican food."

"Hi travelers, I'm a trucker and giving this app a try, headed to Ohio!"

"Aloha, Seattle! Off to BI for some ice cream."

"Got here just as the leasing office closed :-(Better luck tomorrow I hope but for right now, I'm getting tacos."

Everyday Commuter

"Just another ride to work at the shack. One day soon this ride won't be necessary and instead go on to do bigger things. That day will come soon I hope."

"My commute is farther from home than most people in history travelled in their entire lives."

"This my everyday, five day's out of the week route to my job at {redacted} Hospital."

Frequent Flyer

"I feel elated. Airborne. Rising higher. Soaring like a bird. With massive metal wings. And lots of creatures inside. People. Inside a bird. Odd."

"Left FAT airport at 2pm. It's never a long line so it took only 45 minutes to get in and in line for the plane. File out to SFO. Got there in 45 minutes."

"Kiruna is small airport with nothing else than the essential. Souvenirs and restaurant."

Journaling Traveller

"Loved Prague.. could see living here with learning just a few words of Czech. On to Poland!"

"Beautiful ambience, exotic wildlife, a calm weekend... What else do you want? The Boatbill strongly recommends this place."

"Stopped by Carkeek Park to see the salmon."

5.7 Discussion

We believe we have identified a rich new space, ripe for future HCI research: developing mobile and social computing systems for engaging people in non-places. To explore this domain, we created Journeys & Notes, a checkin app that augments journeys in the physical world with online places where people interact with other past, present, and future travelers of the same their journey. Our intention was to design a system that might surface new experiences and address unmet needs of travelers passing through non-places. We grounded our design decisions around four archetypal scenarios where non-place travelers might encounter social computing: the everyday commuter, the frequent flyer, the journaling traveler, and the quantified traveler.

Through two small scale user studies, and one field deployment, our preliminary investigation shows evidence that social computing can indeed imbue a transient physical space with basic characteristics of a place: elements of a history, a culture, a community, and mechanisms to foster a heightened sociality among those that pass through it.

Our small scale interview studies revealed a broad range of reactions, both positive and negative, to individual features of the design. They also present strong evidence in support of the central premise of this work, that there is opportunity for social computing to grow online communities that are rooted at non-places. The most valuable aspect of Journeys & Notes that emerged from these interviews seemed to be the fact that through a small set of very basic interactions (checkin mechanisms, and note compositions), the system could support a range of different uses: self-reflection, atemporal interactions with others, discovery of new places, self-tracking and community building.

Although the app-store release of Journeys & Notes has yet to successfully generate sustained usage or foster dense, anonymous, hyper-local communication channels (see the limitations section below), it has nevertheless been successful at providing a window into the needs and thoughts of the non-place traveler. Because communication in Journeys & Notes is atemporal, the notes that people write are like messages in bottles tossed into the sea, composed for future travelers of the journey to read, regardless of whether anyone ever finds them. The content of the messages examples above give us a fascinating glimpse into the range of different things people post about, and the potential place-making impacts such a communication channel might have in transient spaces. We take these messages as further evidence that Journeys & Notes speaks to interactions and scenarios that resonate with people, and yet are not fully explored by existing research or technologies. The richness and opportunity for social computing for non-places is clear.

Finally, we want to shed light on the public reaction to the app in the form of tweets, marketplace reviews, and news articles. Many of these statements made references to usage scenarios that perfectly aligned with those we outlined here. For instance, one journalist highlighted the long-distance traveler scenario: "(similar to) Foursquare, although it prioritizes the journey itself, rather than checking in at your final destination [217]." A different journalist mentioned the commuting usage scenario "Why We Love It: It helped us see our daily commute through new eyes [94]." Another mentioned using Journeys & Notes for journaling: "it's a novel idea and fun way to document trips [162]." A fourth write-up mentions both the community aspects: "the aim is to create a community of travelers, no matter if it will be just on foot between two Metro stations, or trekking through the Himalayas," as well as the anonymous and journaling features of the app: "you can, of course, remain hidden behind your nickname, keep a log of your travels, and share your stories for the community to see [164]."

For instance, one journalist highlighted the long-distance traveler scenario: "(similar to) Foursquare, although it prioritizes the journey itself, rather than checking in at your final destination. So if you frequently take the Eurostar from London to Paris, you can easily define your start point, end point and mode of transportation" [217]. A different journalist mentioned the commuting

scenario, "Why We Love It: It helped us see our daily commute through new eyes," highlighting the commuting scenario. [94]. Another one mentioned the journaling scenario: "it's a novel idea and fun way to document trips" [162]. A fourth write-up mentions both the community aspects: "the aim is to create a community of travelers, no matter if it will be just on foot between two Metro stations, or trekking through the Himalayas," as well as the anonymous and journaling features of the app: "you can, of course, remain hidden behind your nickname, keep a log of your travels, and share your stories for the community to see" [164].

One user on the Google Play store said in their review, "I've been using this app through a trip overseas for a week now in addition to more mundane use while at home. (…) I'm not expecting to run across any other users where I am, so the fact I'm a trailblazer is unsurprising. (…) I hope more people use it so I get to see some notes from others!"

5.7.1 Limitations and Lessons Learned

In our evaluations of the design, we uncovered a number of limitations and lessons that might be valuable to future researchers in this area. Many of these lessons stem from the tensions between being a low fidelity research project, while also being a product available in an app market. On the surface Journeys & Notes appears somewhat polished, but as an experimental app, it lacked many features and details that product teams would typically invest in.

In order to truly get sustained usage of the app, we would have needed to invest more into cracking the two-sided problem of geographic sparsity hindering the discoverability of posts. A number of approaches might have helped. Instead of a world-wide release in an app store, we could have embraced geographic-contagion model for the release, focusing on one dense geographic region to start and scaling out. We also would have needed to embraced device notifications as a mechanism to inform people when other activity happens near them, or on the posts that they leave behind, thus increasing interactions, and discoverability of people and content.

We also found that post-sections (e.g. missed-connections, tips & tricks, etc.) were barely used at all, likely because of a flawed UI design that made

them difficult to discover. While we included these as a way to nudge users to focus their conversation around fixed topics, in retrospect, people seemed post compelling and interesting content without using them, so they may not be necessary after all.

There were a number of features that we explicitly chose not to support that ended up being requested by users. We wanted to create an ephemeral experience similar to other online communities [28], and designed our posts so that they were only visible when people were actually checked-in to their journeys. People didn't like this. Here's an example review written by one of our users: "i want to be able to delete a journey and review the notes I've made…bc right now, i have to log in another journey to see my notes and it looks so messy now." We also wanted to design a text only experience, but users today are so used to rich media, that there was a strong desire to see photos in posts.

Some people, especially the quantified travelers, found it too much work to have to manually enter every journey. While we made it easy for people to checkin to previous journeys by simply clicking on them; other apps make it even easier. For example, the Moves app uses the geolocation features in smartphones to automatically log people's activities [64]. While this auto logging opens up challenges for privacy and device battery-life, it is a feature some people expect to have. Future iterations should consider giving people this option.

The system tried to capture all types of a journey's modalities, from bus to plane to skateboard. This reduces the possibility to optimize for one type of community; in retrospect, the system could have been created with one specific community in mind, similar to what Waze has done by focusing on automobiles. This need to focus on a specific community was highlighted by one of the emails we received from one of our most avid users: "I think that you should work on a trucker version. Drivers could leave notes about truck stops, warehouses, road hazards, places with truck parking and such. I think that it would be a hit. (…) I am a truck driver. I have been driving for about 20 years."

5.8 Conclusions and Future Work

This work opens the door to a number of different promising areas of future research. By strengthening community structures around common commute paths, non-place communities could help finally realize the original vision of peer-to-peer ride-sharing (not the "ride-for-hire" form of ride sharing popularized by Uber and Lyft). Beyond specific end-user functionality, we also envisioned these type of systems being useful sources of civic data that communities can use to better understand mobility patterns, transit choices, and people's perceptions of their surrounding environments. We also believe that developing technologies specifically for non-places can help meet the challenges of rebuilding and strengthening communities in the 21st century. The increased occupation of non-places, and the growing communities these non-places contain, makes them increasingly central to social development and interaction, and properly designed technologies can transform Milgram's familiar strangers into knowledge sharing and human contact even in an asynchronous and pseudonymous fashion.

A Framework for Representing Place in Information Systems

As I hope is clear by now, place is a multifaceted concept that can be understood in numerous, sometimes contradictory ways. In this chapter, I distill the learnings from the systems presented in Chapters 3–5 into a six-dimensional framework of attributes of place that have been integral to my work: *scale*, *transformation*, *interconnectedness*, *openness*, *"throwntogetherness,"* and *politics*. Below, I situate each dimension within relevant literature on place, and I highlight specific ways each dimension has provided insights on representing place. I further discuss general implications for the design of place-based information systems.

Six Dimensions for Representing Place	
Scale	Places exist at many scales, from the small and personal, to the large and all encompassing. A favorite chair is a place; so, too, is the Earth itself [232].
Transformation	Places are always in a state of change. While the nature of the change may be unpredictable, the change itself is certain.
Interconnectedness	Places are tangled ecosystems of interconnections that link people, fauna, flora, buildings, infrastructure, objects, ideas, actions, and other places.
Openness	Even the most walled-off places are, in fact, open. Flows of people, culture, ideas, and capital pass into and out of places, irrespective of borders [139].
Throwntogetherness	Distinct human and non-human agents are all "throwntogether" at places; their trajectories might intersect, or may not, by total happenstance [140].
Politics	Power differentials govern, both explicitly and implicitly, who can access a place and how they are allowed to use it once they are there.

Table 6.1: Six consequential attributes of place distilled from my work in building place-based information systems.

6.1 Motivation and Methods

To provide actionable insights into representing places in information systems, I derive six fundamental but oft-overlooked attributes of place that have been essential in my work: *scale*, *transformation*, *interconnectedness*, *openness*, *"throwntogetherness,"* and *politics*. Table 6.1 provides brief definitions which are further explained in section 6.2. These six qualitative dimensions highlight aspects of places that are commonly either misrepresented or not represented at all in computing systems. It is my intention that future system designers might find these dimensions useful in generating insights and empathy that will give them a renewed perspective on how to represent place in their designs. To support that goal, Appendix B condenses many of the insights from this chapter into a series of 18 provoking questions—with 3 questions per dimension—that

designers can analyze when encountering places in their designs.

I arrived at these specific dimensions systematically, following a grounded theory approach [215] that drew from both my detailed review of the literature on place across several fields of study, as well as my first-hand experience designing and researching specific place-based systems. First, during my literature review, I made index cards for quotations and significant concepts that either represented major milestones in thinking on place, or that pertained in some way to interaction design. I then iteratively grouped similar index cards until they formed several distinct themes covering key concepts of place in theory and practice. Finally, I removed any top-level themes that did not relate to my research and findings on how to design place-based systems.

The resulting six dimensions of place draw heavily on the ideas of geographer Doreen Massey, in particular on her progressive perspectives on space, spatial politics [140], and her conception of a *global sense of place* [139]. The parallels between Massey's progressive and forward-looking approach to place make her work particularly well suited for my task of weaving together interaction design with the study of place. Like Massey's theories on place, design is forward-looking at its core; it problematizes the struggles, shortcomings, injustices, inefficiencies, and imbalances of life today, and seeks to build a better world tomorrow by engaging rigorous and disciplined iterative design practices to craft thoughtful solutions to ever-changing sets of problems. Massey avoids the sentimental or nostalgic characterizations of place that overly fetishize *"authenticism"* in an endless quest for the places of yesterday. Such perspectives, which are common in humanistic schools of thought, can often be regressive and and exclusionary in their nature, defining places by drawing hard boundaries about who belongs and who does not. In contrast, Massey teaches us that places are not closed and static landscapes, forever set in time; they are dynamic and constantly evolving open systems, quite like the process of design itself. Design draws inspiration from a dynamic and continuously evolving open marketplace of ideas, which influences both how designers problematize the world as well as the solutions they develop. Similarly, the human-centered design process is itself open, gathering input and feedback from a wide range of stakeholders to help craft solutions that are representative of key voices. Finally, Massey also teaches us that any action or outcome at a place is necessarily

political, as the underlying context in which any action takes place is one of conflict, negotiation, and underlying geometries of power. Design occurs in a similar context where every outcome reflects the political context that produced it. No design is politically neutral [71, 109]. I personally find such parallels between Massey's philosophies of place and design, especially human-centered design, offer constructive starting points for thinking about how designers can be be more place-oriented in their practices.

These are by no means the only aspects of place relevant to representing information systems, but they were consequential to my explorations and they provide a compact and useful analytical foundation for bridging the gap between representations and experience.

6.2 Six Dimensions of Place

In the presentation that follows, I introduce six dimensions in order of increasing in complexity, with later dimensions representing higher-order concepts that are enabled or informed by earlier dimensions. *Scale* and *transformation* are basic properties that describe fundamental spatiotemporal contexts of place. Embedded in this setting of constantly changing places of different scales are webs of dense, multi-agent *interconnected* networks, bridging people, places, ideas, capital, infrastructure, and more, defining a topology of place. *Openness* emerges from a global perspective on the *interconnectedness* of place, and the corresponding flows of people, culture, and capital around the world; if all the world is connected, all its places must be open. *"Throwntogetherness"* describes the assemblage of human and non-human agents that constitute a place, all of their intersecting and non-intersecting trajectories passing through a global network of open, interconnected places [140]. Finally, it is this state of *throwntogetherness* that necessitates the *politics* of place, and the various power dynamics, systems, and institutions and that emerge to negotiate our living and being together. In the reminder of the section, I provide additional detail to better define each dimension, with motivation and context from the literature and concrete insights from my own design explorations.

