

A Multi-site Investigation of Community Awareness Through Passive Location Sharing

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ABSTRACT

Local community ties are an important social resource, but research shows that these ties have been declining. The social significance of location information offers an opportunity address this decline and support local community building. Through this research, we aim to understand if and how passive location sharing might be socially beneficial for communities. We conducted a deployment of MoveMeant, a location awareness app, across three different communities. Following a research through design approach, we conducted 45 interviews with users of the system and community leaders. The findings suggest that communities face issues related to lack of awareness, cohesion, and identity. We show that the app can help increase awareness of important community resources. At the same time, the findings also show a negative effect of surfacing divisions in a community, which we discuss as a intermediate, perceptual step that may contribute to the amplification effect of technology.

ACM Classification Keywords

H.5.3. Group and Organization Interfaces

Author Keywords

local community; awareness; location sharing; surfacing

INTRODUCTION

“With much greater frequency, neighbors have become, for want of a better phrase, similarly situated strangers.”
-Mark Dunkelman [10]

According to the General Social Survey, the number of Americans reporting spending a social night with their neighbor at least once a month dropped from 61%, in 1974, to 46% in 2014 [50]. Robert Putnam notes the decline in social capital that is both a cause and effect of decreased interactions within local communities [40]. These trends are particularly worrisome as local networks have significant benefits for individuals and the community as a whole, from providing physical

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support to reducing neighborhood violence to increasing life expectancy [5, 13, 43, 44]. The importance of local relationships is evident, for example, when examining the case study of Hurricane Sandy. Researchers found that social capital in a community was highly associated with the resilience of a neighborhood, regardless of socioeconomic group [55]. The importance of local community suggests that more work can be done to support the development of these networks.

One way to use technology to develop these networks is facilitating local connections via increased awareness of different kinds of information. Previous studies demonstrated the potential social benefit of increasing awareness between individuals in a community for social connection. For example, surfacing similarities between strangers can encourage social interactions between them, especially if the attribute is contextually rare [33]. People-nearby applications providing (real-time) location awareness have been shown to allow people to develop social and cultural capital [19]. Awareness of people’s screens in cafés have led to reports of engaging with others by using a shared laptop screen for watching a video together or reading something aloud [14].

To promote awareness, we were interested in utilizing a data source that would be automatically collected to reduce the burden on users and ease issues of critical mass of participation [3]. Recent work provides evidence that location data, available on increasingly ubiquitous mobile phones, might be able to be leveraged for this purpose [3, 11, 30]. Locations carry significant social information that suggest they might be helpful for the purposes of community development [46].

In this work, we examine the meaning of locations for community through the deployment of an app we designed for this purpose. *MoveMeant* is a privacy-aware mobile application that tracks venues frequented by community members and shares them in aggregated, anonymized form. Details of the app design and iterative design process can be found in previous work, describing a pilot deployment of the app [52]. The pilot revealed that *MoveMeant* differed significantly from other services because (1) it does not require explicit, ongoing contributions by users and (2) it has the potential to expose local resources that are not ‘performative’ like those captured by services like Foursquare and Facebook check-ins (e.g. can expose grocery stores rather than restaurants). The present study builds upon the preliminary deployment by conducting wide field deployments with 118 users across multiple sites,

examining different types of communities, and engaging with community leaders as well as individual users of the system. With this study, we aimed to understand:

RQ1: *How is aggregated community location data interpreted by individuals in different communities, and what meaning do these individuals extract from such data?*

RQ2: *How does aggregated community location data align with or oppose challenges and initiatives from community leaders?*

This work provides a deeper understanding of the benefits—and drawbacks—of using location histories and location awareness in local communities. Employing a research through design approach, we find that lack of awareness, cohesion, and identity are common challenges across the communities we studied. The findings from our deployment described below suggest potential benefits, including how such data aligns with community leaders’ awareness goals. At the same time, we extrapolate our findings to propose an intermediate step of surfacing divisions in a community, a negative outcome that may contribute to the amplification effect of technology [56].

RELATED WORK

Since 1903, sociologists like Georg Simmel have noted the difficulty of connecting with others in urban environments [48, 49]. Over-exposure to strangers has caused people to create a buffer to protect themselves from the constant stimulation of city life. We do not attempt to cover the entire field of urban sociology here, but instead review more recent HCI research on how locations have been used as social information and work on community informatics applications that focus on collocated people and awareness.

Location as Social Information

Previous research has shown that location information carries social significance. Sociologist Lyn Lofland argues that spatial information is what people have come to depend on in order to make judgments of strangers [27]. Location information has been shown to reflect personality, and is in turn interpreted by others as a source of personality and social cues [35]. Further, participants were able to judge the aesthetics of a place based on the profiles of the people who frequent that locale [41]. Beyond the places themselves, sharing information about locations through apps like Foursquare and Facebook can enhance social exchange through parochialization, “the process of creating, sharing, and exchanging information, social and locational, to contribute to a sense of commonality among a group of people in public space” [20].

