

# The “Friends and Family” Study and the FunF platform



Nadav Aharony ([nadav@media.mit.edu](mailto:nadav@media.mit.edu))

Wei Pan ([panwei@media.mit.edu](mailto:panwei@media.mit.edu))

Alex (Sandy) Pentland ([pentland@media.mit.edu](mailto:pentland@media.mit.edu))



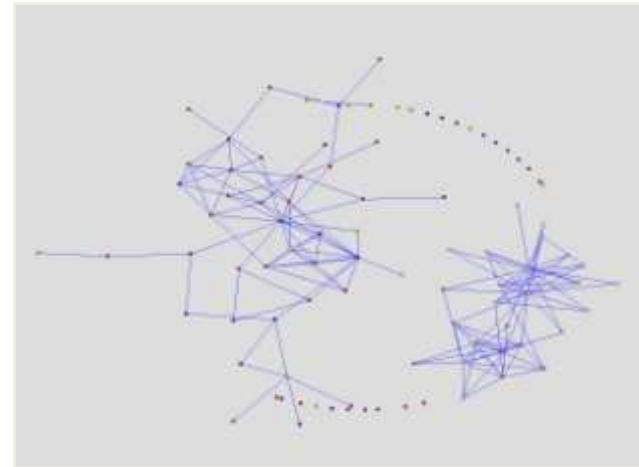
- Using Mobile phones as social sensors
- “Living Lab”
  - Semi-controlled & real-world experiments
- Experiments
  - Original Reality Mining Study (~2005)
    - ML + Sloan, proximity sensing
  - Social Evolution Study (2009)
    - Undergraduate dorm

# 2005 Reality Mining Study

MIT Media Lab  
www.media.mit.edu



Location, Call Logs



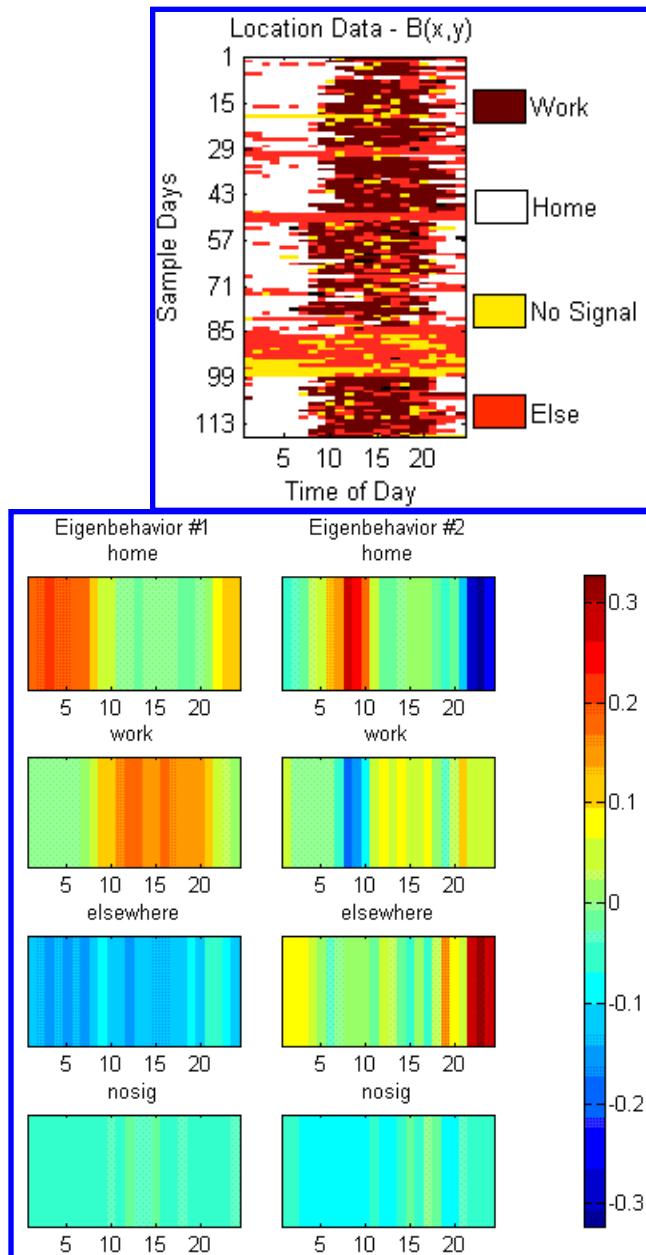
1-Day Proximity

Phone data for 91 people:  
Media Lab & Sloan School

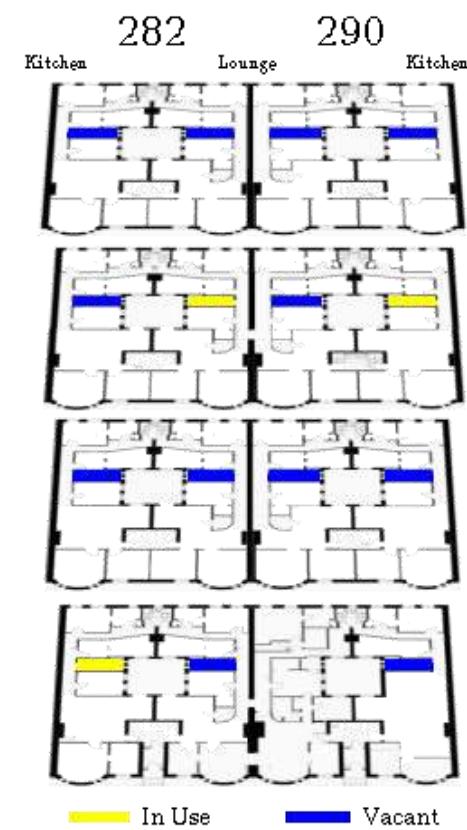
Nadav Aharony © 2010 All Rights Reserved

[Eagle and Pentland]

- Modeling
  - Social relationships
  - Organizational structures
  - Daily routines
  - Interpersonal influence
- Tool Examples
  - Graphical models
  - HMM
  - “Eigenbehaviors”
- People are very predictable!



- Undergraduate dorm, full academic year
- Main question: How do 'things' spread within a face-to-face network?
  - Music
  - Political opinion
  - Smoking habits
  - Eating habits



[Madan and Pentland]



## “Friends and Family” Community

- Housing community of married grad students
- Vibrant community life
  - Events, facilities (playground, BBQ, lounge, etc.)
- Diverse sub-communities and social groups

(pictures for illustration purposes only)





- Rich Identity
  - Dynamic, based on individual and group behavior
- Social Health/Wellness
- Community Dynamics
  - Interactions, social capital
- Diffusion
  - News, ideas, political opinions, flu etc.
- Privacy/Trust

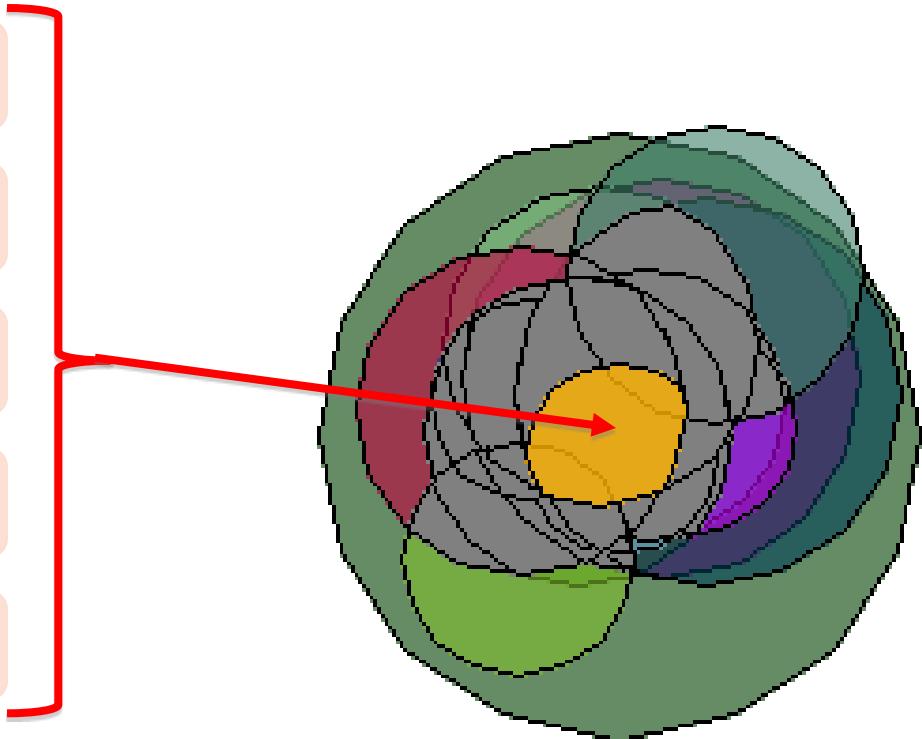


- How do people make decisions?
  - Social aspect of decision making
- How can we empower them to make BETTER decisions?
  - Using personal and social tools

- Currently ~130 Mobile phones (Android)
  - Hope to eventually cover the entire community
  - Used as sensors for behavior patterns, face-to-face interactions, and communication activities
- First **observe**,  
then perform **positive interventions**
- Duration: At least 2 years, ideally more
  - Phase I: 3/10 – 9/10, 55 participants
  - Phase II: 9/10 - ?, 130 participants

## Intricate Sub-Networks & Affinities

- 8 participants
  - Homemaker
- 31 participants
  - Has kids
- 18 participants
  - Religious group A
- 6 participants
  - Lives on floor Y
- 14 participants
  - Hobby group D



## Sensor Platform



# Sensor Platform That Mediates All Your Comms.

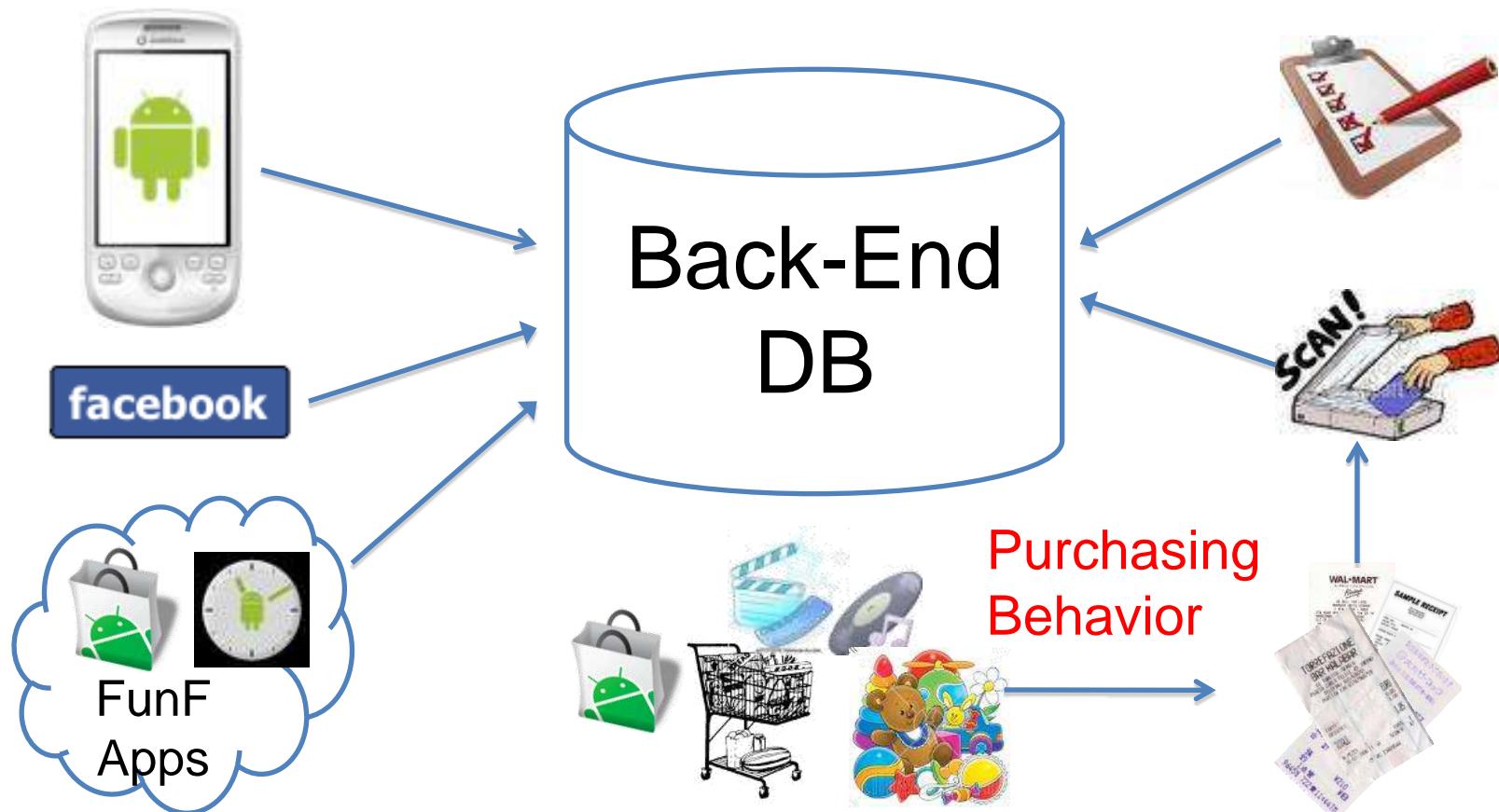


## FunF High Level: Data Collection

MIT Media Lab  
www.media.mit.edu

Personal & Social Behavior +  
Communication Patterns

Surveys





## ■ Key Study Features

MIT Media Lab  
www.media.mit.edu

- Access to multiple network modalities
  - Face-to-face, phone, facebook, ...
- “10% off life”
  - Users get compensation per receipt submitted
- App-store behavior + influence
  - FunF Market App gives us data on exposure + intervention abilities
- Interventions and their effects:
  - Data Visualization, Recommendations, “Nudges”