6.2.1 Scale

It is common to see places represented either as points anchored in space—like a pins on a map—or as areas with rigid boundaries at one fixed scale. In reality, places exist at many *scales*, from the small and personal, to the large and all encompassing [232], and they can even exist at multiple simultaneous scales depending on the context. At one end of the spectrum, small spaces such as writing nooks may be a places to some people, wrapped in the memories and meaning that come with the daily ritual of work. At the other end, the Earth itself is a place. In between these two extremes are a continuum of places of different scales: bedrooms, kitchens, font porches, office buildings, blocks, parks, shops. Sometimes place scales are hierarchical: a house is contained on a block, which is contained in a neighborhood, which is contained in a city. However, places might be non-hierarchal too, either because they're mobile, like a tour bus, or because their borders are fuzzy, like an ethnical enclave that spills across multiple other neighborhoods.

When representing a place in an information system, the challenge is, how do you at what scale do you hone in on? Along these lines, I had to grapple with scale when designing Livehoods. How big is a neighborhood? Is it the size of a block? Or does it encompass a large swath of the city? According to sociologist Gerald Suttles, people reason about the areas of the city at different scales depending on the circumstances and context. Stanley Milgram describes the Suttles's typology of community organization [218]:

> Of greater pertinence to an analysis of urban life are the *multiple* levels of community organization in which residents participate.
>
> The smallest of these units is the "face block." For children it is the prescribed social world carved out by parents. It is here that face-to-face relations are most likely, and the resulting institutional form is the block association. Next, in Suttles's typology, is the "defended neighborhood," which is the smallest segment of the city recognized by both residents and outsiders as having some corporate identity, and possessing many of the facilities needed to carry out the daily routine of life. The defended neighborhood frequently lacks official recognition, and its boundaries, because they have no legal

> status, are often precarious. Street gangs arise which protect it from unwanted incursion by outsiders.
>
> The urban resident also participates in the "community of limited liability," a larger realm possessing an institutionally secure name and boundaries. The concept originally developed by Morris Janowitz, emphasizes the "intentional, voluntary, and especially the partial and differential involvement of residents in their local communities." Frequently an external agent, such as a community newspaper, is the most important guardian of a community's sense of boundaries, purposes, and integrity. A single individual may be defined as living in several such communities. The multiple claims of a person may limit and even paralyze active involvement in any of them.
>
> Even larger segments of the city, such as an entire East Side area, may also take shape in response to environmental pressures, creating an "expanded community of limited liability." Thus an individual may find himself picketing to keep a highway not just out of his neighborhood, but out o the entire South Side. [144]

Livehoods are approximate representations of Suttles's defended neighborhoods—they lack official boundaries, but as our study demonstrates, they are atomic areas that both residents and outsiders understand to have their own identity, spatial logic, and regional self-sufficiency. In contrast, the official municipal neighborhood boundaries are communities of limited liability; their boundaries are delineated and secured by institutions such as city planning departments and online mapping platforms, but they may not necessarily reflect the socially-constructed realities of the neighborhood. Our results also point to a fifth level of organization—the area captured by a Livehood and its related Livehoods, which contains of broader and more distant socially recognized place associations than the defended neighborhood. Let's call this area the *expanded defended neighborhood*. Like the expanded community of limited liability, it captures a larger-scale segment of the city; however, its borders are not officially recognized. Livehoods reveal that neighborhood exist at multiples scales, expanding and contracting to fit the moment and context. With respect to

scale, neighborhoods are somewhat like non-Euclidean geometries—they are formed through a tapestry of distanced-based relations that are more qualitative than quantitative, more emotional than logical.

The many scales of places suggest information systems should be able to adapt their scale of representation based on contextual factors. In the case of Livehoods, we could imagine re-rendering the maps to expand or contract to show neighborhoods at finer or coarser levels of granularity, depending on factors such as zoom level, or mode of transportation. Journeys & Notes employed a similar contextual rescaling based on the distances people are traveling while using the app. When traveling shorter distances (e.g., to the corner store), we may reasons about places at finer scales than when we are traveling longer distances (e.g., across the country). Building on this insight, Journey & Notes provisions wider social spaces when people travel longer journeys, and more intimate social spaces when traveling on shorter journeys.

The scale of a place influences its attributes and characteristics. Small places are typically more intimate. While they can foster deep personal connections to people, they typically offer less diversity in experience to fewer people than larger places. Larger places, on the other hand, more agglomerate, encompassing heterogeneous populations and activities. Understanding the characteristics of a place at a given scale is important to developing representative models of place.

In Curated City, I use scale hierarchically to capture the urban experience at different levels of aggregation. First, there is the macro city-wide scale; by definition, a city guide must capture the essence of a city, so the most quintessential experiences are bubbled up to the city-level. Then there is the micro individual venue scale—the destinations, the attractions, the sites. This is the scale at which most experiences happen. However, there is a scale in between the macro and the micro that acts as an organizational layer, grouping the city into different constituent parts to helps to make the guide more understandable and usable. In Curated City, I used neighborhoods.

A person's perspective in how they observe a place at a given scale plays a significant role in whether or not they are even aware of a place at all. Larger places are typically recognized by broad cohorts of people, both inside and

outside of the places' borders, but they can be so all encompassing that they are sometimes taken for granted by those who inhabit them. Small places, on the other hand, can be so personal and intimate that they're overlooked by those observing the world at a much broader scales, and are almost always only known by a handful of people, though there are exceptions to this. The writing nook is probably only a place to the writer who hovers over it each day. Tuan describes the role of perspective in recognizing places at different scales:

> …that the Earth is our place is a simple fact of observation to homesick astronauts …It is obvious that most definitions of place are quite arbitrary. Geographers tend to think of place as having the size of a settlement: the places within it may be counted as a place, but usually not the individual houses, and certainly not that old rocking chair by the fireplace. [Tuan 231, p. 245 quoted in 61, p. 36].

While we are all residents of the Earth, it is in stepping away from it and seeing it as an outsider that one truly recognizes it as a place. And with small places, like the old rocking chair by the fireplace, it is the insider's perspective that is essential in understanding and knowing the place. This idea of perspective and scale with respect to knowing a place is important to design, as we interact with and begin to form mental models of user's place-based needs.

6.2.2 Transformation

Places are often represented as static or even frozen in time, however, they are actually constantly in a state of *transformation*. The changes to place may happen at blistering speeds, like when the Great Chicago Fire of 1871 wiped out 3.3 square miles of the city overnight, or the remarkable rise of Shenzhen, which in just under 50 years grew from a small village of just over 10,000 people in the 1970s to the global metropolis of over 10 million people that it is today. Transformations can also happen at drastically slower speeds. While we often take the landscape for granted as the literal bedrock of naturalistic places, the landscape, too, is constantly changing, albeit at geological scales often beyond our perception. Massey writes about such changes while visiting the serene Lake District in north western England:

> It is evident, of course, that much of the landscape here has been

> etched and moulded into its present-day basic shape by the glaciers of ice ages, the last of which retreated some 10,000 years ago. The traces are everywhere: in the U-shaped valleys inherited and reused in the last advance of the ice, in the hummocky landscape of moraines (material dumped by ice as it passed), in so-called *roches moutonnees* (rocks which have been scraped smooth and striated as the ice ground over them plucked into jagged shapes on the downstream—downglacier— side), in in drumlins, of which there are many in these parts, egg-shaped hills deposited under the ice as the glacier passed on and over, from what is now the valley of Derwentwater north to Bassenthwaite. …What this geological history tells us is that this 'natural' place to which we appeal for timelessness has of course been (and still is) constantly changing. [140, p. 131]

So while the pace and precise characteristics of change may vary greatly making it difficult or impossible to predict *how* a place will change, change itself is a constant certainty of place.

Livehoods are centered around the premise that neighborhoods are constantly changing—their people change, businesses change, buildings change, the scenery changes, streets change, perceptions change, property values change, and even their names change. This dynamism of neighborhoods is in stark contrast to their static representations in information systems, which are often based on old information. As neighborhoods change, the way people experience them changes too, and eventually so too does their perceived boundaries. By basing the computed areas on constantly changing data, the Livehoods methodology depicts areas in flux. In this way, Livehoods are never set in stone, they live, breathe, and evolve as peoples interactions with places evolve.

There are a myriad of factors that drive places to change. From the dramatic transformations of natural disasters to gradual entropic decay, physical forces are constantly acting on the built and natural landscapes of places. Human factors of power, politics, culture, capital, migration, and technology are equally persistent at making, remaking, and unmaking places. At one extreme, wars are the ultimate human-driven transformer, both through physical acts of destruction and displacement, and through the transformative restructuring of

geopolitical power relations that follow in a war's wake. Capital can be both a constructive and destructive agent of transformation. People, organizations, and governments are driven to transform places to improve them, extracting ever more value from the land and its people by building housing, commerce, infrastructure, recreation, and other capital investments. However, the very same constructive forces of capitalism also displace, disrupt, and destroy.

Our interviews with Pittsburgh residents about Livehoods shed light on many of these forces that transform neighborhoods, such as capital, transportation, demographics, and design. On top of mind to people in our interviews, was the gentrification of neighborhoods, which drives people from places they no longer recognize and can no longer afford, wiping away the cultural history and identity of places along with it. The Livehoods research also shows us that neighborhood maps themselves are also agents of change. Maps—and in particular, boundaries drawn on maps—exert considerable power and influence over places. Boundaries influence how people travel, how resources are apportioned, how political power is wielded, how property is valued, and where economic forces flow. In a self-fulfilling cycle, as maps start to influence peoples' behaviors, boundaries that start out as superficial lines on a map may evolve over the years into calcified divisions between radically different communities. A dark and troubling example of this can be seen in 20th century redlining practices in the United States [194].—the arbitrary boundaries (and their associated stereotypes) made by home loan underwriters of desirable and undesirable areas have developed identities that persisted long after those firms and their racist practices faded [20]. Figure 6.1, for example, shows the remarkable similarities between redlined areas of Brooklyn drawn in 1938 by the Home Owner's Loan Corporation, and the modern-day neighborhoods of Brooklyn. For a map to be truly place-centered, then, it should exert as little influence as possible on the place it depicts. A more representative neighborhood map should flex itself to the changes of the neighborhood, not the other way around.

If we accept that places are always in a state of transformation, constantly being made and remade [140, p. 175], then the idea of being *at* a place is not as stable a concept as it might seem; when we are at a place, the ground is, figuratively and literally, always shifting beneath us. Massey asks, "And yet, if

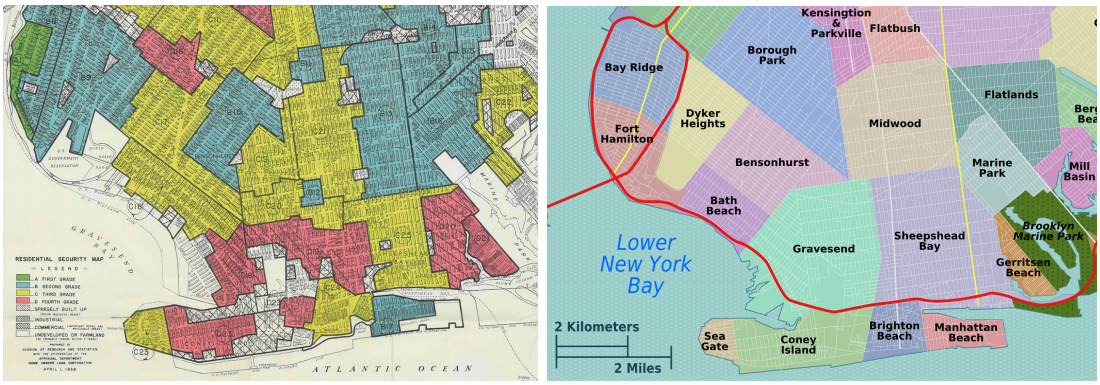

Figure 6.1: Two views of Brooklyn, New York. (Left) A map from the 1938 Home Owners' Loan Corporation map of Brooklyn, showing desirable and undesirable places. (Right) Approximate neighborhood boundaries of present day Brooklyn. Image sources: [6, 20]

everything is moving where is here [140, p. 138]?" Her answer is what she calls "the event of place" highlighting the momentary transitoriness of places.

> This is the event of place. It is not just that the old industries will die, that new ones may take their place. Not just that the hill farmers round here may one day abandon their long struggle, nor that the lovely old greengrocers is now all turned into a boutique selling tourist bric-à-brac. Nor evidently, that my sister and I and a hundred other tourists soon must leave. It is also that the hills are rising, the landscape is being eroded and deposited; the climate is shifting; the very rocks themselves continue to move on. The elements of this 'place' will be, at different times and speeds, again disperse. [140, p. 141]

If places are always changing, then what distinguishes a "stationary" place from a journey? After all, Einstein teaches us that a traveler in constant motion is physically indistinguishable from a stationary observer watching the landscape change around them. Only the speed and the nature of their respective transformations separate journeys from places—the world changes too fast and too ephemerally on journeys for them to become places on their own. Journeys & Notes explores virtual augmentations that give journeys more of a sound foundation for sociality to take root. Creating virtual spaces that are anchored to the start and endpoint of a journey counters the journey's transience to endow it with some of the necessary conditions for the creation of

place.

One important corollary of this is that places are always *new*.

> Los Angeles and Amazonia, as they were to become, were new to the early European settlers. But even for those who do not roam so far, or even those who remain 'in place', place is always different. Each is unique, and constantly productive of the new. [140, p. 162]

This constant production of "the new" forces us to view places not as things for us to visit, to long for, or to conquer, but rather as constellations of constantly evolving processes that we from experience moment to moment [140, p. 141].