Recent work in HCI suggests that location tracking technology could potentially be used for building social relationships. As mobile phones are becoming more ubiquitous, companies have begun to leverage the mass amounts of data being collected on these portable devices. Google and Apple offer location sharing services, but these are identifiable and shared only to specific parties for a pre-determined amount of time. Location-based, real-time dating (LBRTD) systems like Tinder and

Grindr match individuals who are currently in the same location [1]. One notable exception is the location-based post-hoc dating (LBPHD) app, happn, which shows location overlaps to potential matches. Research indicated that the LBPHD information was valuable because of its warranting power since location data is less easily manipulated [30]. MoveMeant builds on this idea of identifying implicit location overlaps, extending it to communities (rather than a dyadic context) to understand the effect of such data in this context.

Awareness

Local awareness has emerged as a topic of interest since early research in CSCW. As Schmidt argues, awareness “is not the product of passively acquired ‘information’ but is a characterization of some highly active and highly skilled practices” [45]. He argues that social context is necessary to achieve awareness. Initial work predominantly derived from a focus on awareness in the workplace, but has expanded to urban interventions and installations that also address the issue of awareness such as Jabberwocky [38], CityWall [39], LoveBomb [15], and Social Streets [37]. These projects aimed to increase awareness of familiar strangers, local photographs, emotions of proximate individuals, and online discussions of local events. Our work reflects on Schmidt’s definition of awareness, using automatically collected data to consider a new type of community awareness.

Community Informatics

A number of research projects and consumer products have been designed to aid community development. These include engaging citizens with their local government, empowering communities through voting devices, and creating forums for civic engagement [2, 28, 53]. The present study is situated in other work on the bottom-up use of technology for civic involvement [2] and identifying the potential benefit to local community of this research [24]. Our app integrated location information with community informatics to understand how this kind of data might be used by communities. Carroll identifies two types of location-dependent apps for community networks, including Suprathresholding apps—which MoveMeant may be an example of—that aggregate local content to help ease issues of critical mass [3].

A subset of HCI research has explored the relationship between geographic location and community development. In their work on local community informatics, Carroll & Rosson highlight the importance of place as “the most basic shared community infrastructure.” [4]. Indeed, previous research on community apps suggest that location information is potentially valuable to share at a community-scale, which we explore with the MoveMeant app in this work. For instance, the app Movement¹ was a platform that allowed communities to generate their own location-based review applications [11]. The deployment of the Movement app showed that location recommendations based on community-generated information are valuable. Another app, Journeys, used overlapping endpoints to allow users to leave notes to one another traveling on the same path. Their findings showed that the app

¹While the name is similar, this app is not related to ours and offers entirely different functionality.

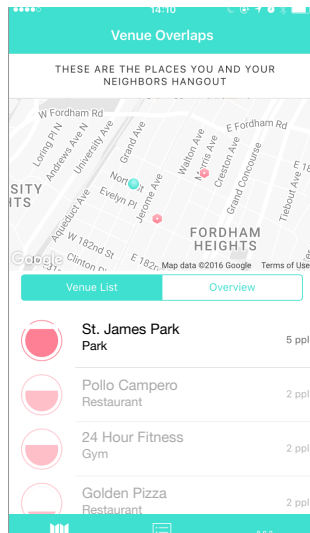


Figure 1. Aggregated list of venues screen of the MoveMeant app

was able to facilitate knowledge sharing and human contact asynchronously and pseudonymously [7].

THE MOVEMEANT MOBILE APPLICATION

At a high-level, MoveMeant:

- tracks participants' locations (venues visited) on their own mobile devices
- collects and displays anonymous aggregated community venue data in a dedicated screen within the app

Locations are collected passively on the phone, not requiring any explicit user-input. Users can also choose to turn off their location tracking at any time through the settings tab of the app. The anonymized locations are stored on the server and associated with a particular community. Only aggregated data, a list of visited venues by the community, is presented in the app (see Figure 1). For privacy, venues only appear on the list of locations if two or more people from the community visited them. On sign-up, users input their zip code or group name to designate them in a particular community. For more details of the design guidelines, process, and full functionality of the app, please refer to [52].

METHODS

We followed a research through design methodology [58] in our approach to studying MoveMeant. The goal of the research was to produce knowledge about using location history overlaps for communities by gaining an understanding of the social structures in which we introduced the technology. Strengthening communities could be considered a “wicked problem,” a challenge that we can’t accurately model because of conflicting perspectives from stakeholders [59]. As such, we found it valuable to interview both community leaders and members of different communities. Our deployment of MoveMeant could be considered a probe [21] since the focus was on understanding the potential of utilizing location technology for community awareness rather than usage of the app itself.



Figure 2. Map of New York City with the field sites highlighted (note that the Cornell Tech campus had since moved to another location)

The field sites were selected based on our criteria of communities that varied in type, density, diversity and that are earning below the median income of New York City, aiming for lower-income communities which are often marginalized by technology [9, 54]. We chose three sites that matched the requirements and to which we had ties that allowed for convenient access: two neighborhood communities in New York City, East Harlem and Jackson Heights, and one urban graduate school campus community, Cornell Tech. The three field sites are several miles (and about 30–50 minutes on the subway) apart from each other (see Figure 2).

For recruitment of app users and interview participants in the neighborhood communities, we partnered with local organizations (community council, merchant’s association, and a local café). Community leaders were recruited through reaching out to presenters at community meetings, emailing people with roles related to leadership, and snowball sampling. Recruitment on the Cornell Tech campus was conducted through presenting at a campus-wide meeting, offering extra credit for a master-level class, and snowball sampling. A total of 118 MoveMeant users were recruited across the three field sites (53 from Cornell Tech, 35 from East Harlem, and 30 from Jackson Heights). The app was then used in each community for about seven weeks before participants were recruited for follow-up interviews. Participants were compensated \$10 for downloading the app and an additional \$10 for participating in the interview.

