Drawing the City: Differing Perceptions of the Urban Environment

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ABSTRACT
In building location-based services, it is important to present information in ways that fit with how individuals view and navigate the city. We conducted an adaptation of the 1970s Mental Maps study by Stanley Milgram in order to better understand differences in people's views of the city based on their backgrounds and technology use. We correlated data from a demographic questionnaire with the map data from our participants to perform a first-of-its-kind statistical analysis on differences in hand-drawn city maps. We describe our study, findings, and design implications for location-based services.

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Mobile apps; location-based services; cities; urban informatics

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human factors, design.

INTRODUCTION
As of 2008, a majority of the world's population now lives in cities [13]. With the widespread adoption of smartphones, tablets, and portable computers, cities are increasingly becoming the primary locations for interacting with computing systems. Many mobile computing systems integrate with large concentrations of users in these urban spaces and with data about the environment around the user. Location-based check-in apps such as Foursquare are now attracting millions of users while many million more use mobile map applications, GPS, and bus/train trackers.

In order to build better mobile services and applications that work with the ways that people understand their cities, we believe that it is important to have an understanding of how people view the cities that they live in and visit. This research focuses on the question of whether demographics (e.g. age, gender, neighborhood, transit use) or the use of location technologies (e.g. online maps, mobile maps, transit apps) impact how people view a city.

Early work in understanding mental models of the city includes Milgram's Mental Maps study from 1976 [9] which explored peoples' perceptions of Paris and later other cities. In this study, participants both drew a map of what 'their Paris' looked like and later identified arrondissements that they viewed to be dangerous, wealthy, etc. Now, 35 years later, we are interested in the extent to which we can use similar methods to inform the design of future mobile services through analyzing how views of the city might differ with demographics and technology use. In this paper, we describe a study performed in Chicago replicating Milgram's work, while adding demographic and technology use analyses, and gear our discussion toward specific ways that mobile services can adapt to differing views of the city.

BACKGROUND
Recently, urban informatics has been gaining a large interest in the HCI community (e.g. [5]) as computing has moved away from the desk and towards interactions in the environment of the world. Work ranges from understanding the familiar stranger phenomenon [11], to involving citizens in the collection of (sensor) data from the urban environment, the role of urban informatics in increasing urban civic engagement [6], and its opportunities for urban planning [5, 12]. A multitude of location-based services and locative media are also available [1], and motivations for their usage are diverse (see e.g. [7, 3]).

Cities are now hybrid spaces that combine digital data with the traditional environment. They consist of many layers: for example physical layout, infrastructure and locations, socially constructed places, individuals and social structures, and reviews of locations on mobile and web services. While maps may appear a default choice for location-based applications, Church et al. show that maps are often not the optimal presentation paradigm, and that applications should support alternative modalities [2].

Milgram (and later also Lynch [8]) showed that people's mental maps of cities differ from, and go beyond, the actual physical layout of cities. While these classic studies are well known, there are surprisingly few studies, if any at all, available on whether their results still hold given the wide adoption of maps and mobile location services today. We were unable to find any analyses of potential demographic

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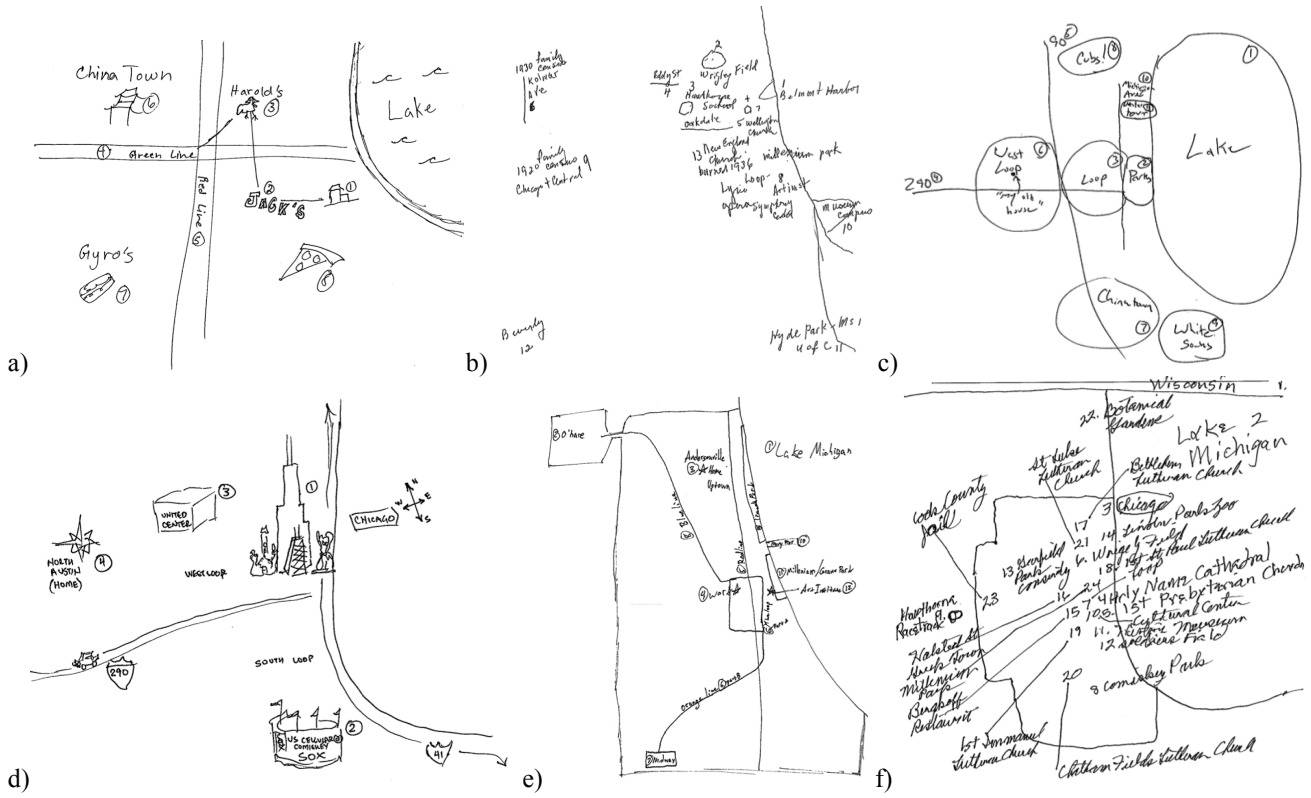

