

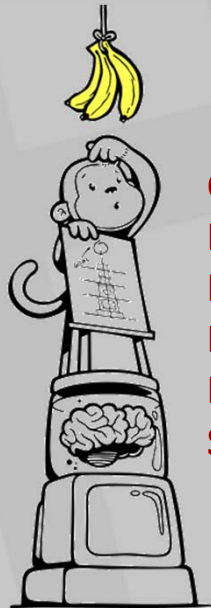
# Privacy, Ethics, and Big (Smartphone) Data

ICISSP 2016

February 20, 2016



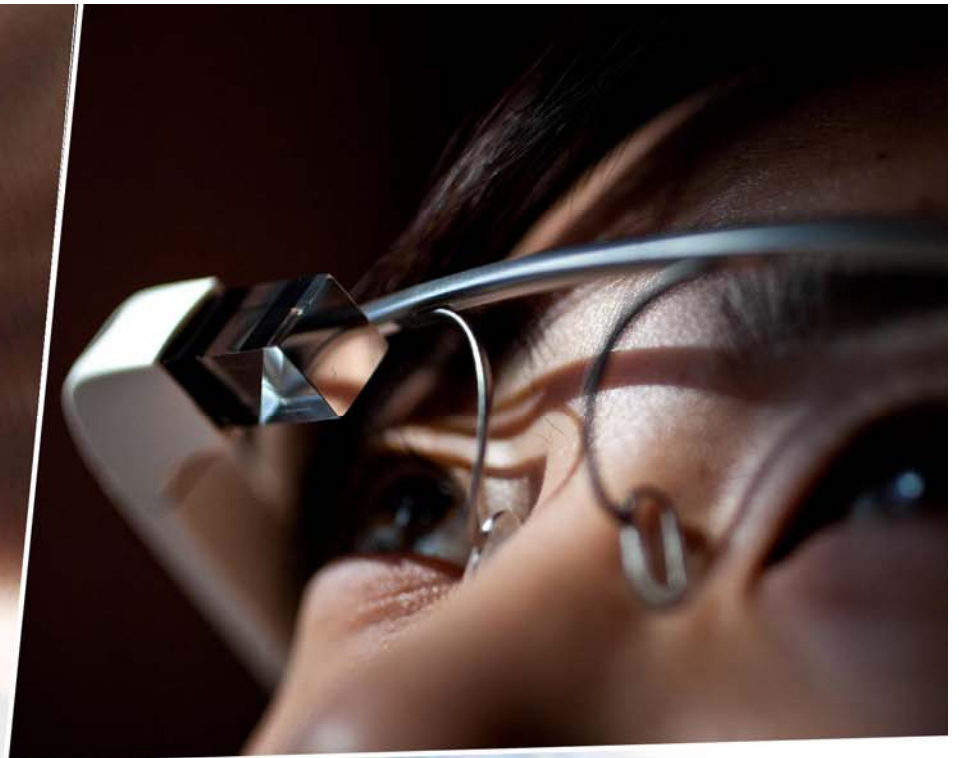
• Human-  
Computer  
Interaction  
Institute



Computer  
Human  
Interaction:  
Mobility  
Privacy  
Security

Jason Hong

Carnegie Mellon



# Smartphones are Pervasive



- Over 1B smartphones sold last year
- 75% penetration in the US as of late 2014, about 25% worldwide
- Over 100B apps downloaded on each of Android and iOS



# Fun Facts about Millennials

83% sleep with phones





# Fun Facts about Millennials

83% sleep with phones

90% check first thing in morning



# Fun Facts about Millennials

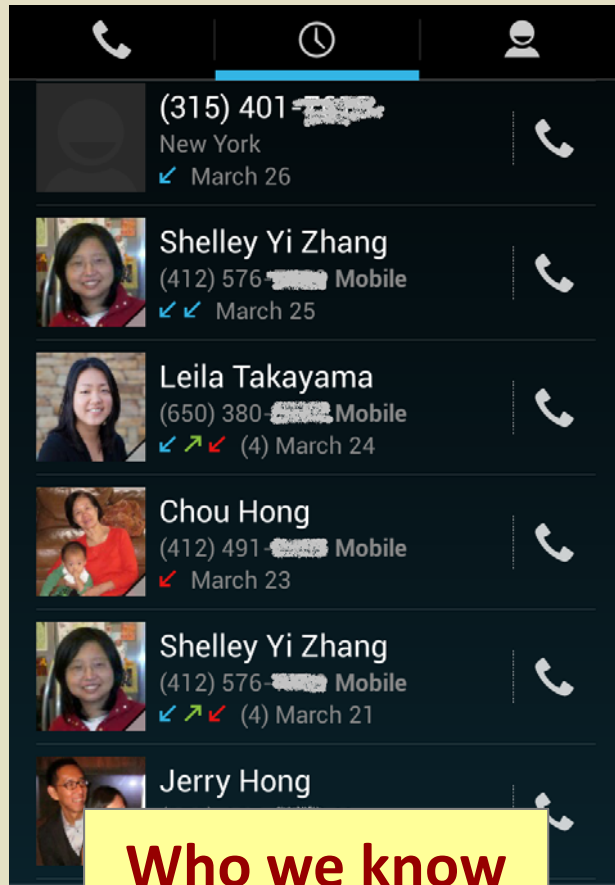
83% sleep with phones

90% check first thing in morning

1 in 3 use in bathroom



# Smartphone Data is Intimate



**Who we know**  
(contacts + call log)



**Where we go**  
(gps, photos)



**Sensors**  
(accel, sound, light)





# The Opportunity



[http://www.flickr.com/photos/robby\\_van\\_moor/478725670/](http://www.flickr.com/photos/robby_van_moor/478725670/)

- We are creating a worldwide sensor network with our smart devices
- We can now capture and analyze human behavior at unprecedented fidelity and scale



# Talk Overview

- What might this brave new world be like?
  - What kinds of amazing opportunities?
- What kinds of privacy challenges will we face?
  - What kinds of new approaches for privacy?
  - Today's notice and choice won't work



# Talk Overview

- Story 1: Livelihoods Urban Analytics
  - How can we use geotagged data to understand cities?
  - Privacy issues about inferences and uses of data
- Story 2: PrivacyGrade
  - How can we help people understand what their apps are really doing?
  - Why are developers collecting so much data?
- Reflections on improving the privacy ecosystem



# Story 1: The Challenge of Getting Data About Our Cities



- Today's methods for getting city data slow, costly, limited
  - Ex. Travel Behavioral Inventory
  - US Census 2010 cost \$13b
  - Quality of life surveys
- Some approaches today:
  - Call Data Records
  - Deploy a custom app



# The Vision: Urban Analytics

- How can we use smartphones + social media + machine learning to offer new and useful insights about the dynamics of cities?





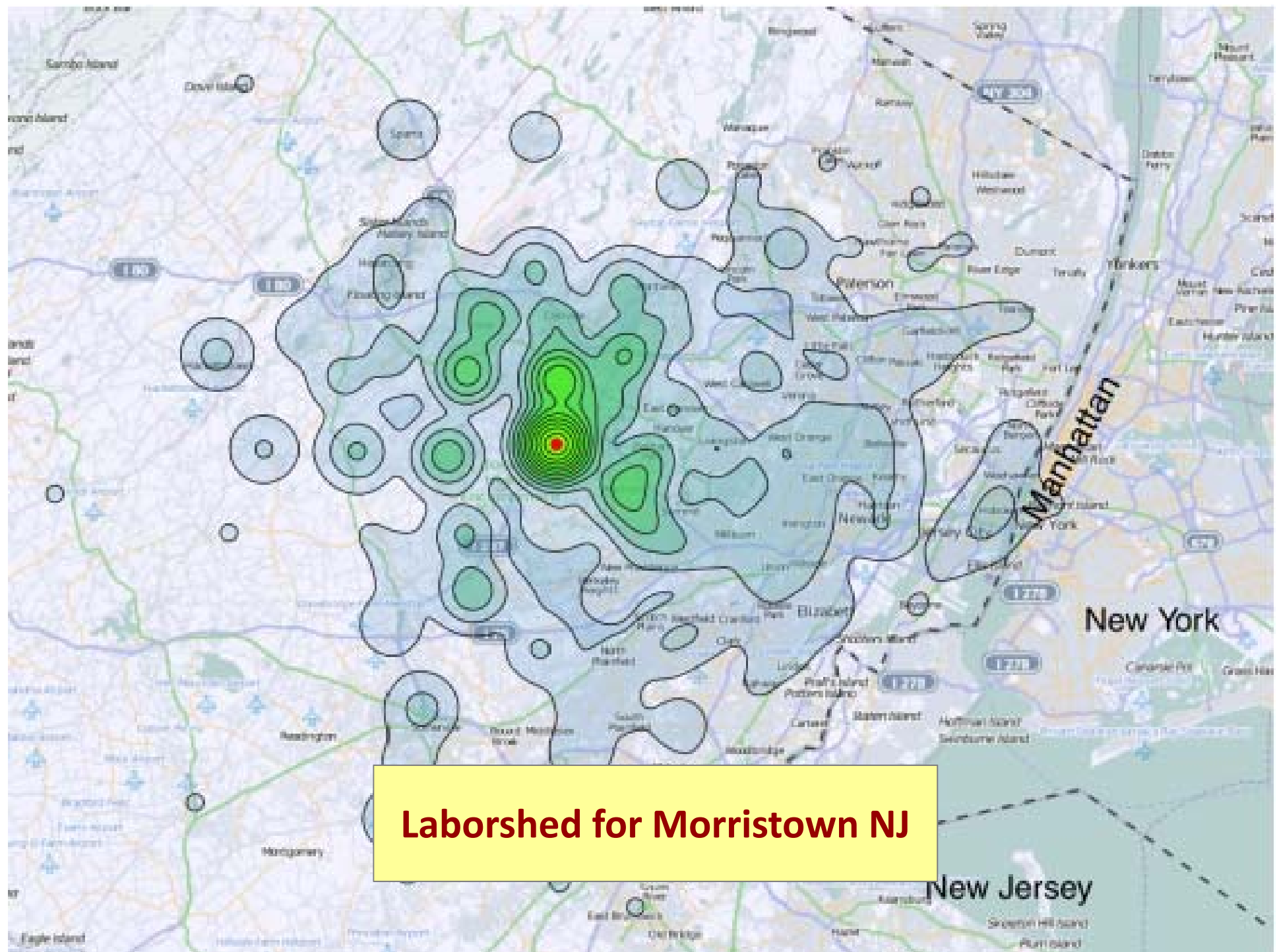
# Understanding Urban Areas

- AT&T Work on Human Mobility

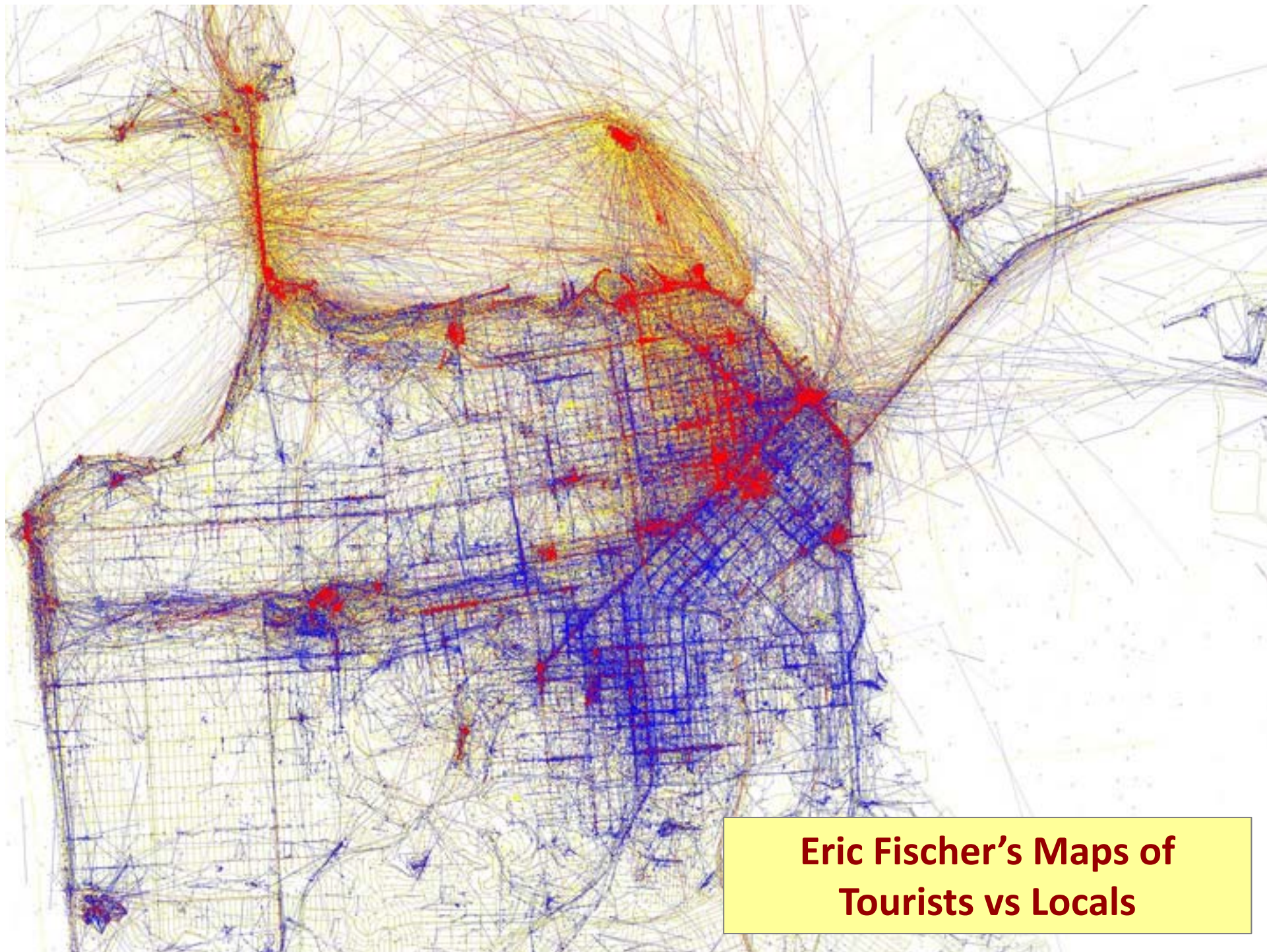


**Median distance  
traveled per day**









**Eric Fischer's Maps of  
Tourists vs Locals**



# Livehoods

## Our First Urban Analytics Tool

- The character of an urban area is defined not just by the types of places found there, but also by the people that make it part of their daily life

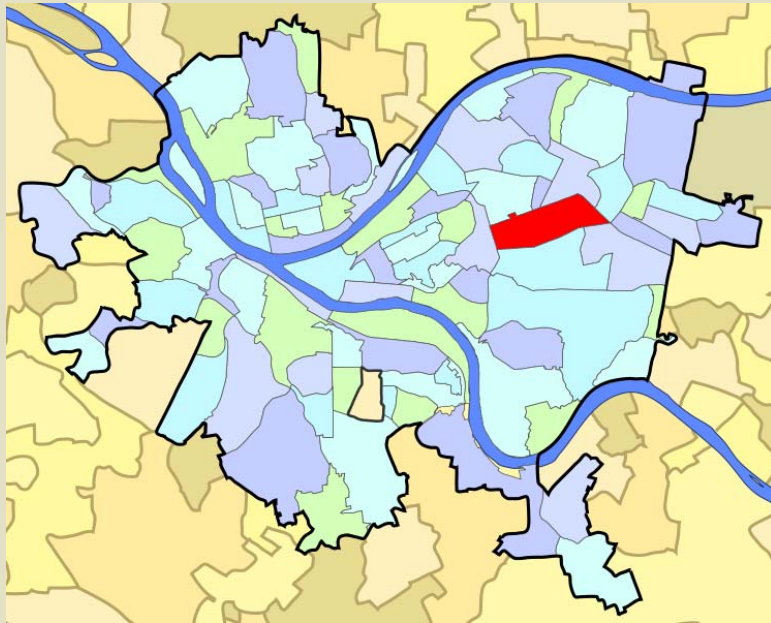


Cranshaw et al, The Livehoods Project: Utilizing Social Media to Understand the Dynamics of a City, ICWSM 2012.



# Two Perspectives on Cities

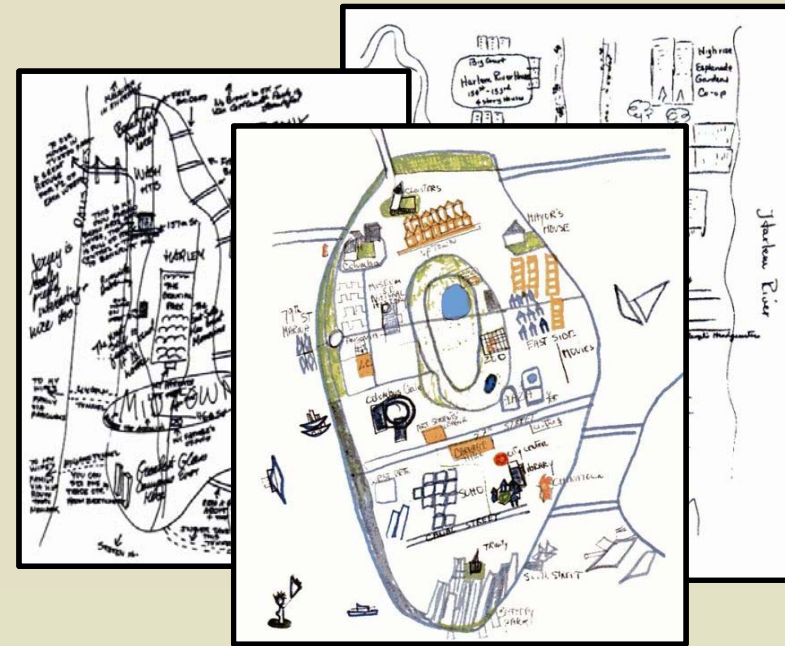
# “Politically constructed”



Neighborhoods have fixed borders defined by the city government



# “Socially constructed”



Neighborhoods are organic,  
cultural artifacts. Borders are  
blurry, imprecise, and may be  
different to different people

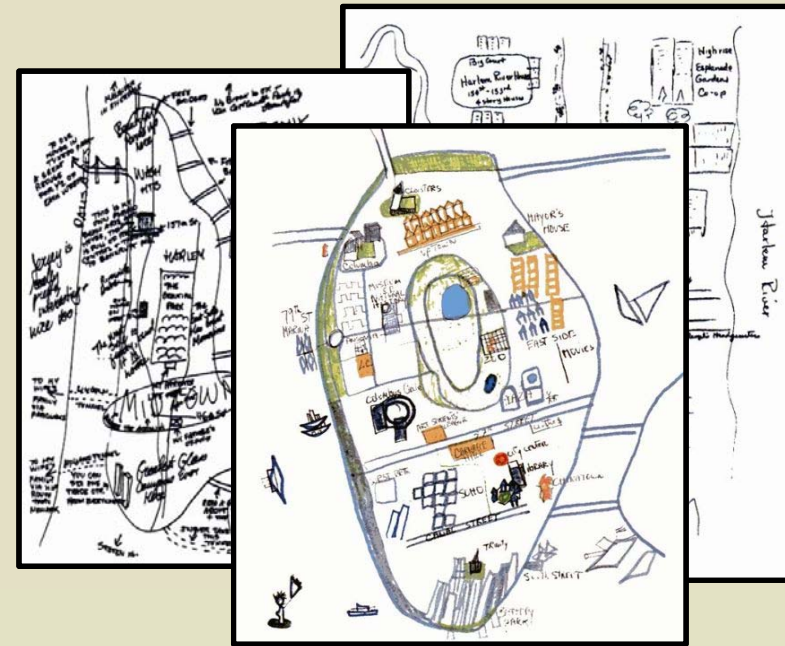
# Two Perspectives on Cities

Can we discover automated ways of identifying the “organic” boundaries of the city?