We conducted a total of 45 interviews, which consisted of a mix of 15 community leaders and 30 members of the communities across the three field sites. The community leaders varied in the power they had, with official titles ranging from community board member and director of HR to student government leader and block association organizer. The interviews with community leaders focused on attributes of the community, initiatives that they and their organizations are working on, challenges they face as a community, and how their goals

might be addressed by the features offered by MoveMeant or similar applications. Interviews with individuals covered their usage of the app, including a session where they opened the app and discussed the content they saw, and their experience as a member of the community. Interviews were held in-person at cafés and participants' offices, and over the phone. Interview audio was recorded and transcribed. In addition to the interviews, and to develop context for the interviews, the first author spent over 20 hours in the field conducting observations at community-related meetings such as monthly community council meetings, the weekly greenmarket, and local town halls.

The interviews were coded by two independent coders using a grounded coding approach with the aid of Atlas.ti². Once phrases and sentences had been coded, the coders met face-to-face to discuss their codes and merge similar ones. The codes were then grouped according to the larger themes presented below.

PARTICIPANTS

As mentioned above, our participants and app users were both community leaders and other members of the three communities.

East Harlem is a neighborhood in the north of Manhattan with a median income of \$28,500. According to U.S. Census data, East Harlem is 47.6% Hispanic, 33.6% Black, 10.7% White, and 5.9% Asian³. In this community, we interviewed seven users (three of them women, median age of 29 years) whose jobs included nonprofit worker, entrepreneur, and engineer. We also interviewed six community leaders (four women) whose roles in the community included council members and block association organizers.

Jackson Heights is a neighborhood in the borough of Queens with a median income of \$52,600. Jackson Heights is 57% Hispanic, 19.8% Asian, 14.3% White, and 6.5% Black. We interviewed seven users from Jackson Heights (five women, median age of 34 years) whose jobs included nurse, social worker, and pet care worker. We interviewed three community leaders (one woman) who worked as representatives for local organizations.

Cornell Tech is a mix of graduate students, faculty, and staff on a small campus. At the time of the study, no housing was available to people working on the campus, which resulted in people commuting to the office from a mix of neighboring areas. We interviewed 16 users from Cornell Tech (11 women, median age of 24 years). We also interviewed six community leaders (four women) whose roles included government representatives and student service leads.

FINDINGS

The findings are divided into categories of challenges that were discussed by community leaders and MoveMeant users. Even though the leaders were aware that we were deploying MoveMeant in their communities, we prompted them to discuss challenges that their communities face outside of the app.

²<http://atlasti.com/>

³<https://www.census.gov/>

We present the findings by describing the issue, recounting interviews with community leaders that engaged with the issue, and summarizing interviews and data from MoveMeant users that reflected on the issue. We organize the challenges raised by community leaders and addressed by participants using MoveMeant into three main buckets: awareness, cohesion, and community identity.

Participants are designated by their field site (Cornell Tech = CT, East Harlem = EH, Jackson Heights = JH). Community leaders have an "L" added to the end of their field site, e.g. EHL5 is the fifth leader interviewed from East Harlem. The age and gender of participants is also given for the individual users of MoveMeant, e.g. EH4-28F is a 28-year-old female and the fourth interviewed user of MoveMeant from East Harlem.

Awareness

One of the challenges for communities that was mentioned across the field sites was lack of awareness. The two types of awareness discussed by leaders and members of the community were awareness of resources available in the community and awareness of patterns of movement within and outside of the community. This heightened awareness aligns with the main motivation for MoveMeant, but also showed complications that are highlighted below.

Interviews with Community Leaders

Community leaders across the field sites mentioned how an increase in awareness would help their communities, from informing members of what resources are available to knowing members' behavior to guide leadership's actions.

Awareness of Resources Increasing knowledge of what resources are available was a crucial part of several community leaders' work. One leader, who works at the local hospital in addiction recovery, bases much of her work on collecting information to share with people in the community. "*[I've] gone around to all the different churches, community based organizations and everything, written out everything that they need that they have, and put it together in a resource book*" (EHL6). Resources were brought up by another East Harlem leader, saying "*We have a high level of narcotics shelters in the neighborhood. Those people need to find the resources to be healthy. All the people that are going to come to our fair, we try to make sure we have resources*" (EHL4).

Awareness of Patterns Awareness could also help community leaders be more effective in their work. EHL2 described potential usefulness of MoveMeant for her work on addressing the 'food desert' in East Harlem:

"By tracking [the residents], we get a picture of their daily routine. How much time they're putting into grocery shopping and traveling to some other store and also the frequency. That would be very helpful to understand people's shopping patterns." (EHL2).

Another organizer commented on the potential usefulness for newcomers:

“We have the balance of people who know New York really well and... a lot of people who don’t know New York at all... could be really interesting for people to just feel like, what are the patterns, and where are people going and what’s of interest, and maybe even identify activities, landmarks, parks, things nearby that they weren’t even aware of” (CTL2).

For other organizers, the awareness triggered ideas around different kinds of data sources. For example, a grassroots organizer in Jackson Heights described how awareness of the police biases in the neighborhood was important to creating a safe community for residents.