The "newness" of places is one aspect that city guides struggle to represent. Traditional (paper) guides are static snapshots of the experiences of a city. Book publishers are constantly printing new editions for guide books to keep up with the pace of how experiences change in a city. In theory, online social city guides based on user-generated content can have an easier time staying up to date, however in practice this is not always the case. Guides that are based on rankings and ratings also have trouble keeping up with transformations, for different reasons. Rating systems are highly stable in aggregate—an unfortunate artifact of the central limit theorem that can hide transformations at a place. Review systems do offer insights about transformations, but they are often buried in noise and are difficult to surface. Curated City approaches transformation and the constant "newness" of cities thought social curation. The changes in place are often subtle at first—perhaps a new drink at a favorite café, or a new house band at a the corner dive. By incentivizing people to represent *their* experiences at *their* places, these kinds of subtle changes are able to bubble up in Curated City in meaningful ways.

By embracing transformation as a fundamental, we avoid the overly romantic characterizations of place and the often exclusionary search for 'authenticity' that accompanies such characterizations. Massey argues that such romanticized accounts are often grounded in male-centered world views, while accepting the constancy of transformation offers a feminist counterpoint on place. In Massey's words: 'Places change; they go on without you. Just as a Mother has a life of her own' [Featherston and Painter 79, p. 11, quoting Massey 138, p. 230].

6.2.3 Interconnectedness

No place can exist in isolation; places are *interconnected* to the world around them and they are themselves defined by their internal and external connections. Examining the network of relations that mesh together to make a place offers a richer understanding that may be beneficial for designing information systems. If embracing transformation makes us more aware of Massey's event of place, interconnection helps us grasp the underlying social, political, and natural contexts where the event of place unfolds.

Viewing places relationally stands in contrasts to viewing them as solitary and self-contained entities. Drawing on Massey, Beel et al. explain this distinction:

> The relational approach has developed as the somewhat critical opposite to the territorial approach. If the territorial account looks at the world from a structural, top-down perspective, relationalism seeks to invert this and open it up, stressing that space should be seen 'as an open and ongoing production' [140, p. 55]. [23]

The networked view of place is thus more holistic and organically produced, forcing us to engage with the various bottoms-up processes that constantly make, remake, and unmake places. Or as Amin and Thrift note: "networks are, then, an attempt to depart from Cartesian space and Aristotelian place [12, p. 29]."

In Chapter 3, Livehoods is both intellectually and technologically built around networks. Instead of thinking of neighborhoods as administrative areas with rigid boundaries, for example, the networked view imagines neighborhoods as evolving concepts that emerge from the millions of shared encounters and cultural understandings of the city's residents. Neighborhoods are like a tapestry woven out of the many collisions between people and places that unfold in a city. Two nearby places are woven more strongly together when many people perceive them to be part of the same neighborhood. Boundaries between distinct neighborhoods are areas on the tapestry where the fabric has worn thin—the interconnections between places at either side of the divide are weak or nonexistent. Tightly woven parts of the fabric are where neighborhoods are most well defined—the neighborhood's center. The traditional visualization of

neighborhoods neatly partitioning a city is a lossy approximation of the neighborhood tapestry–it hides the richness that's encoded in the interconnections between places.

The clustering approach I developed for Livehoods is heavily influenced by a relational perspective on neighborhoods. The affinity matrix that powers the clustering is a direct analog to the idea of a tapestry of place relations. Except, instead of basing relationship strength on whether people perceive two venues as being in the same neighborhood, in the Livehoods graph, two nearby venues are strongly related when many of the same people check in to them. Our work suggests that these two kinds of relations might be correlated—that the more common visitors of two nearby venues have, the more likely people are to perceive them as part of the same neighborhood core.

Returning to the tapestry metaphor, instead of visualizing our clusters with hard boundaries, future work on Livehoods could explore visualizations that are more like tapestries themself—multi-dimension surfaces that depict the city's interconnections. Instead of hard-edged neighborhoods, these maps could depict neighborhoods as clouds of places that gradually blend into one another, where the rate of blending at a border would depend on how distinct the adjacent neighborhoods are from each other.

Livehoods also explore the interconnectedness among neighborhoods themselves. Neighborhoods as places are not islands. They are dependent on one another and are therefor interconnected. There are a host of different ways neighborhoods are connected to one another—road networks, transportation routes, demographic similarities, food access, recreation options all can be used to connect neighborhoods in different ways. Each type of interconnection presents a design opportunity for representing the relationships between neighborhoods in different ways. In Livehoods, to explore related neighborhoods, we used the same approach we applied to Livehoods themselves—checkin movement patterns. Future work on place-centered neighborhood mapping could look into other ways to explore and represent the interconnections between city neighborhoods.

Instead of harnessing existing real-world connections to represent places, Journeys & Notes layers a new virtual network on top of the physical space

between an origin and a destination to virtually bridge people who may otherwise have never connected. Journeys & Notes creates new affordances for connections that are atemporal rather than in the moment, virtual rather than in spatial. By building connections where before there was none, Journeys & Notes seeks to represent places that are not yet there.

The many networks of a place do not just exist independently of one another, each floating in its own plane of existence without interaction. Rather, they are constantly colliding and interacting through moments of encounter that constitute the enduring pulse of places. Amin and Thrift describe such encounters in cities:

> But this sense of a kaleidoscopic urban world, crammed full with hybrid networks going about their business, enables us to see the importance of encounter. Networks cannot be sealed off from the world, they are always in collision with other networks: touching, fighting, engaging, cooperating, parasitizing, ignoring—the variations are almost endless. In other words, encounter and the reaction to it, is a formative element in the urban world. So places, for example, are best thought of not so much as enduring sites, but as moments of encounter, not so much as 'presents,' fixed in space and time, but as variable elements; twists and fluxes of interrelation. Even when the intent is to hold places stiff and motionless, caught in a cat's cradle of networks that are out to quell unpredictability, success is rare, and then only for a while. Grand porticos and columns framing imperial triumphs become theme parks. Areas of wealth and influence become slums. [12, p. 30].

Massey's event of place then is not only a temporal concept describing the inevitable transformations of place over time. The event of place is also a product of connections; to be at at place is to bear witness to the "twists and fluxes of interrelations" in momentary encounters.

In Curated City, my approach to building a city guide embraces these "kaleidoscopic" networks between people, places, and the experiences people have at places. We are all individuals in a social world—the experiences we have in cities, even the ones that are individual and highly personal, are shaped by

the collective social context in which we are embedded [146, 208]. Curated City uses the interplay between individual and collective experiences at place as a design principle—it allows people to express the things about the city they find individually meaningful, but it also exposes the interconnections between the many individual experiences people have through remixing and social curation. The commonalities and shared experiences that bind us together bubble up to the surface, while still allowing people to expressiveness to represent their experience of place as an individual.

6.2.4 Openness

In a globalized world with increasingly free-flowing capital, goods, labor, and culture, even the most seemingly closed-off places are *open* to enumerable 'outside' influences. While we may be *at* a location when we visit a place, our experience there is shaped by global forces. Imagine yourself in the middle of Times Square in New York. While you might be physically on the corner of Broadway and Seventh, you'll no doubt encounter a jumble of elements from all over the world, including billboards advertising multi-national brands, tourists visiting from thousands of miles away, and restaurants and food carts serving cuisine from cultures near and far. This kind of openness is not just a product of global centers like Times Square. Doreen Massey vividly describes the global influences in her own local shopping center near the outer boroughs of London:

> Take, for instance, a walk down Kilburn High Road, my local shopping centre. It is a pretty ordinary place, north-west of the centre of London. Under the railway bridge the newspaper stand sells papers from every county of what my neighbours, many of whom come from there, still often call the Irish Free State. The postboxes down the High Road, and many an empty space on a wall, are adorned with the letters IRA. Other available spaces are plastered this week with posters for a special meeting in remembrance: Ten Years after the Hunger Strike. At the local theatre Eamon Morrissey has a one-man show; the National Club has the Wolfe Tones on, and at the Black Lion there's Finnegan's Wake. In two shops I notice this week's lottery ticket winners: in one the name is Teresa Gleeson, in the other, Chouman Hassan.

> Thread your way through the often almost stationary traffic diagonally across the road from the newsstand and there's a shop which as long as I can remember has displayed saris in the window. Four life-sized models of Indian women, and reams of cloth. On the door a notice announces a forthcoming concert at Wembley Arena: Anand Miland presents Rekha, life, with Aamir Khan, Salman Khan, Jahi Chawla and Raveena Tandon. On another ad, for the end of the month, is written, 'All Hindus are cordially invited'. In another newsagents I chat with the man who keeps it, a Muslim unutterably depressed by events in the Gulf, silently chafing at having to sell the Sun. Overhead there is always at least one aeroplane - we seem to have on a flight-path to Heathrow and by the time they're over Kilburn you can see them clearly enough to tell the airline and wonder as you struggle with your shopping where they're coming from. Below, the reason the traffic is snarled up (another odd effect of timespace compression!) is in part because this is one of the main entrances to and escape routes from London, the road to Staples Corner and the beginning of the M1 to 'the North'. [139]

In the geography literature, such dislocations of place are often attributed to a *time-space compression* brought about by the modern human condition in which "things are speeding up and spreading out [139]" as communication, human mobility, and global commerce become increasingly far flung and interdependent.

With the rise of globalism over the last half century, time-space compression has arguably grown more prominent in many places throughout the world. For some people, this has brought with it solastalgia—feelings of fear and anxiety towards the loss of place and identity. While it's important to recognize the consequences of globalization and empathize with fears people might have of change, many discussions on the loss of place tend to be overly reactionary, invoking problematic conceptions of places as romanticized areas of refuge where one can escape the bustle of the modern world. As the argument goes, "'time' is equated with movement and progress, 'space'/'place' is equated with stasis and reaction," and so a longing for places as sources of heritage and rootedness offers "a response to desire for fixity and for security of identity in the middle of

all the movement and change [139]." Implicit in such a world view is a hardening of places as areas with fixed and closed boundaries, unitary identities that are strongly coupled to an image of historical heritage, and clear notions of inside versus outside and belonging versus unbelonging.

This 'closed' conceptualization of place is problematic for several reasons. First, being closed implies a singular, unitary identities, but places are multitudinous, simultaneously containing a plurality of experiences and histories that each contribute to the sense of place in different ways. In treating places as closed and singular, traditional city guides and rating and review apps marginalize anyone who might have minority experiences or perspectives. Building a system for capturing the openness of experience at place is the essence behind Curated City.

Second, a closed view of place puts too much emphasis on boundaries, for in order for something to be closed off, it must also be demarcated. While places can have well-defined boundaries (e.g., a walled-city), boundaries are neither a necessary attribute of place, nor are they typically a dominant trait of most places. The blurriness and permeability of neighborhood boundaries is a major focus of Livehoods. Neighborhoods are an interesting exemplar of openness. The complex, multi-actor process that determines a neighborhood's identity is itself an entirely open process. Try as they might, residents of a neighborhood can never fully close down outside influence on their neighborhood's identity and character. Rather, as I've discussed throughout Chapter 3, the character of a neighborhood is shaped by numerous city-wide forces that operate on the neighborhood both locally and at a distance. "Outsiders" can exert just as much influence on the character and definition of a neighborhood as any resident of a neighborhood, which can create tension and adverse effects for the in-group. For example, residents of affluent neighborhoods are quick to exclaim "not in my backyard!" (NIMBY) when things happen in their neighborhood they don't approve of.

Recognizing the openness of a neighborhood helps us understand how that neighborhood is situated in a global context. However, traditional neighborhood maps fall short at drawing attention to the issue. While neighborhood maps don't exactly portray neighborhoods as closed, their use of hard borders does

suggest much more separation and distinction between neighborhoods than there often is in reality. Depicting neighborhoods as more shut off than they are could have adverse effects, such as perpetuating neighborhood stereotypes. If a neighborhood is feared, taboo, or just generally undesirable to a constituency of people, hard boundaries may amplify a sense of aversion and closed-ness—the borders on the map may be interpreted as a line of demarcation not to be crossed, further reinforcing the negative stereotype. Similarly, hard borders may artificially constrain people from exploration, shutting them off to the wonder and serendipity that comes with wandering off into uncharted territory. Finally, hard map boundaries may amplify NIMBY-isms, as people may be more territorial of areas when they view them as closed to outsiders. Projects like Livehoods could enable a new breed of neighborhood maps that embrace openness.

Rejecting these reactionary positions, Massey presents a progressive vision of place as "open and as internally multiple [140, p. 141]." In laying out this vision, she conjures up a vivid image of watching the Earth from space, imagining the flows of people, ideas, and relationships as a pulsating network stretched over the globe.

> So, at this point in the argument, get back in your mind's eye on a satellite; go right out again and look back at the globe. This time, however, imagine not just all the physical movement, nor even all the often invisible communications, but also and especially all the social relations, all the links between people. Fill it in with all those different experiences of timespace compression. For what is happening is that the geography of social relations is changing. In many cases such relations are increasingly stretched out over space. Economic, political and cultural social relations, each full of power and with internal structures of domination and subordination, stretched out over the planet at every different level, from the household to the local area to the international.
>
> It is from that perspective that it is possible to envisage an alternative interpretation of place. In this interpretation, what gives a place its specificity is not some long internalized history but the face that it is constructed out of a particular constellation of social

> relations, meeting and weaving together at a particular locus. If one moves in from the satellite towards the globe, holding all those networks of social relations and movements and communications in one's head, then each 'place' can be seen as a particular, unique, point of their intersection. It is, indeed, a meeting place. Instead then, of thinking of places as areas with boundaries around, they can be imagined as articulated moments in networks of social relations and understandings, but where a larger proportion of those relations, experiences and understandings are constructed on a far larger scale than what we happen to define for that moment as the place itself, whether that be a street, or a region or even a continent. And this in turn allows a sense of place which is extroverted, which includes a consciousness of its links with the wider world, which integrates in a positive way the global and the local. [139]

This extroverted notion of place that "includes a consciousness of its links with the wider world" and that "integrates in a positive way the global and the local" is an attractive framework for thinking about place in information systems, as the sentiment aligns philosophically with several other recent movements towards broadening the focus of design to consider, for example, social justice [71], the non-human perspective [70], and users with different needs and abilities [214].