- Mandatory Surveys
  - Monthly (20-30 minutes)
  - Weekly (5-10 minutes)
  - Daily Phone surveys (1 minute)
- Phone Survey Extension:
  - Experience sampling: Random or tied to events

- Many approaches:
  - Visualization: Show users their own data
  - Recommendations:
    - Facebook privacy settings (“real friends”).
    - Introductions, presence notifications
    - “People you know do ‘x’”, “People like you do “y”
      - (Amazon recs on steroids)
  - “Nudge” user in right direction
    - Food choices, spending patterns

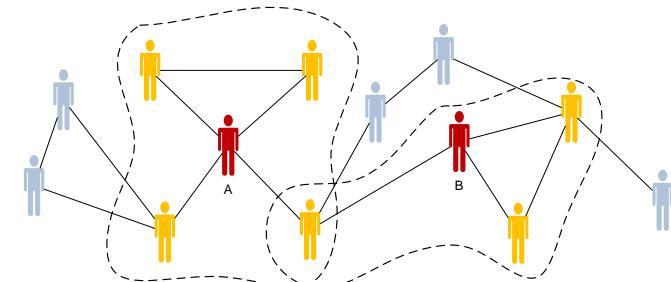
## Actual Interventions and Sub-Experiments

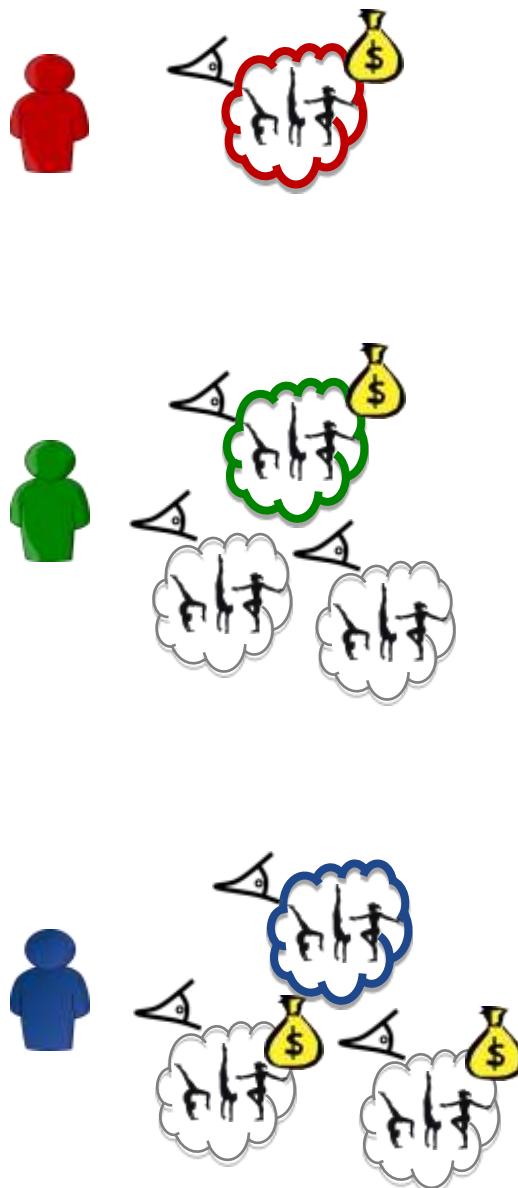
- FunFit
  - Wellness and Incentives
- Funf Data Visualizations
  - Effect of personal and community information
- FunFatigue
  - Sleep study
- FunFavors
  - Social capital and market mechanisms





- Wellness game
  - Game goal: Increase Activity Level
  - Experimental goal: Explore aspects of motivation, and incentives
  - Multiple experimental groups
  - ~105 participants opted-in
- Context: Localized Externalities [Mani, Rahwan, Pentland]





## Friends and Family - Me

Generated 2010-10-27 00:45:41.041000. Data last updated 2010-10-27 00:45:41.041000.

The following graph shows all your game results.

Nadav's Progress



The following graphs show your buddies' game results.

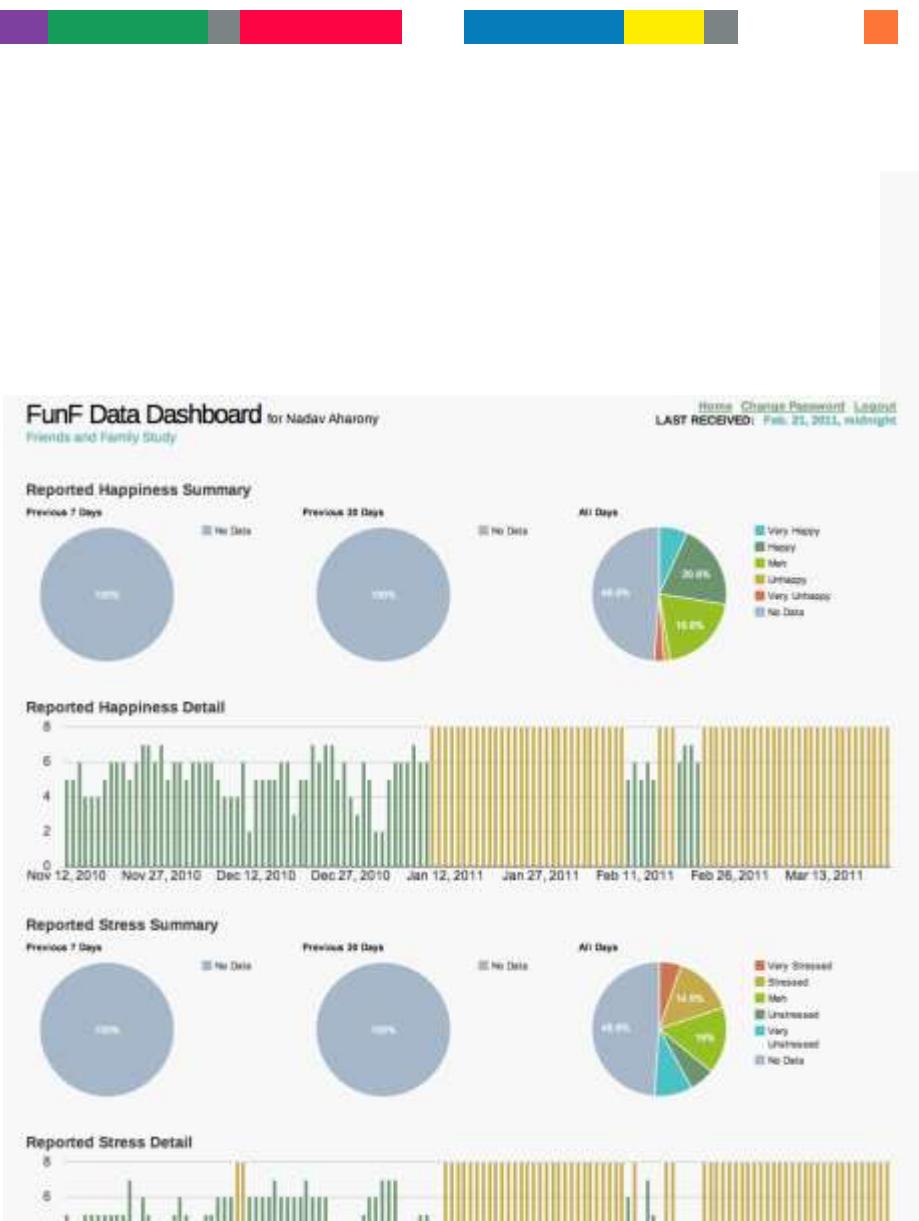
Cody's Progress



Cory's Progress



# Personal Data Visualization



## General Fitness Health Results for Nadav Aharony

Friends and Family Study

### Weight (lbs)

[Home](#) [Change Password](#) [Logout](#)  
LAST RECEIVED: Dec. 8, 2010, 8:30 a.m.

### TOTAL PROGRESS (1398800 - 1398810)

|                 |       |
|-----------------|-------|
| START WEIGHT:   | 208.4 |
| PRESENT WEIGHT: | 212.8 |
| WEIGHT CHANGE:  | +4.4  |
|                 | ▲     |
| START BMI:      | 30.8  |
| PRESENT BMI:    | 31.0  |
| BMI CHANGE:     | +0.2  |
|                 | ▲     |

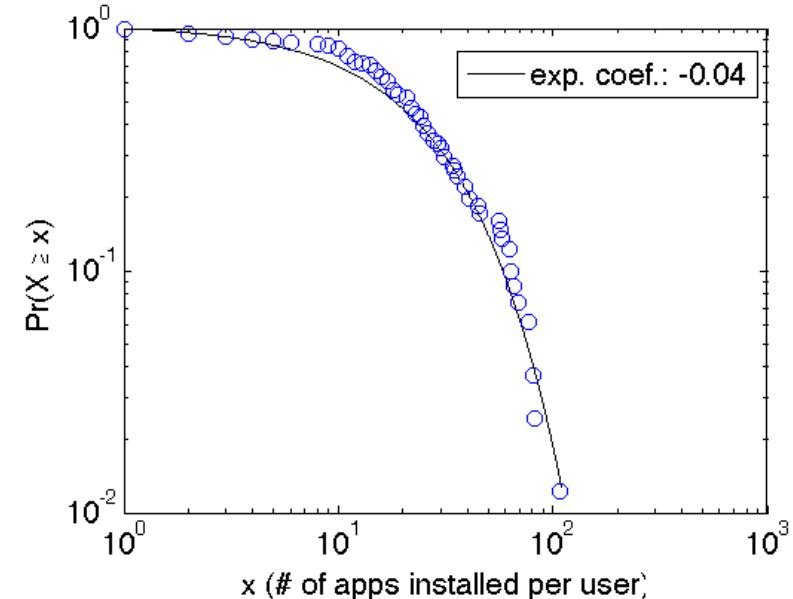
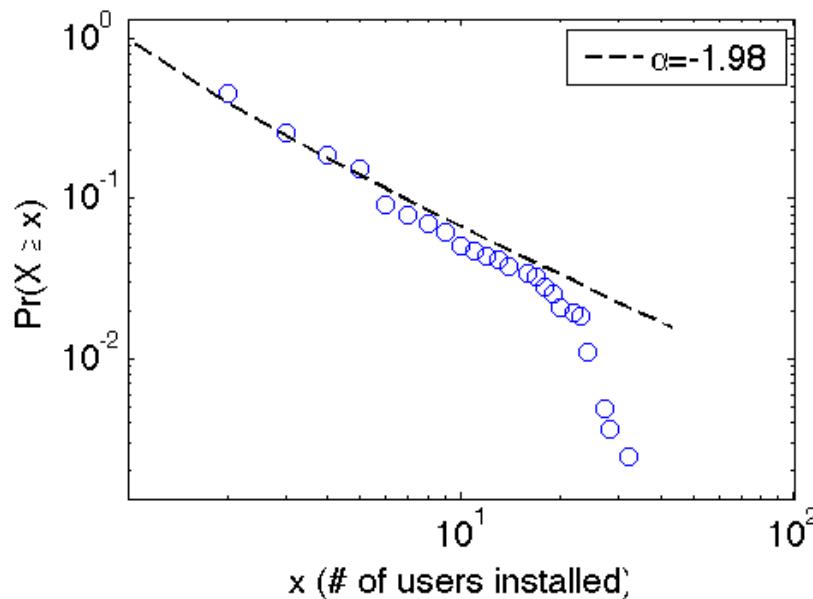
### Body Composition (Muscle/Fat)

### TOTAL PROGRESS (1398810 - 1398810)

|                     |       |
|---------------------|-------|
| START BODY FAT:     | 33.0% |
| PRESENT BODY FAT:   | 33.0% |
| CHANGE (%):         | -0.0% |
|                     | ▲     |
| START VISCERAL FAT: | 13.0  |
| PRESENT VIS. FAT:   | 14.0  |
| LEVEL CHANGE:       | +1.0  |
|                     | ▲     |
| START MUSCLE:       | 31.0% |
| PRESENT MUSCLE:     | 31.4% |
| CHANGE (%):         | +0.2% |
|                     | ▼     |