Interviews with Individuals in the Community

Interviews with MoveMeant users indicated that the app helped them gain an awareness of local knowledge that otherwise predominantly traveled through word of mouth as well as an awareness of the general patterns of movement of the people around them. The resources discussed by users, however, differed from the kind mentioned by leaders.

Awareness of Resources Twenty-one participants (70%) mentioned that the app helped them increase their awareness of knowledge that is specific to locals or finding value in the app being used by community members. By limiting the app data to locals, the result was information accumulated by those who are familiar with the area. One participant explained the value of local information, saying,

“I wouldn’t care for the opinion of someone who just came through and decided oh, I love this part, maybe you should visit it when you go, because you wouldn’t necessarily have any sort of context for what life was actually like in a neighborhood. So I would definitely take neighbors’ or residents’ word or advice over just anyone” (JH2-28F).

Another participant made an analogy to using the app as a local’s guide. He said,

“It’s like going to Disney World versus going to some other little town in Florida. We all know Disney World, we all know Indian food in Jackson Heights, but you don’t know the real area. How do you get that, in my opinion? Through a local perspective which is something like your app” (JH6-48M).

Similarly, in East Harlem, a participant described how the app would identify local hotspots.

“It means something that you’ve regularly got a hotspot of only locals going to this one place, or these five places. That means a lot to me, I guess. Like, how many people from East Harlem go to Red Rooster [an expensive local restaurant]?” (EH5-29M).

The app made overt information that may have commonly traveled invisibly. A Jackson Heights participant explained how important word of mouth is to dissemination of information.

“We know a woman on this and such street who makes the best bread, so everybody goes to her. Or if you want good... arepas, go to this over Venezuelan spot... geared

towards word of mouth because there’s such a heavy immigrant population and there they’ve sort of set up internal, informal system of the way things work” (JH2-28F).

CT14-33M echoed this sentiment when he described MoveMeant as an app form of word of mouth, and added:

“You’re learning where there’s a lot of foot traffic, which sometimes for a place that’s really good, but maybe not necessarily hugely popular, as far as notoriety, might be a good place to go” (CT14-33M).

Another participant explained how the data in the app reflected the information that was already traveling invisibly.

“I feel like a lot of people in that place, my community already knows where the hot spots are. When my parents ask about where are good places to eat, by word of mouth, so I’ve seen that reflected on the actual app data” (JH7-21F).

Awareness of Patterns Across the field sites, nine participants (30%) mentioned that MoveMeant increased their general awareness of their communities. One participant described it as *“weirdly voyeuristic, where it’s kind of cool to know what people are up to or what the patterns are in the neighborhood.” (JH4-28F).* Another participant described the app as supporting evidence of her existing beliefs about the community when she said, *“It was like more validation of what I already knew. It’s interesting to visualize it, something that you only know, like kind of theoretic” (EH3-39F).* A Cornell Tech participant described a time when the location awareness resulted in her realization that people were traveling during spring break.

“I live in Jersey and then usually there’s a dot on the Newport Center or something. Suddenly, I noticed for that week... no dots showing up there. So I assume everyone just living in Jersey City is out of town” (CT7-24F).

For another participant, the increased awareness changed his opinions about who was going to a particular venue in the community. *“Blink Fitness is an interesting one to me. Does it surprise me? No, but I never thought locals would go there. They do. I was wrong on that one” (JH6-48M).*

Cohesion

Lack of cohesion was brought up as a challenge by community leaders across the field sites. Divisions between job roles, race, and geography contributed to feelings of separation between factions of the same community. The location overlaps captured by MoveMeant reflected some of these divisions, as did user interviews reporting feelings of isolation from the community. MoveMeant users indicated an interest in places based on perceived similarity of visitors to them, which could contribute to the lack of cohesion reported by leaders.

Interviews with Community Leaders

One common issue across the different field sites was the separation between different factions within the same community. While the nature of the split differed depending on the community, lack of cohesion was frequently brought up during interviews with community leaders.

At Cornell Tech, the community is divided by position or role at school, degree program for students, and also by cultural differences.

“Based on our size it would be nice to have more of a sense of community across the different populations. Master’s students, PhD students, staff, faculty. . . I feel like there’s this sense of community within pockets of the population” (CTL2).

CTL1 explained that one of their general goals was to bridge between students who are in different degree programs. *“We do want to make sure that people are integrating. We don’t want like cliques of students necessarily, and that is hard to manage” (CTL1).* Given the large international population of incoming students, CTL6 also mentioned divisions across cultures.

In Jackson Heights, the neighborhood is divided by different immigrant populations that moved to the area at different points in history, including more recent wave of upper-middle class non-minority population. JHL2 explained the breakdown of different factions within the neighborhood.

“There’s that pocket. . . heavily Dominican. People in Jackson Heights don’t really think of that portion as being part of Jackson Heights. . . That’s really what I think about when I think of Jackson Heights, and. . . the immigrant population is mainly Colombian, some Portuguese as well. . . South Asians that live on, let’s say 69th street would be different from those who live on 75th street in terms of class, wealth disparity, so once again it’s also that small pocket of other Jackson Heights” (JHL2).