Can we extract local cultural knowledge from social media?

Can we build a collective cognitive map from data?

“Socially constructed”

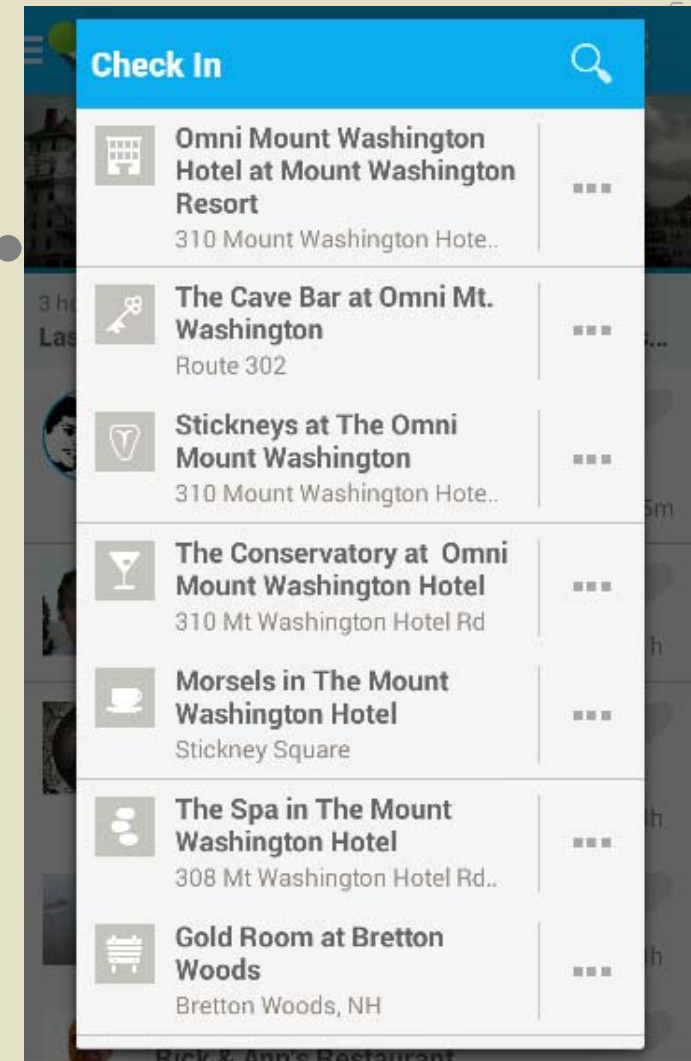


Neighborhoods are organic, cultural artifacts. Borders are blurry, imprecise, and may be different to different people



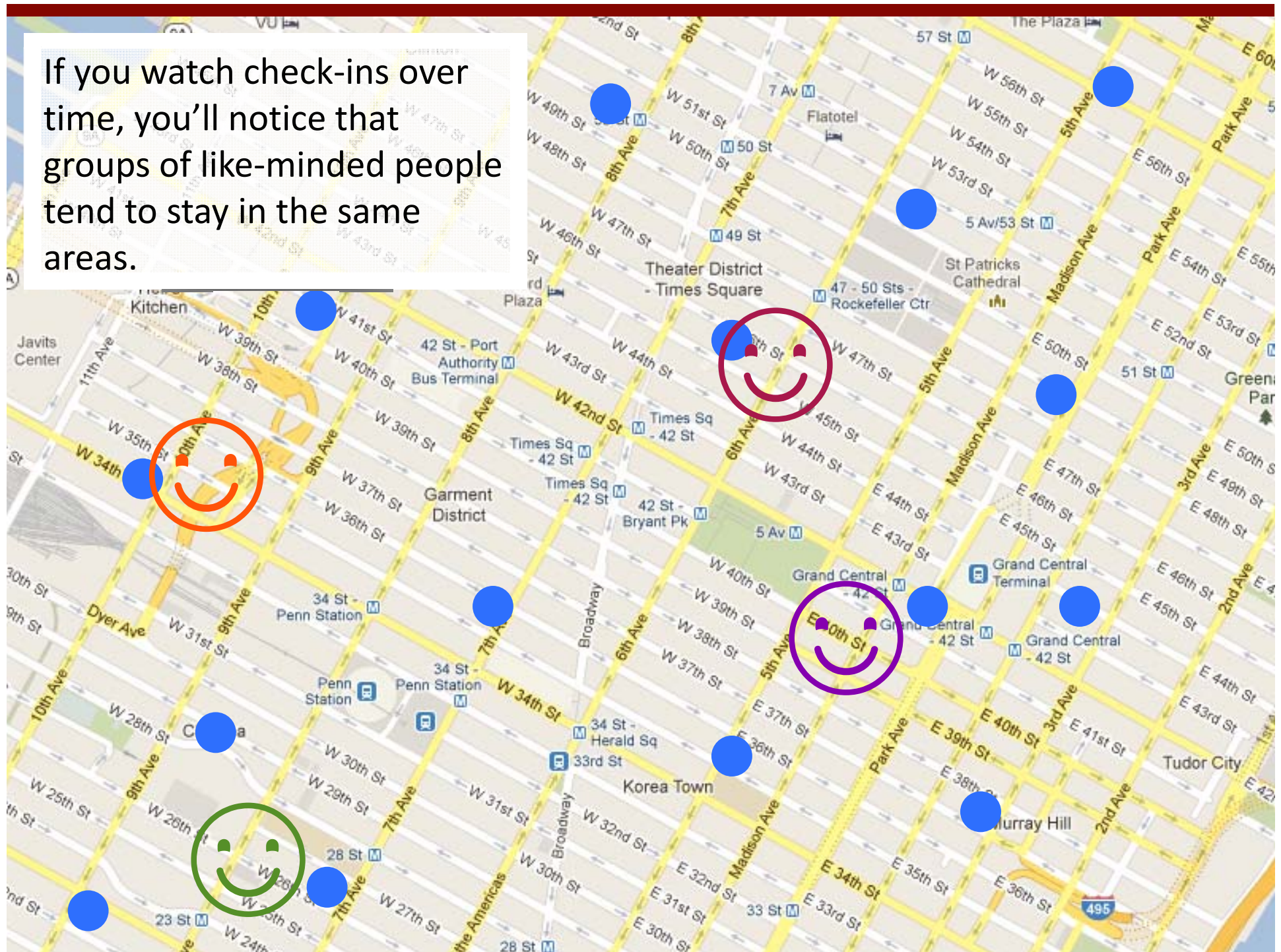
# Livehoods Data Source

- Crawled 18m check-ins from foursquare
  - Claims 20m users
  - People who linked their foursquare accts to Twitter
- Spectral clustering based on geographic and social proximity



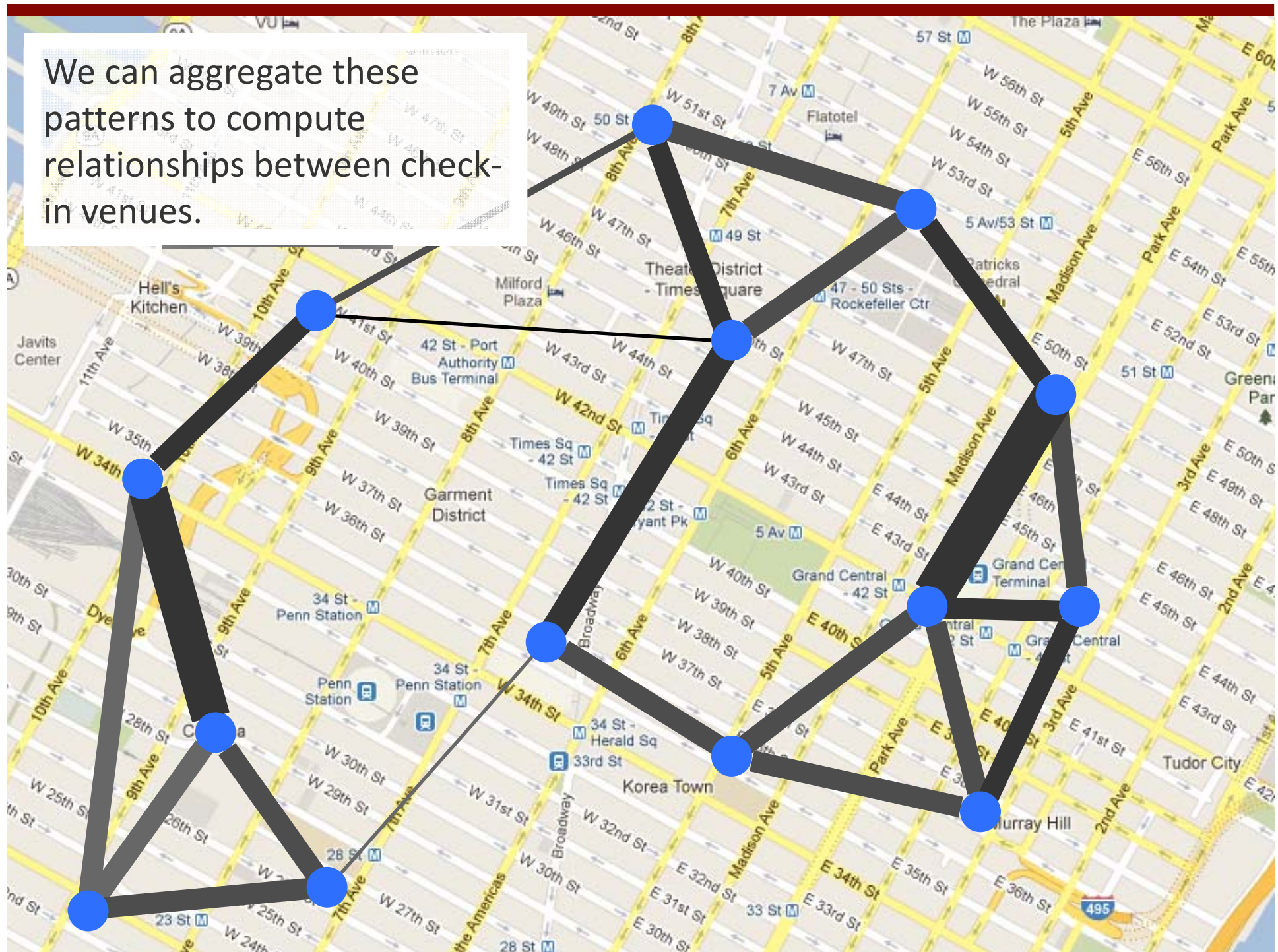


If you watch check-ins over time, you'll notice that groups of like-minded people tend to stay in the same areas.





We can aggregate these patterns to compute relationships between check-in venues.

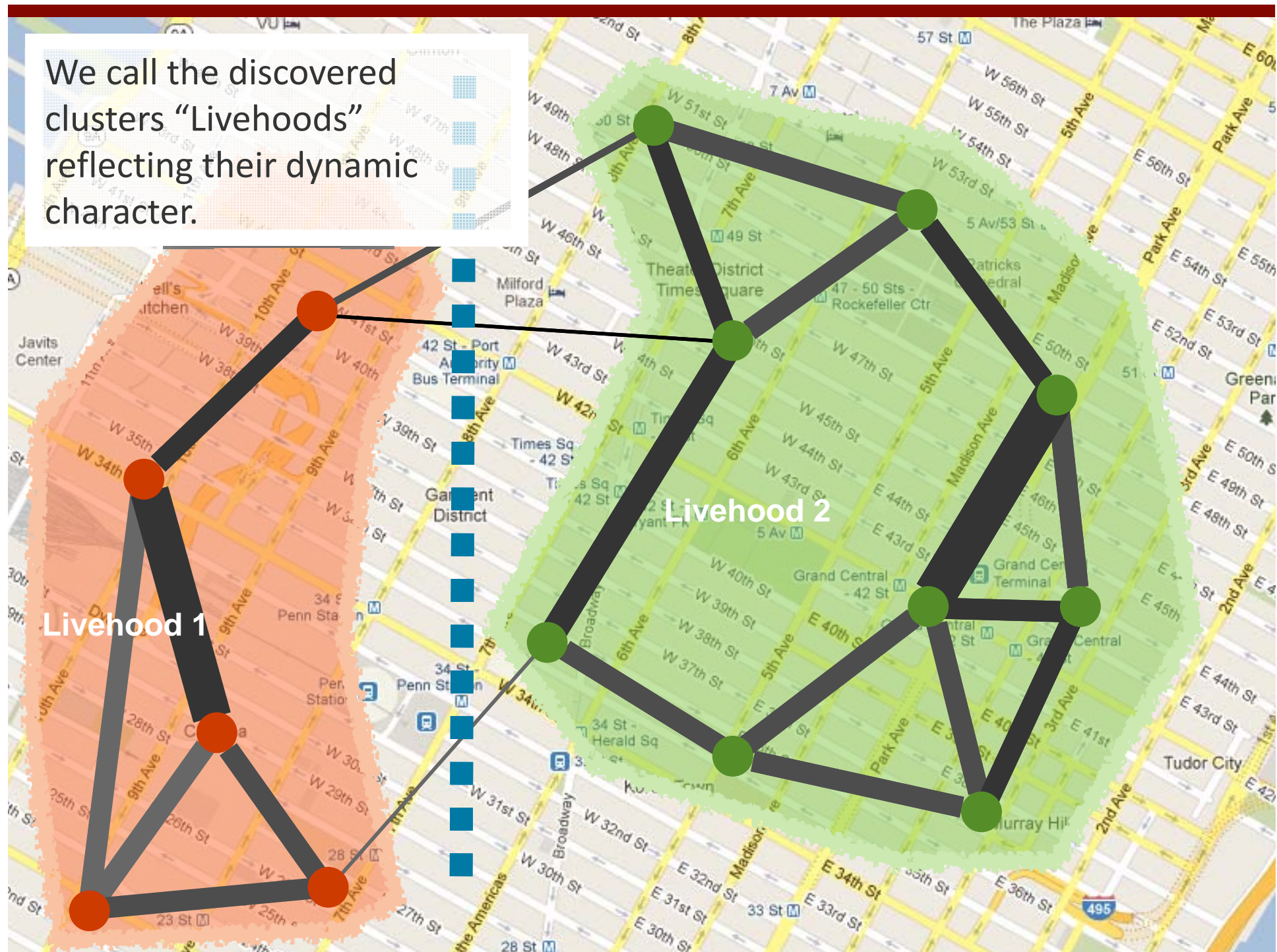




These relationships can then be used to identify natural borders in the urban landscape.



We call the discovered clusters “Livehoods” reflecting their dynamic character.





## Welcome to Livehoods!

Each dot on the map (●) represents a check-in location. Groups of nearby dots of the same color form a Livehood.

The shapes of Livehoods are determined by the patterns of people that check-in to them. If many of the same people check-in to two nearby locations, then these locations will likely be part of the same Livehood.

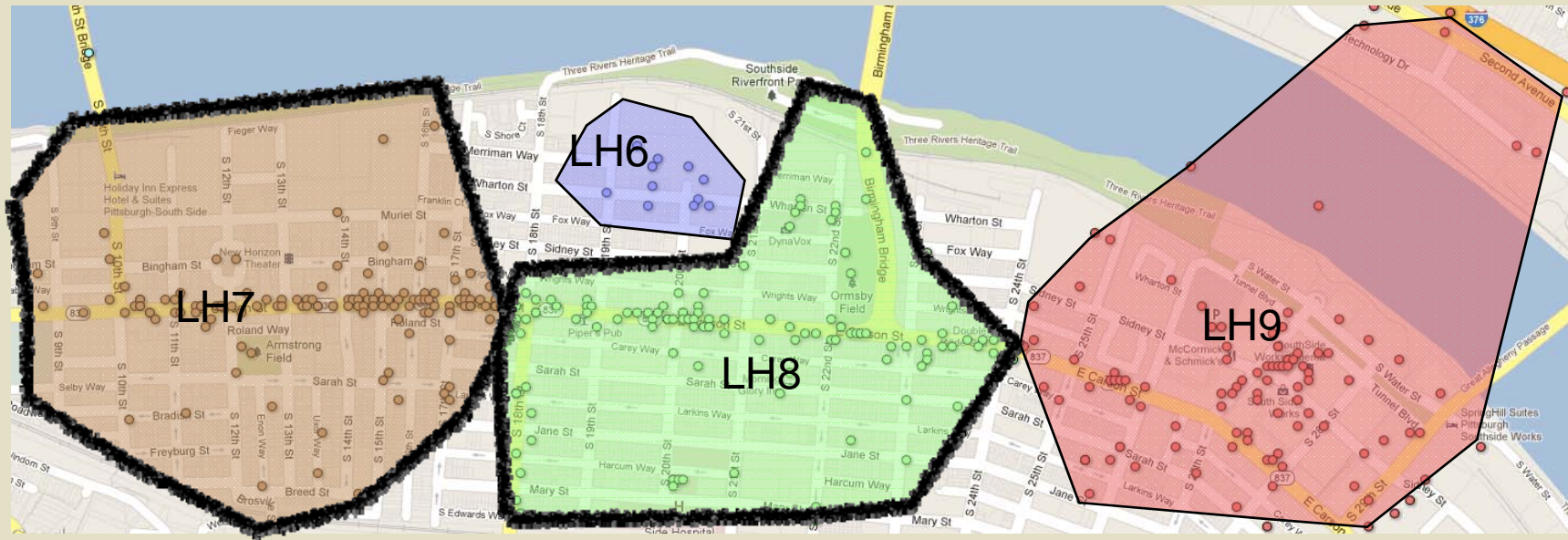
Livehoods reveal how the people and places of a city come together to form the dynamic character of local urban areas.

Click on a location to learn about its Livehood.