6.2.5 Throwntogetherness

In Sir Arthur Conan Doyle's story *The Adventure of the Blue Carbuncle*, Sherlock Holmes describes his latest challenge as "one of those little incidents which will happen when you have four million human beings all jostling each other within the space of a few square miles." Elaborating on the diversity of behaviors that are fermented by the city, he continues: "amid the action and reaction of so dense a swarm of humanity, every possible combination of events may be expected to take place [76]." This "action and reaction" that Holmes describes of humans all "jostling together" at a place, is precisely what Doreen Massey poetically calls the *"throwntogetherness"* of place [140]—the "almost accidental juxtaposition of communities, groups and individuals linked out into wider networks yet actively–locally–engaged together in the making up of

neighbourhoods, cities, and regions [50, p. 90]."

While thrownogetherness is closely related to *interconnectedness* and the *politics* of place, the three concepts are distinctly different. Interconnectedness emphasizes that place is a complex ecosystem of interdependent links; if you effect one component of the ecosystem, you might inadvertently effect other components. Politics describes the constant struggle, negotiation, and group decision making that plays out among the different power relations in the governance of places. Thrownogetherness bridges these two concepts: the interconnectedness of place creates and intensifies a state of thrownogetherness, and it is precisely the chaos and dynamisms inherent in thrownogetherness that demand negotiation and "at a moment of antagonism, is revealed in particular fractures which pose the question of the political [140, p. 151]."

Several notable corollaries follow from thrownogetherness. First, like openness, thrownogetherness emphasizes the multiplicity of places, since one cannot be thrown together in isolation. Again, thinking of places as junctions of intersecting and non-intersecting trajectories—literally meeting places connecting different but overlapping stories—then places must emerge from the multiple. Thrownogetherness also means that places are teeming with the chance encounters and serendipitous events that unfold from the many juxtapositions and intersections. In discussing thrownogetherness, Massey says that there are no rules of place [140]. Of course, she does not mean that places cannot *have* rules (e.g., 'no loitering'), but rather that those rules are not inherent to place itself, and instead emerge from the required improvisation and negotiation of our thrownogetherness.

> The negotiation will always be an invention; there will be need for judgement, learning, improvisation; there will be no simply portable rules. Rather it is the unique, the emergence of the conflictual new, which throws up the necessity for the political. [139, p. 162]

Thrownogetherness shows us that "multiplicity, antagonisms and contrasting temporalities are the stuff of all place [140, p. 156]."

Perhaps the most surprising aspect of thrownogetherness is the self-regulating order that emerges from the "ever-shifting constellations" of intersecting and non-intersecting trajectories [140, p. 151]. Jane Jacobs observed

this in the fractal-like 'sidewalk ballet' of people moving through cities:

> Under the seeming disorder of the old city, wherever the old city is working successfully, is a marvelous order for maintaining the safety of the streets and the freedom of the city. It is a complex order. Its essence is intricacy of sidewalk use, bringing with it a constant succession of eyes. This order is all composed of movement and change, and although it is life, not art, we may fancifully call it the art form of the city and liken it to the dance — not to a simple-minded precision dance with everyone kicking up at the same time, twirling in unison and bowing off en masse, but to an intricate ballet in which the individual dancers and ensembles all have distinctive parts which miraculously reinforce each other and compose an orderly whole. The ballet of the good city sidewalk never repeats itself from place to place, and in any once place is always replete with new improvisations. [112]

To Massey, this combination of order and chance inherent to throwntogetherness is a crucial to places [140, p. 151]:

> what is special about place is not some romance of a pre-given collective identity of the eternity of the hills. Rather, what is special about place is precisely that throwntogetherness, the unavoidable challenge of negotiating a here-and-now (itself drawing on a history and a geography of thens and theres); and a negotiation which must take place within and between both human and nonhuman. This is no way denies a sense of wonder: what could be more stirring than walking the high fells in the knowledge of the history and the geography that has made them here today. [140, p. 140]

It is the mix of order and chance inherent to throwntogetherness that necessitates the inventiveness, improvisations, negotiations, antagonisms, and politics that make places special.

To Massey, all places are throwntogether—they are built up from "almost accidental juxtaposition of communities, groups and individuals [140, p. 90]" that make up a place, and the evolving constellations of trajectories, relationships, and interactions that unfold among them from moment to

moment. But neighborhoods are especially emblematic of throwntogetherness. They are quite literally defined by the assemblages they contain—the buildings, the shops, the streets, the sites and landmarks, and the people of all different backgrounds living in a diversity of manners. However, throwntogetherness also tells us that places are more than the collection of their parts; they are also shaped by how their constituent components interact with each other and with the fabric of the whole. This implies that we should think of neighborhoods not just in terms of their nouns, but also their verbs—the actions, reactions, and interactions that are constantly at play within the neighborhood.

Viewed through this lens, the very premise of neighborhood maps as nothing more than sets of static boundaries makes little sense, and is, in fact, antithetical to throwntogetherness. If throwntogetherness implies neighborhoods are fluid containers of the here and now, traditional maps are frozen, lossy depictions of a particular here and a particular now. For a map to fully embrace throwntogetherness it must be truly *live*—that is, it must represent the dynamism that flows from moment to moment in Massey's conceptualization of place. As our name suggests, Livehoods sets a foundation for moving neighborhood mapping in this direction. If throwntogetherness describes the evolving collection of intersecting and non-intersecting trajectories that make up a place, Livehoods offers one approach to making sense of these trajectories by analyzing a throwntogether stream of digital footprints people leave behind. The promise of such a method is the ability to map neighborhoods as the evolve from moment to moment as measured by a proxy of people's trajectories.

The fact that Livehoods clusters are not formed from bespoke sets of rules about neighborhoods, but rather they emerge from relatively simple algorithms that know nothing of the concept of "neighborhood" hints at their throwntogetherness. There are no rules for how neighborhoods should be drawn; they emerge from peoples' collisions and interactions at place. This is precisely the approach we took with constructing Livehoods.

Livehoods doesn't fully embody throwntogetherness, however. For one, although the clusters are algorithmically generated, they are still only static snapshots of the data. Additional research is needed to explore both algorithms and visualizations that can faithfully represent neighborhoods from moment to

moment.

Livehoods also falls short in its representation of the multiplicity of neighborhoods. Massey tells us that places like neighborhoods emerge out of "multiplicity, antagonisms and contrasting temporalities [140, p. 156]." In analyzing people's digital footprints, Livehoods aggregates multiple people's trajectories to discern clusters of common places people visit. While this approach is successful at finding dominant patterns in aggregate, it hides the multiplicity, antagonisms, and contrasting temporalities of places. Particularly, Livehoods is not reflective of the stories of people or groups with trajectory patterns deviating from the majority, and it's not representative at all of those people or groups whose trajectories aren't captured in the underlying data source.

A clear example of this can be seen from our case study in the failure to represent the Hill District in Pittsburgh. The throwntogetherness of place implies that both users and non-users are impacted by place-based systems. In the case of neighborhood maps, boundaries exert power over places, regardless of whether a person uses a map. Because residents of the Hill District are not fairly represented in the underlying data, their communities have been completely overlooked by the Livehoods clustering. Even if Hill District residents never interact with the system, the omission of the district and its neighborhoods may reverberate outward through those that do interact with it, impacting residents in ways that are hard for designers to foresee. Any method that leverages streams of data to study place must reckon with the inherent biases in the underlying data. Failure to account for such biases is a failure to account for the throwntogetherness of place.

Both Journeys & Notes and Curated City also embrace throwntogetherness in different ways. For example, in Journeys & Notes, people on a journey are quite literally throwntogether in a virtual space that has nudges for how they should interact, but few hard rules. We also explicitly made the decision to put people using different modes of transit in the same journey, rather than separating them out into their own spaces. Curated City creates structures to make it easy for people to share their individuals perspectives at a place, and it also makes it easy for common experiences to bubble up to the surface. In doing

so, it incentivizes people to share a diversity of different perspectives, really emphasizing the multiplicity that is inherent in throwntogetherness.

Throwntogetherness is essential to place. It represents the idea that anything could happen. Embracing throwntogetherness in the design of place-based information systems can be one way to translate the vibrancy of the experience of place in the physical world to virtual places.

6.2.6 Politics

Places and *politics* are fundamentally intertwined. Channelling Massey, Featherstone and Painter call space and politics "co-constructive," noting "that they are built together as the outcomes of different ongoing processes [79, p.3]." It's not just that places are the arenas where political activities, like elections, petitions, or regulations, unfold, it's that places by their very nature are political—by their throwntogetherness, by the constant negotiation that they require of us, by the improvisation and invention that they inspire, and by the simple fact that so much of our everyday lives is centered around places. Jane Wills calls the former notion *politics in place* and the latter the *politics of place* [242]. Although both are relevant, the politics of place is perhaps more pressing a concern for design, and so it will by my focus here. It is in unravelling the politics of place we realize, according to Featherston and Painter, that "different ways of thinking spatially have different consequences." This lesson also has direct parallels to design. Just as any act of design caries with it its own deeply embedded politics [71, 109], "thinking spatially is never politically neutral [79, p. 3]."

I write this chapter from my home in Seattle in the summer of 2020, a time in which my city and my country would come to vividly embody the inseparableness of place and politics. This year, the dual forces of a global pandemic and civil unrest have swept across the United States, causing massive upheavals in how people experience and internalize place in their daily lives that would dominate the election-year politics that follow. The COVID-19 pandemic has made people all across the world hyper-aware of the space around them, as they avoid places where they might come into close contact with others. Meanwhile, in response to the death of George Floyd in police custody, the Black Lives Matter movement has drawn people out to the streets in massive

numbers to protest police violence towards people of color, as cities all across the nation grapple with reimagining law enforcement in the wake of this new political moment.

In the United States, rather than adopting unified, science-driven public response to the COVID-19 pandemic with clear, top-down directives, the response would instead become another one of the many polarizing issues in the culture disputes of 21st century American politics. Wearing a protective face mask (or rather not wearing one) has become, for some, a political statement; despite state and local mandates requiring masks in public, some people have refused in protest, citing their personal freedoms and their systems of belief about both the virus and their expectations for how society should function. Social media is brimming with dramatic, emotionally charged videos of clashes between mask deniers who wander into local businesses without face masks and the unfortunate store clerks who must confront them to enforce their safety policies. These clashes offer prime example of how politics and place are both deeply intertwined and co-constructed. Of course, the virus spreads most effectively in confined places where people are near one another. The risk of transmission at places prompted local mask mandates and heightened sensitivities for how people should behave when they are near one another. These changes in place-based norms create tension in those who resist such policies, pushing some to act out in protest. These actions further reinforce the political struggle as both sides dig in, while also changing the nature of the places where these conflict occur. Additionally, because many of these videos receive viral coverage, these highly-local, place-based political struggles have morphed into a national political movement of sorts, highlighting a blurriness between local and global in the politics of place.

The recent Black Lives Matter protests in American cities offers another example of the co-construction of place and politics. It also reminds us that the Black Lives Matter movement, is itself intertwined with the politics of space and place in demanding that a Black person have the same basic rights and dignities granted to a white person of occupying space in a city without fear of being shot by police. Just down the street from where I write this, a dramatic political struggle over place has unfolded over the last few months. The epicenter of the Black Lives Matter protests in Seattle has coalesced around the

Figure 6.2: Left: the front lines of the Capitol Hill, Seattle Black Lives Matter protests. Middle: The East Precinct of the Seattle Police Department taken over by protesters. Right: Entry to the Capitol Hill Autonomous Zone (CHAZ). Image sources: [1, 4].

intersection of 12th Avenue and Pine Street, where the Seattle Police Department's East Precinct headquarters is located (see Figure 6.2). For weeks, protesters and law enforcement clashed, sometimes violently, each side striving to gain control of the area in a struggle that lays bare the underlying evolving power geometries at play in city politics. The standoff reached a turning point mid-summer when the police abandoned their position, vacating the precinct building, allowing the protesters free reign of the neighborhood. In the weeks that followed, some demonstrators sought to redefine the place they now occupied to reflect their movement, from a place dominated by the antagonistic authority (in their view) of city police towards one defined by community and grass roots governance. The activists organized various public services such as a food co-op, medical stations, community gardens, and art installations and they renamed the six-block area around the precinct the Capitol Hill Autonomous Zone (CHAZ), and later the Capitol Hill Occupied Protest (CHOP), to underscore this redefinition of place. This subversive act of placemaking offers an explicit embodiment of the co-creation of place and politics—the literal creation of CHAZ/CHOP as a place is fully intertwined with several local and national political movements and countermovements.

Just as mask wearing during the pandemic is both a local and a global (political) act, the protests similarly reveal a blurring between local and global in the politics of place. As national media organizations covered the activity on a daily basis, the protest movement was thrusting to the center of political discourse across the nation. Right wing media organizations latched on to the actions of the protesters and the creation of CHAZ/CHOP as evidence of

rampant lawlessness in society, emphasizing the need for hard-line tactics to reclaim the place for law and order. Meanwhile left wing media organizations pointed to indiscriminately violent acts by law enforcement towards protesters as further proof that policing across the country needs to be reigned in.