In East Harlem, the primary distinction is between the African-American and Latin-American parts of the neighborhood. As EHL5 described,

“This neighborhood is not very close knit. . . People in the 0029 [the 10029 zipcode] are generally Latino, which is El Barrio. [1]0035 generally is African American, and they don’t kinda get along on the same trip. Right now, this side of the equation wants to kind of break away from El Barrio. . . El Barrio wants to keep El Barrio. In other words, you’re not gonna have La Marqueta called The Market” (EHL5).

Interviews with Individuals in the Community

The usage data from MoveMeant and subsequent interviews with participants on their experience with the app echoed the concern brought up by community leaders regarding cohesion. The interviews, as we show next, suggested that one potential contributing factor to the issue of cohesion could be homophily, people’s attraction towards others who are similar to them. The interviews also highlighted a potential negative effect of exposing *lack* of overlap, resulting in feelings of isolation from the community.

The location overlaps captured by MoveMeant reflected the geographic divides of the neighborhoods described above. At Cornell Tech, people were commuting to campus from different areas around New York City, leading to locations that were spread out all over the city. The divisions between roles

on campus or program were not reflected geographically. In contrast, Jackson Heights and East Harlem showed distinct divisions. In Jackson Heights, the overlapping venues fell within 73rd St and 82nd Ave from Roosevelt Ave up to Northern Blvd. Significantly, no venues were included in what was described by JHL2 as the heavily Dominican area or the South Asian area. In East Harlem, the primary area of location overlaps was between Lexington Ave and Malcolm X Boulevard. This area is closer to Central Harlem, not in the center of what is geographically considered East Harlem, indicating a lack of overlaps within the heart of the neighborhood.

Similarity Sixteen participants (53%) mentioned interest in the places shown in the app because they reflected the opinions of people who were similar to them. JH6 described a farmer’s market that appeared in the app.

“Eight people have been to the Jackson Heights Green Market, to me, makes perfect sense. I go [there] because people here tend to be a little more organic, want fresh vegetables. . . I know a lot of locals don’t go there because the prices are a little higher than going to the local fruit stand” (JH6-48M).

An East Harlem resident described the desire to find people based on locational similarity.

“In a city that’s as antisocial and averse to talking to strangers. . . it would be nice to have an interesting set of data to see are there people who I would frequently see more often and be able to get to know because we seem to have overlapping hot spots” (EH5-29M).

Some participants also assumed that locations shown in the app were reflective of practices that they themselves go through. As one East Harlem participant said, *“125th Station I knew, and I figured that must’ve been the people picking up vegetables like me” (EH3-39F).* CT12 described how she expected others to go through the same kind of research on restaurants she went through and therefore trusted the locations in the app.

“Because it’s like the similar background, right? . . . a lot of them are going to go through the same process I would, and that’s going through like researching different places. . . ’Cause that’s what I do a lot. . . Just from that, I have that assumption that they’re going through the same process, so their opinion is probably going to be better” (CT12-21F).

Similarity that became apparent through the use of the app could contribute to the community issue of lack of cohesion. Despite the fact that the app did not highlight similarity other than the community affiliation, people indicated that they were more likely to go to places that they perceived are frequented by other people *like themselves*. This tendency would seem to lead to further divides in the community as those in the Latin-American area of East Harlem, for example, would want to find out about other places that Latino-Americans frequent instead of those frequented by the African-Americans in their community. While MoveMeant has the potential to expose popular places amongst different groups within the

same neighborhood, it is unclear whether people would choose to go to those places that are perceived to be outside of their in-group.

Isolation from the Community A few people across the different field sites indicated that the location data also had the potential implication to make them feel isolated from their community. Five people (17%) mentioned that their personal location histories did not match that of their communities. People whose personal data or places were not reflected in the app could lead to feelings of separation from the community.

In Jackson Heights, one participant noted this trend since he was unfamiliar with many of the places surfaced by the app. *“Most of the places I go to they’re apparently not that popular...As Europeans, we’re like minorities, so maybe our taste in food and things might be different than the majority of the population, you know?”* (JH3-34M). A Cornell Tech user had the same experience, noting the feeling of sadness that can accompany identifying as part of the out-group. *“It’s kind of surprising because I’ve never been to any of them...I know maybe I’m at the edge of the Cornell Tech group... It makes me feel sad”* (CT6-24M). The separation was also made more apparent for a Cornell Tech participant who lived farther away. She said, *“Since I’m an outlier, I keep checking on it like, ‘Oh, nobody logged into your area”* (CT16-F). However, another Cornell Tech participant suggested that these differences might not always be a negative indicator, instead favoring the isolation. She said, *“I like unique things. I’m scared to have the same thing as people. If I have my thing, I want to keep it that way”* (CT10-19F).

The isolation that became more apparent from using the app could also exacerbate the lack of cohesion. By making apparent that people’s behavior were different from the rest of their community, individuals using the app could feel further separated and *decrease* their identification with the community. We explore this finding in greater depth in the discussion.

Community Identity

A third theme we identified in the interviews was community identity. In interviews with community leaders, they revealed their desires to establish and maintain a positive culture, while users interpreted the data from MoveMeant as affirmation of their observations of the community’s existing or changing identity.

Interviews with Community Leaders

Community identity was important for leaders to establish for newly formed communities, to improve for communities with negative images, and to maintain for areas that were undergoing gentrification.