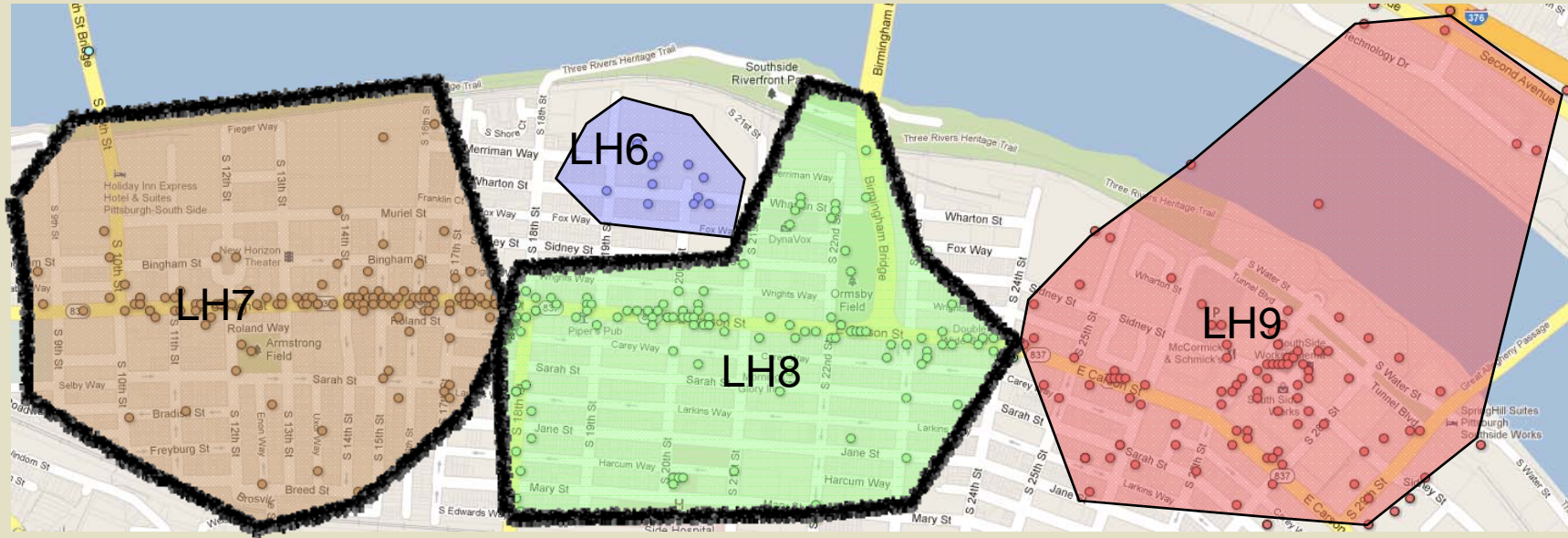
Try it out at [livehoods.org](http://livehoods.org)



# South Side Pittsburgh



# South Side Pittsburgh



LH7 vs LH8

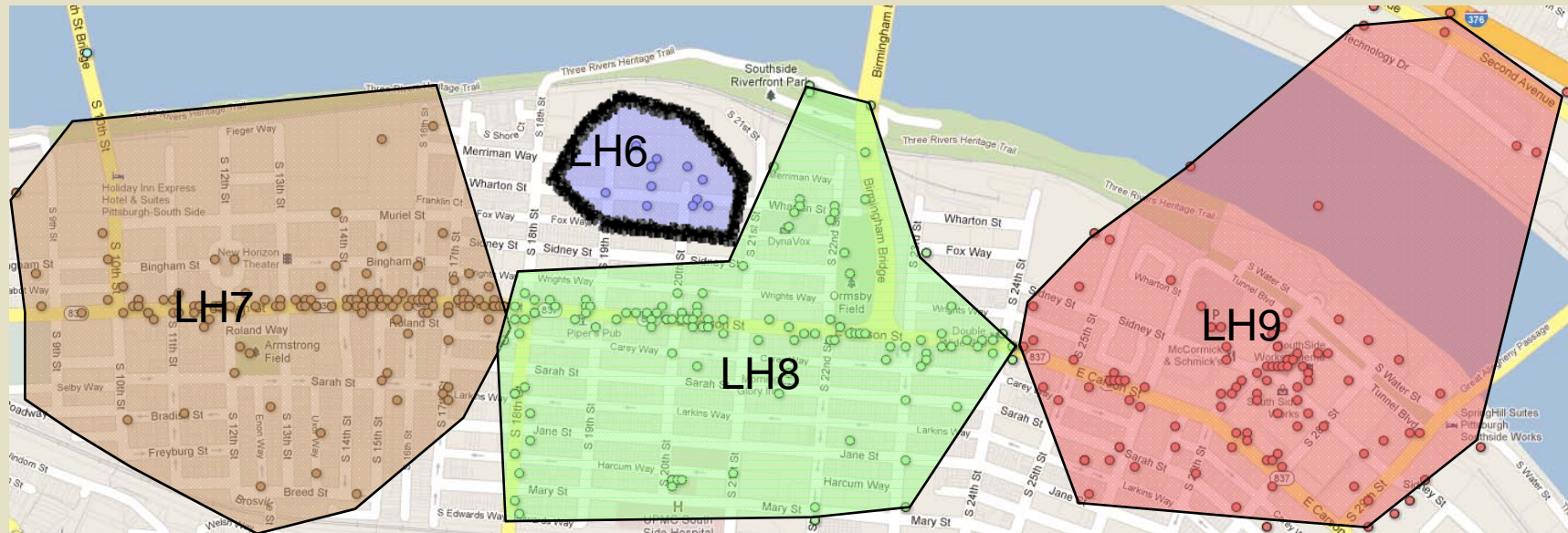
Safety

“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.”





# South Side Pittsburgh



LH6

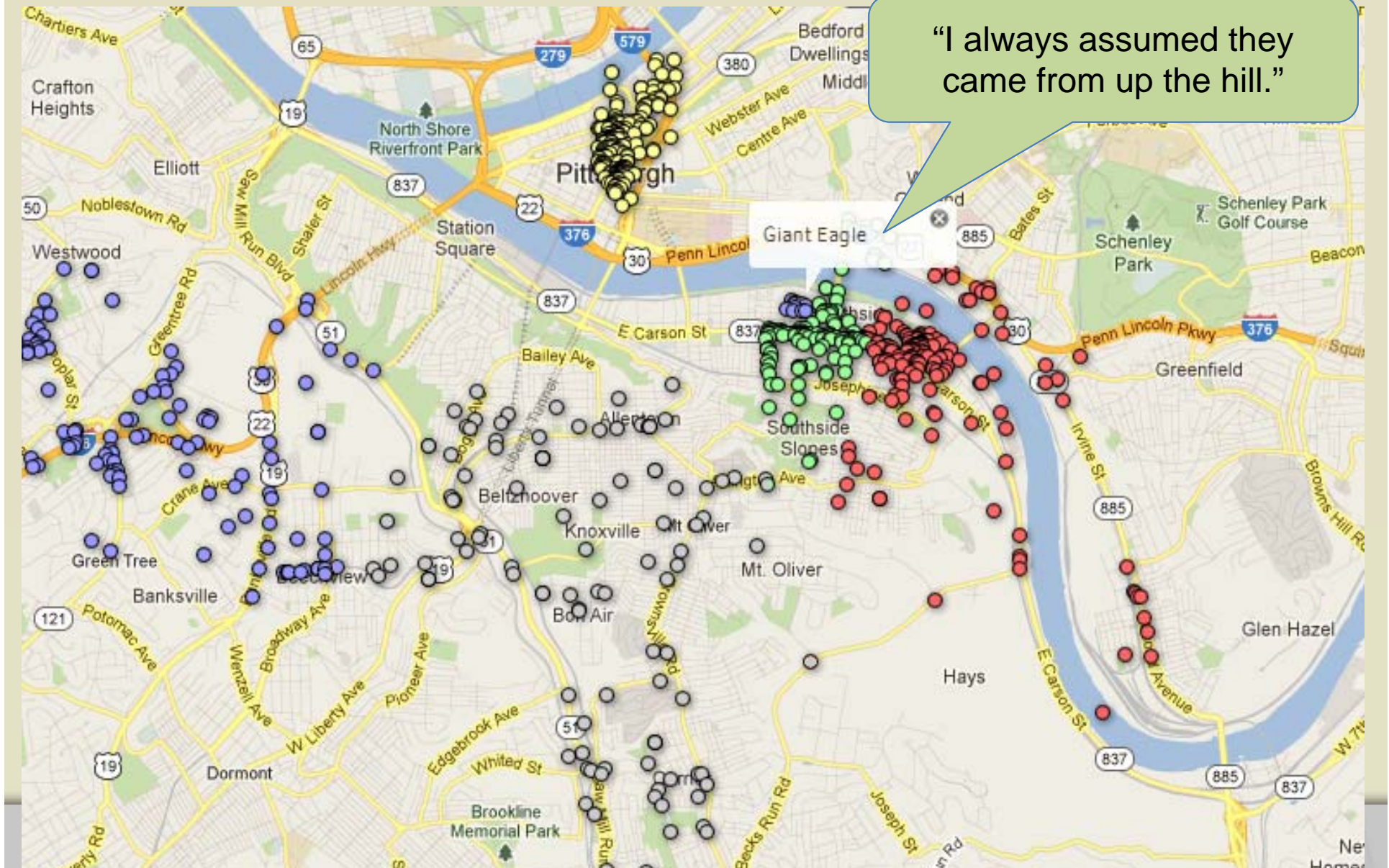
## Demographic Differences

“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 [grocery store] from lower income neighborhoods... **I always assumed they came from up the hill.**”