I share these two examples because they provide vivid and contemporaneous depictions of the co-construction of politics and place, yet this co-construction need not be so extraordinary or extreme. Massey, referring to Donald (1999), notes that "politics is the (ever contested) questions of our being together [140, p. 142]." In this way, the many prosaic decisions, actions, encounters of daily life are, in some level, also political, from using a ride hailing service to get to work, to using a reusable bag at the grocery store, or having a family cookout at the local park. Ultimately, the politics of place is about power differentials, how these differentials manifest across space and place, and how certain people or groups of people might be positioned differently with respect to any power imbalances.

Since politics and place are so tightly woven, and both forces have such encompassing impacts on peoples lives, any design purporting to be place-centered must also unpack the politics of place. I'll present examples of how designers might do so in the chapters that follow.

The act of mapping is inherently political. Mapping categorizes space through the codification of boundaries, the naming of places, and the reinforcement of identity. It is through such categorization that neighborhood maps wield considerable power. When a neighborhood is mapped, all of the individual places that fall within it—the homes, businesses, streets, and other points of interest—are explicitly categorized as part of that neighborhood, whether or not everyone agrees with the categorization. Understanding this tension between the mapping and the mapped is at the heart of understanding the politics of neighborhood maps.

While it may not be immediately obvious how boundaries on a map can impact the reality of a neighborhood, boundaries are powerful and sticky things, especially when combined with the socially agreed upon names for the areas enclosed by those boundaries. Once named, these areas take on self-reinforcing identities, in a feedback loop of affirmation and assimilation; the public comes

to associate these named areas as a collective with its own local culture, and practices and the people who live in these neighborhoods begins to take ownership of that identity.

To better understand the politics of neighborhood maps, we must unpack the myriad complex power geometries at play in map creation. First, there is power inherent to the categories themselves—the neighborhood names and boundaries. Neighborhood names are not politically neutral. Rather, the labels carry with them associations of status, income, race, ethnicity, and safety. Because of this, some neighborhoods are more desirable than others, more powerful than others, and more influential than others, and so too by association, are the people, businesses, and addresses in these neighborhoods.

Neighborhood labels also get wrapped up with community identity. Sometimes, a neighborhood's boundaries are rooted in the common bonds of shared ethnic, national, or cultural heritage, as can be seen in the many Chinatowns, Little Italys, and Greektowns spread across major cities in the United States. While self-selection and homophily offer some explanation for these ethnic enclaves, they also point to a dark past of discrimination, redlines, and segregation, as blacks, gays, Jews, Gypsies, or other discriminated-against groups were relegated to undesirable areas by those with money and power [194]. The boundaries (and their associated stereotypes) made decades ago by home loan underwriters of desirable and undesirable areas have persisted long after those firms and their racist practices faded into non-existence [20]. Comparing the left side of Figure 6.1, which shows redlines of Brooklyn drawn in 1938 by the Home Owner's Loan Corporation, and the right side, which shows the approximate modern-day neighborhoods reveals remarkable similarities. For example, the four neighborhood boundaries of Coney Island along the southern shore remain nearly identical 80 years later.

Then there is also the issue of who—what people, groups, and organizations—are able to influence how maps are drawn. Traditionally, the processes of mapping is done through top-down, political processes, where one or more people designate certain areas of the city to be neighborhoods by giving them official names and boundaries, which are then marked and recorded by the city. The precise mapping process can vary dramatically across cities. The

decisions makers drawing the city's neighborhoods might be government officials, such as demographers or city planners, or they might be non-governmental agents working to satisfy their own self-interests, such as project developers or a financiers. In some cases, maps are draw primarily to conform to geographic features such as rivers, or existing boundaries of the city's transportation infrastructure, such as rails or highways. In other cases, boundaries might be drawn more systematically, taking into account features such as demographics, land use, property values, and historic identity. In still other cases, boundaries might be completely arbitrary. And, as I've discussed considerably throughout this chapter, the ultimate boundaries that are accepted as official may or may not actually reflect the city's community structure

In the case of digital maps, the processes of neighborhood mapping is even more opaque and the inherent power geometries are even more fraught. A small number of massive corporations are in control of how neighborhood are represented digitally, both in terms of how they are shaped and what they are called. The data collections processes and editorial decisions these corporations make in producing their maps are often trade secretes, completely hidden from the billions of people these decisions impact. In the Introduction, I shared several examples of mis-naming and un-naming of neighborhoods by Google Maps, including the invention of "East Cut" in San Francisco to replace Rincon Hill, South Beach, and South of Market [156], or the misspelled "Fishkorn" of the Fiskhorn neighborhood in Detroit [68]. Mistakes, decisions, and inventions like these that start in digital mapping platforms, like Google, rarely stay confined to the virtual world. They are assimilated by the uses of these platforms and are gradually become a new ground truth in a process that residents are these areas are powerless to stop.

Livehoods help us reconceptualize the various forces that shape the structure and interpretation of a city based on the social media its people generate. In this way, it can be used a a probe of the underlying power dynamics of a city's neighborhoods. To bring some of these forces to the surface, we introduce a novel interview methodology to study the interactions between municipal neighborhood boundaries, Livehoods, and people's urban perceptions, allowing us to investigate and explore the various factors that come together to shape the local dynamics of a city, including municipal borders, demographics,

development, resources, geography and architecture. We show how the Livehood mappings not only present known divisions but they also reveal subtle changes in local social patterns and the effects they have on the character of the city. Each Livehood tells a different story of how these factors manifest themselves on peoples' behaviors.

Of course, Livehoods itself is also political. While it may shine light on the forces shaping neighborhoods, like any map, it too exerts power over places it maps. However, by emphasizing the blurriness and dynamism of neighborhoods, instead of hard, static boundaries, we seek to minimize the risk for any lasting harms. Still, as was blatantly evident from the vanishing Hill District in our Pittsburgh maps, data bias, and the power dynamics inherent in the platforms that Livehoods relies on present real challenges to the viability of this approach on a wide scale. Additionally, by making the mapping process both public and participatory, and treating them as a starting point for community discussion, rather than a foregone conclusion, we hope such challenges may be resolvable in future work.

Conclusion

Because information systems can have a profound impact on places, it is important that places are accurately represented. In this dissertation, I explore the gaps between how places are represented in information systems and how people experience places in their daily lives. In doing so, my thesis claims that closing these gap will produce place-based systems that are more meaningful and insightful to all stakeholders.

Let's step back and review both my overall research approach and the evidence I have uncovered in support of this thesis. First, let's review my overall approach. I identified three gaps in how places are represented and how they experienced:

- **Gap 1**: Information systems represent places as static, frozen in time and space, but places are dynamic and constantly evolving.
- **Gap 2**: Information systems represent places as singular and monolithic, but places have multiple identities backed by many diverse stakeholders.
- **Gap 3**: Information systems require places to have a fixed location, but many places have complex spatialities, like moving targets, trajectories, or places that don't have any location whatsoever.

Following a Research through Design [249] approach, I designed, built, and analyzed three systems that explore these gaps:

- **Livehoods**: A new way to represent neighborhoods in cities, as dynamic areas that evolve as neighborhoods evolve. (Chapter 3)

- **Curated City**: A new kind of social city guide that represents the multiplicity of experiences people can have at places. (Chapter 4)
- **Journeys & Notes**: A new kind of social place for the journeys people take, both near and far. (Chapter 5)

Through these design explorations, I uncovered six attributes of places that emerged and were helpful in capturing the essence of place to close these gaps in my designs. These are *scale*, *transformation*, *interconnectedness*, *openness*, *throwntogetherness*, and *politics*. Chapter 6 has a full accounting of these.

Returning to my thesis statement, the essential remaining question then is to review what ways people found these systems more **insightful** and **meaningful** than traditional information systems in their approach to place? I'll address this question in the next sections.

7.1 Creating Insight

7.1.1 Making the Invisible Visible

Representing places as they are experienced pushes the designer to grapple with making visible the many intangible aspects of day to day life at places. This theme of *externalizing the hidden insights derived from the experience of place* runs throughout the three systems in this dissertation.

Livehoods, reveals areas of the city that have their own recognizable identity, but may not be officially recognized in city neighborhood maps. As I discussed in Chapter 3, our interviews uncover multiple underlying factors at play in what gives an area its unique character. For example, participants mentioned an apparent shift in feel and "different vibe" between neighboring Livehoods. "The look isn't different, but the vibe and the feel are very different," said one participant describing two different Livehoods inside the neighborhood of Lawrenceville. Other participants linked an areas identity to the composition and demographics of people that visit a place. Explaining a split in the Shadyside neighborhood between two Livehoods, one participant described: "When you go to Walnut Street, that's where I often see an older demographic. You will see women and men above the age of 50 walking around with shopping bags. I don't see that demographic on Ellsworth ever shopping

around." In externalizing these areas, Livehoods is also making the changes in places more visible, like the softening of boundaries between historically different neighborhoods of East Liberty and Shadyside, which one life-long Pittsburgh resident described as "becoming more the same." Our system depicted a new Livehood that spilled across the city boundaries in the area she described as becoming more the same.

Curated City attempts to make visible the intangible essence of a place, by cataloging the experiences people find most definitive there. In contrast to place review apps, like Yelp and Google Maps, which focus first and foremost on presenting an aggregate view of what a place is like, from the users's perspective, Curated City is primarily focused on letting people build their own personal guides to their favorite things to do in the city. This shift in focus from the aggregate to the personal encourages users to externalize the things their favorite places that are more salient to them. This has a net effect of However, while aggregation is not where Curated City starts, it does create aggregate views of the individual experiences that people create in their personal city guides that is surfaces as a feed of re-sharable insights about places. The re-sharing mechanisms creates another layer on which insights about place experiences can be derived. While making city guides personal motivates people to externalize diverse insights that aren't available other places, allowing those insights to be re-shared and re-mixed on other guides creates mechanisms for the most socially relevant experiences and insights to bubble up to the top to make them visible.

With Journeys & Notes, my research portrays new insights by making visible entirely new categories of places that didn't exist before. There is knowledge and experience shared among the people who have travelled on the same journeys, but because journeys are transient, they lack the affordances and overlapping temporalities for people to connect about these commonalities. Journeys & Notes changes that by creating a new virtual place where people can checkin to their journeys and asynchronously be present together. In doing so, my work unlocks the latent insights shared among these connected travelers.

7.1.2 Understanding Relationships

Another insight produced in this work is better understanding of the relationships of place. Livehoods produces insights about place relationships at multiple levels. First, Livehoods very literally built around a relational model between places, that looks at the commonalities of visitation patterns to infer a strength of relationship between two places. It then uses these continuous affinity computations to produce discrete groupings of venues into clusters, thus forming another relation. Finally, it looks at the strength of relationships between the clusters to induce more coarse grain relationships between Livehoods across the city. We saw these longer-distance relations provide insights about how neighborhood resources influence sociodemographic visitation patterns across the city. This was prevalent in the Giant Eagle grocery store located in South Side, which was modeled as its own Livheood. This made sense to our participants who were familiar with the area, because they see a mix of people shopping there that they don't typically see around the immediate neighborhood. One person said:

> There is this interesting mix of people there I don't see walking around the neighborhood. I think they are coming to the Giant Eagle from lower income neighborhoods...I always assumed they came from up the hill.

They were referring to a wide area of different neighborhoods in the hills to the south. Indeed, when we looked at the related areas to the Giant Eagle Livehood, we could see they extended far out to the south to the neighborhoods the participant had mentioned. This points to how Livehoods can be used to provide insights into areas that might be under-resourced for basic services, such as grocery stores.

Curated City is also inherently relational, though in a different way than Livehoods. While Livehoods is more analytical—producing insights through the relational analysis of social data—Curated City is more generative—producing insights through the generation of social data. We explicitly designed the prompt at the heart of Curated City to be comparative, so that when people list a place on their personal city guide, we ask them what experiences at this place are their favorite in the neighborhood. Note that this is different from asking

what their favorite experiences at a place are (i.e., what's your favorite items on the menu)? Our prompt nudges users to think of their experiences at a place in relation to all the other places in the neighborhood. The relational aspect of the task forces them to come up with attributes that might be more unique and specific . Essentially, they are building a catalog of what places are *known* for. One of our Curated City participants describes the interplay between the general and the specific.

> …the website urges you to put specific things, and I think that is better. I saw people putting really specific things. The William Penn tavern is something in Shadyside, that I'm pretty familiar with. They're well known for their wings, but they have a certain flavor called the Kitchen Sink Wings, and I saw that someone added that. … Specific makes it more fun. It gives it more personality. And it could be bragging rights too.

Examples like this one highlight how embracing the relational aspects of place can actual generates new insights.

7.2 Creating Meaning

7.2.1 Capturing Personal Perspectives

Places are personally meaningful to people. We can make more meaningful place representations by supporting ways to let people connect to and express their own personal histories and experiences. In different ways, Curated City, Journeys & Notes, and Livehoods each help users form meaning through highlighting their personal perspectives.

Curated City's primary objective is to capture the diversity of experiences people have in a city. To do so, we tasked people with creating their own personal guides. Our approach stands in contrast to systems like Yelp or Google Maps, which focus on a single, aggregate view of place. In these systems, people add their perspectives to this aggregate view, which tends to incentivize more critical and extreme content as people try to stand out from the crowd. This race to the extremes doesn't happen in Curated City. Instead, people create personal guides that are a presentation of the things they value and would want

to share with others. Because the content is meaningful to them personally, they spend time curating guides that best represent them. Some of the experience people documented in our study, like *Watching Kids Running Around the Fountain*, *Reflecting on Life at Night*, *Forgetting that you Live in a City*, and even *Late Night Basketball* highlight personal dimensions of the urban experience that one would not ordinarily find on place review apps.

The level of care people take is evident from the way they describe their processes, and the pride that came with documenting the places in their own neighborhood:

> I live in Point Breeze, I grew up in the East End, and I'm the director of the Shadyside Chamber of Commerce. So instantly, I was interested in adding things in Shadyside and around where I live. So that was my top priority.