Shifting Identity Cornell Tech is a relatively new community, so leaders mentioned a desire to *“establish better student traditions”* (CTL4) and *“build a cross community culture”* (CTL5). In East Harlem, some changes in the community have been welcomed by long-time residents. As EHL1 described of one particular intersection,

“That first summer, people would come out there, and I would see old women... come up to me just crying... ‘I

never thought that people would think to make this a good place for my family,’... So I think that’s been the most beneficial thing, just watching people connect in this space, and start to take ownership of their community” (EHL1).

However, not all changes to community identity are positive.

In Jackson Heights, the issue of gentrification is a concern that could be displacing residents and reflects societal concerns about this phenomena [25]. As JHL1 explains, *“Policing and gentrification work hand in hand. They’re both tools in order to displace and actually expel people from communities for desirable land”* (JHL1). JHL2 describes how the landscape of stores reflects the undercurrent of change when he said, *“82nd street has shown that corporations are willing to come in and they can take over the neighborhood and take over the small mom-and-pop stores”* (JHL2). The new stores are catering not to locals, but *“to the tourists that are coming to Jackson Heights, the ones that want to go to little India and try out Indian food, or visit a Columbian spot. The momo [type of dumpling] crawl”* (JHL2).

Interviews with Individuals in the Community

Interviews and the types of locations captured by MoveMeant showed that the app surfaced certain attributes of the community as well as reflected shifts in the community identity.

The types of venues visited by people differed between communities. Over the seven-week deployment, MoveMeant captured 23 venues in East Harlem visited by three or more people, 43% of which were subway stations. This compares with 40 venues in Jackson Heights, 27% of which were subway stations, and 198 venues at Cornell Tech, 27% of which were subway stations. It is difficult to draw any conclusions based on the number of venues since each group was a different size. However, the fact that Jackson Heights had almost double the number of overlapping venues to East Harlem with a smaller number of participants indicates that people using the app in Jackson Heights visit more similar places.

Identity Affirmation Several participants mentioned how the location overlap provided them with a broader view of the neighborhood, whether affirming existing impressions or forming new ones. Jackson Heights had a number of restaurants appear on the list of location overlaps, which one participant interpreted as an indication of the nature of community.

“The fact that there’s so many restaurants I think just kind of reinforces sort of the communal aspect of the neighborhood and there’s a lot of, sort of, people like to get together. At any given time, when you walk out you see a group of people or family, a group of friends... I think those results just probably reinforced but I already sort of assume about the people in the neighborhood” (JH2-28F).

An East Harlem resident saw a small restaurant in the list of locations and described how the app indicated the types of businesses the community supports.

“In terms of restaurants and small businesses, where does the neighborhood spend their money? Do they support

the small businesses? Do they go to these little hole-in-the-wall restaurants? Or don't they?" (EH7-31F).

Shifting Identity Eight of the participants (27%) brought up how MoveMeant reflects changes in the neighborhood. When listing places she'd seen in the app, JH7-21F mentioned,

"There was Emoji Burger, which is like where all the hipsters eat. Like my friends refer to it as that... I can understand how it's come to be one of the more popular spots. I guess it's kind of like, further reinforcing kind of the trendsetters that my friends and I have noticed" (JH7-21F).

The trend mentioned by JH7 is reflective of the concern around gentrification as discussed above. In East Harlem as well, gentrification arose as a concern for participants using MoveMeant. One participant explained how MoveMeant could capture the changes in the neighborhood.

"When Whole Foods opens... are we going to actually see a lot of people at Whole Foods? And like, the So What to that is well there's been so much discussion around that Whole Foods and are residents of East Harlem actually going there? Yeah I just think it's sort of, as a barometer of the community and what people are actually responding to and understanding shifting demographics and preferences... I feel like that the app could potentially have a real pulse on that if you had enough people using it and you had a sense of how you wanted to interpret it" (EH2-28F).

Misrepresenting Identity As an app, MoveMeant only captured a subset of people in the community and inherently introduced bias. JH1 described a third place in the neighborhood, a bagel shop frequented by long-time residents of the neighborhood.

"Sometimes I know their names, and I know them by sight. They recognize my children. So yeah, there's just something that's kind of nice about that. Having generations that can enjoy a place, but those aren't the kind of people that are going to be on an app" (JH1-41F).

She did not expect these familiar strangers to have downloaded the app because they were an older demographic. Similarly, an East Harlem participant expressed concern about who was using the app based on the locations overlaps. She said,

"Grand Central and Red Rooster, I mean, I think I was kind of like, 'Oh, are there just a lot of commuters that ended up installing the app and now they're commuting to Grand Central'... Or maybe it is indicative also of how much the demographics are changing here.' It makes me wonder who's using the app" (EH2-28F).

DISCUSSION

Our findings from the three-site deployment and interviews highlight the ways awareness in MoveMeant usage was similar to, and different from, the awareness discussed in leader interviews, a topic we expand on below. Our findings on cohesion can be seen through the lens of amplification theory [56], and we propose below a possible intermediate step towards

amplification, *surfacing*. In addition, our findings on community identity show that the MoveMeant data can potentially be used to shed light on community behavior to political representatives. Finally, we discuss implications of our findings for community informatics design.