# Initial Data Analysis: Mobile Apps

- 55 participants, 870 apps, 3 months



- Contrasting strangers vs. closer ties for self report network and physical co-location

| (a)                            | Group 1 | Group2    |
|--------------------------------|---------|-----------|
| BT Co-Location Closeness Range | [0,10]  | (10,2000] |
| Mean #Common Apps / Pair       | 2.7253  | 4.9       |
| ANOVA: F=74.48, p<0.0000001    |         |           |
| K-S test: True, p=7.8e-19      |         |           |

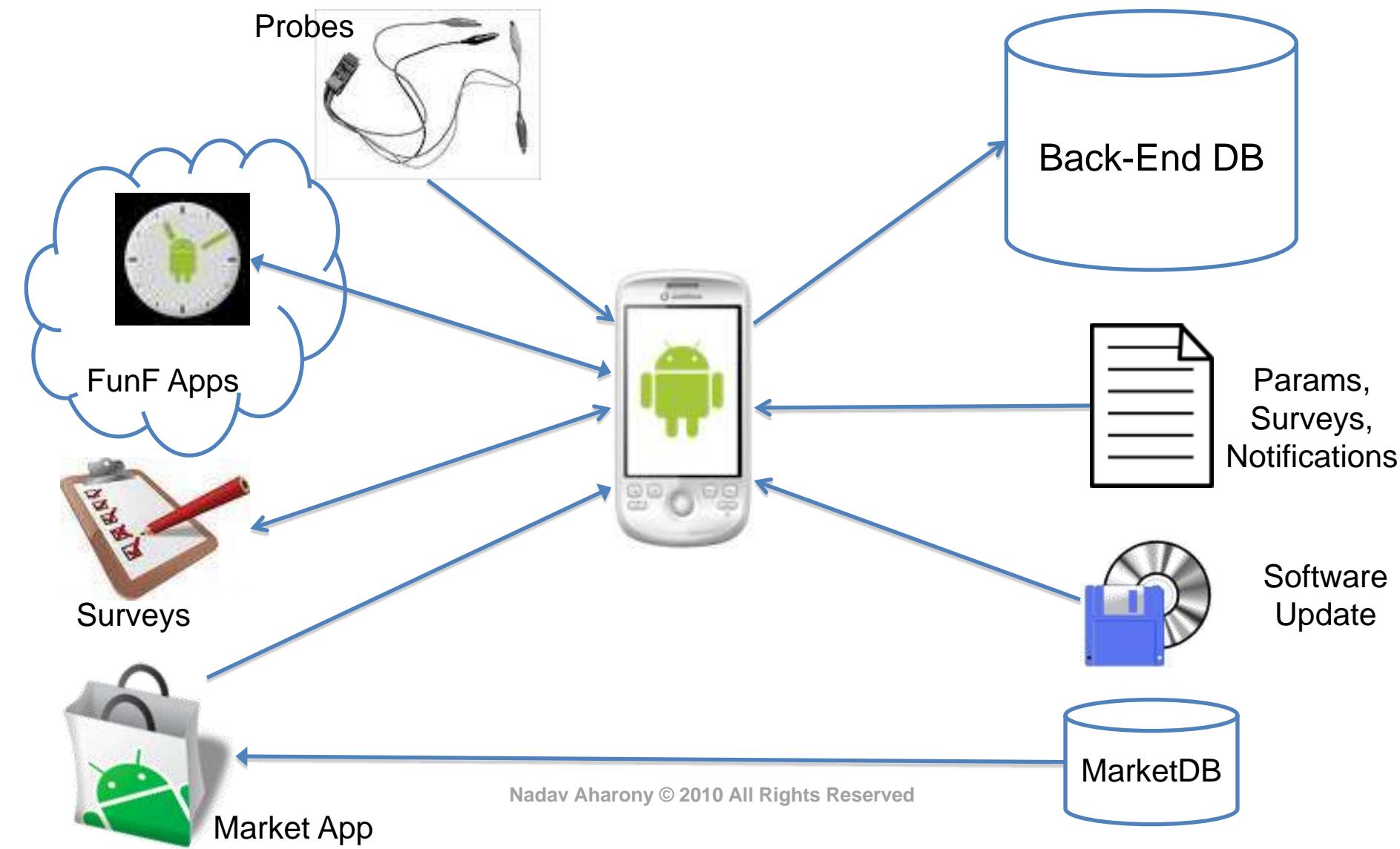
| (b)                           | Group 1 | Group2 |
|-------------------------------|---------|--------|
| Self Reported Closeness Range | [0,1]   | (1,10] |
| Mean #Common Apps / Pair      | 4.75    | 4.05   |
| ANOVA: F=4.97, p<0.026        |         |        |
| K-S test: True, p=0.0045      |         |        |

# fünf platform



## FunF Platform (Android)

MIT Media Lab  
www.media.mit.edu



- Remote configuration + software updates
- Backend database is an active component
  - Daily reports, email alerts, live app access to data
- Support external app integration
  - E.g. FunF Alarm clock, FunF App Market
  - “Experiment-App Market”
- Strategic privacy empowerment goal:
  - Increase user control over the data



## ■ Android Probe Types

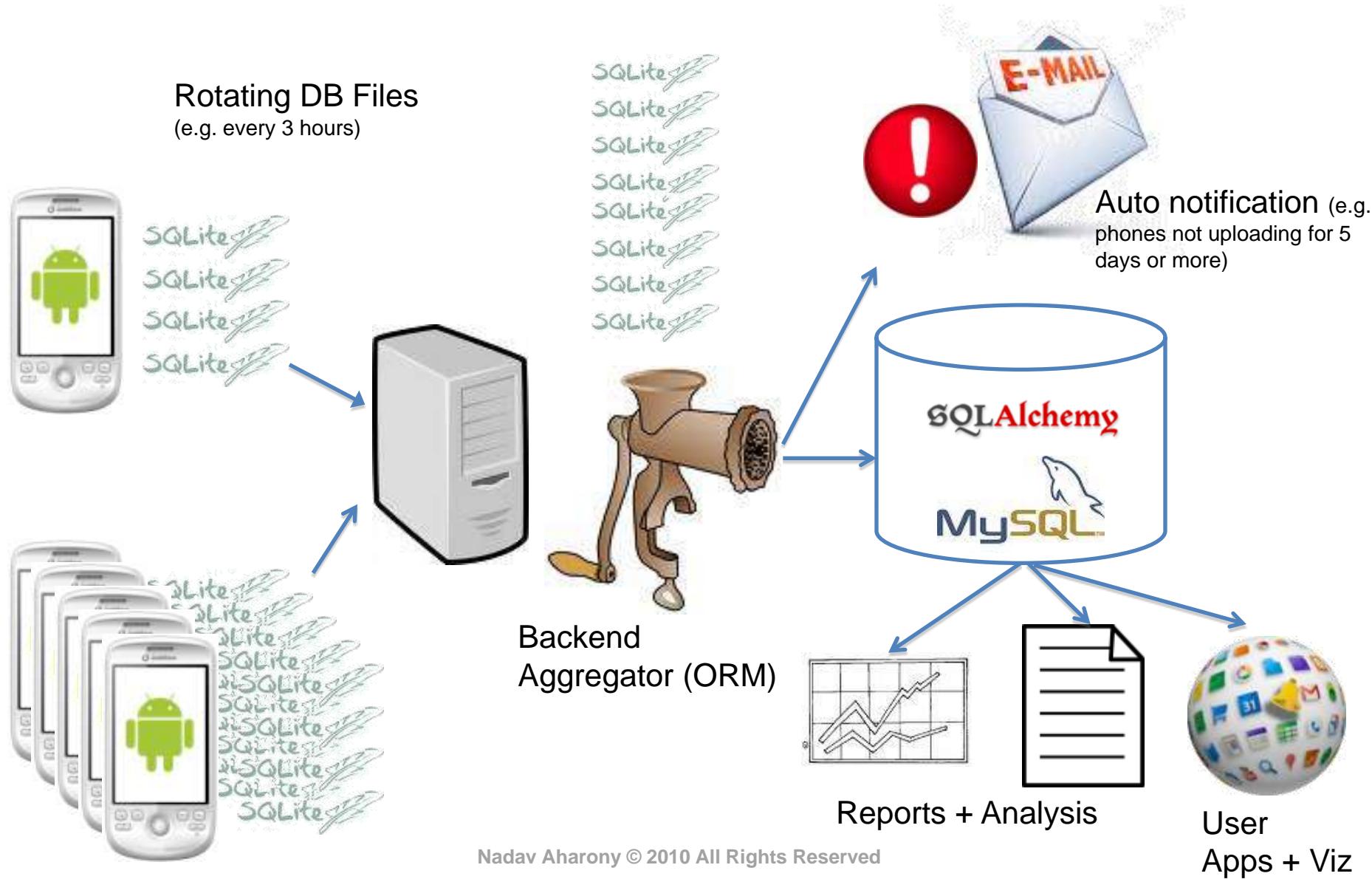
MIT Media Lab  
www.media.mit.edu

- Active Probes (physical component)
  - BT proximity, Location (WiFi, GPS), mic, ...
- Database Probes
  - call log, sms log, contacts, ...
- File probes
  - apps, photos, music
- Listener Probes: Any system event
  - Battery status, app install/uninstall, etc.
  - “Opportunistic” active scans
  - FunF-API Apps

[Database Structure](#) [Browse Data](#) [Execute SQL](#)

| Name               | Object | Type | Schema  |
|--------------------|--------|------|---|
| ► android_metadata | table  |      | CREATE TABLE android_metadata (locale TEXT)   |
| ► scan             | table  |      | CREATE TABLE scan( _id integer primary key autoincrement, date integer, probe text, scanid text)      |
| ► battery          | table  |      | CREATE TABLE battery (_id integer primary key autoincrement,date integer,level integer,present in...) |
| ► meta             | table  |      | CREATE TABLE meta(_id integer primary key autoincrement, androidID text, deviceID text, SDK i...      |
| ► alarm            | table  |      | CREATE TABLE alarm(_id integer, poptime integer, eventtime integer, scanid text,action text,rep...    |
| ► app              | table  |      | CREATE TABLE app(_id integer primary key autoincrement, apppackage text, appname text,appve...        |
| ► preferences      | table  |      | CREATE TABLE preferences(_id integer primary key autoincrement, CALLLOGSCANEnabled text, ...)         |
| ► browserbookmarks | table  |      | CREATE TABLE browserbookmarks(_id integer primary key autoincrement, title text, url text, visi...    |
| ► browsersearches  | table  |      | CREATE TABLE browsersearches(_id integer primary key autoincrement, search text, date long, s...      |
| ► runningapp       | table  |      | CREATE TABLE runningapp(_id integer primary key autoincrement, package text, class text,topcl...      |
| ► file             | table  |      | CREATE TABLE file(_id integer primary key autoincrement, name text, path text, last_modified lon...   |
| ► detailedmusic    | table  |      | CREATE TABLE detailedmusic(_id integer primary key autoincrement, album text, album_id long, ...)     |
| ► sqlite_sequence  | table  |      | CREATE TABLE sqlite_sequence(name,seq)  |
| ► detailedvideo    | table  |      | CREATE TABLE detailedvideo(_id integer primary key autoincrement, album text, artist text, book...    |
| ► detailedimages   | table  |      | CREATE TABLE detailedimages(_id integer primary key autoincrement, bucket_display_name text)          |
| ► sensoracc        | table  |      | CREATE TABLE sensoracc(_id integer primary key autoincrement, time long, x double,y double,z ...)     |
| ► sensorori        | table  |      | CREATE TABLE sensorori(_id integer primary key autoincrement, time long, x double,y double,z d...     |
| ► survey           | table  |      | CREATE TABLE survey(_id integer primary key autoincrement, week text, survey text,questions te...     |
| ► completemarker   | table  |      | CREATE TABLE completemarker(_id integer primary key autoincrement, nothing text)                      |
| ► sms              | table  |      | CREATE TABLE sms(_id integer primary key autoincrement, type integer(1), number text, scanid ...)     |
| ► location         | table  |      | CREATE TABLE location(_id integer primary key autoincrement, latitude text, longitude text, sca...    |
| ► callog           | table  |      | CREATE TABLE callog(_id integer primary key autoincrement, type integer(1), number text, scanid ...)  |
| ► contact          | table  |      | CREATE TABLE contact(_id integer primary key autoincrement, name text, number text, scanid ...)       |
| ► bluetooth        | table  |      | CREATE TABLE bluetooth(_id integer primary key autoincrement, date integer, scanid text, nam...       |
| ► wifi             | table  |      | CREATE TABLE wifi(_id integer primary key autoincrement, date integer, name text, scanid text...)     |
| ► cell             | table  |      | CREATE TABLE cell(_id integer primary key autoincrement, date integer, scanid text, cid integ...      |

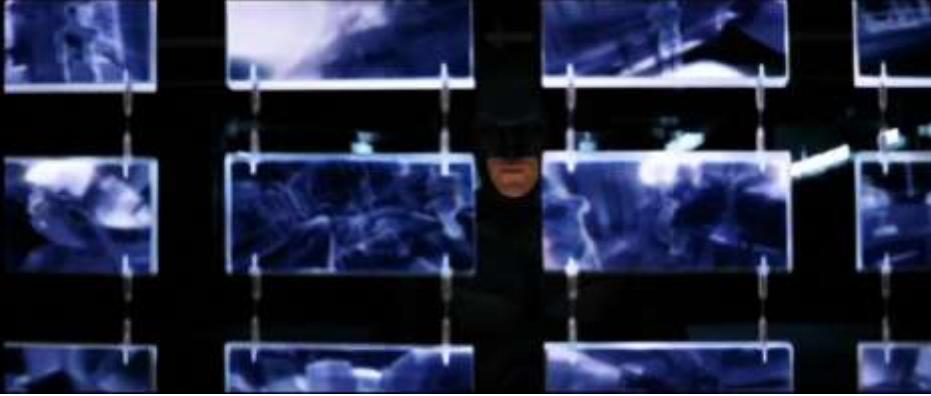
## FunF BackEnd



- User
- “Study Manager”
  - Deploy the APK
  - Configure backend
  - Configure scan parameters
- API Developer
  - Extend 3<sup>rd</sup> party apps + experiments
- Core Developer
  - Contribute to the system core (new probes, etc.)