In addition to being more meaningful to the people creating content, personal content is also more engaging for other people as well. In general, people felt personal content was higher quality content. Perhaps paradoxically, some people even said they were more likely to re-share experiences that are "interesting and personal" to their own guides, as they were viewed as more "detailed and specific." By making each guide more personally meaningful to the individuals who create them, we are also making the collective, aggregate view is more meaningful as well.

In Journeys & Notes, we amplified personal perspectives by elevating the diversity of journeys people can take in their lives. From the near to the far; the every-day to the out-of-the-way; journeys by bike, car, foot, plane, skateboard, bus, wheelchair, sailboat, event spaceship all have a place within in Journey & Notes. The meaning people find in Journeys of different types is best exemplified by these two notes created by users:

- "Just another ride to work at the shack. One day soon this ride won't be necessary and instead go on to do bigger things. That day will come soon I hope."
- "I'm going to meet the love of my life for the first time, and if it doesn't work out I doubt I'll ever have the strength or will to overcome it. This is, regardless, a day of incredible happiness and growth. Optimism, more than

anything."

There is meaning in both the extraordinary and the ordinary. Journeys & Notes provides people with expressive affordances to save and share the things that matter to them.

For many people how they get there is just as meaningful as the journey itself. By focusing on the mode of transit as an identifier within the app, we create a subtle but meaningful way to create sub-communities of practice within a given journey, while also creating opportunities for creating connections across different modes of travel. We heard consistent feedback from users that Journeys & Notes made them more reflective and more curious of their surroundings. The multiplicity of transit icons was explicitly mentioned as one area of reflection: "I think I would try to bike more instead of drive. That was the powerful thing for me with the app since I didn't have any other contact [with others]. It really forced me to consider how I travel and if it was really necessary. I really liked it for that reason." Another person felt that Journeys & Note made him more present on his daily commute: "I think anyone who wants to actively be more aware of their commute would enjoy this. It allows reflection on a part of the day that is often dismissed as a necessary evil best ignored." This was particularly validating.

While Livehoods in its current form doesn't support capturing individual perspectives in the way that Curated City and Journeys & Notes do, its algorithmic lens on neighborhoods as flexible and dynamic systems inspires new perspectives in how neighborhoods can be represented in more personal ways. For example, although Livehoods clusters are currently implemented as singular, discrete divisions, the underlying algorithms and data structures could be modified to support multiple neighborhood definitions simultaneously. In this way you could imagine different stakeholders could have their own representations of *their* neighborhood boundaries. This opportunity for flexible personalization could be much more meaningful than traditional maps.

7.2.2 Emphasizing the Commonalities

The last section highlighted how people found meaning in the individual and personal experiences at places, but places derive meaning from collective

experiences [147, 208]. In addition to empowering people to find individual meaning in places, my work explores the collectivist view as well.

In Livehoods, is primarily focused on deriving a collective view of neighborhoods by aggregating across common movement patters in social media. I constructed an affinity score between venues that measured the degree to which places share common visitors—if many of the same people visit two nearby places, my metric views them as more similar. The collectivism of Livehoods clusters was on full display in the language people used to describe why our algorithm grouped Polish Hill with Lower Lawrenceville (two distinct but adjacent city neighborhoods). One resident of Polish Hill said "I think it's pretty accurate... I think that's how some of our residents identify with Lower Lawrenceville because of their activities and their perception. Where they go to for entertainment, where they go for food, where they go because they enjoy the walk." Notice the collectivism inherent in his choice of words: *"our residents"* and *"their activities."* Similarly, a resident of Lower Lawrenceville noted that "there are some places in Polish Hill *we* hang out a lot that feel more like *our* neighborhood."

Collective aggregation happens more organically in Curated City through remixing. If someone likes an experience another person has at a place, they can add it to their own city guide. There are a couple of benefits to this. First, it is a way to bubble up interesting content, so that more people can see it (sort of like a re-tweet in Twitter). Second, it is also a reward mechanism, providing social status to those who's content is shared, which further incentivizes users to think of interesting content. One participant describes how the collectivism of remixing gives Curated City a *sense of community*:

> I think it [resharing] bolsters a certain area's reputation. If one person suggests it, and another agrees with it, like "yeah it is a good place for that." It sort of has a sense of community, that it's being vouched for. If I remember correctly, like Yelp or Urban Spoon, it's more like "this is a good place for so and so" but they you have to look through five people's comments to find someone agreeing on it, as opposed to one person saying it, and others saying "yeah I agree with it." You eliminate a lot of redundancy, and still get the same amount of support.

Journeys & Notes creates a virtual social place that is anchored to the origin and destination of a journey. While people can have vastly personal and individual experiences along the way, the endpoints of their trip are the common thread that binds all the participants together. Even if people are physically alone on their journeys, Journeys & Notes creates a virtual sense of togetherness that participants felt changed the way they thought of their journeys. Some found themselves more curious, eager to see who else might be around—"the app just made me curious. It made me want to explore and look for people in the area. I really wanted to have a conversation with someone!" Another person found the virtual presence of others made them more conscious and engaged with their surroundings:"When I did get to read other's posts I felt some sense of connection — like hey, other people are going through here and are sharing their experience. I liked the opportunity to pick up little secrets about places." She continued: "Each time I logged in, I felt thoughtful and more conscious of my surroundings (except for having my head in my phone). But when I wasn't looking down, I was more aware of my surroundings because I wanted to write descriptively." These insights lend weight to the idea that, while journeys are meaningful because they are so personal, their meaning is amplified by the shared presence of other people who might be on the same path.

7.2.3 Encouraging Creativity

Research has documented ways people find meaning through creative expression [11, 115, 196], as well as the tensions between freedom and constraint in the creative process, suggesting the right kinds of constraints can improve creative output [192]. In Curated City and Journeys & Notes, I introduce novel structured user interactions that promote meaning generation at place through creative expression.

Curated City catalogs diverse experiences in cities by asking people to answer a "mad-lib-style" prompt about a place: "*This venue is my favorite place for (fill in the blank) in the neighborhood.*" The prompt balances free-response with constrained input, allowing people to be expressive with their answers, while focusing their creativity towards a narrow easy-to-answer task. In contrast to fully unstructured place reviews, Curated City efficiently gather a wide range of expressive statements about experiences at places across the city.

Instead of the the pressure of a blank page, prompt provides scaffolding that makes it easier for people to quickly come up with a response. It also aligns users's efforts in the same directions, making it easier to aggregate across common answers. For example, if multiple people note that a place is their favorite for *pepperoni rolls*, it's a meaningful signal that we can aggregate across all users and venues. As one participant described the scaffolding, "you had to really think what in particular is that you like so much about it. …it makes you concentrate solely on what makes it good." This concentrated effort frees people up to be more creative and expressive in documenting meaningful experiences for their city guide..

Journeys & Notes takes a different approach to designing for creativity. The idea of attaching a note to a journeys evokes leaving a message in a bottle, not being sure who, if anyone, will ever find it. Instead of rigid constraints, we encourage users to be creative by priming the app with inspiring content that nudges people to engage with the sentimentalism of the moment, and to think about the range of possibilities of who their audience is. For example, users are presented with haikus related to traveling before they post to a journey. 'I did notice the Haikus! I liked them. They seemed to inspire me more than anything. They build up this idea that just around the corner I might meet someone unexpected."

Several users took the opportunity to be poetic with their posts. For example:

- "From the shelter of my bus stop I watched the mist hug the walls of the building. Everything seemed to be wrapped in drops."
- "The train is empty. Seats creak. The guard approaches silently. Gliding like he has done for years. I have no ticket to show him. I am not here."

Posts like this have a cascading effect. Of course, they are meaningful for those who write them, but through their creativity, they also creating meaningful moments for all who encounter them.

One interesting side effect of imposing a structure on users is that they invariably find creative, often humorous ways to bend if not break that structure to suite their needs. In the case of Curated City, some people

repurposed the prompt to use it sarcastically or to humorously express a negative experience. For example, one participant mentioned they wanted to add "best place to get shot" to a place they thought was not safe, and another added "worst smelling dumpster in the city" to a restaurant. In Journeys & Notes, some participants used the different post sections in creative an humorous ways. For example, "Some of the missed connections are really funny. There was one guy that lost his blue velvet jacket somewhere up there [laughter]... he was looking for it. He lost it on a bet. That was hilarious!" And so one person's comic note creates a meaningful moment of entertainment for another on their journey.

7.3 Reflections and Lessons Learned

Writing this dissertation with the benefit of hindsight gives me the opportunity to reflect on the impact of my work. Here I share some insights and lessons learned, and I highlight decisions I made along the way that were successful as well as some things I wish I had done differently.

7.3.1 Launching in the Wild

Both Livehoods and Journeys & Notes were research systems that I launched in the wild. Livehoods was relatively influential—it received positive attention in the press, hundreds of thousands of website visits in the first year, and today Google Scholar counts 744 citations to the research paper. Journeys & Notes has been much less influential—while it received positive attention in the press initially and attracted tens of thousands of downloads in the first few weeks, it was quickly shut down soon after launch and thus far the research paper has only received 15 citations. In this section I try to distill some lessons from launching these two systems in the wild, and I speculate how their launches might have impacted their subsequent impact.

Launching Livehoods

Livehoods started as a basic research project exploring new approaches to studying cities through social media. Before we even thought about releasing anything publicly, I built a research platform as an interactive website, simply

because web-based mapping technologies were the most user-friendly way to let people explore our clustering results during research interviews. When we showed our participants the maps, they were visibility excited to explore and discover insights about their city. The excitement people felt seemed to stem from something we discovered somewhat accidentally—that people crave all sorts of data about their city that isn't widely available. This gave us our first inkling that Livehoods might be valuable to release on a wider scale.

In addition to Pittsburgh (our initial analysis), we analyzed data from New York, Los Angeles, Seattle, and San Francisco. The results in the other cities looked just as promising as what we had seen in Pittsburgh, so we decided to release the maps publicly to see what people in these other cities thought, hoping they'd share their reactions on social media.

Although we didn't totally realize it at the time, the approach of launching to a limited number of cities ended up being a good strategy for generating viral interest in the project. People who lived in these cities were excited to see such rich data about their own cities, and they shared their excitement about Livehoods on social media. Their friends from other cities we hadn't mapped yet saw their post and felt left out and they posted on social media too, wondering aloud when Livehoods would map their city. These kinds of posts snowballed, generating a scarcity and a sense of demand that attracted interest from all over the world. We also helped amplify the pent up demand by posting social media polls asking what we should map next. This kept people engaged while also help us prioritize what cities to analyze.

All the attention we were getting on social media also helped elevate the academic impact of the project. Cross-disciplinary research like ours often has a discoverability problem, where researchers from disciplines outside of the main publication venue may not be aware that the work exists. The diversity of citations to our research paper from fields such as geography, science and technology studies, and urban planning suggest Livehoods didn't have this problem. I speculate that the spotlight that our public website shone on the research may have helped a wide range of researchers discover our work.

However, expanding Livehoods to more cities came with challenges. First there was the upfront cost to do the analysis and add cities to the database.

Then there was the support cost of keeping the website running and engaging with people from each mapped city. Neither of these costs were huge, but they were non-trivial and difficult to automate or outsource.

The biggest problem with expansion was actually the data itself. As we added more cities, the need for more permanent, extensive, and real-time sources of checkin data became more and more apparent. Because of the way our dataset was assembled from Foursquare checkins that were shared to Twitter, each city had underlying biases that were difficult to untangle. There were population biases stemming from use and adoption of the underlying social media systems, Foursquare and Twitter. Then there were sample biases in how the data was gathered using Twitter's public search API, which to stay within their query limits, required targeting narrow geographic areas at a time. All of this means that it is difficult for external researchers to understand how checkin behavior might differ across geographies. For example, Foursquare might be widely popular in New York, where the company is headquartered, but much less popular in Madrid or Lincoln, Nebraska. Again, these biases are highly likely, and could impact analyses, but it's difficult for researches to measure them.

Additionally, our data were already starting to get stale. If the premise of Livehoods is that data can create a "live" view of the city, then we would need a more robust data collection and analysis pipeline. It took several months to collect and clean the initial sample of data that I compiled by cross-referencing the Twitter Search API with the Foursquare Venues API. This approach would simply not be scalable or sustainable for collecting a continuous stream of checkins.

At a certain point, at least from a research perspective, there were diminishing returns to adding new cities. Because of all this, I decided to freeze the number of supported cities and stop actively working on Livehoods so I could explore other research questions—questions that would ultimately inform the other two systems presented in this paper. I do have some regrets about this decision, however. As I mentioned at the start of this section, Livehoods did end up being an influential piece of research that was one of the early success stories in the field of urban analytics. If we could have figured out a way

to secure access to clean, real-time streams of volunteered checkin data, perhaps through partnerships with other organizations, it would have opened the door to a whole range of research that could have been even more transformative.

The lack of first-party access to checkin data was one motivating factor in why I pivoted my research away from analyzing social-media data towards designing and building new location-based social networks with Curated City and Journeys & Notes. I thought, perhaps naively, that if I couldn't get access to checkin data to analyze, then I would build my own checkin system. As I discuss in the next section, there are many challenges to launching and supporting a new checkin system in the wild.

Launching Journeys & Notes

Launching Journeys & Notes was a different experience. Perhaps inspired by my release of Livehoods, from the outset I had ambitions to launch a system into the wild that explored new grounds with location checkins. However, since it started as my Microsoft Research intern project, I needed to scope the project so that design, research, and development fit within a 3 month time-span, which limited our ambitions considerably.

Since the app was released by Microsoft, one might think that there was a large team to support it. In fact, the team was small, mostly part-time, and not fully committed to the project. It was me, just an intern at the time; Andrés Monroy-Hernández, my internship manager who had other primary projects; Sarah, a designer who also had other primary projects; and a part-time contractor developer.