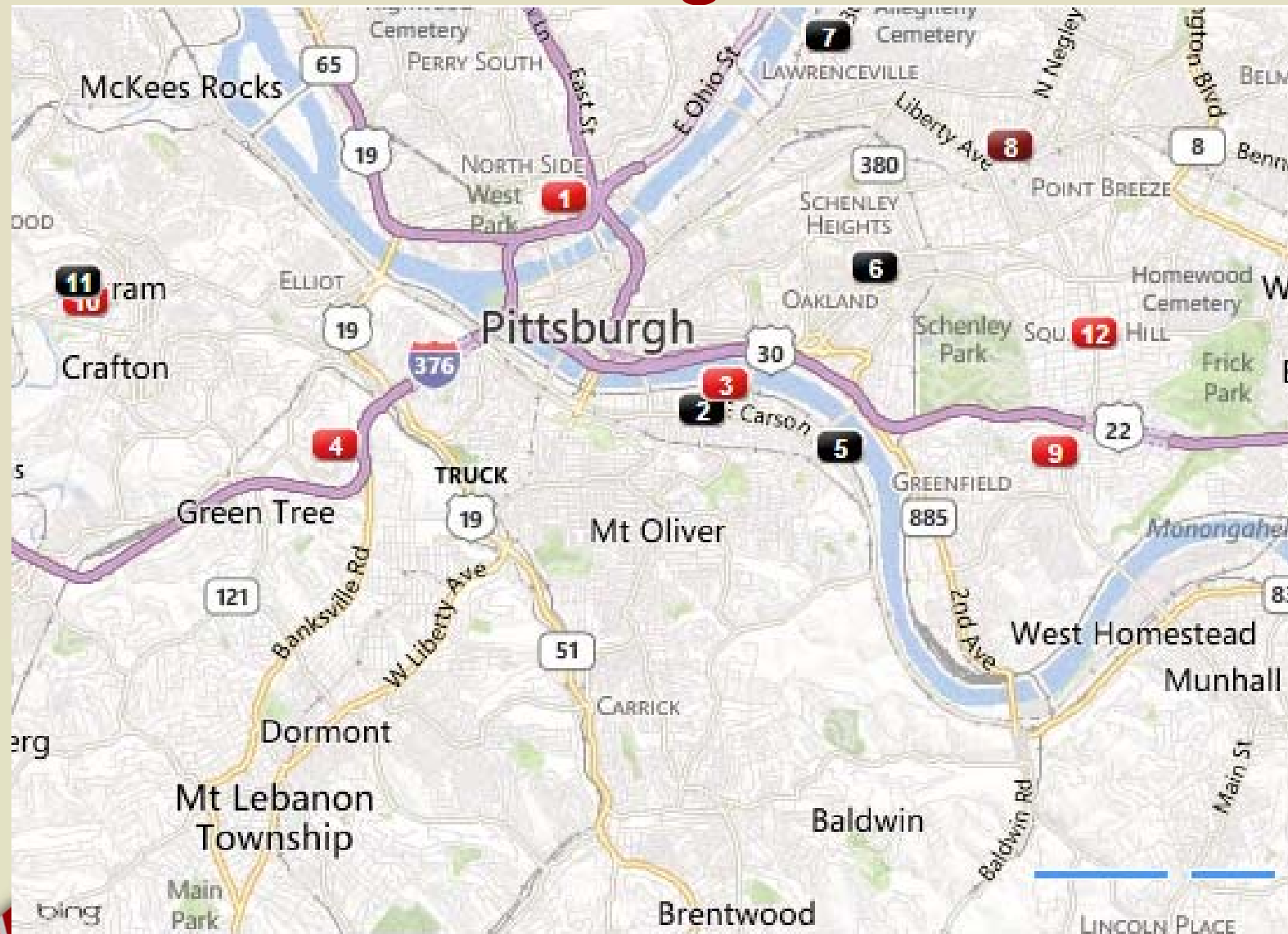




# South Side Pittsburgh

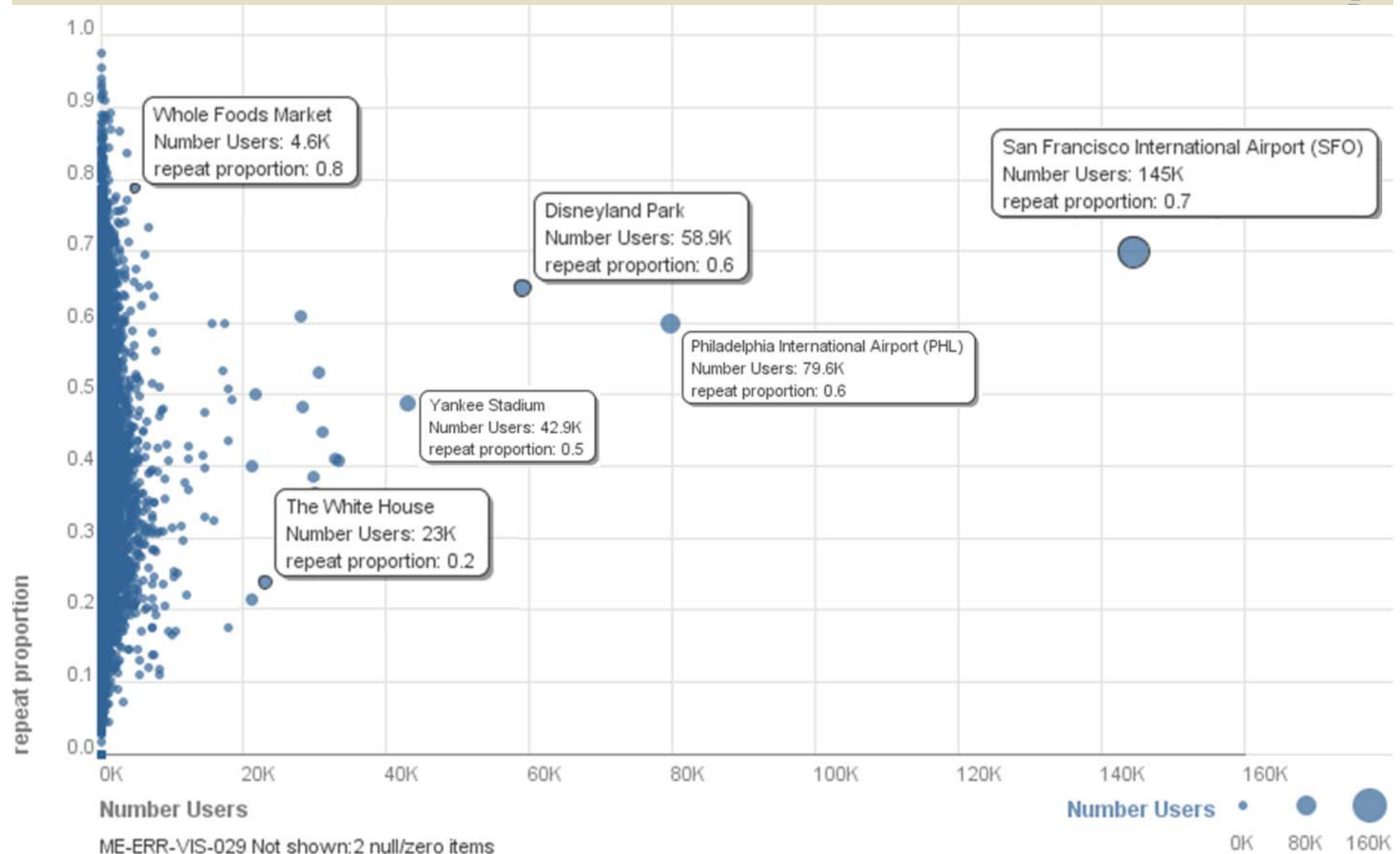


# South Side Pittsburgh

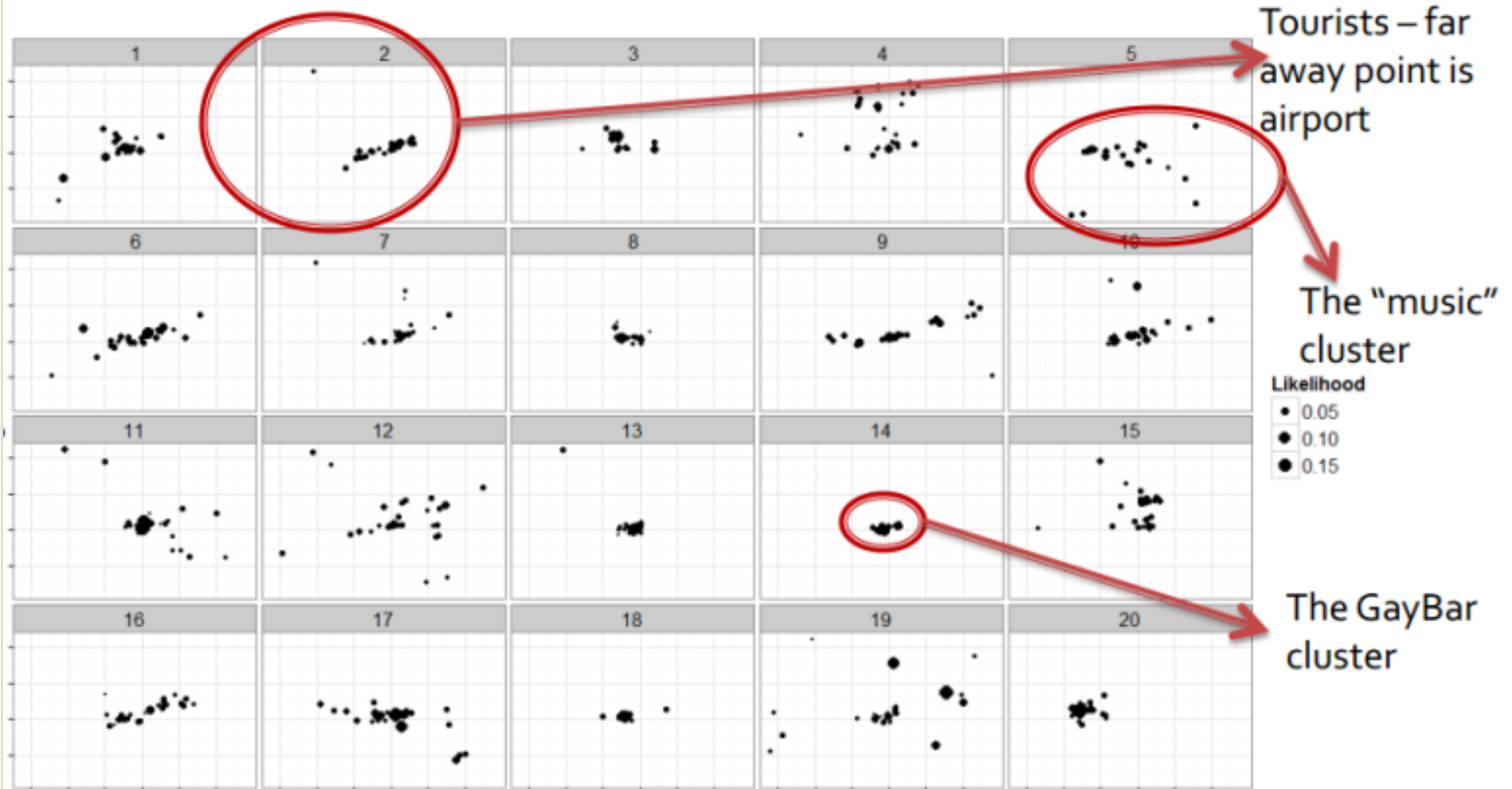




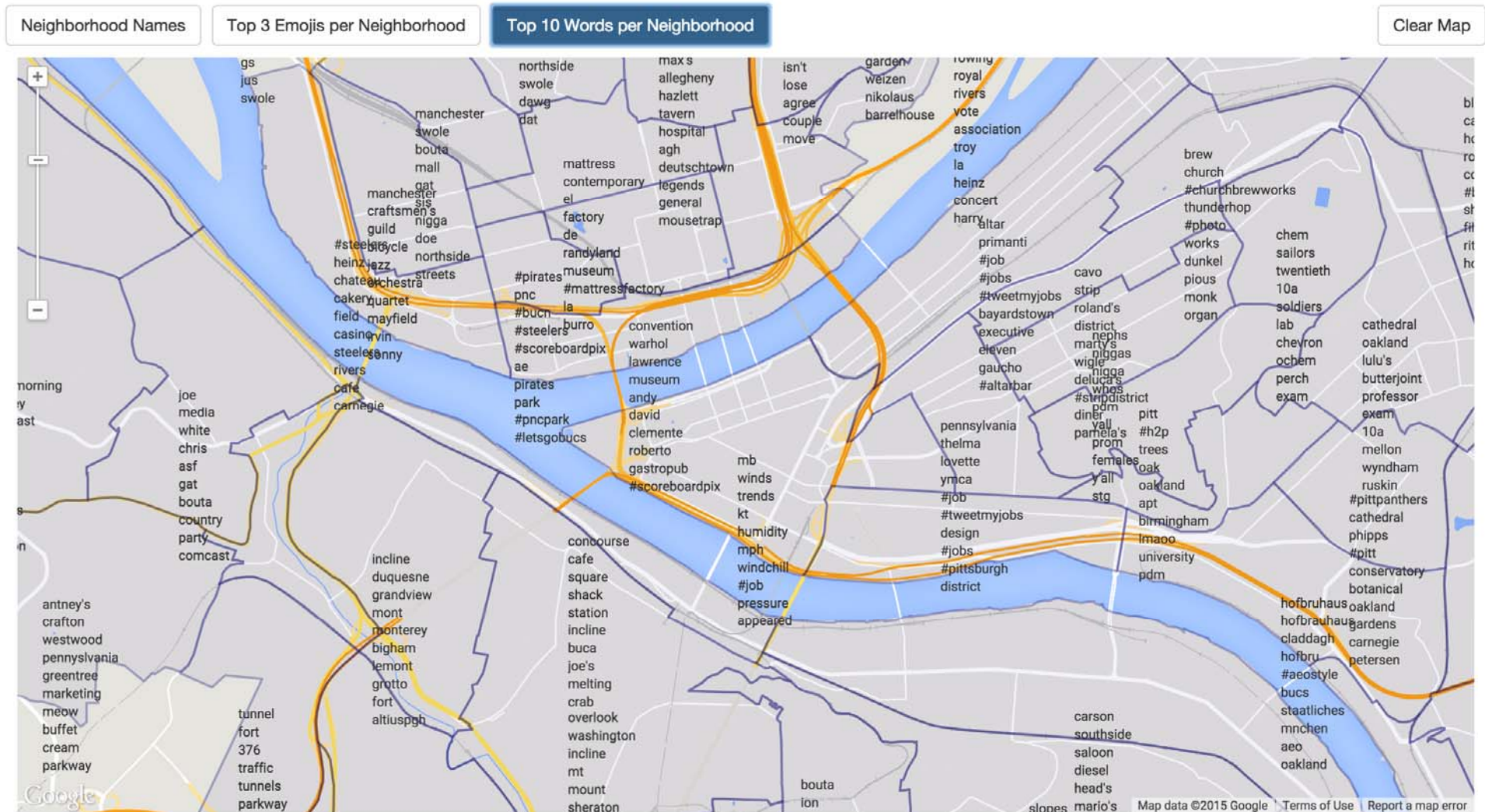
# Other Urban Analytics



# Topic Modeling (LDA)

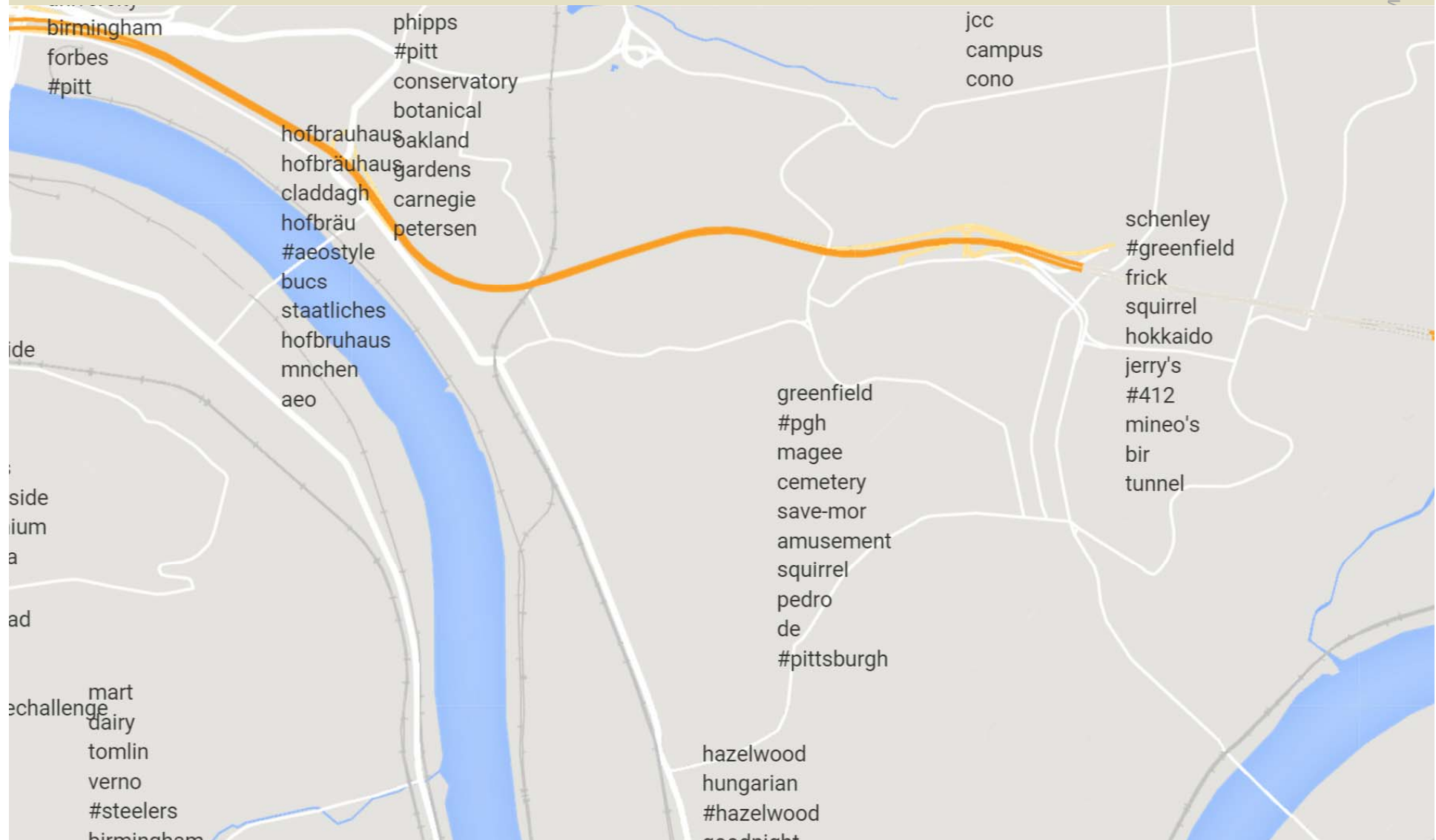


# Geotagged Tweets in Pittsburgh

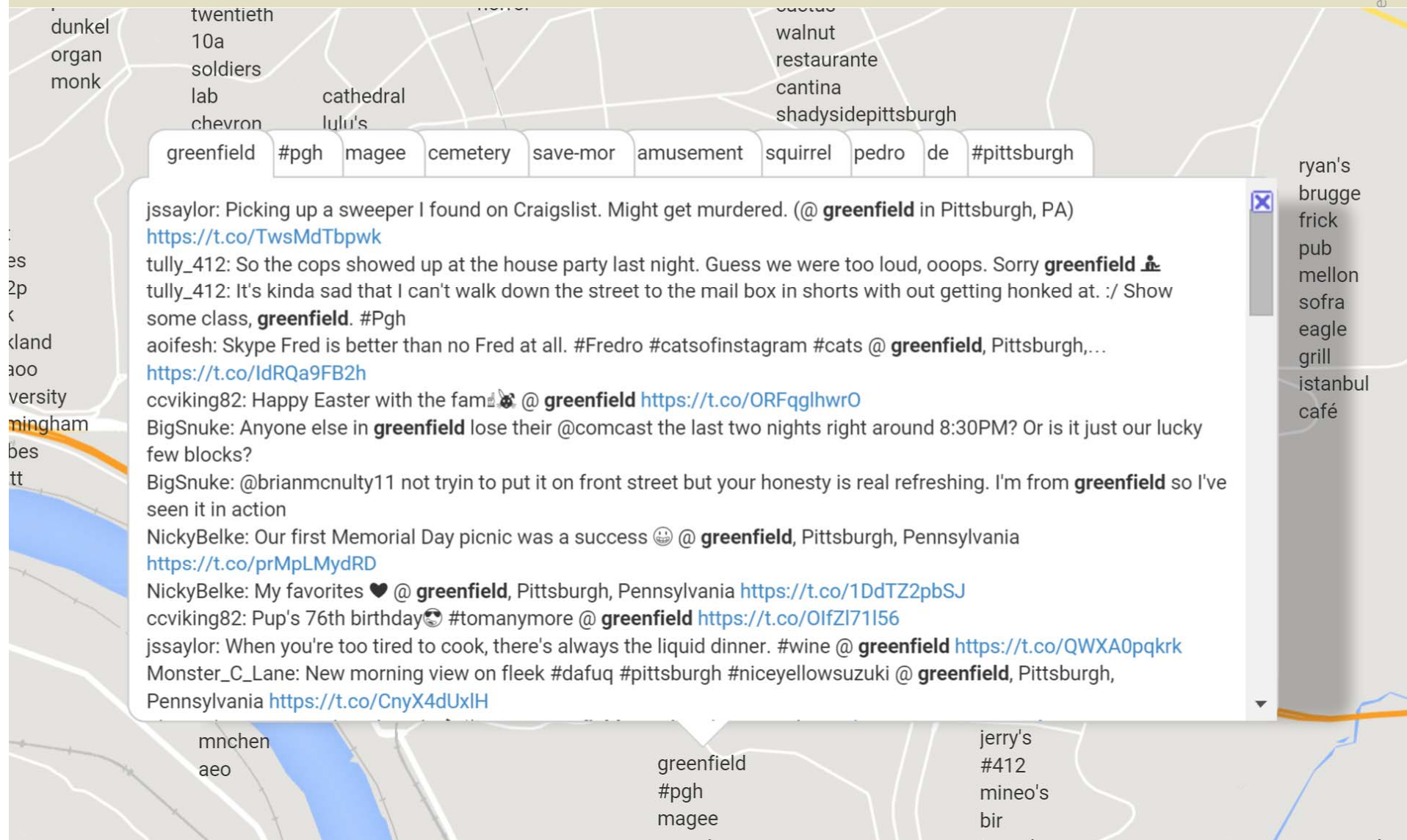




# Geotagged Tweets in Pittsburgh



# Geotagged Tweets in Pittsburgh



greenfield #pgh magee cemetery save-mor amusement squirrel pedro de #pittsburgh

jssaylor: Picking up a sweeper I found on Craigslist. Might get murdered. (@ **greenfield** in Pittsburgh, PA) <https://t.co/TwsMdTbpwk>

tully\_412: So the cops showed up at the house party last night. Guess we were too loud, ooops. Sorry **greenfield** 🙄

tully\_412: It's kinda sad that I can't walk down the street to the mail box in shorts with out getting honked at. ./ Show some class, **greenfield**. #Pgh

aoifesh: Skype Fred is better than no Fred at all. #Fredro #catsofinstagram #cats @ **greenfield**, Pittsburgh,... <https://t.co/ldRQa9FB2h>

ccviking82: Happy Easter with the fam 🐰 @ **greenfield** <https://t.co/ORFqglhwr0>

BigSnuke: Anyone else in **greenfield** lose their @comcast the last two nights right around 8:30PM? Or is it just our lucky few blocks?

BigSnuke: @brianmcnulty11 not tryin to put it on front street but your honesty is real refreshing. I'm from **greenfield** so I've seen it in action

NickyBelke: Our first Memorial Day picnic was a success 😊 @ **greenfield**, Pittsburgh, Pennsylvania <https://t.co/prMpLMydRD>

NickyBelke: My favorites ❤️ @ **greenfield**, Pittsburgh, Pennsylvania <https://t.co/1DdTZ2pbSJ>

ccviking82: Pup's 76th birthday 🐶 #tomanymore @ **greenfield** <https://t.co/OlfZI71I56>

jssaylor: When you're too tired to cook, there's always the liquid dinner. #wine @ **greenfield** <https://t.co/QWXA0pqkrk>

Monster\_C\_Lane: New morning view on fleek #dafuq #pittsburgh #niceyellowsuzuki @ **greenfield**, Pittsburgh, Pennsylvania <https://t.co/CnyX4dUxIH>

ryan's brugge  
frick  
pub  
mellon  
sofra  
eagle  
grill  
istanbul  
café

mnchen  
aao  
greenfield  
#pgh  
magee  
jerry's  
#412  
mineo's  
bir

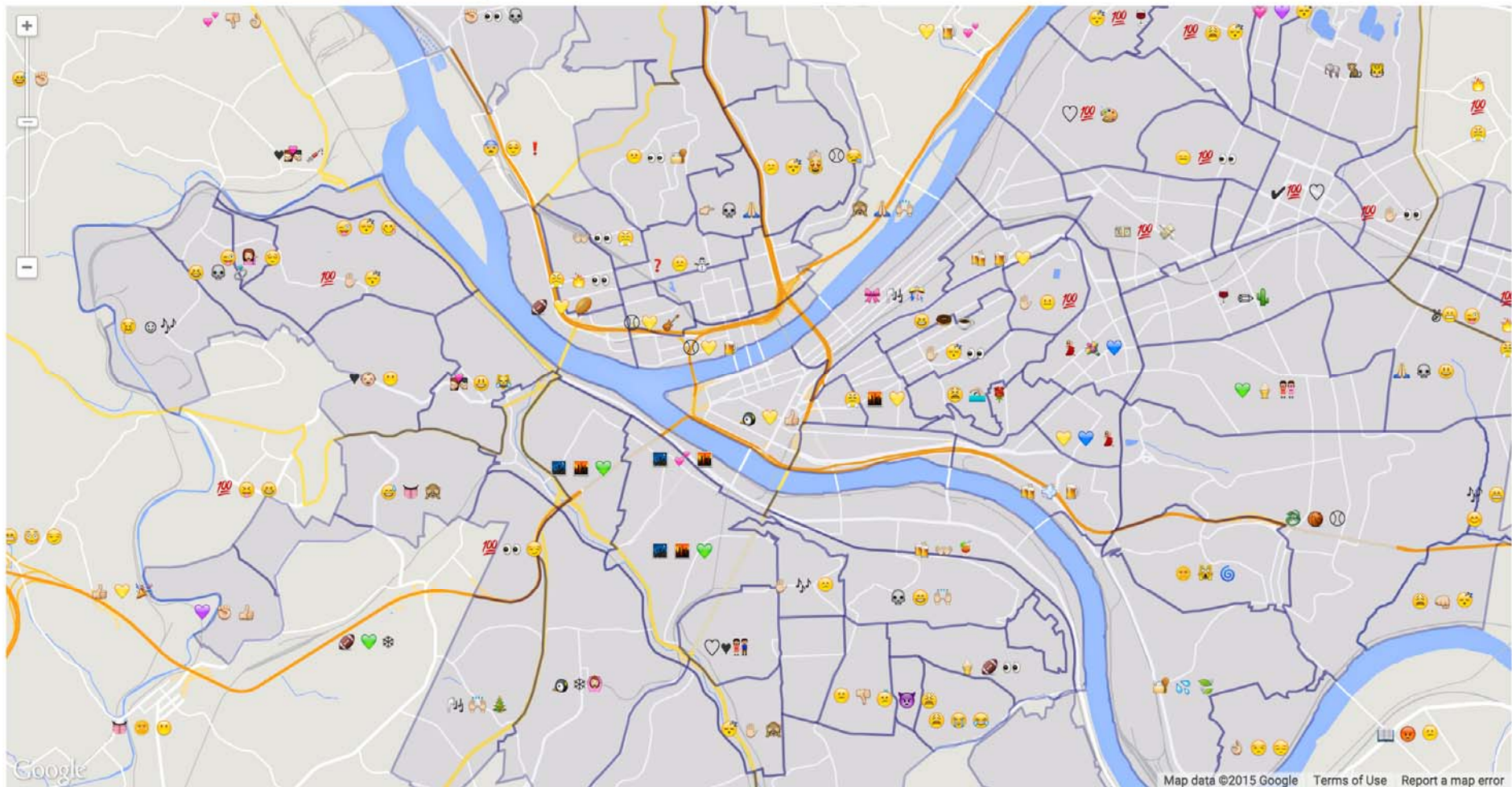
# EmojiMap of Pittsburgh

Neighborhood Names

Top 3 Emojis per Neighborhood

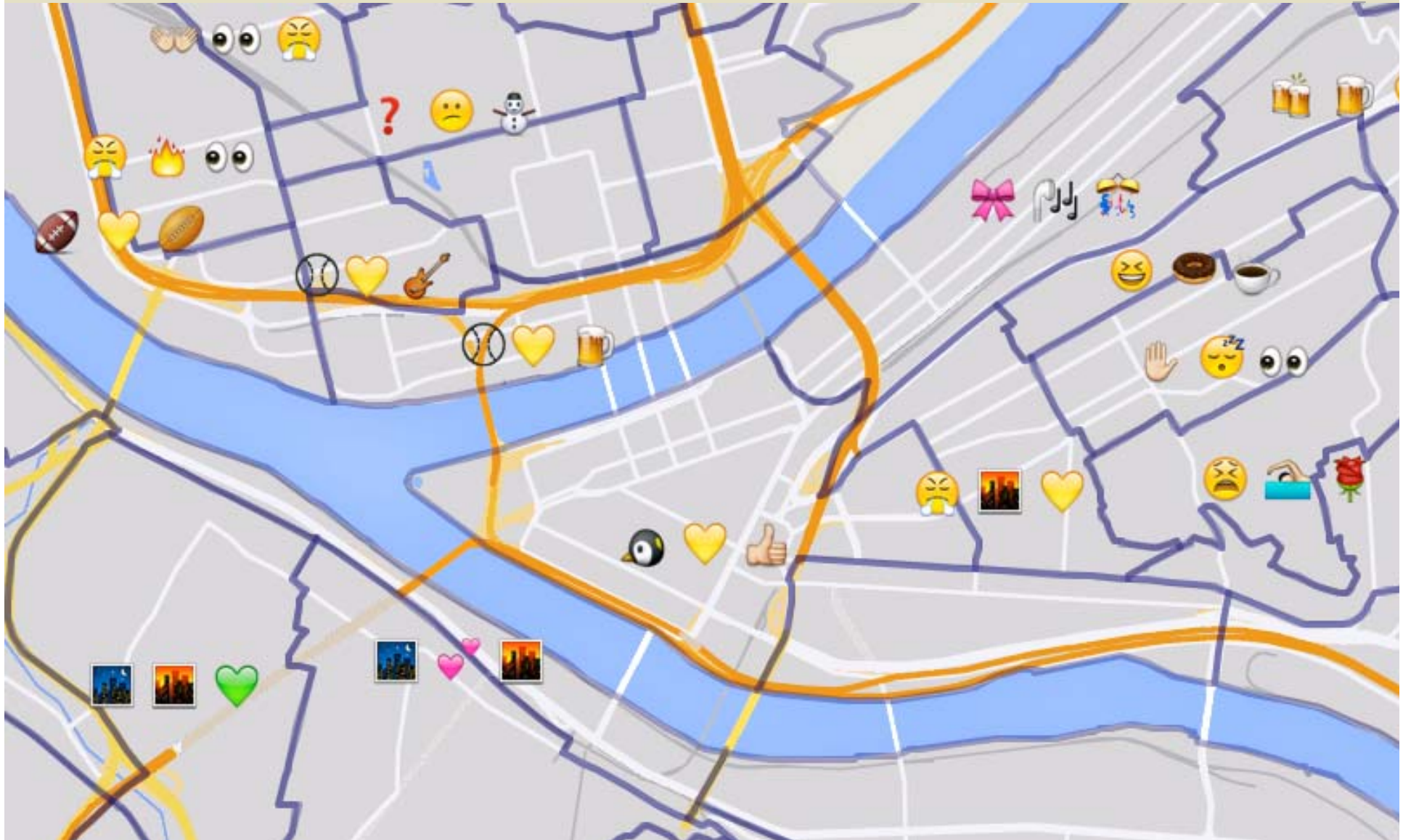
Top 10 Words per Neighborhood

Clear Map





# EmojiMap of Pittsburgh



# Reflections on Urban Analytics

## Few Privacy Issues on the Surface

- Publicly visible data with no expectations of privacy
  - No formal IRB issues
- Removed venues labeled as “home”
  - We only received one request to remove a venue (wasn't labeled as a home)
- We only show data about geographic areas vs individuals
- So far, so good for privacy, but...