Figure 1: Examples of maps created. Some maps focused on particular neighborhoods while others contained many landmarks of importance to the creator. Others, like map c, show a model of the city made up of neighborhoods.

differences and the influence of technology usage on hand-drawn maps of the city. At the same time, others are arguing that new means of communication have been transforming urban spaces and perceptions thereof [10]. We here aim to shed light of such potential differences.

METHOD

Overall, we sought to replicate the Milgram Map study as closely as possible, while focusing on participants' use of current location-based services and demographics. Since our core research questions involved differences in perceptions of the city based on demographics and tech usage, we added a questionnaire at the end of the study to capture these demographic aspects.

We wanted to reach the broadest set of Chicagoans and visitors and set up a table for two days in one of the main parks to use for recruiting and running the study. At midday we found a good number of tourists and professionals on their lunch breaks. In the evening, during a large (~10,000 person) concert, residents from all sides of the city attended. In the end, we had 87 participants (of which 25 were tourists and 62 were Chicago residents from all sides of the city). They ranged in age from late teens to 70s and covered a wide range of occupations, educational backgrounds, and location technology use.

Participants who approached our table were informed about the nature of the study. They were asked to draw a map of what "their Chicago" looked like and not to focus on making a map four a tourist, but on aspects of the city that are important in their lives. We followed as closely as possible the instructions given to the Milgram participants in the 1970s based on the details in [9]. After drawing their map, participants completed a packet of blank maps with the official Chicago neighborhood boundaries where they were asked to circle parts of the city that they liked most, thought were dangerous, would like to go to for dinner, etc. Again, we followed the Milgram procedure as closely as we could from details in the original paper.

Finally, participants completed a short questionnaire on their background (age, gender, profession, educational background, various items on their tie or visits to the city) and how often they used location technology (frequency of use of maps on the web, mobile maps, GPS navigation systems, location-sharing apps such as Foursquare, and mobile transit apps), and frequency of use of various transit modes (walk, bike, bus, train, subway, car) on a 5-point scale from never to daily. They were also asked to indicate which feature of the city they felt was most essential to "Chicago" and what the city could do without. All participants received a $10 gift.

We reviewed the maps that our participants created and logged aspects of the maps such as elements and features of the city included in the map (using features such as nodes, districts, edges, and paths from Lynch's urban planning

parks & outdoors	arts & entertainment	travel	sports	food	shops	college & education	church	other businesses	event	nightlife
134	96	66	36	27	26	18	17	15	8	3

Table 1: Frequency of place types drawn on our participants' maps of "their" city. Note the relatively low number of places in the food, nightlife, and shops categories, some of the most popular on mobile location sharing systems.

taxonomy [8]), the percentage of the city that the maps covered, the neighborhoods included (explicitly and implicitly), and the types of places listed (using categories from foursquare). We also logged the neighborhoods circled in the secondary maps. We decided on the Lynch features since they are easily countable and could be quantitatively compared across groups.

RESULTS

Perhaps the most striking result was the similarities in the types of maps across groups. Old and young, wealthy and poor, those with PhDs and those with less than a high school education drew mostly the same categories of maps. Some maps showed individual neighborhoods in great detail, some maps gave an overview of the city. Some maps focused on transit or roads while others were just a set of points floating in space. Figure 1 illustrates typical maps.

Map size

Most maps drawn by our participants only covered small percentages of the city. Drawings of included on average elements (such as landmarks, roads, etc.) from 5.3 neighborhoods (Mdn=5, SD=3.2), whereas the official map of Chicago neighborhoods covers 95. When asked which neighborhoods they knew the best, participants highlighted an average of 11.5, which was slightly more, but still only a fraction of the city (Mdn=9, SD=9.4). Demographics or technology use did not have a significant correlation to the broad type of maps drawn or the total area covered.