Community Resources

Awareness was one of the key topics discussed by community leaders and users of MoveMeant. Awareness of resources available in the community and awareness of the patterns of behavior of members were the main types of awareness that arose from interviews. Some of the resources that community leaders mentioned wanting to increase awareness of were different from the kind that were presented to users in the MoveMeant app. Grocery stores were shown in the app, but resources like addiction centers were not. Part of the reason for this discrepancy could have been due to the fact that the population recruited for the study was not representative of people who would have been visiting those types of resources. However, interview findings suggest the promise of using passive location histories for this type of resource gathering as well (recall that our app offers anonymity). Participants mentioned that the app helped expose places that were previously spread by word of mouth and invisible otherwise.

The fact that the app passively collected locations meant that venues that were non-performative, and might not show up in traditional check-in services like Facebook or Foursquare, could potentially appear in the app [26]. Places that are useful for drug treatment would likely be kept private on other apps rather than volunteered geographic information so as to not contribute to a person's self-presentation [17, 46]. However, extending previous work on the warranting power of location data, our findings suggest that passive sharing of location data might be a way of warranting which resource centers might be more useful than others [30, 52]. These types of places might be warranted through use of the app because people's visitations would be unlikely to be manipulated [57]. Our results thus hint that passive location tracking could potentially align with the efforts of community leaders and be useful for increasing awareness to various types of community resources — potentially in a more reliable manner than available in other services.

Amplification Theory

Our findings on cohesion show that the MoveMeant app reflected the issues raised by community leaders as well as reinforced pre-existing notions of members of the community. The seemingly homogeneous location data was ascribed social meaning as to belonging to one group or another in the community. Instead of increasing cohesion in the neighborhood, MoveMeant sometimes surfaced the distinction between groups within the same community. Participants expressed a desire to visit the venues in the app based on an imagined notion of how similar the other people were to them. Across the field sites, there were instances of participants describing being isolated from other people in the community. Similarly, participants did not express a change in their opinions of the

community by using the app. Rather, they interpreted the location overlaps as a reflection of both the positive and negative impressions they had already formed about their communities.

These findings are related to the ideas expressed by Amplification Theory. Formalized by Toyama, Amplification Theory posits that “technology is merely a magnifier of underlying human and institutional intent and capacity, which can themselves be positive or negative” [56]. Amplification Theory suggests that technology tends to magnify existing inequalities in communities rather than fix missing elements in a social structure. Toyama identifies three mechanisms behind amplification: differentials in access, the digital divide resulting in varying exposure to technology; capacity, the disparities in education; and motivation, what people want to do with technology [56]. In our study, participants’ homophilous tendencies and reported instances of feelings of isolation from the community suggest that the app did not always support feeling of cohesion, but might even exacerbate the distinction by making more overt the differences within the community.

Our findings are related to but do not quite fit the definition of amplification. The distinction between community-members was not based on the differentials described as the mechanisms behind amplification. While differential access may have been responsible for limiting some users from using the app (like the patrons of the bagel store described by JH1), other factors considered by amplification theory, like capacity and motivation, are *not* responsible for the increased salience of differences between groups, since locations were passively logged. Additionally, amplification discusses the positive and negative *impact* of technology whereas our findings did not reflect a difference in impact between groups. Rather, the effect on communities seemed to be *perceptual*, and based on members’ subjective interpretation of the data.

Surfacing

To account for the differences described above, we propose that there might be an intermediate step prior to amplification, that of *surfacing*. Surfacing suggests that before amplification occurs, technology exposes perceived differences and that these differences might exacerbate amplification. For example, some users of MoveMeant observed that they were visiting different types of venues than others in their community. One can imagine that over an extended amount of time, the Matthew effect might occur [36]. Colloquially summarized as “*the rich get richer and the poor get poorer*,” the Matthew effect suggests that the locations visited by similar people could reinforce further visits by other people in their in-group. The perceived difference between places will exist even though there is no explicit group separation in the app itself. The interpretation of the data and how it is perceived creates these divisions. The change in behavior that results in separation of people would then become an instance of amplification.

This idea of surfacing proposes that knowledge of data itself can lead to amplification. Instead of being limited to the introduction of new technology, our findings suggest that amplification might be extended to apply to the *awareness* that is brought about by having access to data. Different mechanisms

could be causing surfacing than ones that cause amplification. Surfacing might be caused by intergroup anxiety and homophily [34, 51]. The tendency of people to prefer their in-group over their out-group results in the interpretation of locations as belonging to one group or another. Similarly, the observed occurrence that “birds of a feather flock together” suggest that people perceive the ability to distinguish between factions of a community based on data alone and could even potentially alter their behavior based on information being presented. Surfacing would not be possible without an understanding of local social context. The existing social awareness of the neighborhood influenced users’ interpretations of the locations. As has been shown from work in mental maps, people develop preferences and fears based on their knowledge of their local geography [12, 32]. This awareness of the self in relation to others would be unknown, or at least more implicit, without the data from the app.

We imagine that surfacing might also apply to other types of technologies. One example of where surfacing was reported was a deployment of voting devices in stores on a street in the UK that was divided between two types of areas [22]. The resulting votes were stenciled onto the pavement to serve as a public display. The authors found that the visualizations promoted comparison and competition between shops and between areas. Similar to what we reported with MoveMeant, the street visualizations provided people with evidence to support or refute their individual prejudices. Another example can be found with Pokémon Go, a popular geographically-based augmented reality game. Researchers found that the game incentives led to a reinforcement of existing geographic socioeconomic disparities [6]. Participant responses indicating that rural areas were “boring places” to play the game serve as instances of surfacing the distinction between advantaged and disadvantaged areas as well as urban and rural places. Nextdoor, a local social media service for neighborhoods, also demonstrates issues that are related to surfacing. Nextdoor allows people to post to a message board once they have proven that they are physical residents of a neighborhood [31]. The service was reported to have “become a forum for paranoid racialism” where people would use racial profiling to identify suspicious people in the neighborhood [18]. Nextdoor could be viewed as having surfaced the racial divide inside neighborhoods by making data available, similar to MoveMeant.