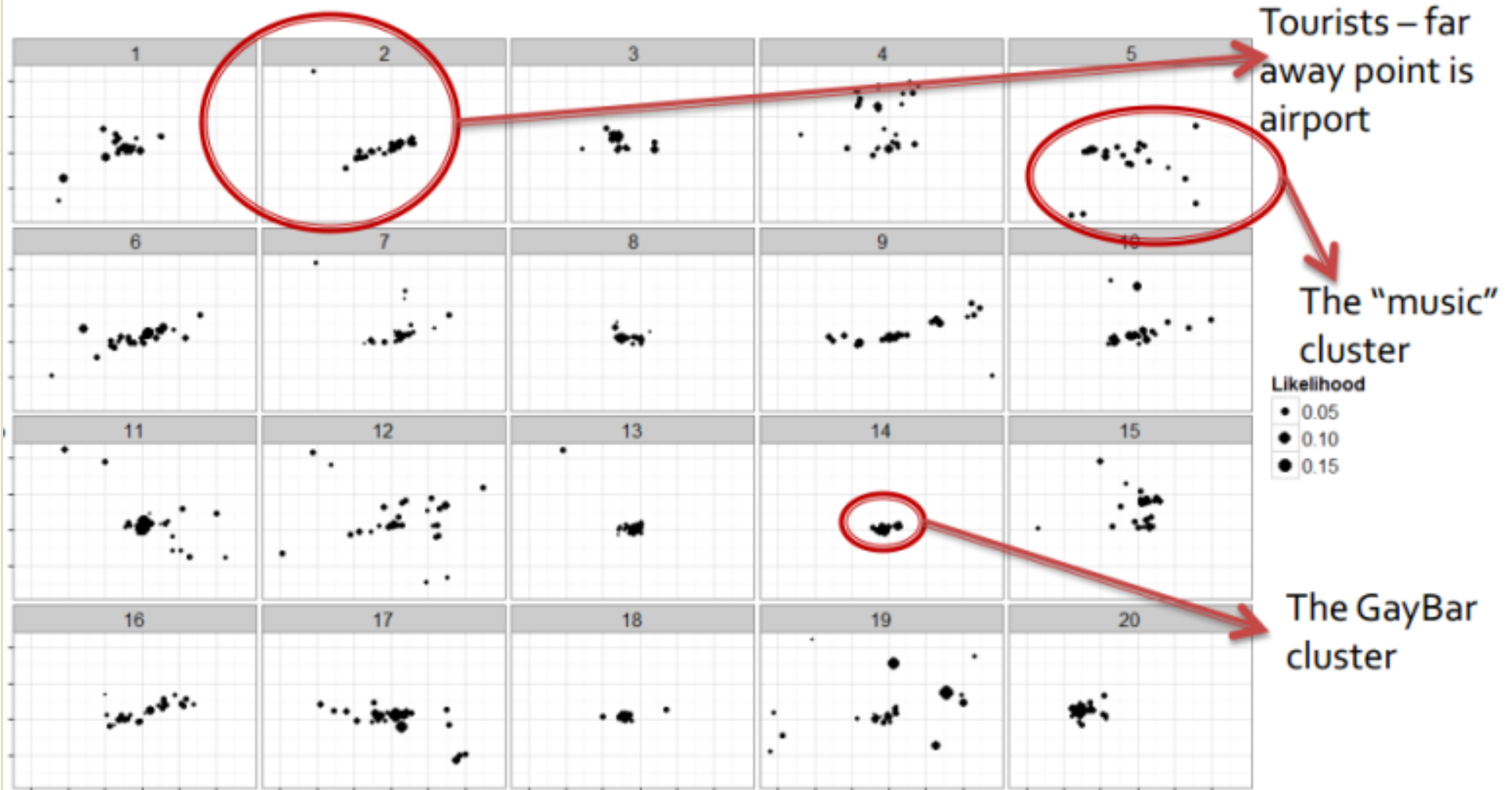


# Reflections on Urban Analytics But Lots of Deeper Questions

- Many discussions on how data like this *might* be used negatively in the future
  - Urban planners, Yahoo, Facebook, Google Maps, Startups, and more
- Lots of hard questions
  - Not so many great answers
  - Representative of many challenges we will face with lots of rich data



# How Much Can Be Inferred?





# How Much Can Be Inferred?

- Much more can probably be inferred using rich data like this
  - Demographics, socioeconomic, friends
  - Physical and mental health (depression)
  - How “risky” you are (bars, clinics, etc)
- Unclear how far inferencing can go
  - Very hard to detect (and thus to regulate)
  - Not much can stop advertisers, NSA, GCHQ, startups
  - Even if you disclose little, lots can be inferred based on what others similar to you (homophily)



# How Much Can Be Inferred?

The screenshot shows the header of the 'firstminded' website. The logo consists of two rows of stylized characters: 'f i ® s t' on a red background and 'm x ñ d @ ¥' on a black background. Below the logo is the text 'PEER-REVIEWED JOURNAL ON THE INTERNET' followed by a dashed line. The navigation menu includes links for 'ABOUT', 'LOGIN', 'REGISTER', 'SEARCH', 'CURRENT', 'ARCHIVES', 'ANNOUNCEMENTS', and 'SUBMISSIONS'. Below the menu, a breadcrumb trail reads '> Volume 14, Number 10 - 5 October 2009 > Jernigan'. At the bottom of the header, the logo is repeated above the text 'PEER-REVIEWED JOURNAL ON THE INTERNET'.

Built a logistic regression to predict sexuality based on what your friends on Facebook disclosed

Gaydar: Facebook friendships expose sexual orientation

by Carter Jernigan and  
Behram F.T. Mistree



## baby

**save 20%** when you  
spend \$75

[girls' clothing](#) | [boys' clothing](#) | [offer details](#)

**save 10%** when you  
buy 2 swim diapers  
or baby sunscreen.

[swim diaper deals](#) | [sunscreen deals](#) | [offer details](#)

**free B-safe** infant car seat,  
with B-ready  
stroller purchase.

[Britax deals](#)

### clothing & shoes

[baby & toddler boys' clothing](#)  
[baby & toddler clothing](#)  
[boys' shoes](#)  
[girls' shoes](#)

### baby gear

[activity gear](#)  
[bouncers & car seats](#)  
[infant carriers](#)  
[strollers](#)  
[swings](#)

### baby basics

[baby bath](#)  
[diapering](#)  
[feeding](#)

“[An analyst at Target] was able to identify about 25 products that... allowed him to assign each shopper a ‘pregnancy prediction’ score. [H]e could also estimate her due date to within a small window, so Target could send coupons timed to very specific stages of her pregnancy.” (NYTimes)

or Baby,  
ally.

eneration  
aby naturally.  
eneration



# How Much Can Be Inferred?

MORE  
RISK



Chrome-  
skull accessories  
-----

were in the top 1 percent of  
products signaling a risk  
of default among 85,000 types of  
purchases analyzed.

LESS  
RISK



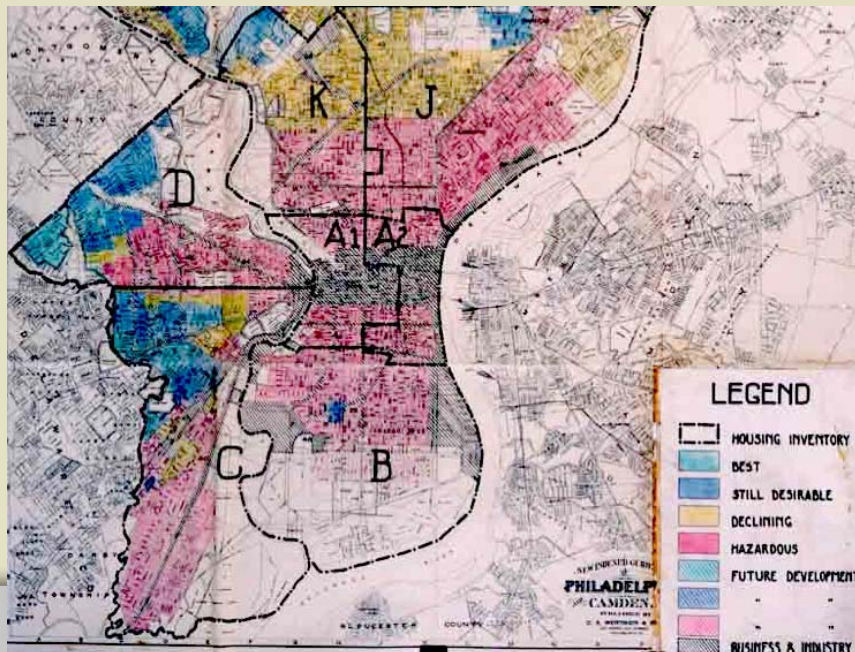
Premium  
wild birdseed  
-----

was in the bottom 1 percent of products  
signaling a risk of default among 85,000 types  
of purchases analyzed.



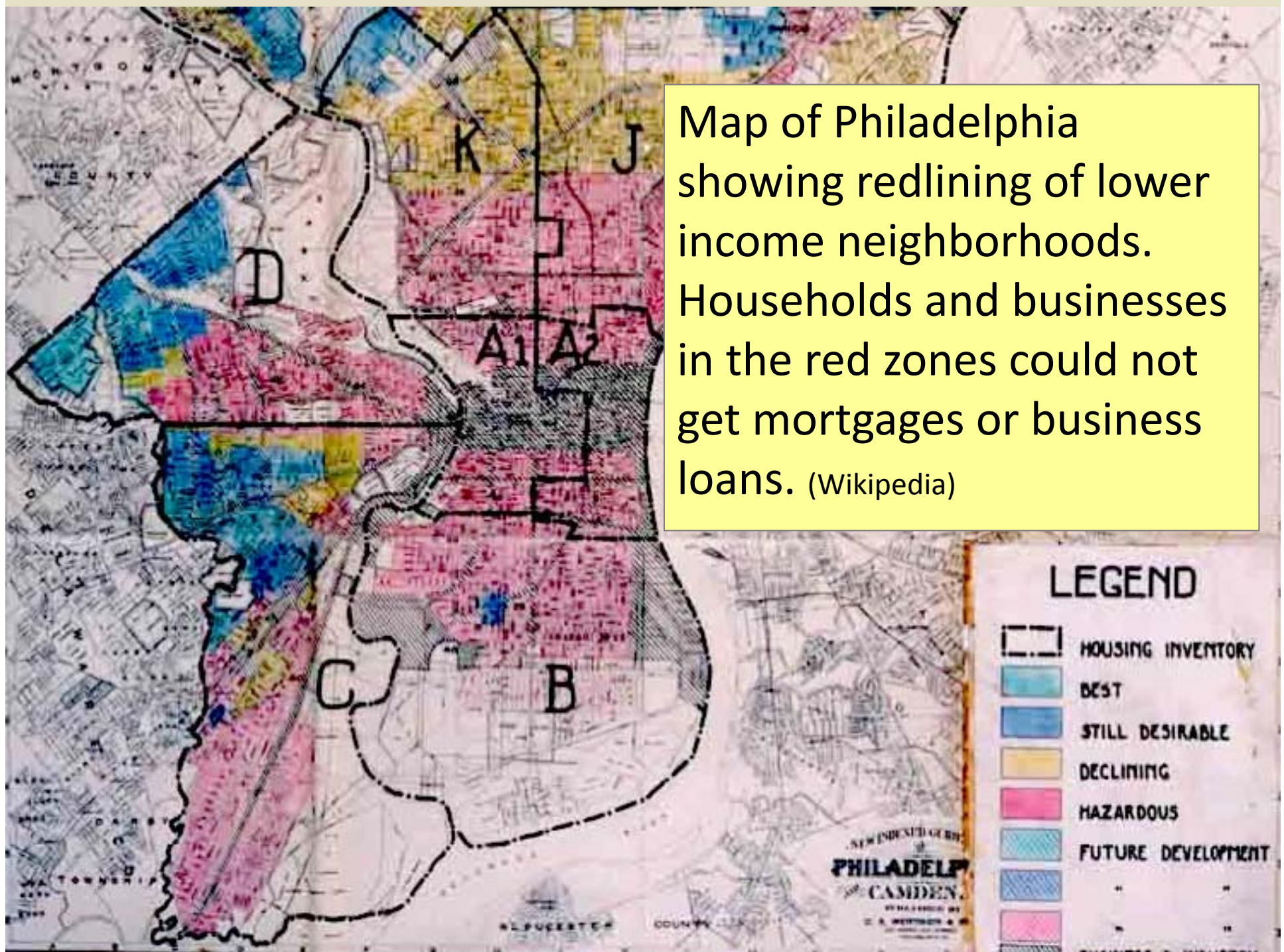
# A New Kind of Redlining?

- “denying, or charging more for, services such as banking, insurance, access to health care, ... supermarkets, or denying jobs ... against a particular group of people” (Wikipedia)





Map of Philadelphia showing redlining of lower income neighborhoods. Households and businesses in the red zones could not get mortgages or business loans. (Wikipedia)





# 'GMA' Gets Answers: Some Credit Card Companies Financially Profiling Customers

Jan. 28, 2009

By CHRIS CUOMO, JAY SHAYLOR, MARY McGUIRT and CHI



Like

75



share

44



Tweet

5



+1



Johnson says his jaw dropped when he read one of the reasons American Express gave for lowering his credit limit:

"Other customers who have used their card at establishments where you recently shopped have a poor repayment history with American Express."

# Recap So Far

- More rich data about people than ever before
- Can do lots of inferencing of people's behaviors
  - Hard to detect this inferencing
  - Homophily very powerful
- Already leading to problematic behaviors by companies
  - Others: Insurance, employee hiring, banking?
- Hold thoughts for now, will get to reflections and recommendations at the end



# Talk Overview

- Story 1: Livelihoods
- Story 2: PrivacyGrade
  - How can we help people understand what data their apps are collecting?
  - Why are developers collecting so much data?
- Reflections on improving the privacy ecosystem





# Story 2: PrivacyGrade

## or, What Are Your Apps Really Doing?



**Shares your location,  
gender, unique phone ID,  
phone# with advertisers**



**Uploads your entire  
contact list to their server  
(including phone #s)**



# Many Smartphone Apps Have “Unusual” Permissions



**Location Data**  
**Microphone**  
**Unique device ID**



**Location Data**  
**Network Access**  
**Unique device ID**



**Location Data**  
**Unique device ID**



# PrivacyGrade.org





- Improve transparency
- Assign privacy grades to all 1M+ Android apps

PrivacyGrade

Search for an app

Q

BROWSE APPS




## PrivacyGrade: Grading The Privacy Of Smartphone Apps

We're a team of researchers from Carnegie Mellon University. We have assigned privacy grades to Android apps based on some techniques we have developed to analyze to their privacy-related behaviors. [Learn more here](#) or [browse our analyzed apps](#).


Selected Apps

Most Popular Apps


Most Controversial




Lazors




Instagram



Temple Run 2



Angry Birds



Drag Racing





# Drag Racing



**Developer:**  
Creative Mobile

**Category:**  
Game Racing

Poor



Privacy Grade

## Related Apps



Drag Racing...



Drag Racing...

## App Description

The following description comes from the [Google Play Store](#) description of the app:

- Drive 50+ officially licensed cars, from hot hatches to american muscle and 1000HP supercars
- Buy your dream car, install performance upgrades and show your skills in 1/4 or 1/2 mile races
- Challenge millions of players online: race 1 on 1, drive your opponent's

[Read More](#)

## Privacy Analysis

**App was last analyzed by Privacy Grade on:**

08/19/2014

**Why does this app have this grade?**

Our method for grading apps uses a privacy model that we built. This model is based on crowdsourced surveys that we conducted to capture people's expectations and comfort levels with various app behaviors.

You can [see more information about how we grade apps in our](#)

### SENSITIVE PERMISSIONS USED BY THIS APP ?

PERMISSION	WHAT	WHY
Read phone status and identity	Can read phone current state information like signal, carrier, device	It appears this app uses this data to log system information when app is running for analytics or



Basketball ...

	Can use user's phone id or phone number	It appears this app uses this data to identify users for market/customer analysis
	Can use user's phone id or phone number	It appears this app uses this data to identify users to connect with independent/secondary mobile app stores
	Can use user's phone id or phone number	It appears this app uses this data to identify users for delivering targeted advertisement
Full network access	Can access the Internet	It appears this app uses this data for internal use within the app's functionality
	Can access the Internet	It appears this app uses this data for mobile analytics
	Can access the Internet	It appears this app uses this data for a secondary app market
	Can access the Internet	It appears this app uses this data for targeted advertising
	Can access the Internet	It appears this app uses this data for utility purposes
Precise location (gps and network-based)	Can use user's precise location	It appears this app uses this data for market/customer analysis
	Can use user's precise location	It appears this app uses this data for market/customer analysis

See the sensitive permissions table below the app description to see the permissions that made users of the app uncomfortable.


If you have issues about the information on this page, click the button below to send us feedback.