## Probe Configuration Example

```
<?php
    $pref_default = array("pref_version" => 1, "hours"=>"3",
    "probe_manager_enable" => true,
    "locaton_probe_enable"=> true,
    "location_probe_period"=> 5,
    "bluetooth_probe_enable"=> true,
    "bluetooth_probe_period"=> 5,
    "calllog_probe_enable"=> true,
    "calllog_probe_period"=> 30,
    "sms_probe_enable"=> true,
    "sms_probe_period"=> 30,
    "contact_probe_enable"=>true,
    "contact_probe_period"=> 600,
    "cell_probe_enable"=>true,
    "cell_probe_period"=> 3,
    "battery_probe_enable"=>true,
    "pref_update_enable" => true,
    "update_enable" => true,
    "wifi_probe_enable" => true,
    "wifi_probe_period" => 4
);
echo json_encode($pref_default);
?>
```



**Beautiful, isn't it?**

**Beautiful. Unethical. DANGEROUS.  
You've turned every cellphone in  
Gotham into a microphone.**

• • •

**The database is null-key encrypted. It  
can only be accessed by one person.**

**This is too much power for one person.**



- Users collect, “own”, control their raw data
- Can gain “selfish” benefit from the data
- Can share data with trusted parties
  - People, communities, companies
  - Different granularities of data (raw, aggregate, categorical...)
  - System itself can help with setting configurations

- Users collect, “own”, control their raw data
- Can gain “selfish” benefit from the data
- Can share data with trusted parties
  - People, communities, companies
  - Different granularities of data (raw, aggregate, categorical...)
  - System itself can help with setting configurations

Incoming Call,  
1-617-555-5555  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

- Users collect, “own”, control their raw data
- Can gain “selfish” benefit from the data
- Can share data with trusted parties
  - People, communities, companies
  - Different granularities of data (raw, aggregate, categorical...)
  - System itself can help with setting configurations

Incoming Call,  
1-617-555-5555  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

Incoming Call,  
**“A323FFH3SFRAB”**  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

- Users collect, “own”, control their raw data
- Can gain “selfish” benefit from the data
- Can share data with trusted parties
  - People, communities, companies
  - Different granularities of data (raw, aggregate, categorical...)
  - System itself can help with setting configurations

Incoming Call,  
1-617-555-5555  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

Incoming Call,  
**“A323FFH3SFRAB”**  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

~25 Calls to  
“A323FFH3SFRAB”  
In 2010  
Avg Length: 7m

- Users collect, “own”, control their raw data
- Can gain “selfish” benefit from the data
- Can share data with trusted parties
  - People, communities, companies
  - Different granularities of data (raw, aggregate, categorical...)
  - System itself can help with setting configurations

Incoming Call,  
1-617-555-5555  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

Incoming Call,  
**“A323FFH3SFRAB”**  
10/04/2010, 3:45pm  
Duration: 10 minutes  
...

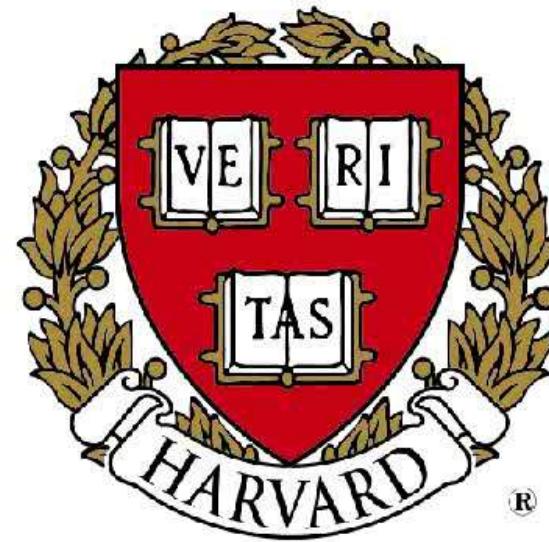
~25 Calls to  
“A323FFH3SFRAB”  
In 2010  
Avg Length: 7m

User is type “x” person  
User is a **student**  
User likes **sports**

# Personal Data Storage



**MIT Human  
Dynamics**



**Harvard  
Berkman Center**



Me, and the behavioral  
data I am generating



Personal Data Storage  
(Digital Wallet)



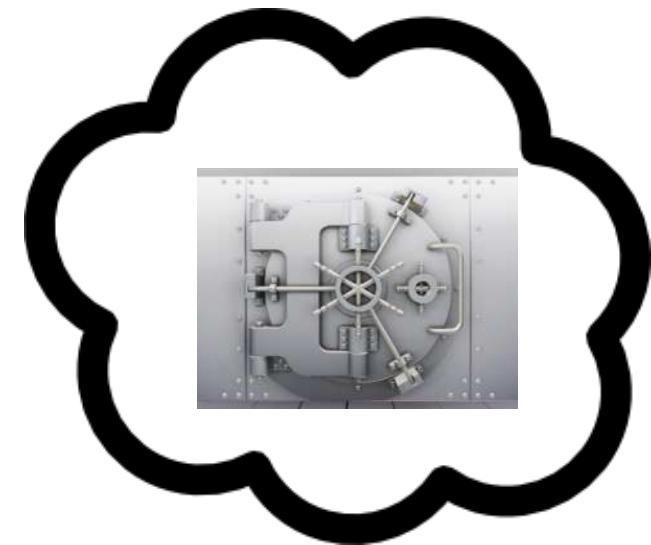
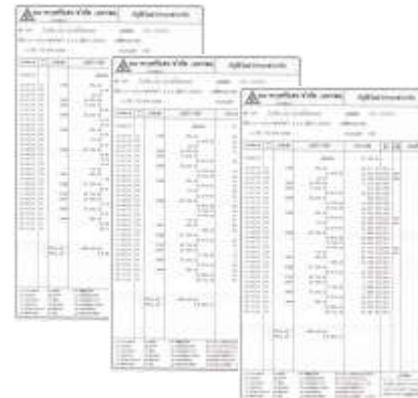
3<sup>rd</sup> Party Data Analysis App



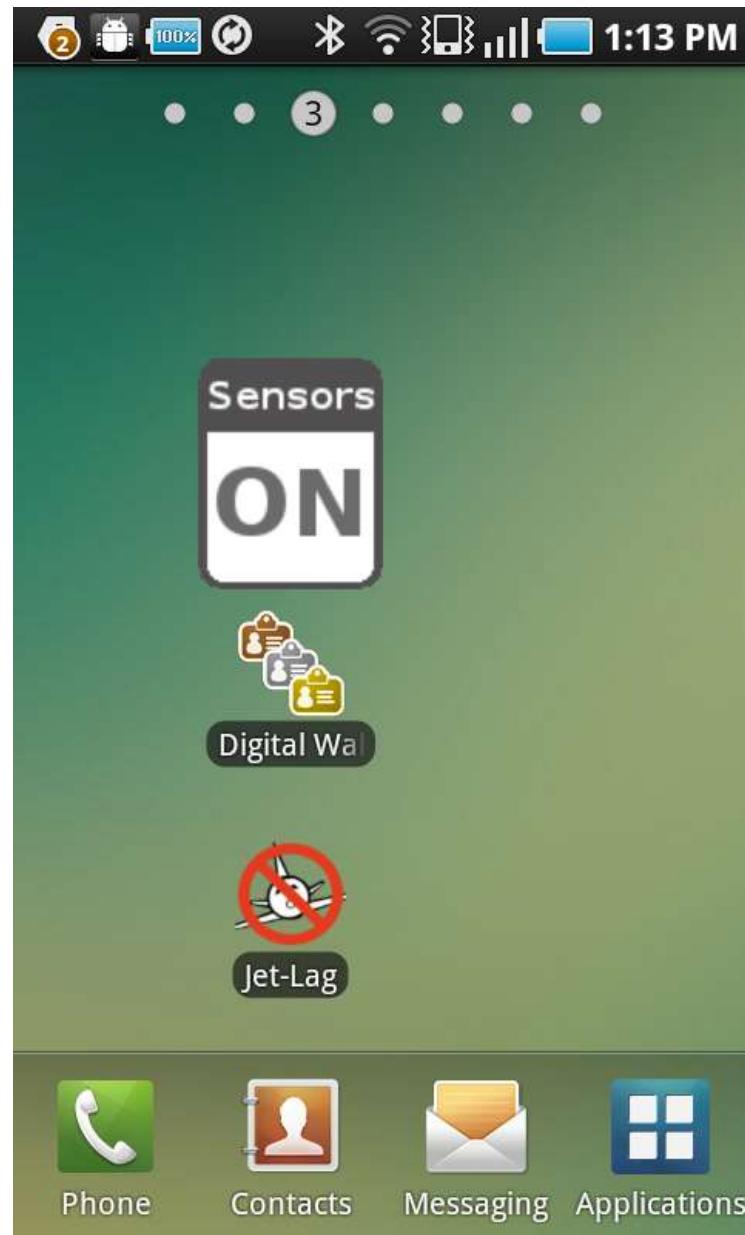
# Personal Data Storage



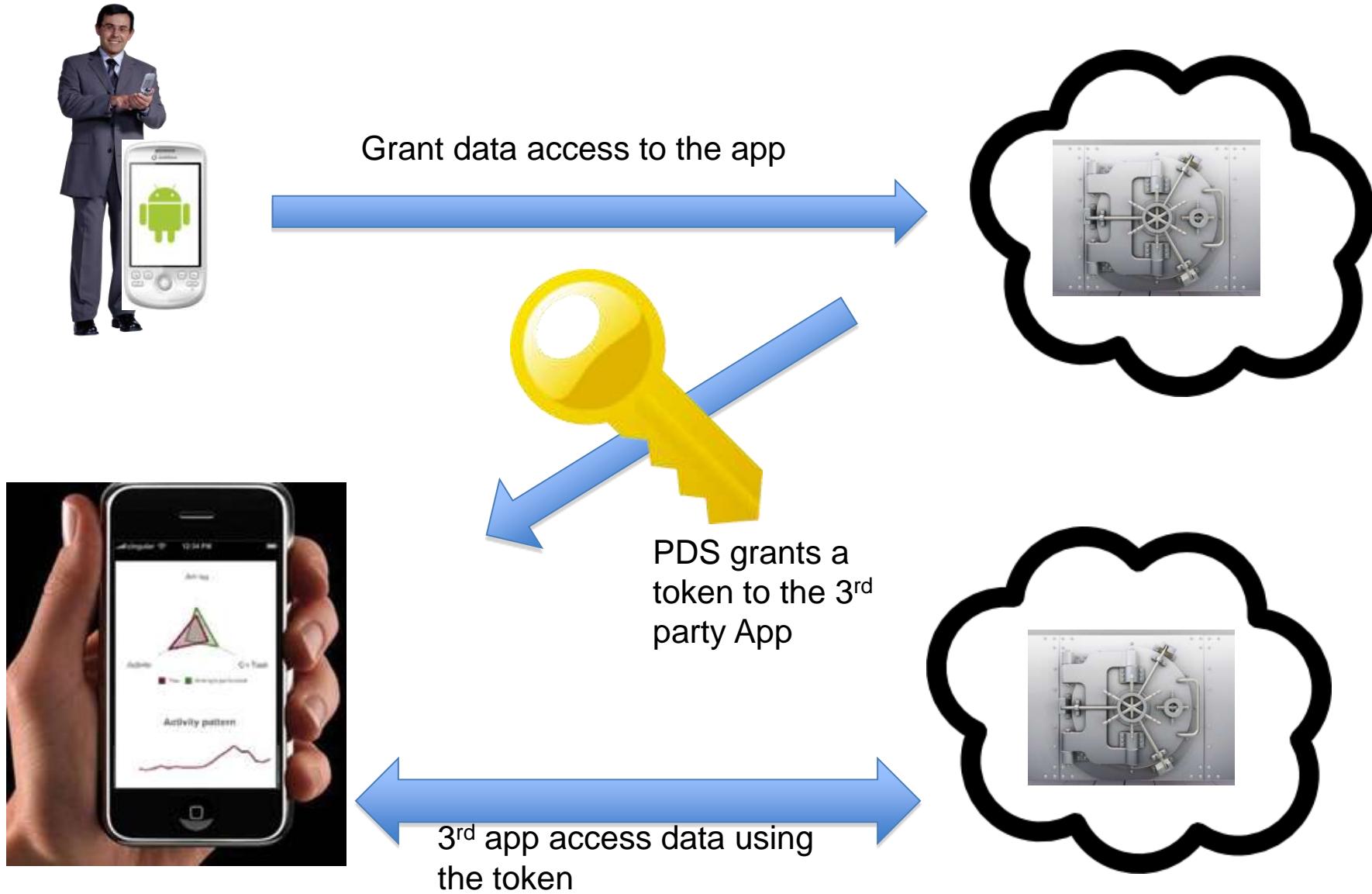
01010101010111110...  
1010100000111110010...