Technology use and the city

However, there were some significant correlations. The use of mobile check-in services was significantly correlated with increased use of multiple forms of transit (walking, car, and suburban rail). Check-in use was also positively correlated with the total number of neighborhoods shown in the hand-drawn maps ($r=0.70$, $p<0.01$). Both of these findings show that mobile check-in users are more likely to travel about the city and know more of it in greater detail. Interestingly, in our study mobile check-in use was not correlated with age, educational background, or different based on gender showing that mobile check-in use has become more mainstream since earlier studies (e.g. [3]).

Mobile map usage was strongly correlated with multiple forms of transit use. Those who walked ($r=0.86$, $p<0.01$), took the El train ($r=0.79$, $p<0.01$) and took the commuter rail ($r=0.57$, $p<0.01$) more often were all more likely to frequently use mobile maps. This makes sense, as they are more likely to be in different parts of the city and more active since they travel more often. Ways to better engage drivers in mobile map use and exploring the city would be interesting given the car-centered nature of many cities.

Tourist Maps

Tourist maps differed in several ways from the maps of long-time residents. Tourists almost never used the official neighborhood names in their maps. While residents included an average of 2.1 neighborhoods names explicitly in their maps, tourists listed 0.12 ($t=5.18$, $p < 0.01$). This is expected, but demonstrates that interfaces that might work well for residents might not work well for tourists. While nearly all Chicago residents think of the city in terms of neighborhoods, these invisible lines are hidden from those new to the city.

Tourists were also twice as likely to draw maps that included pictorial representations of buildings or landmarks (11/25 vs. 13/62). Although not statistically significant ($chi^2= 2.8$ $p = 0.09$), it is interesting how tourists may see the city more in terms of the visual features than do its residents who appear to be more likely to think in terms of neighborhoods, streets, or transit routes. These visual features can be used to help tourists gain a better idea of how the parts of the city fit together and in navigating.

Knowing the city

We were particularly interested in how the use of location technologies was related to how well a person knew their city. Frequent users of online maps were less likely to identify more of the neighborhoods in the city with the highest violent crime rates [4] as 'dangerous' ($r=0.37$, $p < 0.01$). In contrast, those that drew maps covering a larger area of the city were more likely to identify dangerous areas ($r=0.2$, $p < 0.06$). It was also interesting that those who lived on the South Side of the city (containing all but one of the most dangerous areas) were less likely to identify the neighborhoods with high crime rates as dangerous ($t=2.87$, $p = 0.007$).

The types of places that are important

Our participants created hand-drawn maps with many different categories of places in them. Table 1 summarizes the categories of places that appeared in their maps. While approximately ¼ of our participants were tourists, the types of venues in the hand-drawn maps did not significantly differ between tourists and residents. Parks and arts were the most common categories represented, with relatively few nightlife and food-related places drawn. This is in contrast to the types of venues frequently used with today's popular location based services. For example, on Foursquare the most popular categories are Food,

Work/Office, and Shop accounting for the majority of all check-ins in 2010[1]. These categories only represented 12.5% of our locations. Other location-based services such as Yelp and Opentable also cater to the food category.

Therefore, existing mobile services are not widely used in the places that are considered most important to our participants. There is an opportunity for new mobile services that relate to these more important places in people's lives, such as parks and art venues in addition to focusing on currently well-covered categories such as food, nightlife, and shopping.

Interestingly, while the drawn maps featured elements related to the train or subway only very rarely (M=0.6, Mdn=0, SD=1.4), 21 of the 87 participants listed transit as the most essential feature of the city. This essential, yet not particularly personally important, feature of the city should not be forgotten when designing new mobile services.

DISCUSSION

We have conducted the first (to our knowledge) study that analyzes hand-drawn city maps statistically with demographic data. Through this process, we have identified several key differences in perceptions of the city based on demographic data and technology use. We believe that this knowledge is useful in creating new location-based services that work with the ways that people see their cities.

New location-based services should work to increase the percentage of the city that people explore. While many current services focus on finding places nearby, perhaps focusing on relevant venues a bit farther away could help people to explore more of their cities and feel like they know more than 12% of the city "well."

Services should also work for the place types that are important to people including a greater emphasis on arts, entertainment, and park venues. Services that cater towards tourists should describe the city and navigation in terms of landmarks instead of by using neighborhood names that are quite unfamiliar to them. A 'teaching' opportunity arises in transferring local knowledge from locals to tourists, but also using the visual knowledge that tourists already have.

In terms of navigating the city and avoiding dangerous parts of town, applications should provide ways for frequent users of web maps or those who are familiar with fewer areas of the city to better know which parts of the city are unsafe to visit. However, designers need to be aware that even if they are providing information about 'objective' criteria, they are also building in a perception of the city that may not be shared by all its inhabitants. An opportunity is in showing how perceptions differ and change.

While not finding significant differences across technology usage, the use of mobile location technology still adds to one's overall experience in the city. Designing new systems to fit with users' models of urban environments is important to create services that work in daily life.

[1] http://foursquare.com/2010infographic

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