By the end of my internship, the app was mature enough to release, but it was not as fully featured or polished as one might expect from a Microsoft app. Fortuitously, around the time my internship was wrapping up, Microsoft was launching a new program called Microsoft Garage, which was a brand the company would use for launching and testing experimental systems that were not fully-fledged products. We were given the opportunity to launch Journeys & Notes through the Garage as one of its inaugural apps.

Microsoft contributed PR resources to the launch, which got Journeys & Notes a fair amount of press coverage and generated over ten-thousand downloads in the first few weeks. There was clearly interest and demand for the

idea we were exploring, and as I presented in Chapter 5, there was also evidence of real user engagement. However, the team and the app weren't in a position to capitalize on the initial interest at launch. There were many basic features we didn't have the resources to implement, like notifications, instrumentations, and social features such as user follows and discovery that could have kept interested users coming back to the app. So although we had no trouble getting users to come try out the app, and even create engaging content, they did not have much reason to stick around. Because there wasn't a strong business case for Journeys & Notes (it was an experimental app after all), there wasn't much reason for Microsoft to invest resources in the project, and so we stopped work on it almost immediately after launch.

I'm my biased view, Journeys & Notes is the best research systems I've ever designed, at least in terms of the social computing concepts it explores, but the subject matter is largely experimental. Yet, as I noted, it has only had a mild impact thus far when measuring by citation count. While it's entirely speculation, I occasionally wonder if my focus on launching Journeys & Notes might have been detrimental to its research impact. The focus on launching pulled me away from engaging deeper with the design innovations and with the relevant theory, which may have lead to a stronger research paper. The launch also pulled me towards publishing the research at the CHI, with a focus on the various user studies, when it might have had more success at conferences such as DIS or UIST, which focus more on the design innovations.

With respect to the requirements of a launch, Journeys & Notes is also a very different kind of system than Livehoods. Livehoods was predominately an interactive exposition of a data analysis. Our initial launch didn't envision forming a lasting relationship with users who would come back again and again to see new insights. It was a vehicle for conveying our big idea about how to rethink city neighborhoods in the age of social media. Journeys & Notes was a social app. In order for us to be successful, we would need to develop a relationship with users, and this requires orders of magnitude more investment in engineering and support than a website that users are meant to visit only once. Livehoods is also based on a core idea—using social media to understand cities—that is much easier to grasp and for other researchers to build on than Journeys & Notes. Journeys & Notes, in contrast, may serve an unmet need,

but it is also trying to create a new behavior that may not come naturally to most people.

The main lesson here is that getting sustained users of a system, especially a social system, requires careful thought about how that system fits into existing behavior patterns, and even then, it requires sustained effort and with Journeys & Notes, we just didn't have that.

7.3.2 The Uncanny Valley of Polish

The three systems in this dissertation were relatively polished for research systems. In some ways, this was beneficial to my research. It attracted attention from users as well as other researchers and potential partners. One of the reasons why people were captivated by Livehoods was that it had an attractive design that caught people's eye.

However, this may have actually been detrimental in other ways. The ultra-polished research system lives in an uncanny valley, where it looks like it might be something like a real product, but in reality it's not quite fully baked. For example, Curated City was particularly well designed for something that was never released. My motivation for building a hi-fidelity prototype was two-fold. First, although I didn't release it publicly, when I started the project, I wanted to leave that option open in case I built something that could have had impact beyond a research paper. Additionally, I wanted to get naturalistic data of how people externalize their experiences of place on their own and outside of the lab when given the right set of digital tools. If I had taken a low-fidelity approach to the research, at least early on, I could have gathered much of the same data about the core interactions in a fraction of the time. For example, I could have done a paper prototype session or a diary study to gather data about how effective the "mad lib" prompt was at gathering experiences. Granted, this wouldn't have explored the dimensions of remixing, but I could have studied that in a subsequent lab study. The extra polish may have motivated people to engage more with the system as if it were a real product, but it may also have discouraged people from giving feedback on possible alternative concepts or implementations.

These are basic best-practices in user-centered design that I didn't follow

and probably should have. The fact of the matter is, for better or for worse, I like building systems that are polished, even if they're still in the early phases of research. Something about the act of polishing a design makes me understand different dimensions of the problem space I might not have otherwise considered [249]. For example, in Journeys & Notes, I designed an elaborate auto-generated pseudonym system for users based on bird names. This had very little a priori research objective, but it helped me understand how users think about anonymity and identity when using a public forum linked to physical spaces, which ended up generating valuable insights. The main takeaway here is that there can be real benefits to designing and building polished research systems, but there are also potentially significant costs, and in many cases, it's probably best to start with traditional low-fidelity, low-cost methods before committing to major investments in polish.

7.3.3 Working With Partners

The attention that Livehoods received in the media sparked the imaginations of a variety of different potential partners who were interested in exploring how urban data might unlock hidden value for their respective goals. After the launch, we received inquiries from city planning departments looking to streamline their operations, restaurant chains looking to optimize their next locations, national consumer packaged goods brands looking to better understand customer trends, and banks looking to reduce their real estate footprints. The diversity of interest points to the innovation and impact of Livehoods, both in academic research and in industry, but it was also indicative of the considerable hype at the time, especially in board rooms, about the promise of "big data" as a solution to every problem.

In retrospect, much of the interest from third parties ended up being a distraction for a few reasons. First, as I mentioned earlier, Livehoods was built around a sample of data collected from third-party social media sources for research. We did not have first-party access to a sustainable source of data to build analytics around. Because of this, we were not equipped to answer many of the most interesting questions people had, like how to make city planning decisions, or where to open new restaurant branches. Our data were just too limited, too stale, and too biased.

Additionally, the hype of "big data" contributed to a data literacy gap when working with stakeholders. Many interested parties were convinced that they needed to incorporate data somewhere in their operations, but they didn't have feasible articulations of specific questions they needed answered or problems they needed solved. We didn't realize this at the time, but in retrospect it seems as if many of these potential partners saw Livehoods as an opportunity to check a "big-data" box.

While these partnership possibilities were exciting, and pointed to the promise of Livehoods, we were perhaps too early to engage with them. In retrospect, I wish we were singularly focused on solving the core problems that prevented the vision of Livehoods from expanding further—securing access to a broad and representative source of checkin data.

We also explored partnership opportunities with Journeys & Notes that were also similarly unsuccessful, though for different reasons. A Seattle-based arts organization connected with us based on our mutual interest in engaging with people in transit. They were sponsoring a marketing program that displayed poetry from local writers inside Seattle buses as a way to highlight local poets while inspiring riders to be creative and engaged on their journeys. Here our projects were aligned in both mission and in philosophy. Best yet, a partnership could have offered us a density-based deployment strategy that we currently lacked. By advertising Journeys & Notes physically in buses, we could have repeated usage from users along geographically concentrated routes, which could have produced more opportunity for user engagement and interactions. Here the partnership failed for the same reason the deployment failed, we didn't have enough of a commitment to it.

The main takeaway I have is that forming partnerships on research systems is incredibly hard. It is difficult for incentives to align on both sides, and even when they do, they take motivation and continued effort that can be difficult to maintain.

7.4 Looking to the Future

We are currently in the midst of a powerful wave of computing formed by the confluence of three distinct flows: the continuing disappearance of the the

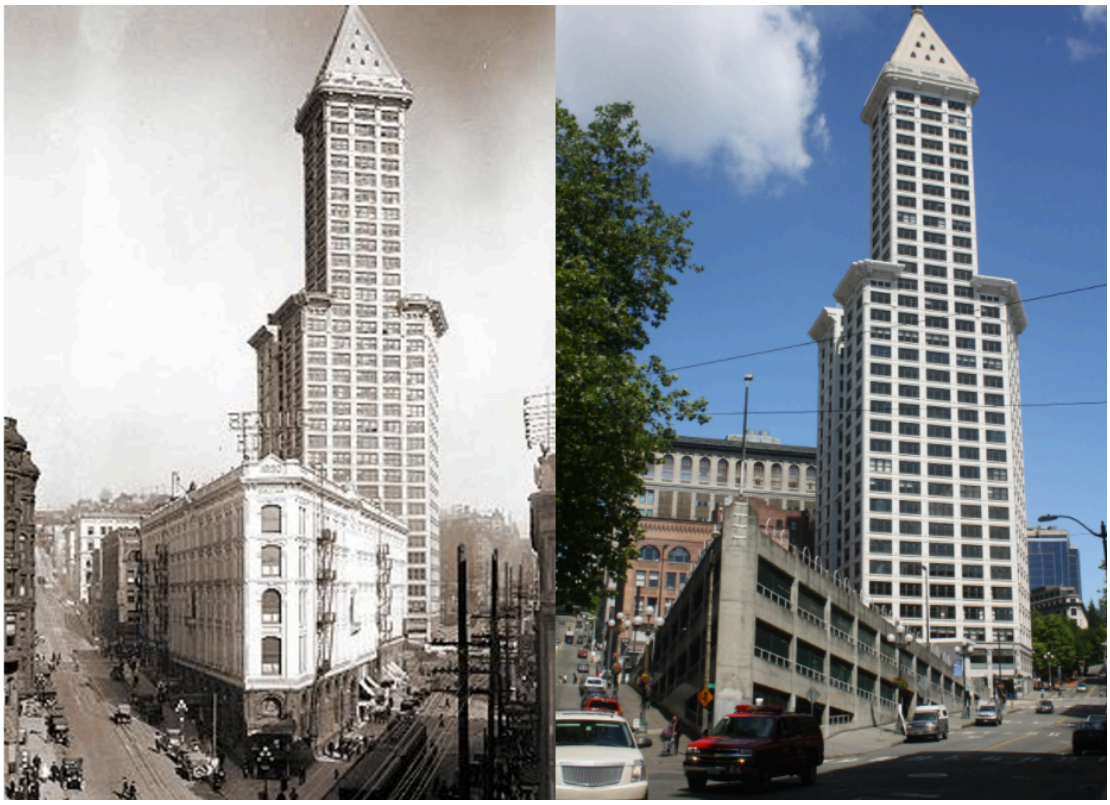

Figure 7.1: A literal embodiment of the changes automobiles brought to cities: The "Sinking Ship" parking garage was built in Seattle in 1961 on the site of the former Seattle Hotel. Photo credit via Reddit [3].

computer, as foretold by Mark Weiser two decades ago [238]; the emergence of powerful techniques in Artificial Intelligence, bringing with them never-before-possible computing capabilities; and the rise of the omni-present networked world of social computing, which connects people to one another in rich, personal, and near-continuous ways. In this era of social, ubiquitous, intelligent computing, increasingly, our daily experiences are mediated by computing systems. This is especially true of experiences of place, both for large scale technology deployments impacting a wide range of places, such as smartphones, navigation systems, or location-based mobile apps, and also for small scale situated deployments anchored to particular places, such as information displays or beacon technologies. The how these technologies effect place can vary dramatically, ranging from improving the vibrance and accessibility of a place, to rendering it undesirable, inhospitable, or totally uninhabitable.

Perhaps because of the simplicity of representation, it is common to see places treated in a purely spatial manner by interactive computing systems, with the entirety of a place's character distilled down to a single infinitesimal point in a coordinate system. In a geographic coordinate system, the city of Pittsburgh might be represented at its center as $(40.4406, -79.9959)$ while an address there, say 4601 Bayard Avenue, might be $(40.4501, -79.94975)$. For many applications, such a lossy representation of place suffices perfectly well. An airplane navigation system probably doesn't need to know anything about the nuances of city life in New York in order to guide a 747 from JFK to LAX on time.

However, in a network nothing is independent. It's thus critical for designers to take stock of the interconnections of the types of places they are designing for, so that they might understand potential network-driven second-order effects. In the case of neighborhood mapping, the largest risk of harm is the mis-representation or non-representation of place-based communities. Of course errors in representation are problematic enough own their own—if the primary objective of a neighborhood map is to represent the city's neighborhoods, any representational errors are a major failure. The communities who are impacted may feel like they're not properly recognized by the broader city—like they're being wiped off the map, perhaps literally. However, it's the second-order effects of these kinds of mistakes that are particularly troubling. Because so many decisions, services, and actions could potentially be based on the maps representations, the downstream effects of an error for people living in these communities could be severe. The fate of outcomes such as public services allocations, economic activity, school access, tourism, transportation, property values, and zoning decisions may be influenced by any cartographic misrepresentations. Indeed, interconnectedness teaches us that there are high stakes for designing place-based information systems.

To see how massive and far-reaching the effects of technology on place can be, one need look no further than the automobile, easily one of the most transformative technologies of the 20th century. Cars enabled people to travel further afield with more convenience and autonomy than ever before, radically transforming our culture and opening up entirely new ways of living in the process. This new found autonomy untethered commuter suburbs from the rail

infrastructure that, in previous eras, gave them life, as new categories of automobile-centric communities began to pop up farther and farther away from the urban core; instead of packing into train-cars to commute into urban centers, commuters in these automobile suburbs took to their personal cars and packed the highways.

Cities too began to reshape themselves around the automobile [142, 216]. With so many people driving cars into and out of cities on a daily basis, massive infrastructure developments were needed to meet the demand. In the race to create new spaces for all these vehicles, many valuable urban places were forever transformed or lost entirely. Once bustling places, like the Seattle Hotel in Figure 7.1, were torn down to make way for parking structures for all the cars flooding into urban cores. Monumental highway projects were launched to bring people into cities; in the process, they plowed through parks and waterfronts, split up urban neighborhoods, and cut off pedestrian access to many places, drastically changing the character of cities for decades to come. Urban historian and social commentator Lewis Mumford reflects on the loss of place during this period of car-centric development fervor in American cities:

> The motorway has repeatedly taken possession of the most valuable recreation space the city possesses, not merely by thieving land once dedicated to park uses, but by cutting off easy access to the waterfront parks, and lowering their value for refreshment and repose by introducing the roar of traffic and the bad odor of exhausts, though both noise and gasoline exhaust are inimical to health. [152]

Cars also changed how new cities were designed and built. While older cities like New York and Paris were retrofit to make space for the car, cities like Los Angeles, that came of age during the automobile era, were built with cars as first-class citizens, with their sprawling footprints, their vast networks of super-wide and congested highways, and their ample space for vehicle parking [142].