Data Usage  
Statement



## Share Data with 3<sup>rd</sup> Party Application



## Grant Access using PDS



Digital Wallet PDS



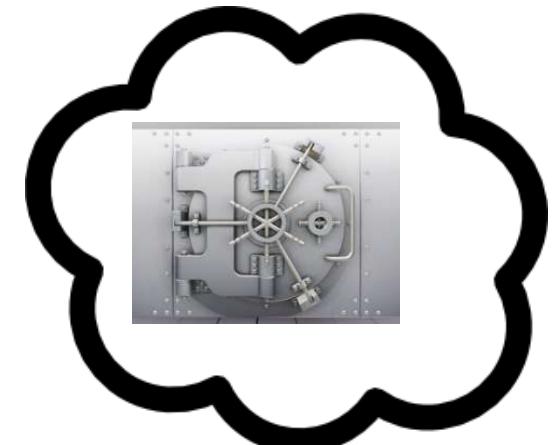
3<sup>rd</sup> Party App



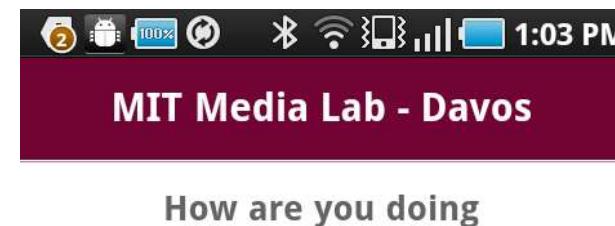
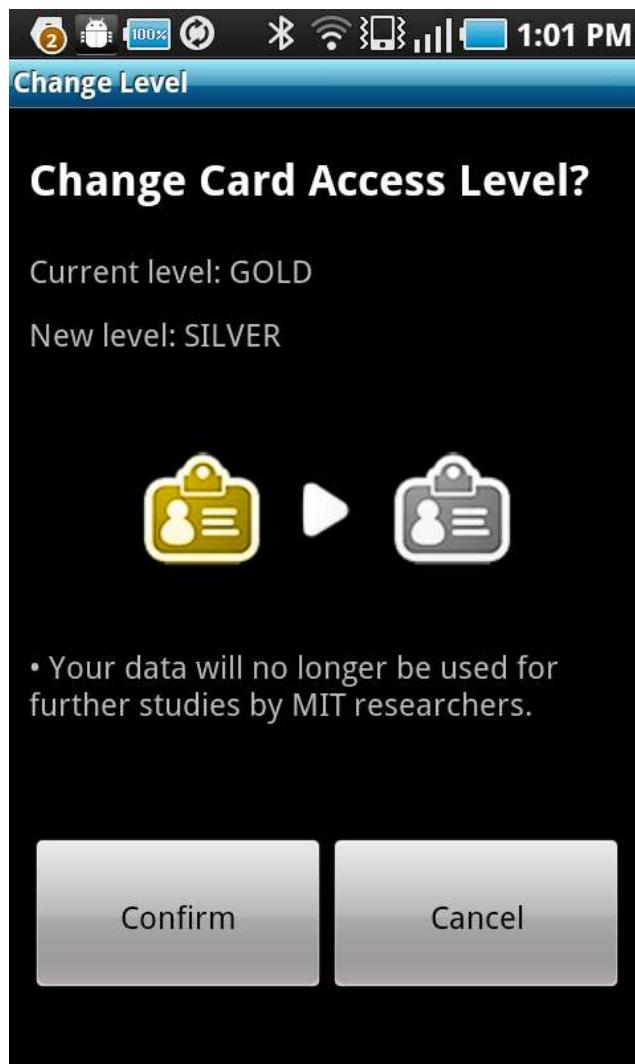
## Change/Revoke 3<sup>rd</sup> Party Applications



Change/Revoke access permission  
to the 3<sup>rd</sup> party application



## Change 3<sup>rd</sup> Party App Access Level



Activity pattern



## Revoke 3<sup>rd</sup> Party App Access

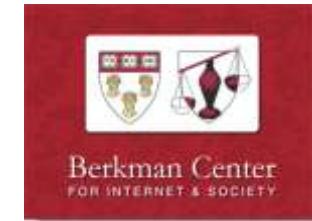




## Collaborations

MIT Media Lab  
[www.media.mit.edu](http://www.media.mit.edu)

- Harvard Berkman Center, Law Lab
  - Personal Data Store/Vault
  - World Economic Forum demo
- Google.org
  - Crisis Response Kit (Haiti pilot)
  - Volunteer Fire Dept. Study
- Google Health
  - Open source platform,  
mobile health & wellness, ‘quantified self’

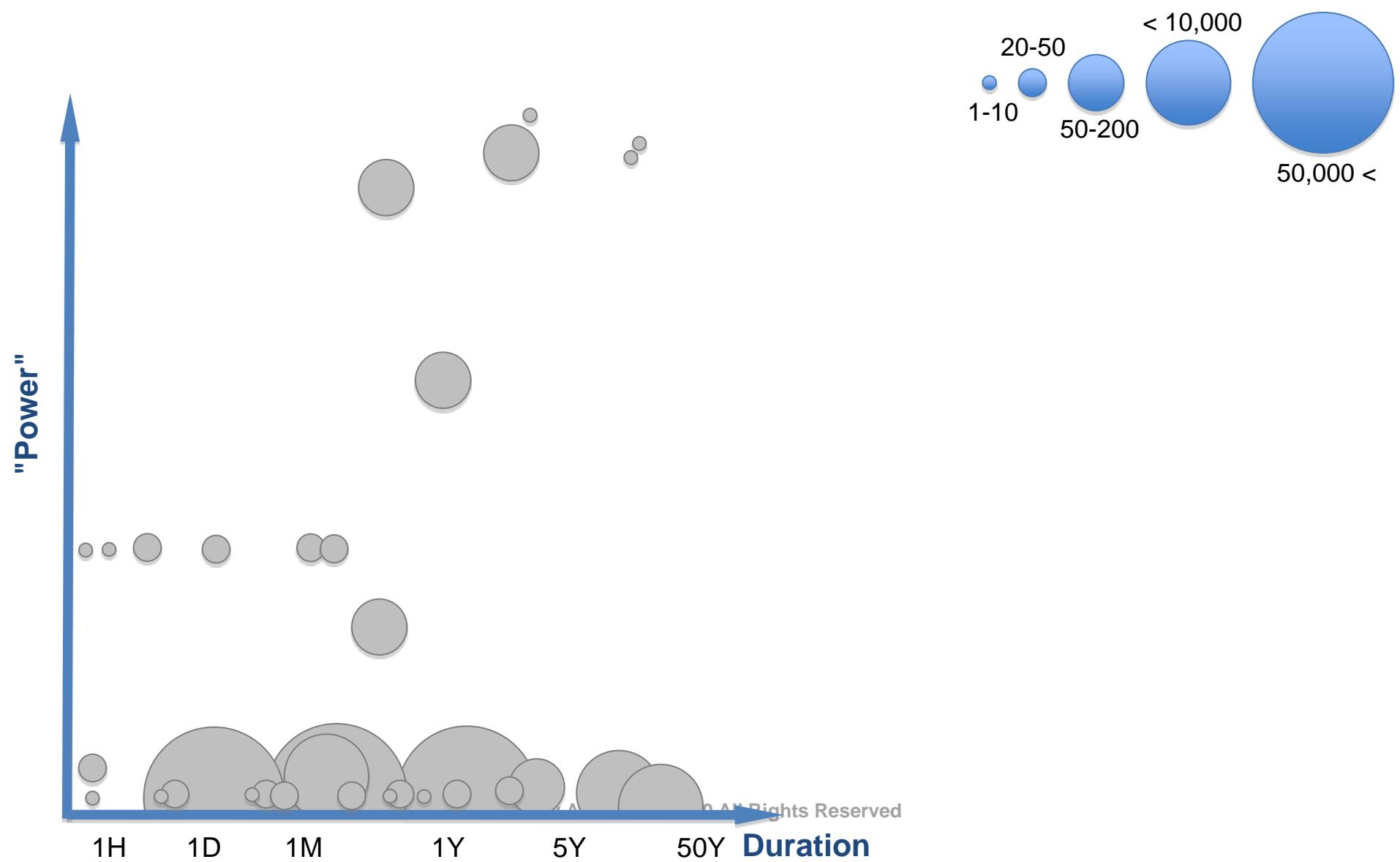


google.org



## Social & Behavioral Datasets

MIT Media Lab  
www.media.mit.edu





## ■ “Experimental Power”

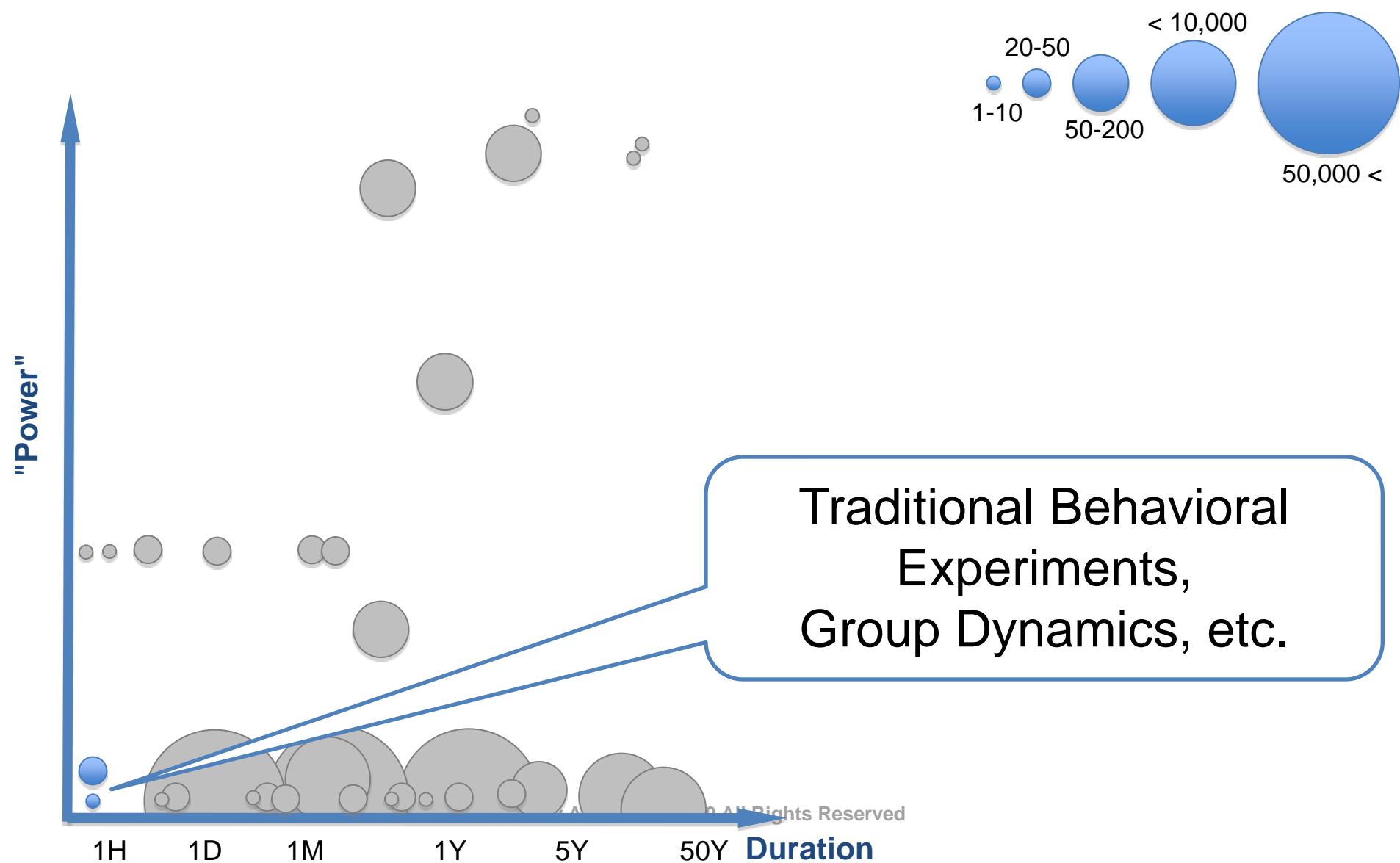
MIT Media Lab  
www.media.mit.edu

- (For lack of better term)
- This is NOT about:
  - Traditional throughput / bit-rate / megapixels
  - Traditional statistical power
- This IS about:
  - Power for proving hypotheses
  - Amount of unique information
  - Quality of information
- Still a fuzzy distinction: “potential” vs. “extracted value”