[Send Us Feedback](#)

Find accounts on the device	Can use user's accounts information stored on the phone	It appears this app uses this data to connect with independent/secondary mobile app stores
Retrieve running apps	Can retrieve information on currently and recently running apps on the device	It appears this app uses this data for a secondary app market
Approximate location (network-based)	Can use user's approximate location	Not analyzed yet
Modify or delete the contents of your usb storage	Can write to your phone's USB storage	Not analyzed yet

THIRD PARTY LIBRARIES USED BY THIS APP ?	
LIBRARY	USAGE
<a href="#">Flurry</a>	Mobile analytics libraries allow app developers to gather usage data about their app. It might gather data on how often an app user uses the app or in what ways is the app being used. Say for example usage data on a map app could be exemplified by a user using the map app twice a day in the morning and evening to find the quickest way to and from work with regards of the effects of traffic on certain roads.
<a href="#">Chartboost</a>	Targeted ad libraries allows developers to monetize their app by allowing their app to serve advertisements to app users.
<a href="#">Millennialmedia</a>	Targeted ad libraries allows developers to monetize their



THIRD PARTY LIBRARIES USED BY THIS APP 	
LIBRARY	USAGE
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<a href="#">Millennialmedia</a>	Targeted ad libraries allows developers to monetize their app by allowing their app to serve advertisements to app users.
<a href="#">Sponsorpay</a>	Targeted ad libraries allows developers to monetize their app by allowing their app to serve advertisements to app users.
<a href="#">Amazon</a>	Utility libraries provide app developers tools to add useful functionality to app that may be more for aiding the developer rather than the end user. They can be authentication frameworks, or logging frameworks.
<a href="#">Getjar</a>	Secondary market libraries allow users to connect to other app markets.

# Expectations vs Reality



# Privacy as Expectations

Use crowdsourcing to compare what people expect an app to do vs what an app actually does

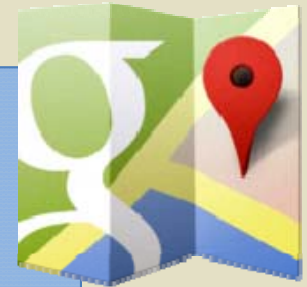


## App Behavior

(What an app actually does)

## User Expectations

(What people think the app does)



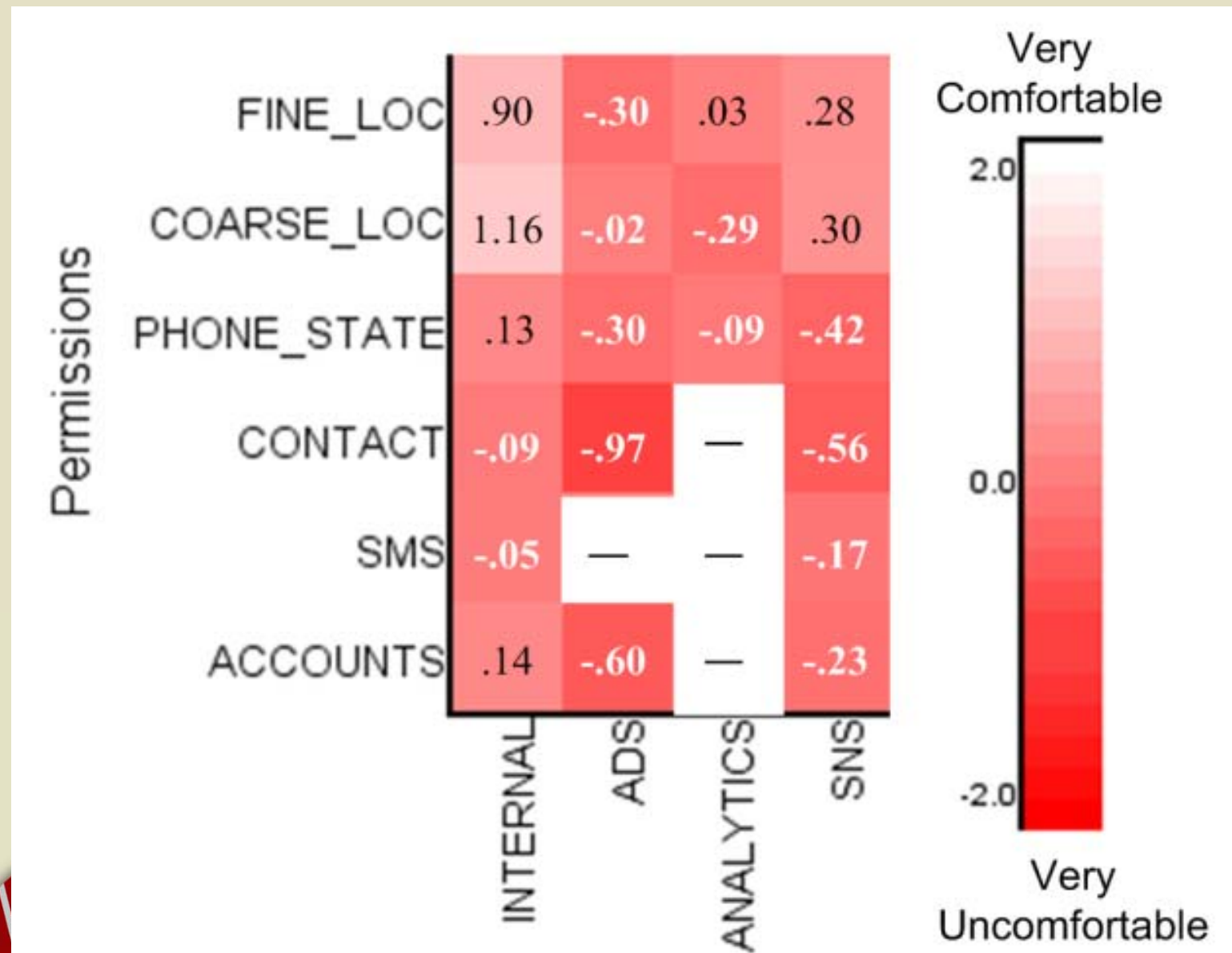


# How PrivacyGrade Works

- We crowdsourced people's expectations of core set of 837 apps
  - Ex. “How comfortable are you with Drag Racing using your location for ads?”
- We generated purposes by examining what third-party libraries used by app
- Created a model to predict people's likely privacy concerns and applied to 1M Android apps



# How PrivacyGrade Works



# How PrivacyGrade Works

ersity : 60

THIRD PARTY LIBRARY NAME	CATEGORY	NO. OF APPS USING THIS
<a href="#">Admob</a>	Targeted ads	121944
<a href="#">Facebook</a>	Social networking service	107131
<a href="#">Slf4j</a>	Utility	70227
<a href="#">ActionBarsherlock</a>	Utility	67890
<a href="#">Millennialmedia</a>	Targeted ads	60437
<a href="#">Inmobi</a>	Targeted ads	57116
<a href="#">Twitter4j</a>	Social networking service	54065
<a href="#">Flurry</a>	Mobile analytics	47129

- Long tail distribution of libraries
- We focused on top 400 libraries

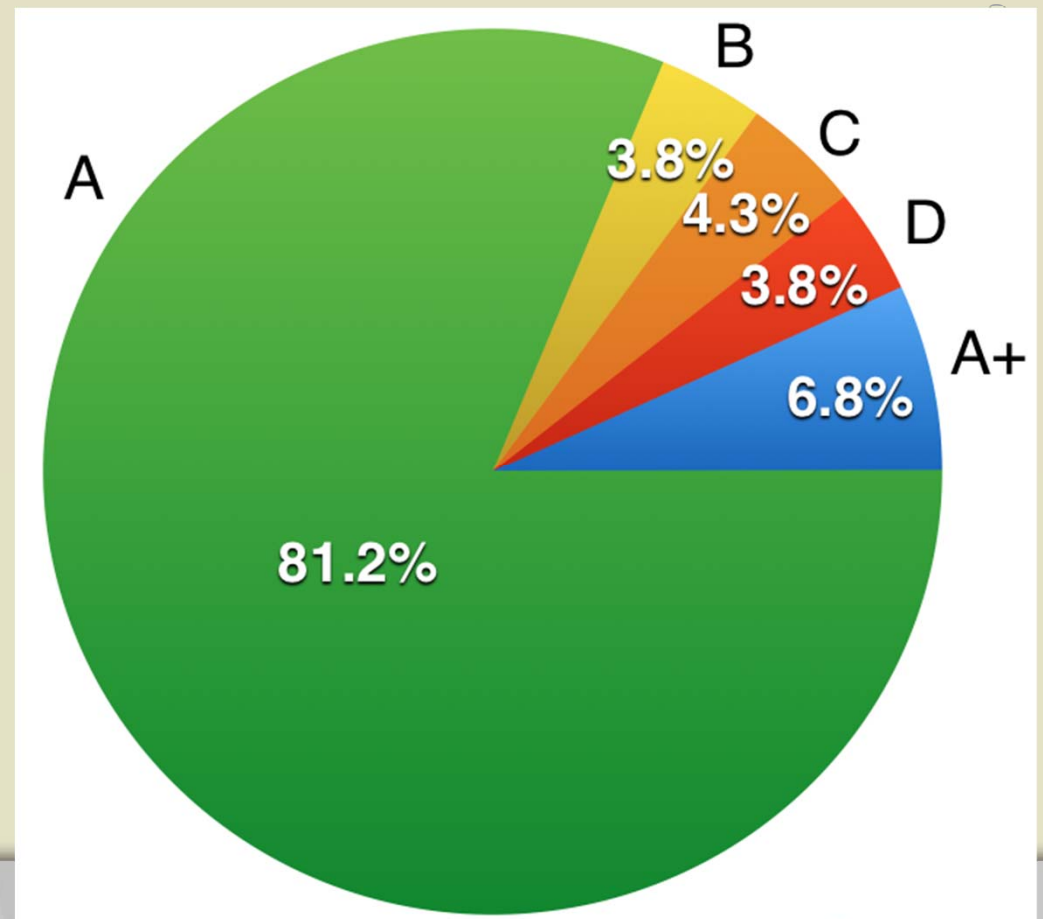




# Overall Stats on PrivacyGrade

## April 2015

- No sensitive permissions used means A+
- Other grades set at quartiles of grade range



# Changes in Grades Over Time

## October 2014 to April 2015

		Current Grade (Apr 2015)				
		A+	A	B	C	D
Previous Grade (Oct 2014)	A+	99.20	0.79	0.01	0.00	0.00
	A	0.03	99.80	0.11	0.05	0.01
	B	0.03	10.22	83.52	5.99	0.24
	C	0.01	2.15	1.62	95.93	0.29
	D	0.00	0.31	0.22	0.91	98.56



# Changes in Grades Over Time

## Most Grades Remained the Same

		Current Grade (Apr 2015)				
		A+	A	B	C	D
Previous Grade (Oct 2014)	A+	99.20	0.79	0.01	0.00	0.00
	A	0.03	99.80	0.11	0.05	0.01
	B	0.03	10.22	83.52	5.99	0.24
	C	0.01	2.15	1.62	95.93	0.29
	D	0.00	0.31	0.22	0.91	98.56





# Changes in Grades Over Time

## A Fair Number of Apps Improved

		Current Grade (Apr 2015)				
		A+	A	B	C	D
Previous Grade (Oct 2014)	A+	99.20	0.79	0.01	0.00	0.00
	A	0.03	99.80	0.11	0.05	0.01
	B	0.03	10.22	83.52	5.99	0.24
	C	0.01	2.15	1.62	95.93	0.29
	D	0.00	0.31	0.22	0.91	98.56



# Changes in Grades Over Time

## Lots of Apps Deleted

Latest Grade	Number of Apps Removed	Percentage of Apps with Same Grade
A+	24463	30.6%
A	359490	37.7%
B	17424	39.1%
C	26809	53.1%
D	24089	53.4%

- Not sure why deleted yet
  - Some apps were re-uploaded

# Impact of this Research

- Popular Press
  - NYTimes, CNN, BBC, CBS, more
  - Consumer Reports interest
- Government
  - Earlier work helped lead to FTC fines
- Google
  - Google replicating PrivacyGrade internally
- Developers



In light of the results from a recent study by PrivacyGrade, Halfbrick is going to still greater lengths to inform players about what data the game is collecting during the in-game experience and why.



# What Do Developers Know about Privacy?

- Interviews with 13 app developers
- Surveys with 228 app developers
- What tools? Knowledge? Incentives?
- Points of leverage?

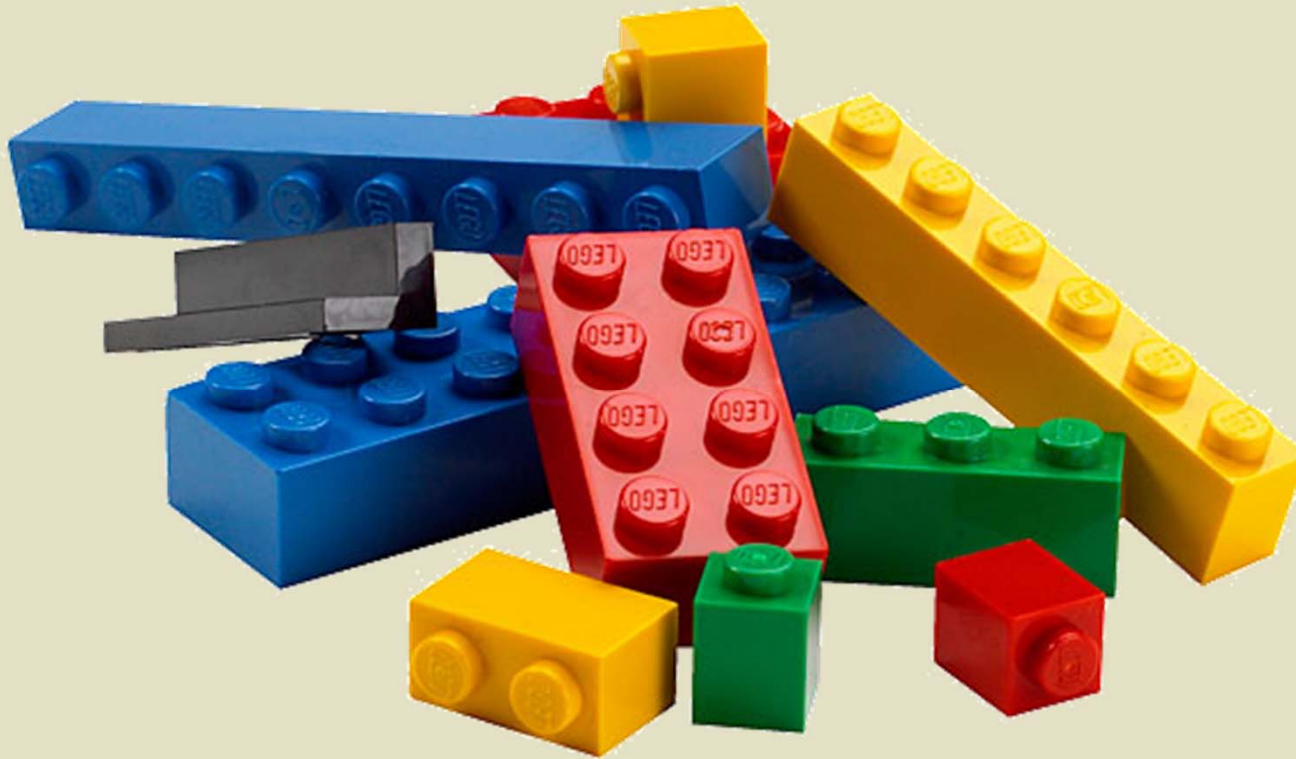
Balebako et al, The Privacy and Security Behaviors of Smartphone App Developers. USEC 2014.



# Summary of Findings

## Third-party Libraries Problematic

- Use ads and analytics to monetize



# Summary of Findings

## Third-party Libraries Problematic

- Use ads and analytics to monetize
- Hard to understand library behaviors
  - A few didn't know they were using libraries (inconsistent answers)
  - Some didn't know they collected data
  - *"If either Facebook or Flurry had a privacy policy that was short and concise and condensed into real English rather than legalese, we definitely would have read it."*





# Summary of Findings

## Developers Don't Know What to Do

- Low awareness of existing privacy guidelines
  - Often just ask others around them
- Low perceived value of privacy policies
  - Mostly protection from lawsuits
  - *“I haven't even read [our privacy policy]. I mean, it's just legal stuff that's required, so I just put in there.”*



# Developers Need a Lot of Help!

- Good set of best practices for security
  - SSL, hashing of passwords, randomization
  - Common attacks: SQL, XSS, CSRF
- What are best practices for privacy??
- Developers also have many problems
  - App functionality, bandwidth, power, making money... privacy pretty far down the list



# Talk Overview

- Story 1: Livelihoods
- Story 2: PrivacyGrade
- Reflections on improving the privacy ecosystem





# Reflections on Privacy

## Consider Entire Ecosystem for Privacy

- I'm increasingly skeptical of end-user privacy
  - Places too much burden on people
  - Lets developers get away with too much
- Instead, leverage rest of ecosystem
  - Developers
  - Third-party developers
  - App stores
  - OS and H/W manufacturers
  - Regulators
  - Third party advocates
  - Journalists



# Reflections on Privacy

## Developers Really Need Help!

- Long tail of developers
  - Most developers just don't know what to do
  - Also very easy to make mistakes
- Developers need better tools
  - PrivacyGrade: Upload your app to our site, we analyze and offer suggestions to fix
  - Understand what a given library does
  - Make it easy to get only minimal data
    - Don't need your location, just if at "work" or "home"
    - Don't need microphone, just level of sound



# Reflections on Privacy

## Developers Really Need Help!

- Developers need canonical online resources
  - Establish Virtual Centers of Excellence
  - Good programming examples
  - Good design patterns and UI examples
  - Good best practices and processes
  - If a developer has a privacy question, make it much easier for them solve it





# Reflections on Privacy

## Other Parts of the Ecosystem

- Third-party developers
  - If most data collected by third parties, push to restrict (either app store, OS, regulators)
- Hardware manufacturers
  - H/W manufacturers care a lot about privacy
  - Try to get them to adopt privacy software
- Third party advocates
  - Better tools to help them analyze



# Reflections on Privacy

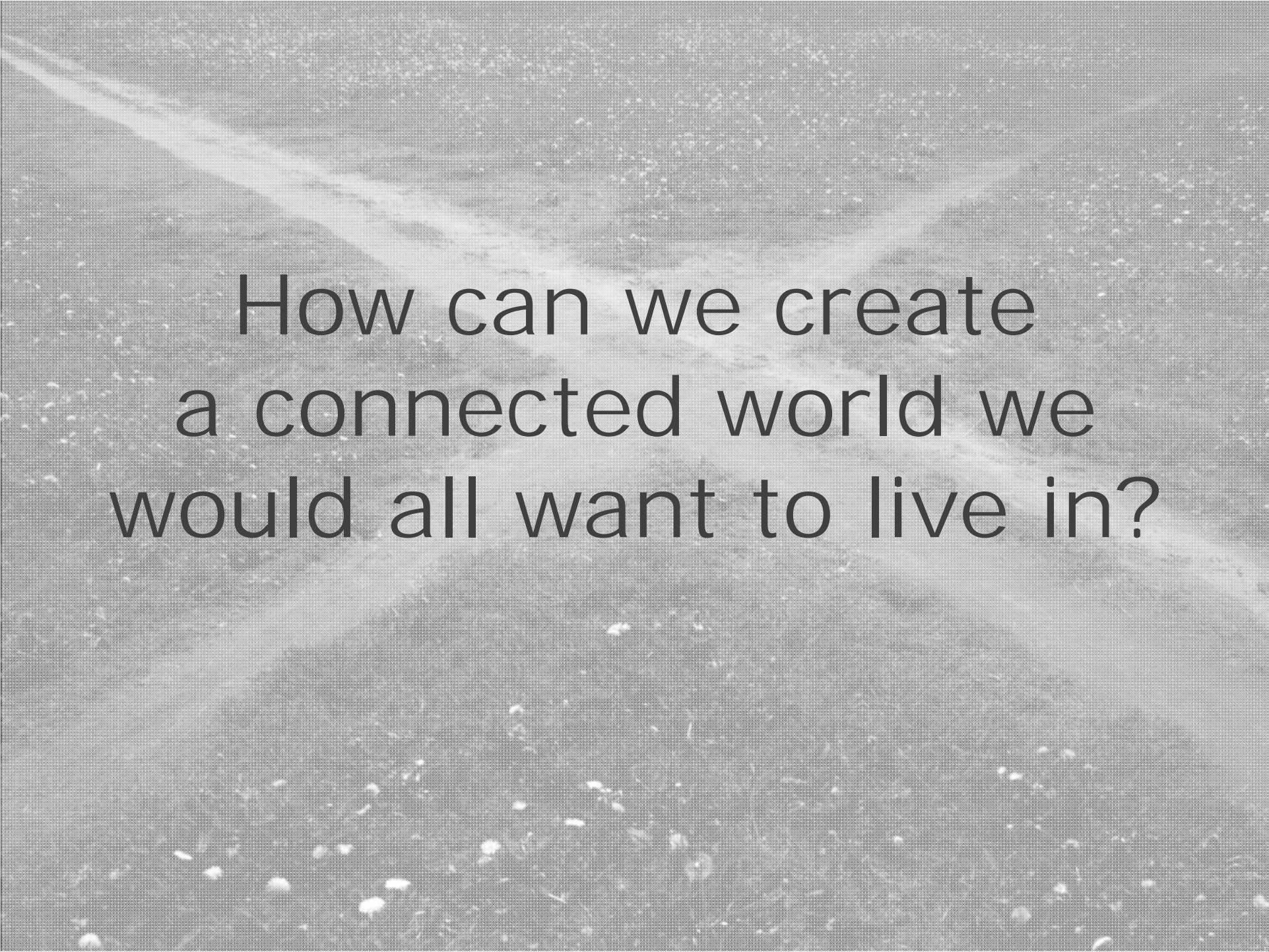
## Other Parts of the Ecosystem

- Regulators
  - Often lawyers without strong technical support
  - Ex. Forthcoming work on identifying apps for kids
- Journalists
  - Shame can be very powerful
  - Angry Birds stopped collecting location data after multiple popular press about their app
- Earlier, hard to detect undesired uses
  - These are possible points of leverage







A black and white photograph of a path leading into a forest. The path is made of dirt and is flanked by trees and foliage. The path leads from the foreground into the distance, where it disappears into the trees. The lighting is soft, and the overall mood is serene and contemplative.