Representation

One of the key issues that was brought up during interviews with community leaders across the different field sites was political representation. Leaders discussed problems including placement of drug addiction clinics and sanitary waste disposals, officials acting against the interest of members of the community, and bribery of other community organizations to push forward politicians’ agendas.

The interview data regarding community identity suggests that the information from the app could potentially be used to aid in certain representation issues through increased awareness. For example, as EH2 explained, the venue patterns in the app could expose whether the new Whole Foods was being frequented by members of the community or not. If data showed

that the new establishment was not actually being utilized by the existing members of the community, and this information was presented to the representatives for the district, it would be difficult for them to argue that the storefront was a benefit for the community. In other words, the aggregated and anonymized data could potentially increase awareness to political representatives of which resources were being utilized by members of the community. This awareness could potentially prompt representatives to address other issues discussed by community leaders and participants like gentrification.

While we do not claim that political representatives would use this kind of data to inform their decisions, our data suggests that having this information available could at least aid community leaders in some of their work by making visible the otherwise invisible patterns of community. In the same way that Heath and Luff [16] showed how workers engage in invisible work with technology and each other in the Line Control Rooms in the London Underground, the technology used in our app has the potential to reveal how members engage with different places in their community. The potential positive change that could come out of this technology, however, would not be possible without the involvement of community leaders, which is consistent with amplification theory.

Community Boundaries

One of the findings from our study is that defining community based on zip code or name are insufficient at capturing accurate groupings of people. Like previous studies on geographically-based communities [29, 42], we defined communities in the app based on neighborhoods distinguished by government boundaries. However, as was highlighted in interviews with community leaders, “*political boundaries are arbitrary lines*” (EHL3), echoing previous research on the difficulty of defining localness [47]. Separating people based on zip code, or any unique and well-defined mapping from location to community, may be distinct but overly simplistic and not capture the nuance groupings within a community. Instead, a fluid definition of community may be more applicable. Assemblage theory provides a useful framework for the purpose of defining community [8]. Instead of a top-down approach to defining a community, assemblage theory argues for a bottom-up approach by observing how component parts interact with each other through *relations of interiority*; the very relationship between components defines the components themselves. From this perspective, community apps would not require users to fit into a defined community. Rather, different clusters would naturally surface based on the data overlaps, allowing users to exist in multiple communities at the same time, and have the community reflect the natural evolution that occurs in the communities. While these definitions of community are much more technologically difficult and complex to execute, they would more accurately reflect the fluid nature of how communities function.

Design Implications

Our findings on surfacing also have implications for the design of community apps. The research suggests that in addition to temporal filtering, local-community filtering may provide more accurate results for location suggestions, though at the

risk of further narrowing people’s filter bubbles [23]. The different clusters of locations that would naturally form for communities could be used to motivate users to visit venues outside of the typical behavior of their community. For example, apps like Yelp could favor locations that were typically not in one’s group by placing them higher in search results. Another possibility would be to compare separate clusters, identify similarities between them, and emphasize the similarities to encourage people to visit places similar to, but not part of, their typical community places. Clusters could also be brought to the attention of community leaders for them to be able to identify venues for community events that are more inclusive of different groups. These design suggestions aim to overcome people’s tendencies towards homophily by nudging them towards more diverse places.

LIMITATIONS

While we attempted to conduct our study across multiple field sites, there are limitations to our study. The three communities were distinct from one another, but were all restricted to New York City, which makes our finding specific to hyper-urban settings. While we studied communities that include neighborhoods and a campus, we hope that our findings would extend to other communities as well, such as religious or cultural groups, or more formal organizations. Another limitation of our study was that recruitment was limited to specific sites, which may have restricted the kind of data collected and populations reached. Self-selection bias may also have led to a user base that was overly technologically-adept and not reflective of the breakdowns of the communities studied.

CONCLUSION

This work described the deployment of MoveMeant, a community app that uses anonymized and aggregated location information for network-to-person communication. Across three field sites and interviews with 45 community members and leaders, we show how the information in the app engaged with the issues of awareness, cohesion, and community identity. We synthesized our findings to propose surfacing, the effect of technology to make differences within a community more salient, as an intermediate step towards amplification. We discussed how the information could potentially be used by community leaders as a tool for political action. Other organizations are beginning to use such personal data for social benefit. For example, Decode⁴ is a consortium of different organizations across the European Union that is exploring how people might use their own data traces for the good of the wider community. Our work suggests the promise behind such efforts in increasing awareness, but also the potential danger of unintentionally surfacing distinctions within the community at the same time. Like architecture, data is given meaning by the way that people use it. More and more data is being collected and efforts taken to make that data available to the public. Taking into account the potential unintended effects of sharing data is a concern for the future that we as designers and researchers should acknowledge and better understand.

⁴<https://www.decodeproject.eu/>

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