## Social & Behavioral Datasets

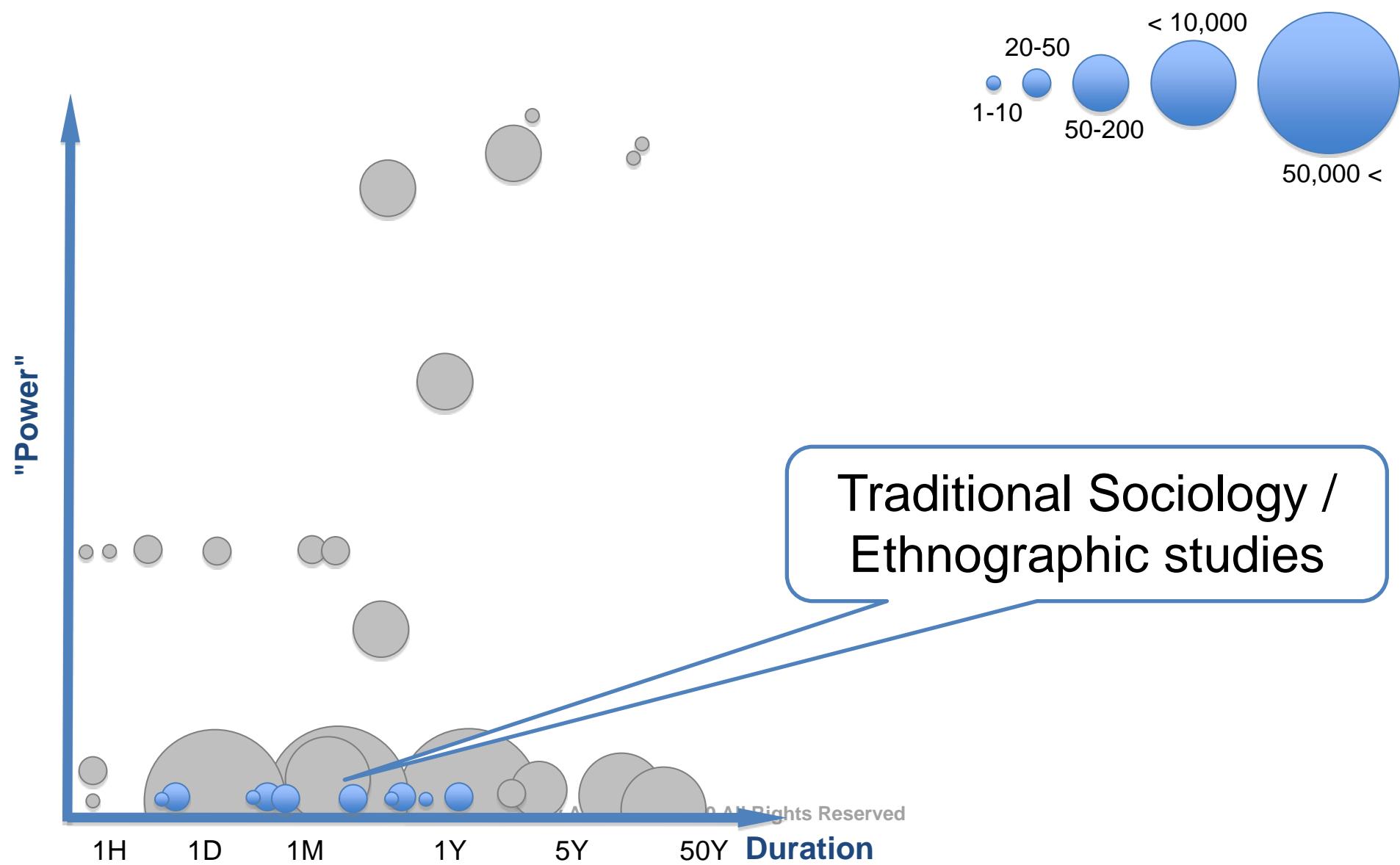
MIT Media Lab  
www.media.mit.edu





## Social & Behavioral Datasets

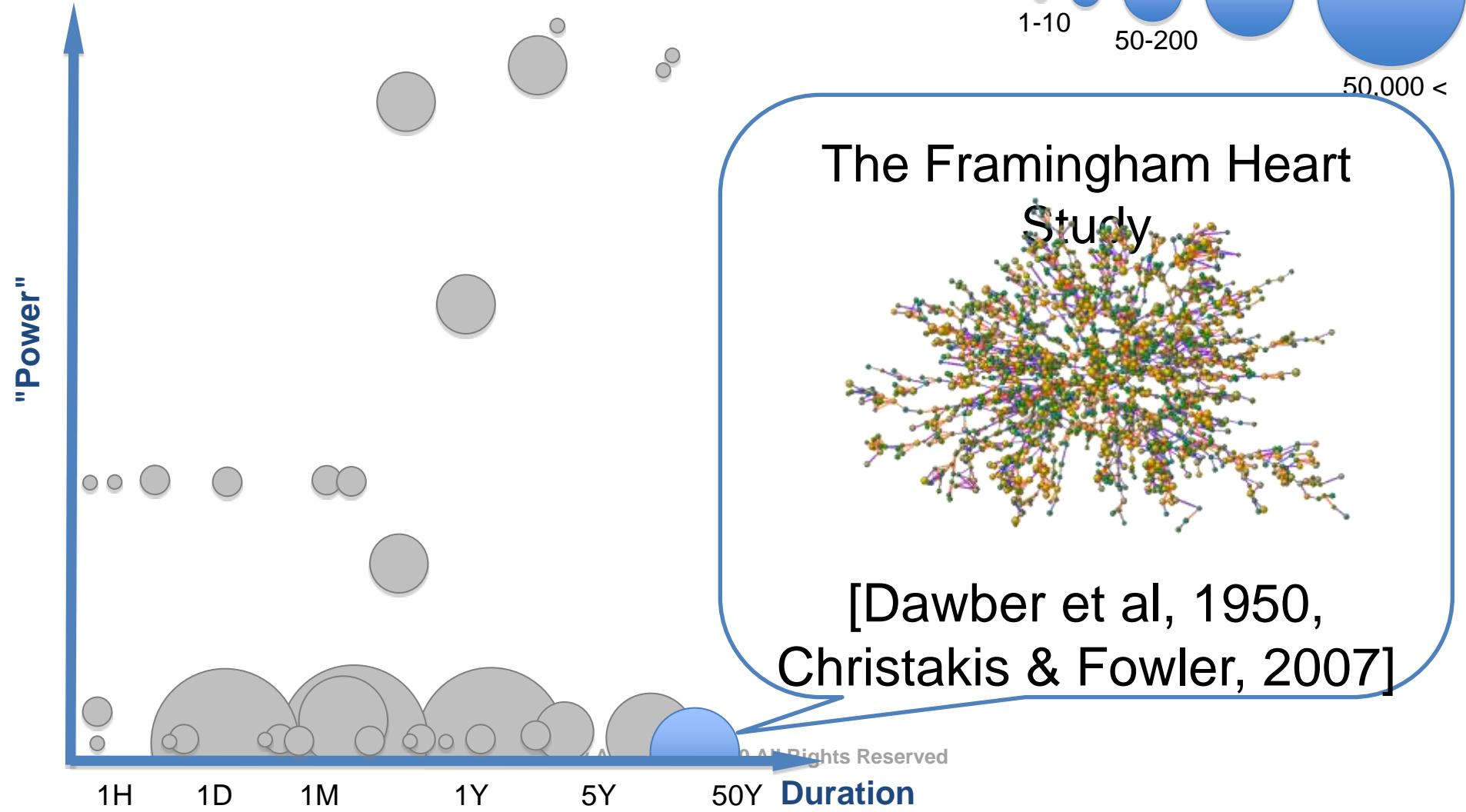
MIT Media Lab  
www.media.mit.edu





## Social & Behavioral Datasets

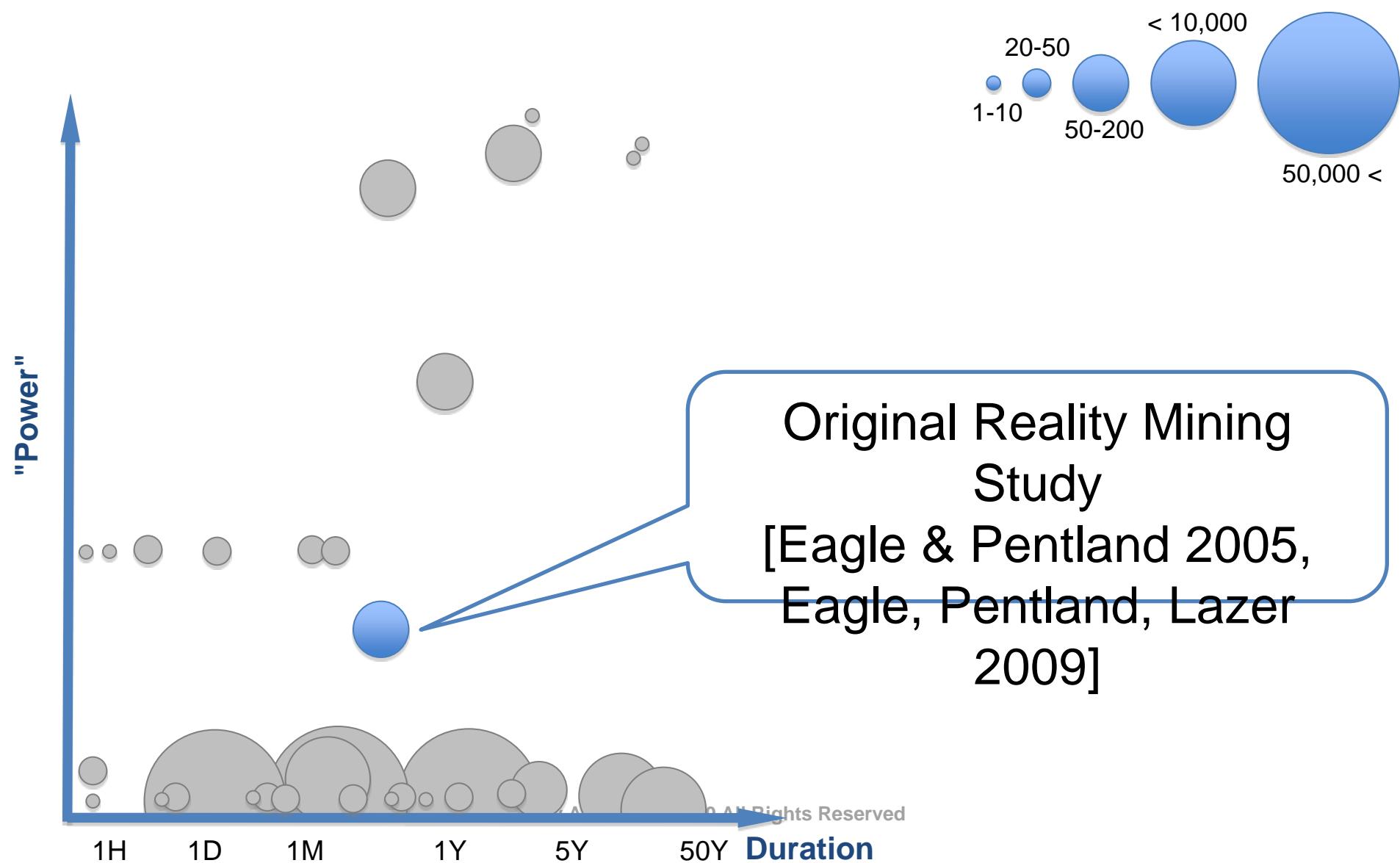
MIT Media Lab  
www.media.mit.edu