The changes in place brought on by the automobile unfolded gradually over generations at the hands of policy makers, planners, and builders striving to meet the needs of car-loving constituents. We should ask ourselves, are we in

the midst of a similar multi-generational reorganization of places by information technologies? I suspect the answer is yes, but we may only know for certain and in what way places change in hindsight.

7.4.1 Data Biases and Limitations

One of the most persistent and persistently troubling challenges in representing places in information systems are biases and limitations in the underlying data. While advances in technology have given us the potential to create up-to-the-minute representations of places as they are experiences, those representations are only as true and valid as the underlying data that generate them.

I saw this pitfall first-hand in developing the systems in this dissertation. Using real-time social media streams to generate insights about places has massive potential, but we must address the question of who is left behind or misrepresented by these data. For example, with Livehoods, the sociodemographic bias in the underlying data was obvious. Pointing to the Hill District on our map, one participant noted the complete lack of representation: "That's a lot of open spaces... It looks like if you were to look around here…it is like there is a plague." Both Curated City and Journeys & Notes would likely have similar sociodemographic biases if they were deployed as real information systems on a large scale. We can never achieve the goal of representing places as they are experienced if entire swaths of the urban experience are missing from our representations.

In a way, by making the scale of the biases visible and tangible, projects like Livehoods are a first step towards solving these challenges. However, a comprehensive solution will require considerable effort to understand the sources of biases and to develop down new ways of capturing lived experiences that are free of systematic exclusions and misrepresentations. This is perhaps the single most important area for future work.

7.4.2 Closing Thoughts and Open Questions

The aesthetics of a world where computers and places are symbiotic is best captured by the Richard Brautigan poem *All Watched Over by Machines of*

Loving Grace, where he imagines a "cybernetic forest filled with pines and electronics where deer stroll peacefully past computers as if they were flowers with spinning blossoms" [30]. While it's debated whether or not Brautigan should be interpreted ironically, it is clear we are nowhere near the world his poem depicts. Looking at the numerous issues society is grappling with in computing, from privacy, to disinformation, to the erosion of attention, some argue that computing is transforming places into Blade Runner-esque landscapes, rather than cybernetic meadows [174]. I believe this is partially due to the fact that we do not adequately consider places in the design of our technologies. I hope this dissertation will inspire future work towards a **place-centered design**.

In my mind, the most urgent questions at the intersection of place and computing are:

- How are information technologies changing places?
- How are these changes distributed across places and society?
- What groups are left behind or disadvantaged by these changes?

In narrowing the gap between how places are represented and how they are experienced in day-to-day life, my work makes us better equipped at investigating these questions.

Appendix: Livehoods Clustering

In this chapter, I describe the clustering method and implementation details used in Chapter 3 to produce the Livehoods clustering. These techniques were originally published by Cranshaw et al. in ICWSM 2012 [57].

A.1 Constructing a Venue Affinity Matrix

Underlying the Livehoods approach to defining local urban areas are relatively straightforward techniques in spectral clustering. Spectral clustering uses properties of the eigenvectors of the graph Laplacian of a data similarity matrix to remap the data into a mathematical space that is better suited for separating groups of dissimilar data points. Spectral methods for data clustering are a well studied [135, 205], and are popular in practice due to the quality of the clusters that are often produced and the simplicity of implementation.

The primary innovation behind the Livehoods technique lies in our design of an affinity matrix that blends the geospatial affinity and social affinity between pairs of venues, creating clusters that are social meaningful while remaining spatially contiguous . Below, I describe in detail how to construct such an affinity matrix.

Let V be a set of n_V Foursquare venues. Suppose that for each $i,j \in V$, we can compute a *geographic distance* $d(i,j)$ given their latitude and longitude coordinates. In practice, we use a great-circle distance approximation for $d(i,j)$. Let U be a set of n_U Foursquare users, and let C be a set of checkins of these

users to the venues in V.

Ignoring the temporal aspects, each venue v can be represented by the "bag of checkins" to v. More specifically, let c_v be an n_U dimensional vector where the u^{th} component of c_v is the number of times user u checked-in to v. Under this representation, the *social similarity* $s(i,j)$ between each pair of venues $i,j \in V$ can be represented by computing the cosine similarity between vectors c_i and c_j. That is, $s(i,j) = \frac{c_i \cdot c_j}{||c_i|| \; ||c_j||}$.

The n_V by n_V affinity matrix $\mathcal{A} = (a_{i,j})_{i,j=1,\ldots,n_V}$ on the venues can the be defined as follows. First, for a given venue v, let $N_m(v)$ be the m closest venues to v according to the $d(v,\cdot)$ for some parameter m. Then define:

$$a_{i,j} = \begin{cases} s(i,j) + \alpha & \text{if } j \in N_m(i) \text{ or } i \in N_m(j) \\ 0 & \text{otherwise} \end{cases}$$

where α is a small constant that prevents degenerate venues from having no connections to any others.

Viewing $\mathcal{A}$ as the weighted adjacency matrix of a graph $G(\mathcal{A})$, each venue node is connected by an undirected edge to its m nearest neighbors in geographic distance, and edges are weighted according the cosine similarity of the checkins distributions of users visiting the two venues.

A.2 Clustering the Venues

Algorithm 1 provides the full details of the approach we used for clustering in the Livehoods work. We use the variation of spectral clustering introduced by Ng, Jordan, and Weiss in 2001 [155]. Similar to Zelnik-Manor and Perona (2004) we introduce a post processing step to clean up any degenerate clusters [244]: step 10 splits each cluster into its disconnected components under $G(\mathcal{A})$, and step 11 removes any clusters that span too large a geographic area. Following many other works, in step 5 we select the number of clusters by searching for the largest gap in consecutive eigenvalues between a minimum and maximum allowable number of clusters.

Algorithm 1 *Spectral Clustering for Livehoods*
Input: V, $\mathcal{A} = (a_{i,j})$, $G(\mathcal{A})$ the graph of $\mathcal{A}$, k_{min}, k_{max}, τ

1: Create a diagonal matrix D with diagonal $(d_1, \ldots, d_{n_V})$ for $d_i = \sum_{j=1}^{n_V} a_{i,j}$.
2: $L := D - \mathcal{A}$
3: $L_{norm} := D^{-1/2} L D^{-1/2}$
4: Let $\lambda_1 \leq \ldots \leq k_{max}$ be the k_{max} smallest eigenvalues of L_{norm}.
5: Set $k = \arg\max_{i=k_{min},\ldots,k_{max}-1} \Delta_i$ where $\Delta_i = \lambda_{i+1} - \lambda_i$.
6: Find the k smallest eigenvectors $e_1, \ldots, e_k$ of L_{norm}.
7: Let E be an $n_V \times k$ matrix with e_i as columns.
8: Cluster $y_1, \ldots, y_{n_V}$, the rows of E, into $C_1, \ldots, C_k$ using k-means.
9: This induces a clustering on $\mathcal{A}_1, \ldots, \mathcal{A}_k$ by $\mathcal{A}_i = \{j | y_j \in C_i\}$.
10: For each $\mathcal{A}_i$, let $G(\mathcal{A}_i)$ be the subgraph of $G(\mathcal{A})$ induced by vertices $\mathcal{A}_i$. Split $G(\mathcal{A}_i)$ into connected components. Add each component as a new cluster, removing $G(\mathcal{A}_i)$.
11: Let b the area of bounding box containing coordinates in V, and b_i be the area of the box containing $\mathcal{A}_i$. If $b_i/b > \tau$, delete cluster $\mathcal{A}_i$, and redistribute each $v \in \mathcal{A}_i$ to the closest $\mathcal{A}_j$ under single linkage distance $d(v, \mathcal{A}_j)$.

A.3 Computing Related clusters

Given a Livehood clustering of for a city, it is possible to discern relationships between pairs of clusters by measuring the similarity in users visitation patterns to venues in those clusters. Such a measure is useful for understanding the movement trends at a macro level across the city. Clusters that are highly similar are likely to contain more places that are visited many of the same people, which could point to various underlying factors that might link these areas together, such as geographic proximity, transportation infrastructure, cultural ties, or functional interdependence.

Again we define this measure using cosine similarity, but aggregated up to the cluster level, rather than the venue level. Representing cluster $\mathcal{A}_i$ by an n_U dimensional vector $c_{\mathcal{A}_i}$, where each component u counts the number of times user u checked in to *any* venue in cluster $\mathcal{A}_i$, the similarity between clusters $\mathcal{A}_i$ and $\mathcal{A}_j$ can be computed as $s(\mathcal{A}_i, \mathcal{A}_j) = \frac{c_{\mathcal{A}_i} \cdot c_{\mathcal{A}_j}}{||c_{\mathcal{A}_i}|| \; ||c_{\mathcal{A}_j}||}$.

A.4 Efficiency and Implementation Details

In computing the affinity matrix $\mathcal{A}$, the set of nearest neighbors $N_m(v)$ to any venue can be computed efficiently using k-d trees. Since we are only connecting each venue v to its m nearest neighbors in geographic distances, the resulting matrix is extremely sparse. Large sparse matrices can be efficiently stored, and the first k eigenvectors can be approximated quickly with a Lanczos solver, enabling us to scale to process hundreds of thousands of venues without any need for parallelization.

Appendix: Questions About Place for Designers

Here I present the six-dimensions of place introduced in Chapter 6 in easy to access information cards, along with questions designers of information systems might ask themselves at design time to be more representative of places.

B.1 Questions about Scale

Scale

Places exist at many scales, from the small and personal, to the large and all encompassing. A favorite chair is a place; so, too, is the Earth itself [232].

Questions to Consider About Scale:

- **What is the place scale?** What is the scale of the place? For reference, think: *room, building, block, neighborhood, city, region, country, globe*. If there are multiple places of interest, are they all the same scale, or are they different scales? Do their scales change, or are they constant?
- **What is the design scale?** What scale does your design work best at? If it were to be used at a different scale than is optimum, what are some possible negative side effects? How might you address these side effects?
- **Is the design adaptive?** Does your design operate differently at different scales of place? If not, should it?

B.2 Questions about Transformation

Transformation

Places are always in a state of change. While the nature of the change may be unpredictable, the change itself is certain.

Questions to Consider About Transformation:

- **What are the changes?** Independent of the design, how has this place changed in the past, how is it currently changing, and how might it change in the future?
- **What is driving the changes?** Independent of the design, what are the dominant forces that might explain these changes? Which stakeholders have the most agency over those forces and which have the least?
- **How might the design change the place?** How might the design change the place in different or unexpected ways? What affordances does your design offer to stakeholders to have agency over those changes?

B.3 Questions about Interconnectedness

Interconnectedness

Places are tangled ecosystems of interconnections that link people, fauna, flora, buildings, infrastructure, objects, ideas, actions, and other places.

Questions to Consider About Interconnectedness:

- **What are the interconnections?** What are the different networks that are important to the place? What types of agents or actors are connected in these networks, and how are they connected? What makes the place unique from other places with respect to its interconnections?
- **What are the direct design impacts?** Which networked agents are directly impacted by your design? How does your design directly impact these agents? How might any negative direct effects be mitigated or guarded against?
- **What are the indirect design impacts?** What are some possible indirect or cascading effects that might be triggered in the network by the direct impacts of your design? How might any negative indirect effects be mitigated or guarded against?

B.4 Questions about Openness

Openness

Even the most walled-off places are, in fact, open. Flows of people, culture, ideas, and capital pass into and out of places, irrespective of borders [139].

Questions to Consider About Openness:

- **In what ways is the place *open*?** How are people, goods, capital, and culture flowing into and out of the place? How are the place's borders permeable and flexible?
- **What *closed* assumptions does the design make?** Does the design assume that the boundaries of the place are fixed or fortified? Does the design either explicitly or implicitly restrict access to places, or assume that access is restricted?
- **How are these assumptions challenged?** How does the openness of the place challenge any assumptions you made about it being closed? What are the consequences of these challenges? Can any negative consequences be remediated?

B.5 Questions about Throwntogetherness

Throwntogetherness

Distinct human and non-human agents are all "throwntogether" at places; their trajectories might intersect, or may not, by total happenstance [140].

Questions to Consider About Throwntogetherness:

- **What is the place like?** What people, groups, animals, systems, or other entities come together at the place? How do they each use it? How do these different stakeholders interact with each other at the place, in both planned and unplanned ways?
- **What is the design like at the place?** How is the design used at the place? How do the different stakeholders interact with it? How do the different stakeholders interact with each other via the design?
- **How do non-users come in contact with the design?** How do non-users negotiate space and place with your design? Are there any negative side effects towards non-users? How might these be mitigated?

B.6 Questions about Politics

Politics

Power differentials govern, both explicitly and implicitly, who can access a place and how they are allowed to use it once they are there.

Questions to Consider About Politics:

- **What are the power geometries of place?** Who or what has power over the place? How are different people or groups of people there positioned with respect to that power? Who is positioned favorably and who less so? How are decisions made at the place?
- **How does the design impact power geometries?** How does it reinforce or exacerbate existing power differentials at the place? How does it disrupt them?
- **How does the design effect disadvantaged groups?** Are disadvantaged people or groups at a place likely to use the design? If they are not users, will they be left further behind or disadvantaged at the place by not using? If so, what remediations could you provide?

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