How can we create  
a connected world we  
would all want to live in?

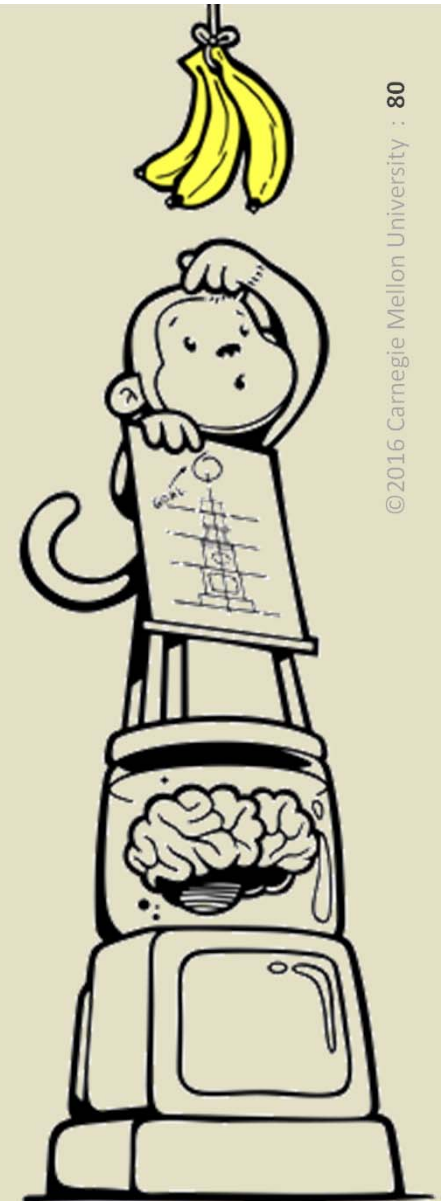
# Thanks!

More info at [cmuchimps.org](http://cmuchimps.org)  
or email [jasonh@cs.cmu.edu](mailto:jasonh@cs.cmu.edu)

- Shah Amini
- Jun-Ki Min
- Justin Cranshaw
- Dan Tasse
- Afsaneh Doryab
- Jennifer Tchou
- Jialiu Lin
- Mike Villena
- Song Luan
- Jason Wiese

Special thanks to:

- DARPA
- Army Research Office
- Google
- NSF
- CMU Cylab
- Alfred P. Sloan
- NQ Mobile



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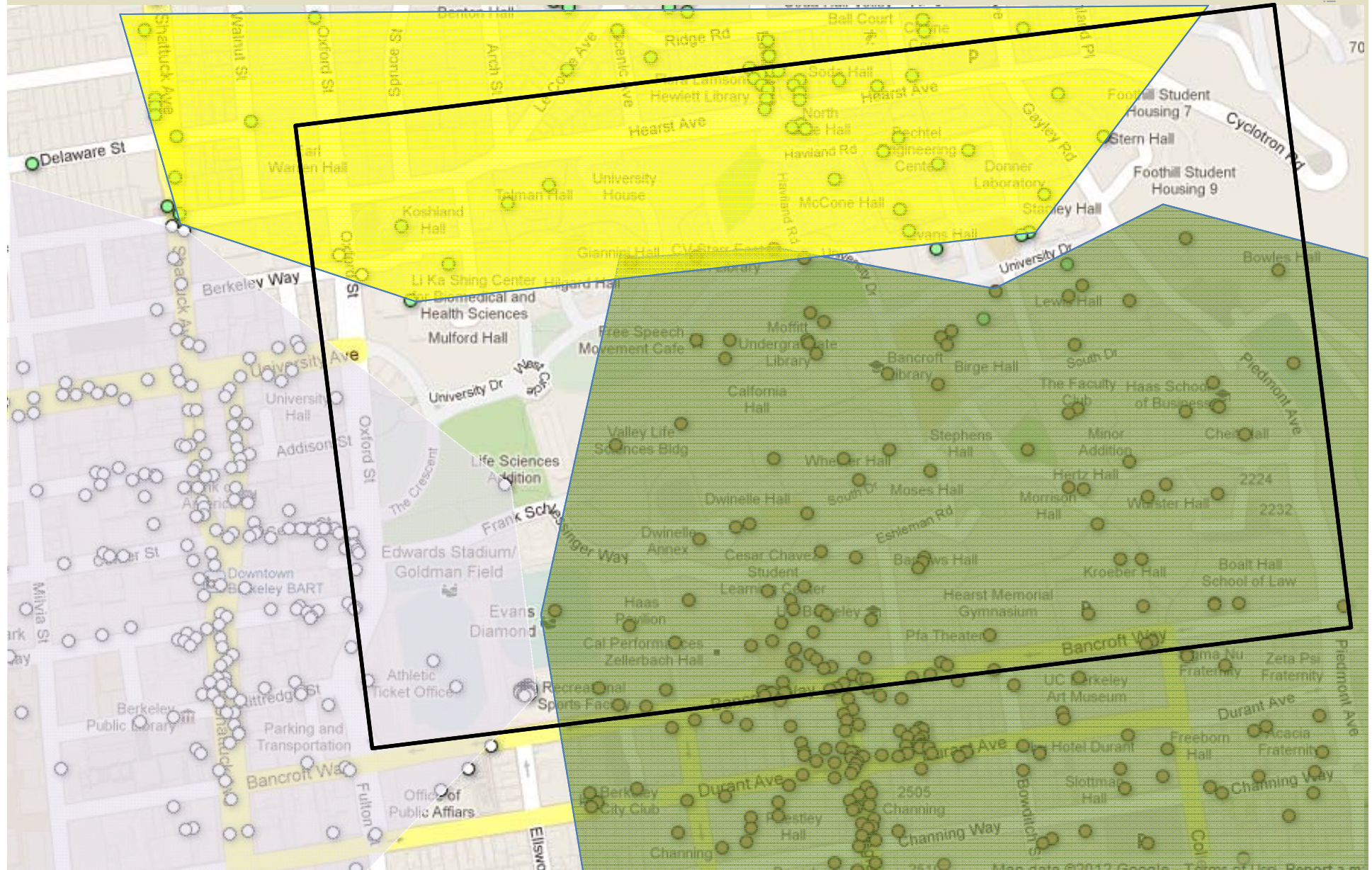
Computer Human Interaction:  
Mobility Privacy Security  
<http://cmuchimps.org>

Carnegie Mellon





# Bezerkeley, CA





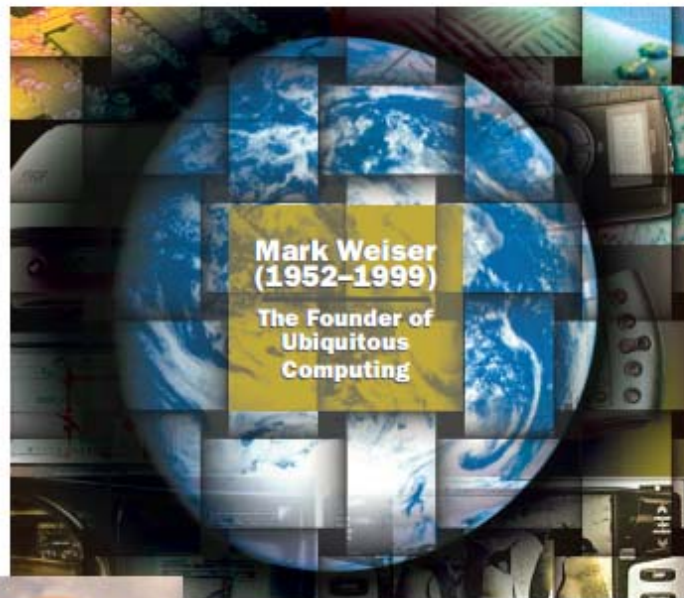


## Story 2: Google Glass

- Why there has been so much negative backlash about Google Glass?
- Are there lessons we can learn here about privacy and adoption of tech?



# Origins of Ubicomp



**Mark Weiser** was the chief technology officer at Xerox's Palo Alto Research Center (PARC). He is often referred to as the father of ubiquitous computing. He coined the term in 1988 to describe a future in which invisible computers, embedded in everyday objects, replace PCs. Other research interests included garbage collection, operating systems, and user interface design. He received his MA and PhD in computer and communication science at the University of Michigan, Ann Arbor. After completing his PhD, he joined the computer science department at the University of Maryland, College Park, where he taught for 12 years. He wrote or cowrote over 75 technical publications on such subjects as the psychology of programming, program slicing, operating systems, programming environments, garbage collection, and technological ethics. He was a member of the ACM, IEEE Computer Society, and American Association for the Advancement of Science. Weiser passed away in 1999. Visit [www.parc.xerox.com/csl/members/weiser](http://www.parc.xerox.com/csl/members/weiser) or contact [communications@parc.xerox.com](mailto:communications@parc.xerox.com) for more information about him.

## REACHING FOR WEISER'S VISION

Images not reprinted. Some were omitted and others reproduced.

## The Computer for the 21st Century

*Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence.*

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrial societies. Not only do books, magazines, newspapers convey written information, but signs, billboards, shop signs and even

colleagues and I at the Xerox Palo Alto Research Center think that the idea of a "personal" computer itself is misplaced and that the vision of laptop machines, dynabooks and "knowledge navigators" is only a transitional step toward achieving the real potential of information technology. Such machines cannot truly make computing invisible, part of people's lives. To conceive a new world of computing, one

By Mark Weiser

wrappers are common. The constant background presence of these privacy technology" and active attention,

information to be transmitted is ready for use. It is difficult to imagine modern life

Silicon-based information technology is far from having become part of the world. More than 50 million personal computers are sold, and the computer nonetheless remains in a world of its own. It is a technology through complex jargon that has not the tasks for which people use computers. The art is perhaps analogous to scribes had to know as much about baking clay as they did about writing.

The arcane aura that surrounds computers is not just a "user interface

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# Popular Press Reaction

## Orwellian Dream Come True: A Badge That Pinpoints You

By LEONARD SLOANE  
Published: September 12, 1992

Is Big Brother

Another tool  
the way. It is

I.D. card, th  
can track yo

"When differ  
who invente

England, an  
Alto, Calif. "

Businessweek Archives

## Big Brother, Pinned To Your Chest

August 16, 1992



SEND TO [kindle](#)

Top of the News

BIG BROT

Alarms do

Laboratory

# WIRED

## You're Not Paranoid: They Really Are Watching You

Surveillance in the workplace is getting digitized - and getting worse.



# Why Such Negative Press?

- PARC knew privacy a big problem
  - But didn't know what to do
  - So didn't build any privacy protections
- Unclear value proposition
  - Focused on technical aspects
  - What benefits to end-users?
- Google Glass is replaying the past



# Why Such Negative Press?



- Grudin's law
  - Why does groupware fail?
  - “When those who benefit are not those who do the work, then the technology is likely to fail, or at least be subverted”
- Privacy corollary
  - When those who bear the privacy risks do not benefit in proportion to the perceived risks, the tech is likely to fail





# But Expectations Can Change

- Initial perceptions of mobile phone users
  - Rude, annoying
  - Casual chat, driving
- Six weeks later...
  - Had same behaviors
- People with more exposure to mobile phones better



## Going Wireless: Behavior & Practice of New Mobile Phone Users

Leysia Palen<sup>1</sup>, Marilyn Salzman<sup>2</sup> & Ed Youngs<sup>2</sup>

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### ABSTRACT

We report on the results of a study in which 19 new mobile phone users were closely tracked for the first six weeks after service acquisition. Results show that new users tend to rapidly modify their perceptions of social appropriateness around mobile phone use, that actual nature of use frequently differs from what users initially predict, and that comprehension of service-oriented technologies can be problematic. We describe instances and features of mobile telephony practice. When in use, mobile phones occupy multiple social spaces simultaneously, spaces with norms that sometimes conflict: the physical space of the mobile phone user and the virtual space of the conversation.

**Keywords:** Wireless communications; mobile, cellular, and digital telephony; communicative practice; qualitative research.

### INTRODUCTION

Mobile telephone use has proliferated in recent years. Some areas of the world have enjoyed especially rapid deployment and high penetration of mobile telephony, with Finland leading the way at 65% [1]. It is no longer unusual to see people using mobile phones in a variety of contexts. Indeed, use is so frequent and common in some places that people are regularly and formally reminded to turn off mobile phones in movie theaters, at public performances, and in restaurants to avoid negative social repercussions. (e.g., [4]). Reminders in hospitals and airplanes are also provided, but usually for safety-critical reasons.

Although mobile phones are perceived as devices that directly serve the individuals who own them, they are also social artifacts. As a communications technology, they support coordination with others. Additionally, mobile telephony communicative practice is influenced by the social contexts in which the phones are used. Communicative practice is also influenced by attributes of the owners' lifestyle, including their social networks. Furthermore, because they are devices that are

now present in a variety of contexts, and can be remotely and unpredictably activated, mobile phones are subject to social scrutiny and play a role in the social world. They are surrounded by a system of actors who wittingly or unwittingly play a role in mobile phone conversation. Finally, a user's understanding of how mobile telephony works is not only a matter of learning about its multiple technical components (hardware, software, and network services), but also of understanding service provider policies and integrating information garnered from sales, marketing, and billing communications.

Mobile telephony is rapidly becoming a feature of our culture, yet we do not understand its effects on communicative practice and behavior, especially with respect to the interaction and co-evolution of the technology and human activity. As wireless communications and information management applications proliferate, empirical understanding of practice and social impacts becomes relevant for scholars and practitioners alike.

We report here on a study of 19 first-time mobile phone users followed closely during the first six weeks after service acquisition. The objective of the study was to understand how and why people use mobile phones in a range of situations, and to understand their processes of discovery and integration of mobile telephony into daily life. We conducted multiple interviews over the course of the six weeks, were in regular phone and voicemail contact with the subjects, and captured actual calling behavior data.

We report on:

- evolving expectations and communicative practices of new mobile phone users;
- perceptions of and adaptation to social norms; and
- user comprehension of mobile telephony technology as a construction of technological and social components.

From these observations, we extend our discussion to include an analysis of how mobile phones occupy multiple social spaces simultaneously, and how that affects public perception and norm development. We also present temporal and spatial aspects of social coordination that we believe are important to mobile telephony practice.

### RELATED RESEARCH

The popular literature is rife with information about mobile telephony products, as well as with anecdotal commentary

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CSCW '00, December 2-6, 2000, Philadelphia, PA.  
Copyright 2000 ACM 1-58113-222-0/00/0012...\$5.00.

# But Expectations Can Change

- Famous 1890 article defining privacy as “the right to be let alone” was about photography

## THE RIGHT TO PRIVACY

ornaments were a string of gold beads around her throat. Her hair was of white roses, and the head by eight bristling sisters. Crebbs, Miss Ke of these

by

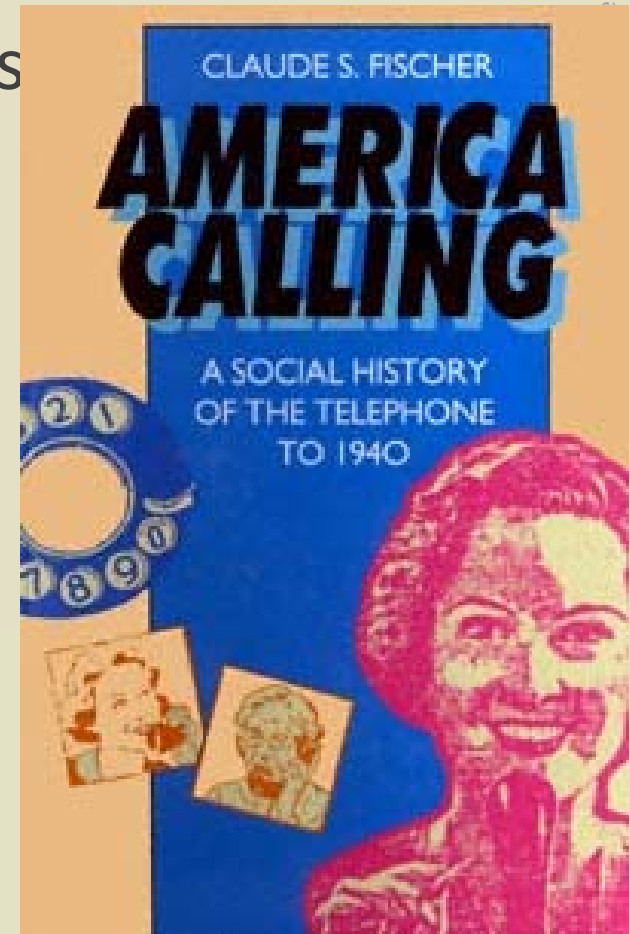
Samuel D. Warren  
and  
Louis D. Brandeis

to the . The ayard, . Miss draws, dresses a mull,



# But Expectations Can Change

- People objected to having phones in their homes because it “permitted intrusion... by solicitors, purveyors of inferior music, eavesdropping operators, and even wire-transmitted germs”





# But Expectations Can Change

One resort felt the trend so heavily that it posted a notice: “PEOPLE ARE FORBIDDEN TO USE THEIR KODAKS ON THE BEACH.” Other locations were no safer. For a time, Kodak cameras were banned from the Washington Monument.

The “Hartford Courant” sounded the alarm as well, declaring the “the sedate citizen can’t indulge in any hilariousness without the risk of being caught in the act and having his photograph passed around among his Sunday School children.”