## Social & Behavioral Datasets

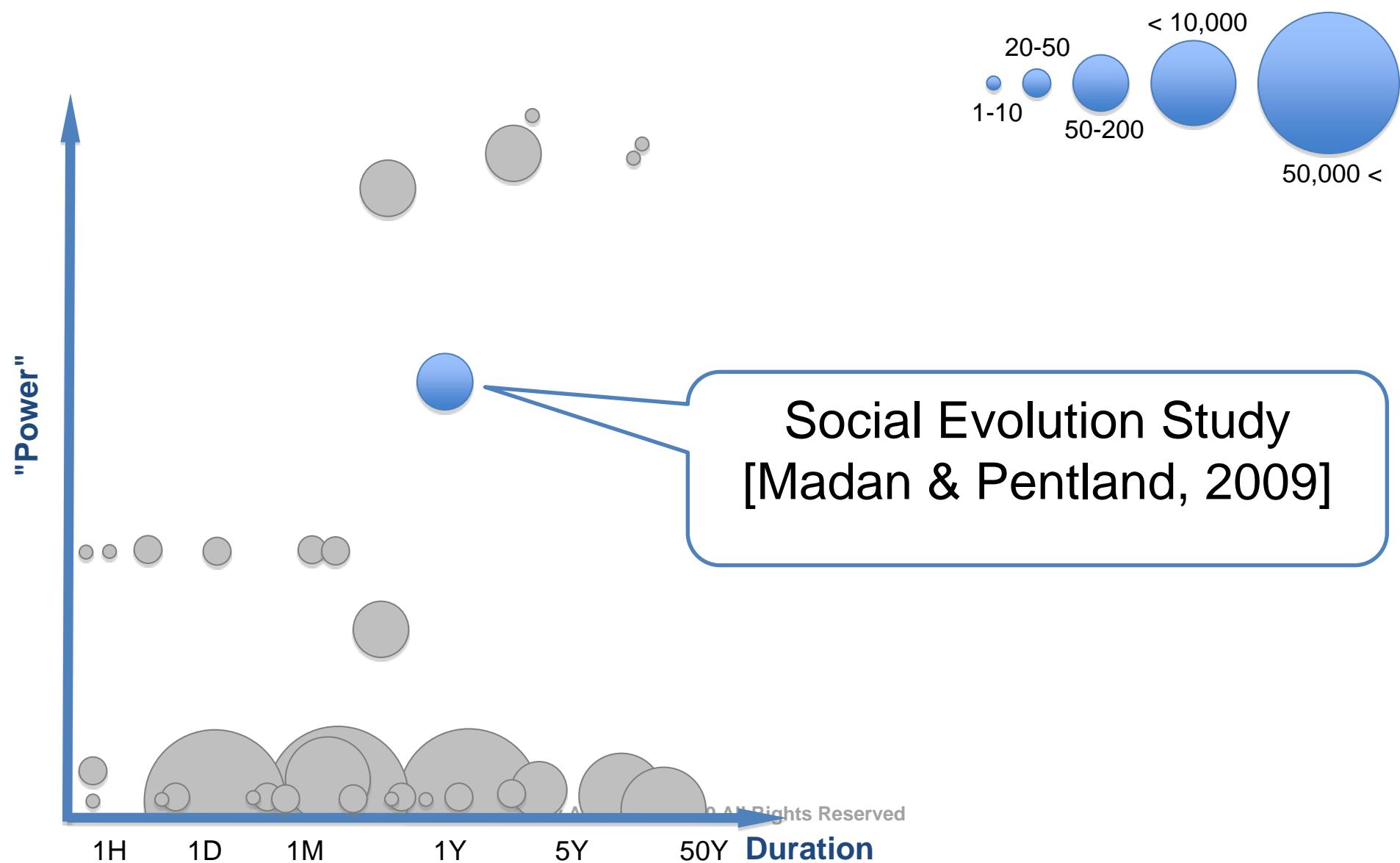
MIT Media Lab  
www.media.mit.edu





## Social & Behavioral Datasets

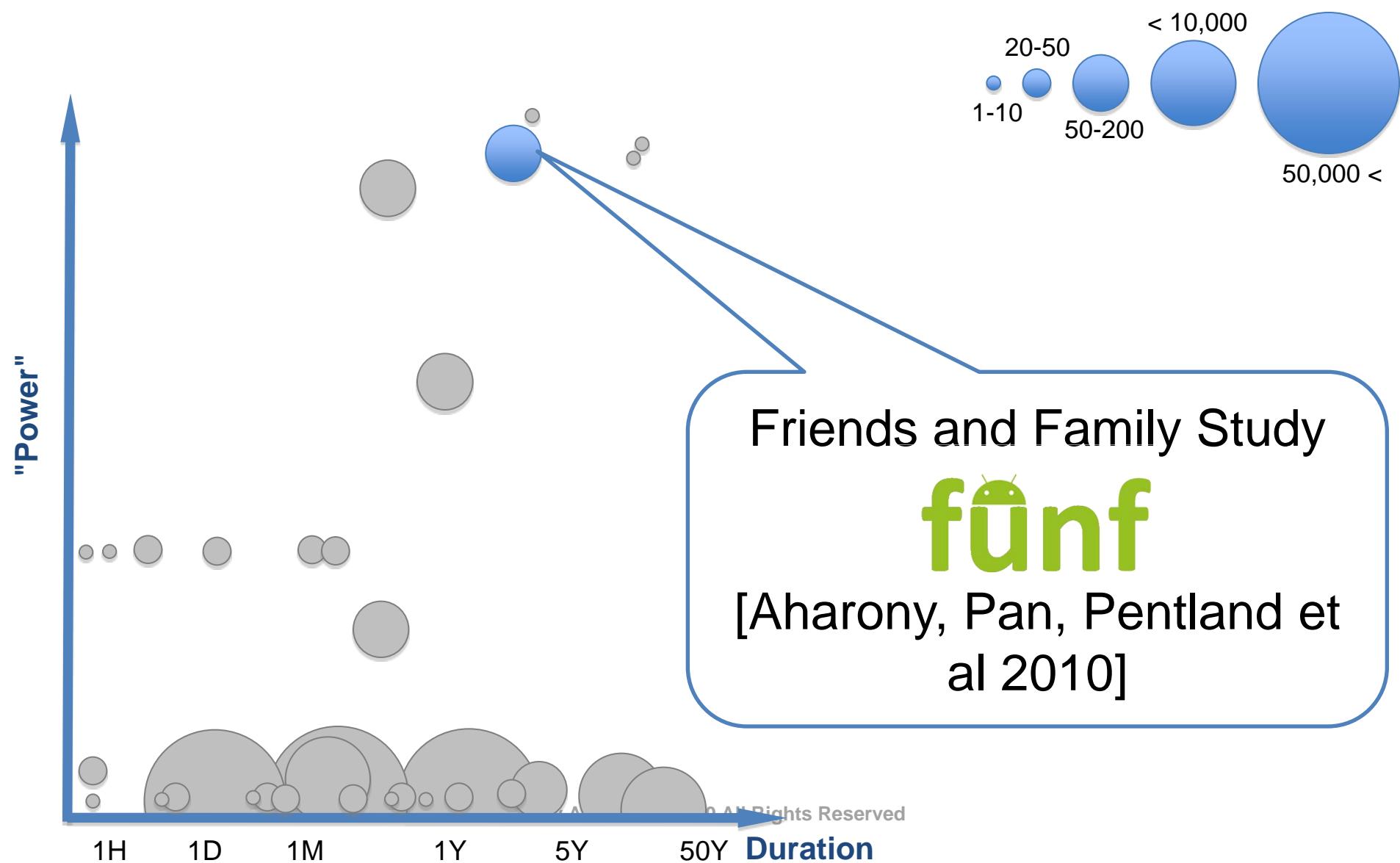
MIT Media Lab  
www.media.mit.edu





## Social & Behavioral Datasets

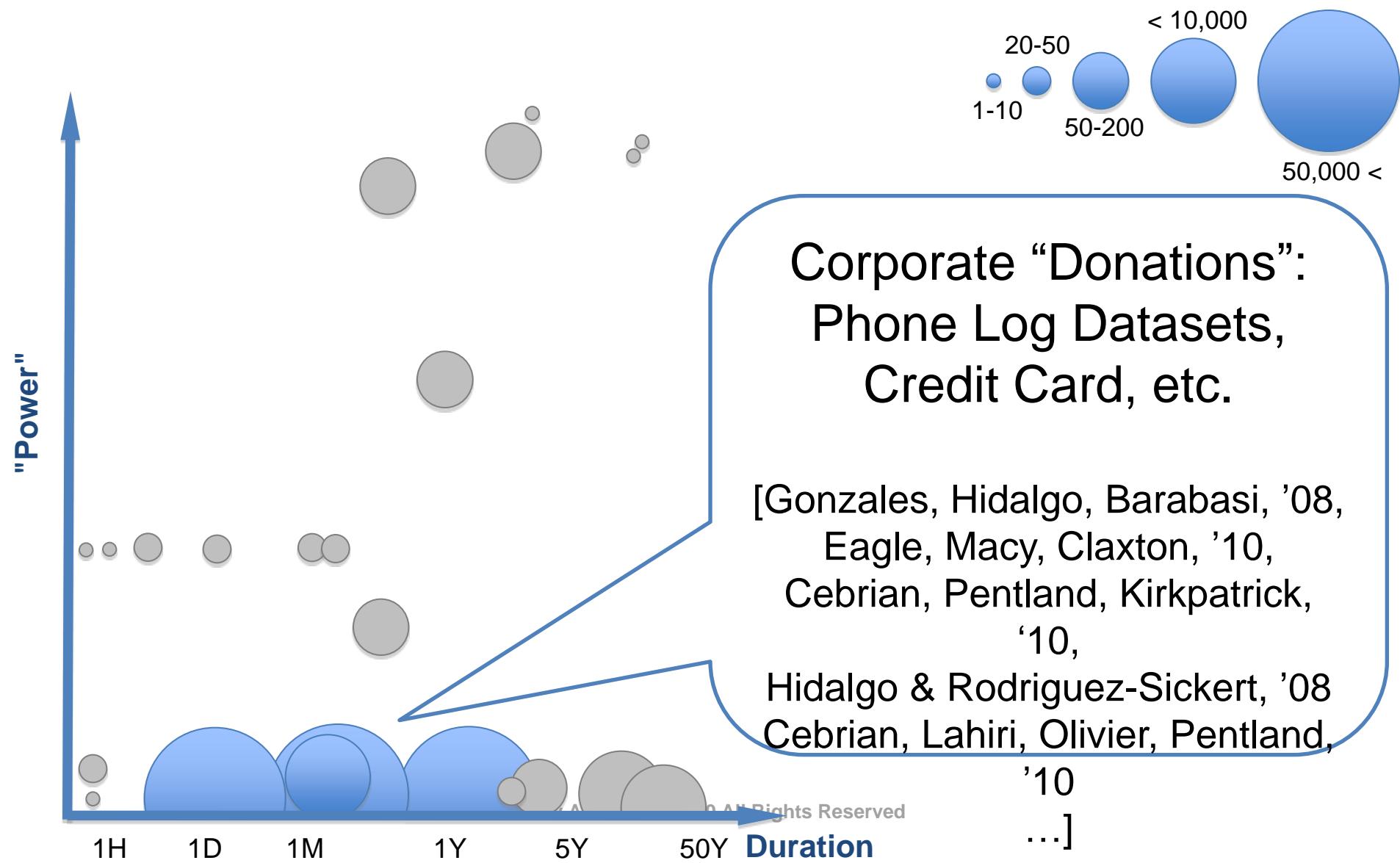
MIT Media Lab  
www.media.mit.edu