# And Framing Really Matters

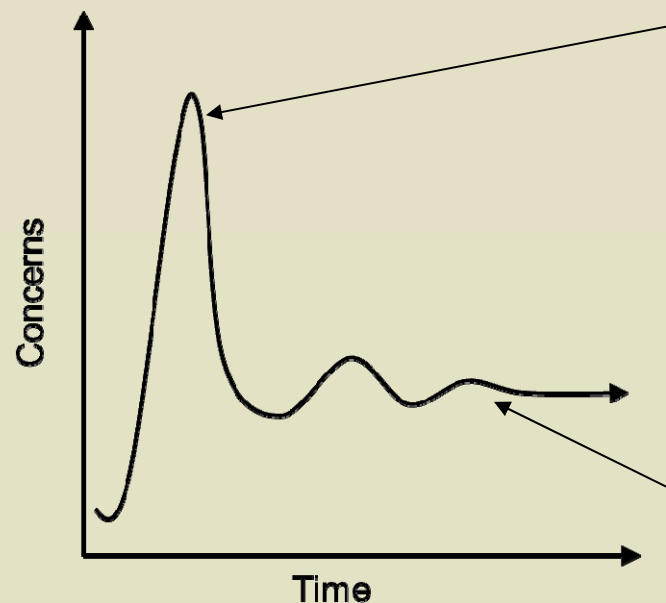
- Ubicomp -> Invisible Computing
  - Talked less about the tech
  - More about how it could help people
  - More positive press



# Privacy Hump

- A lot of our concerns about tech fall under umbrella term “privacy”

- Value, fears, expectations, what others around us think



Many legitimate concerns  
Many alarmist rants  
“Right” way to deploy?  
Value proposition?  
Rules on proper use?

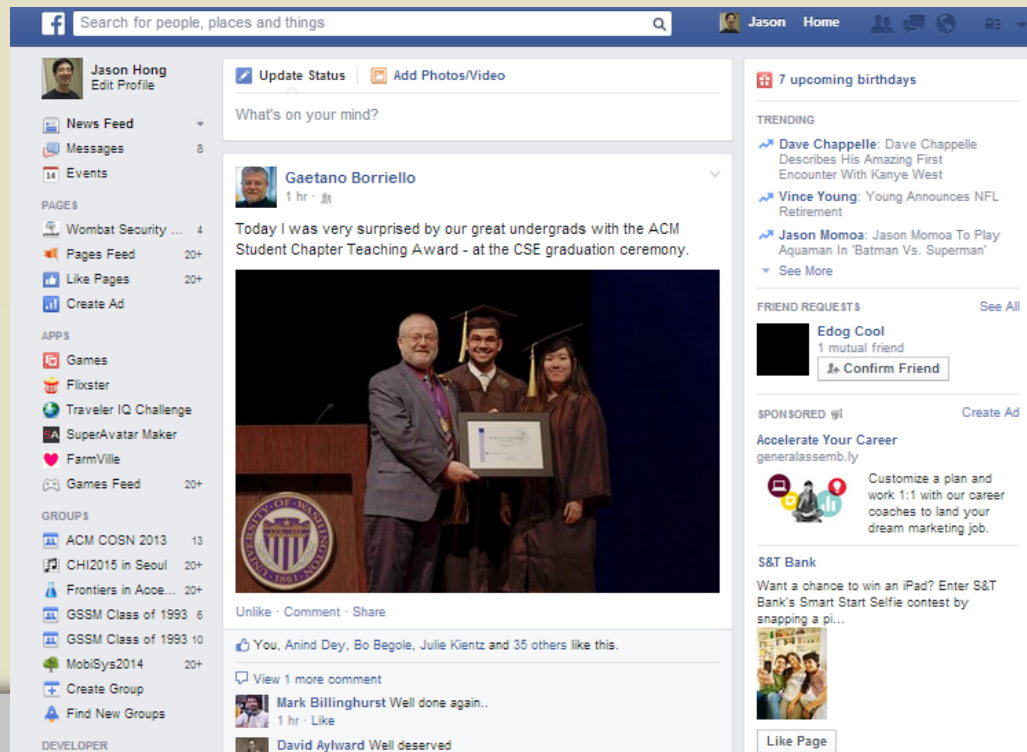
Things have settled down  
Few fears materialized  
People feel in control  
People get tangible value

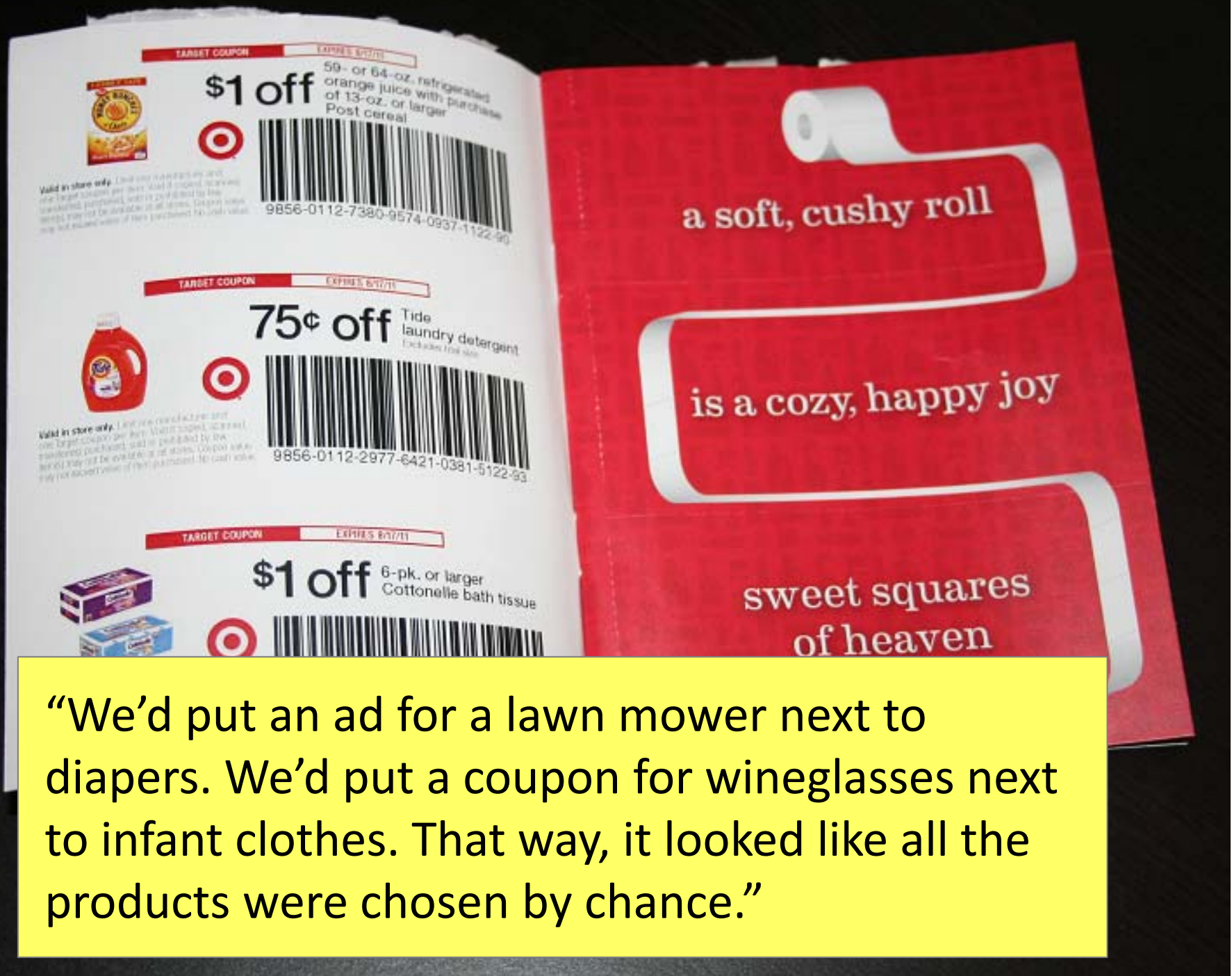




# But How to Get Over Hump?

- Still a big gap in knowledge on best ways of mitigating privacy issues
- Prime example: Facebook news feed





The image shows a Target coupon book and a red Target shopping bag. The coupon book is open, displaying three coupons. The first coupon is for \$1 off 59- or 64-oz. refrigerated orange juice with purchase of 13-oz. or larger Post cereal. The second coupon is for 75¢ off Tide laundry detergent (excludes 1st size). The third coupon is for \$1 off 6-pk. or larger Cottonelle toilet paper. The shopping bag is red with white text and a white roll of paper emerging from the top.

**Target Coupon** **EXPIRES 8/11/11**  
**\$1 off** 59- or 64-oz. refrigerated orange juice with purchase of 13-oz. or larger Post cereal  
9856-0112-7380-9574-0937-1122-90

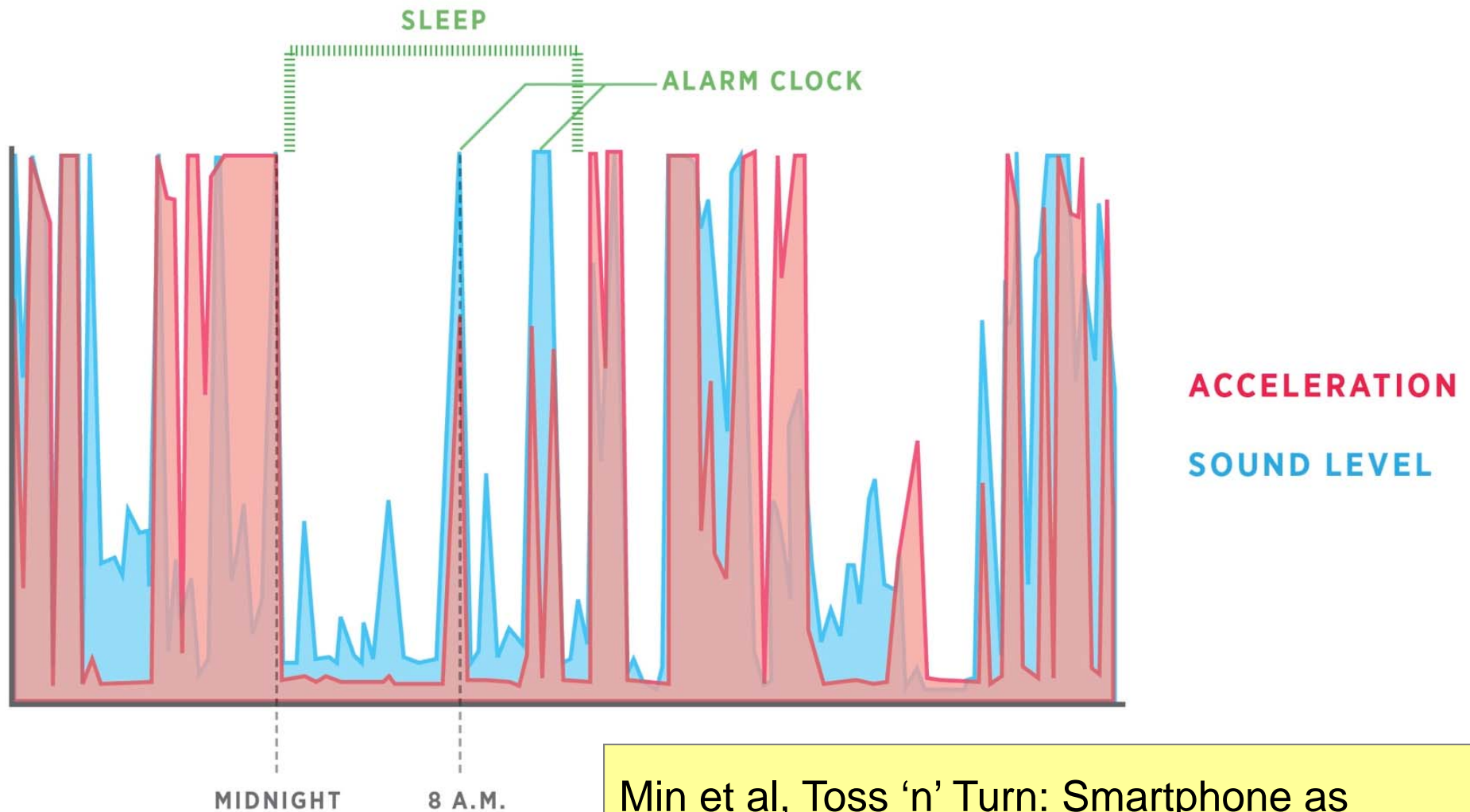
**Target Coupon** **EXPIRES 8/11/11**  
**75¢ off** Tide laundry detergent (excludes 1st size)  
9856-0112-2977-6421-0381-5122-93

**Target Coupon** **EXPIRES 8/11/11**  
**\$1 off** 6-pk. or larger Cottonelle toilet paper

**a soft, cushy roll**  
**is a cozy, happy joy**  
**perfect squares**

- Privacy Placebos: Things that make people feel better about privacy, but doesn't offer much.
- Other examples: Privacy policies, access logs
- How ethical is it to use these approaches?

# Understanding Individuals

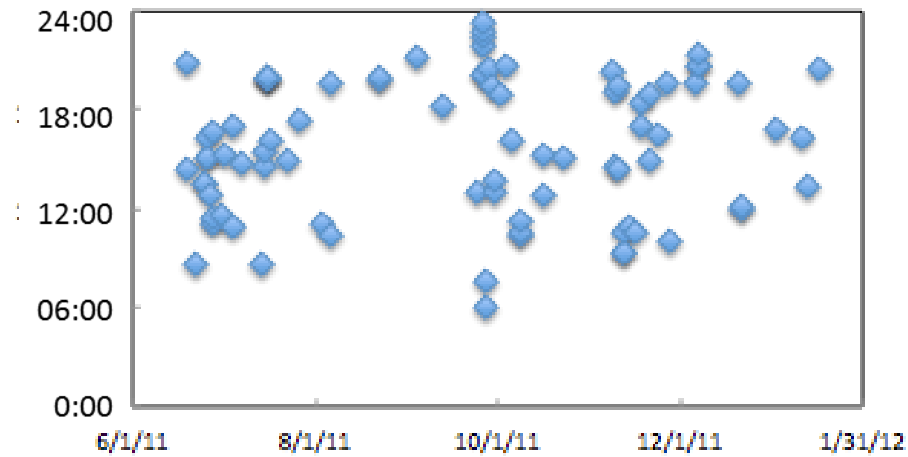


Min et al, Toss 'n' Turn: Smartphone as Sleep and Sleep Quality Detector, CHI 2014.

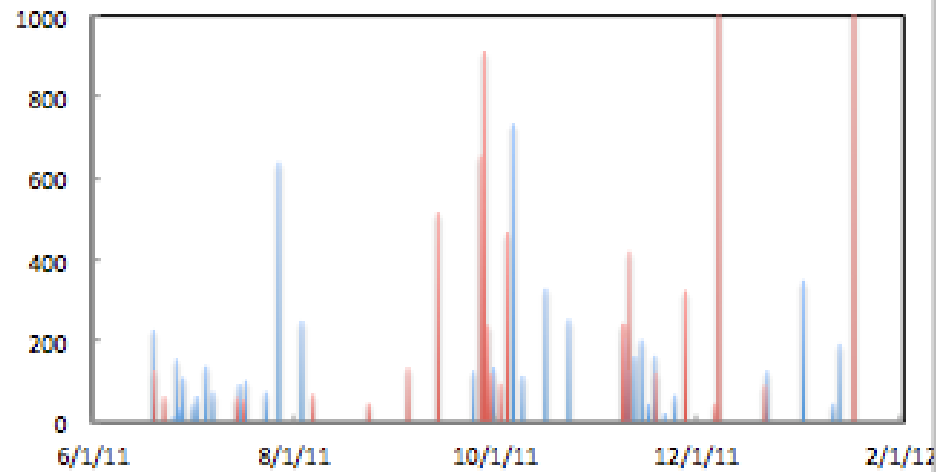


## My Brother

Time and Date of Phone Calls

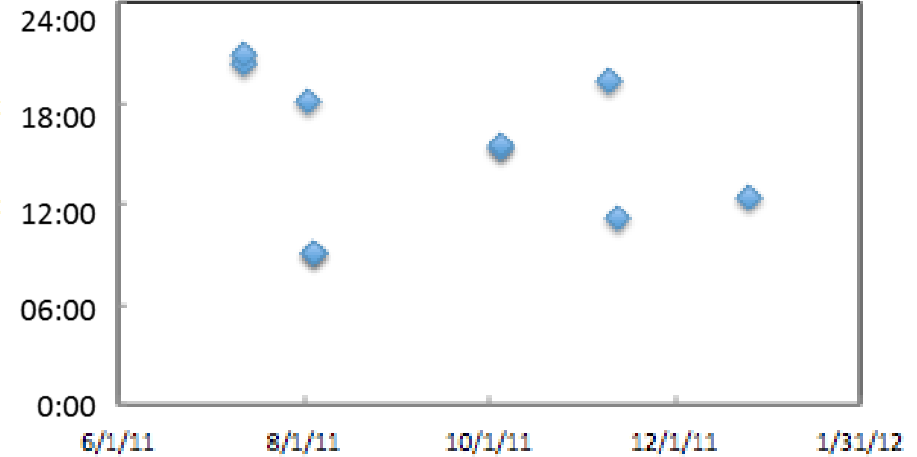


Length of Phone Calls

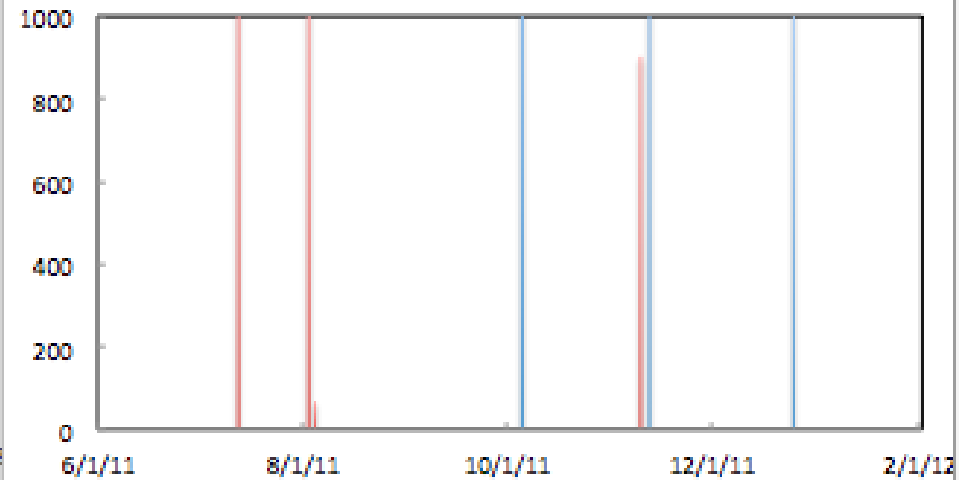


## My Best Friend

Time and Date of Phone Calls



Length of Phone Calls



# Who Gains From this Data?

- Today, most data only flows one way
  - Mainly to advertisers
  - Also banks, insurance, credit cards
- Little value goes back to people or society



# Who Gains From this Data?

- Can we design systems that share the value across more people?
  - People co-create data **and** gain value
  - Participatory design philosophy
- Can we also make people feel more invested in the cities they live in?



# Stronger Emphasis on Getting Our Research Results Out There

- We are great at science, terrible at transfer
- Five major factors for successful innovations:
  - Relative Advantage
  - Trialability
  - Complexity
  - Compatibility
  - Observability