## Social & Behavioral Datasets

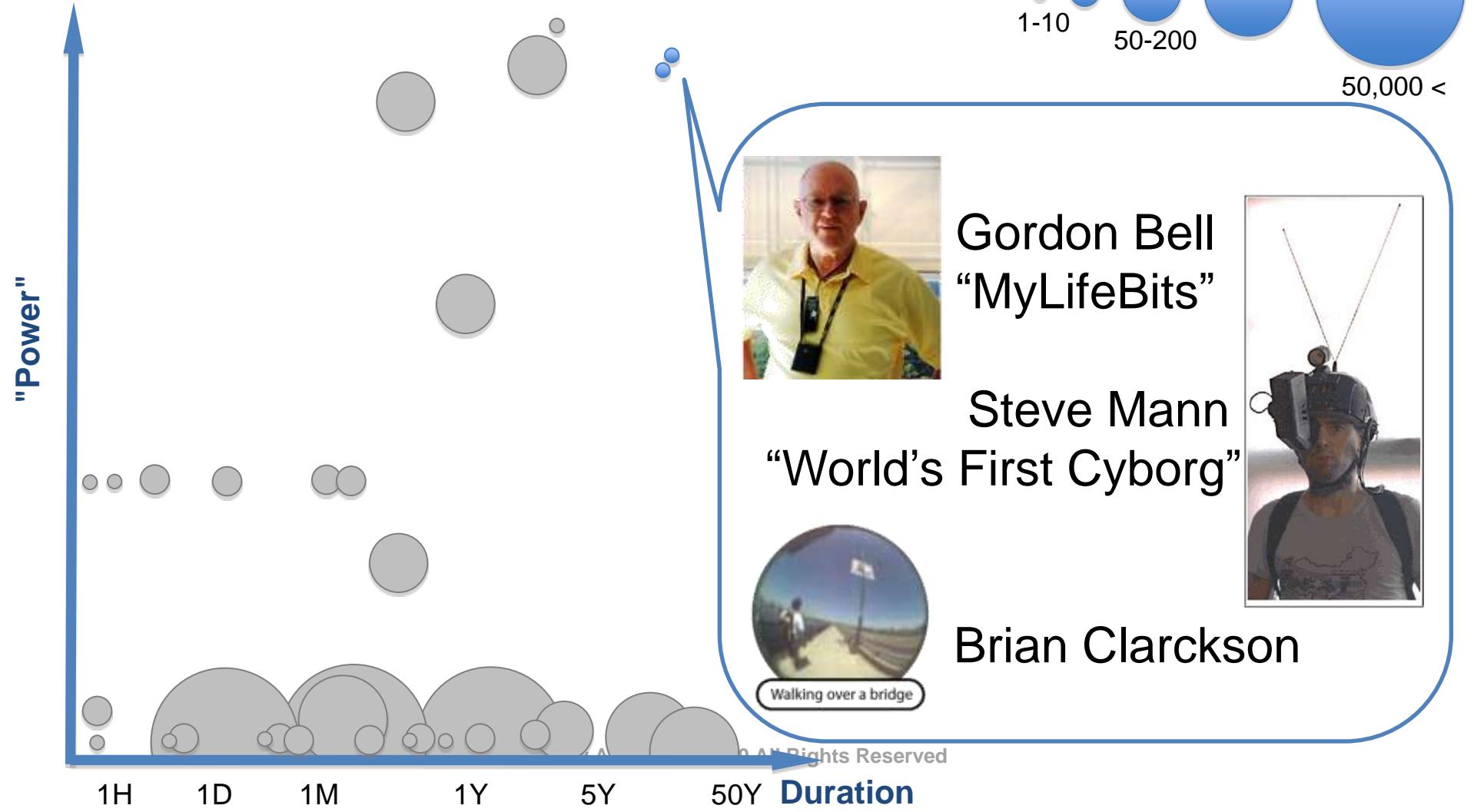
MIT Media Lab  
www.media.mit.edu





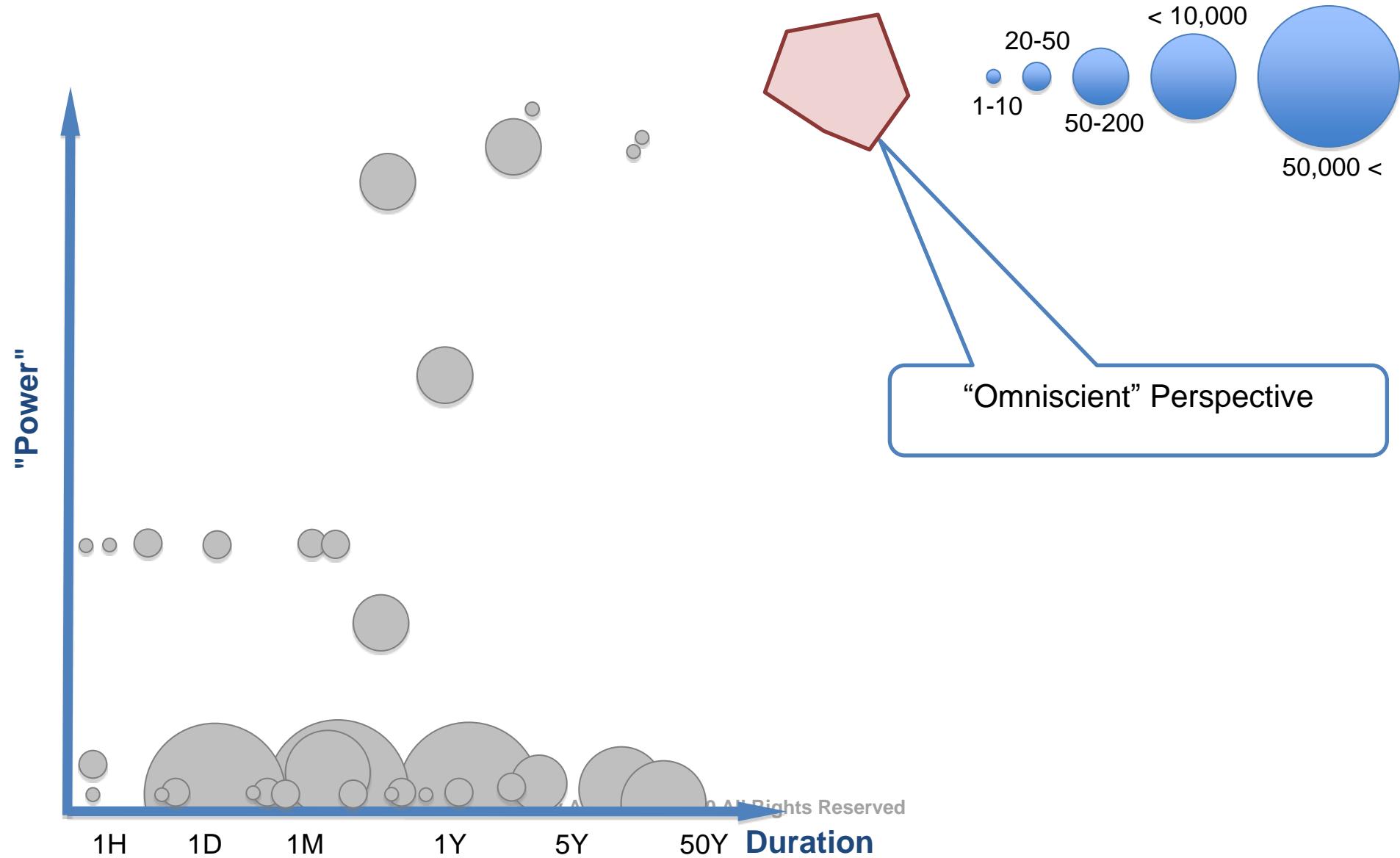
## Social & Behavioral Datasets

MIT Media Lab  
www.media.mit.edu



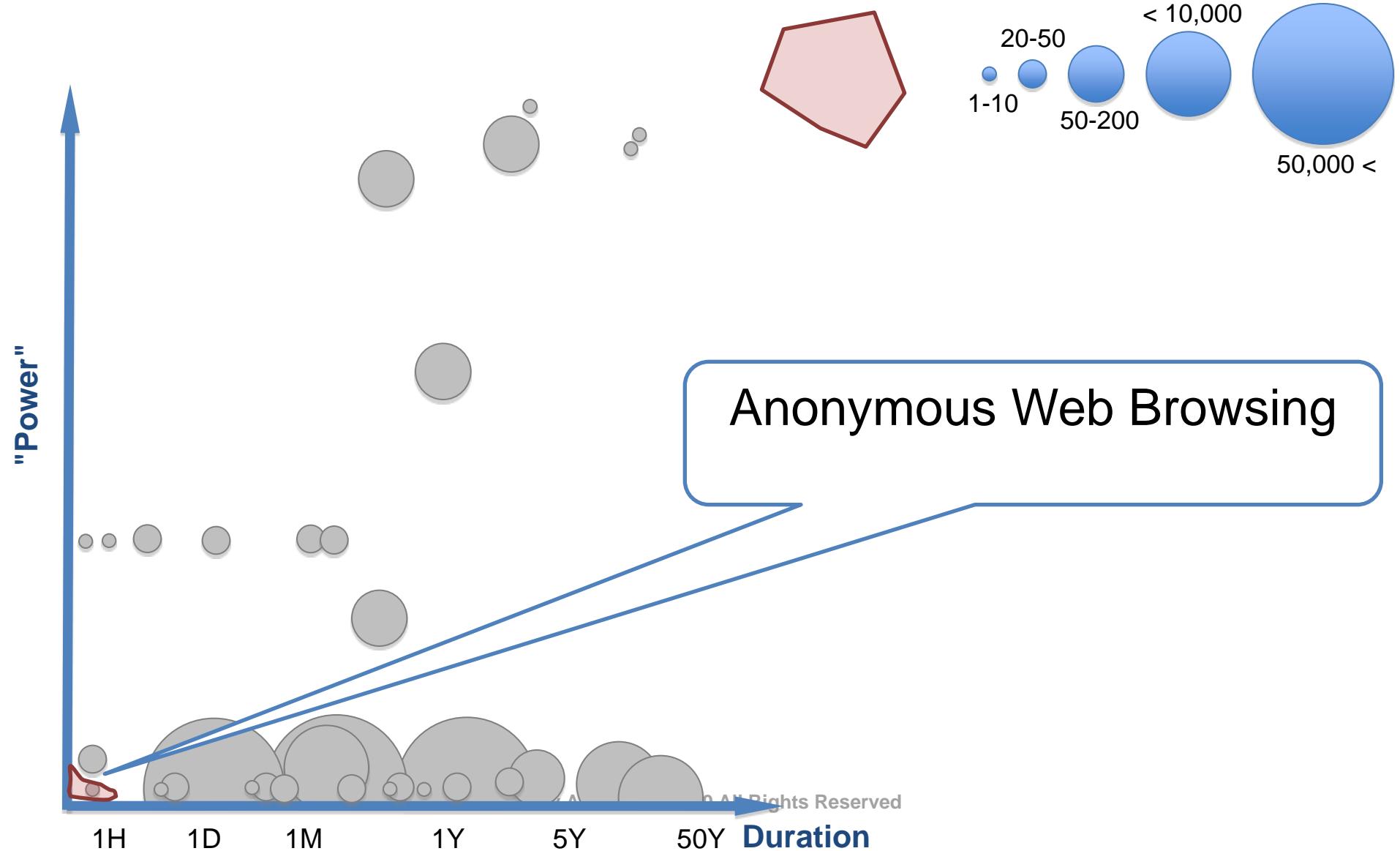


## Additional Trends



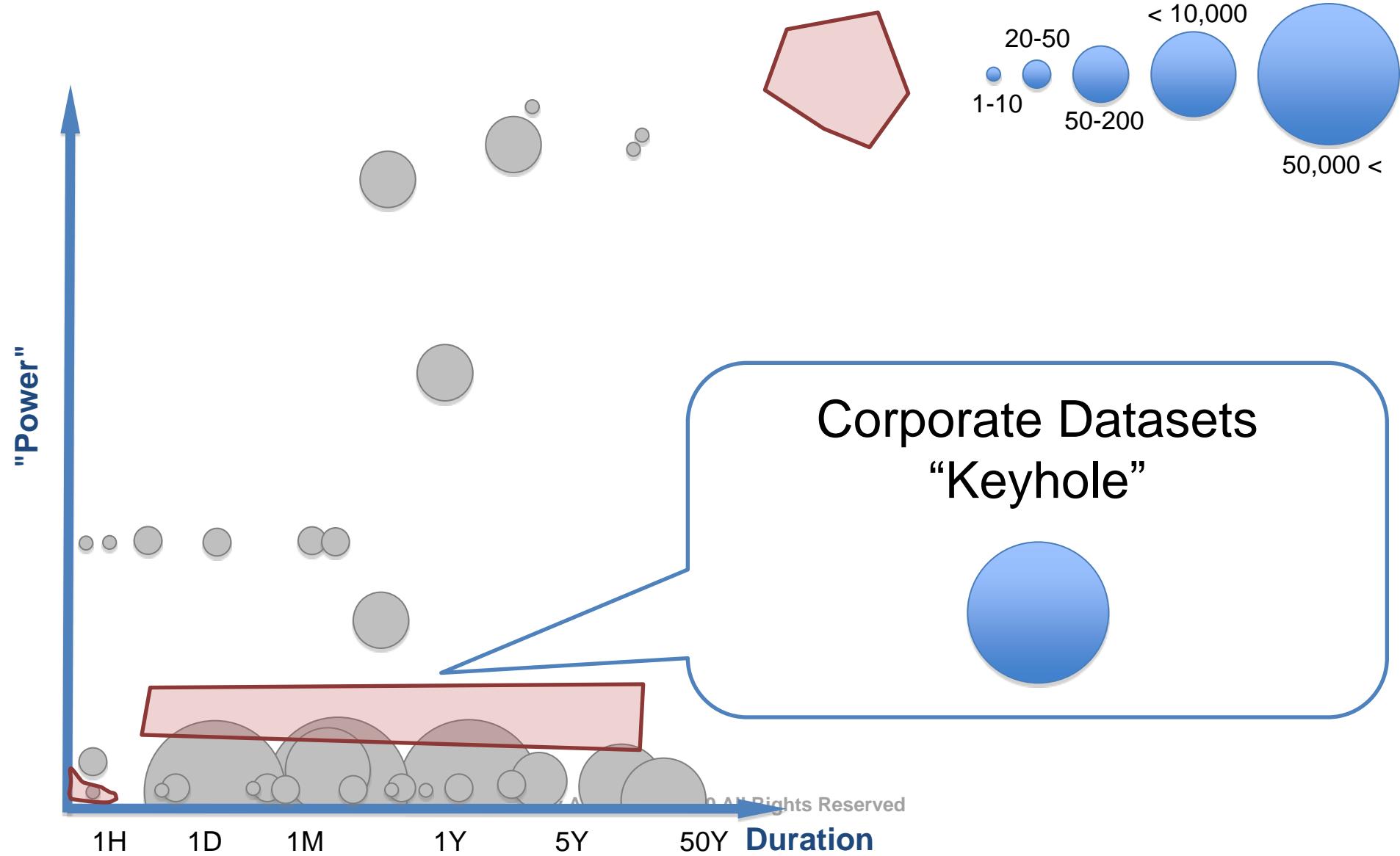


## Additional Trends



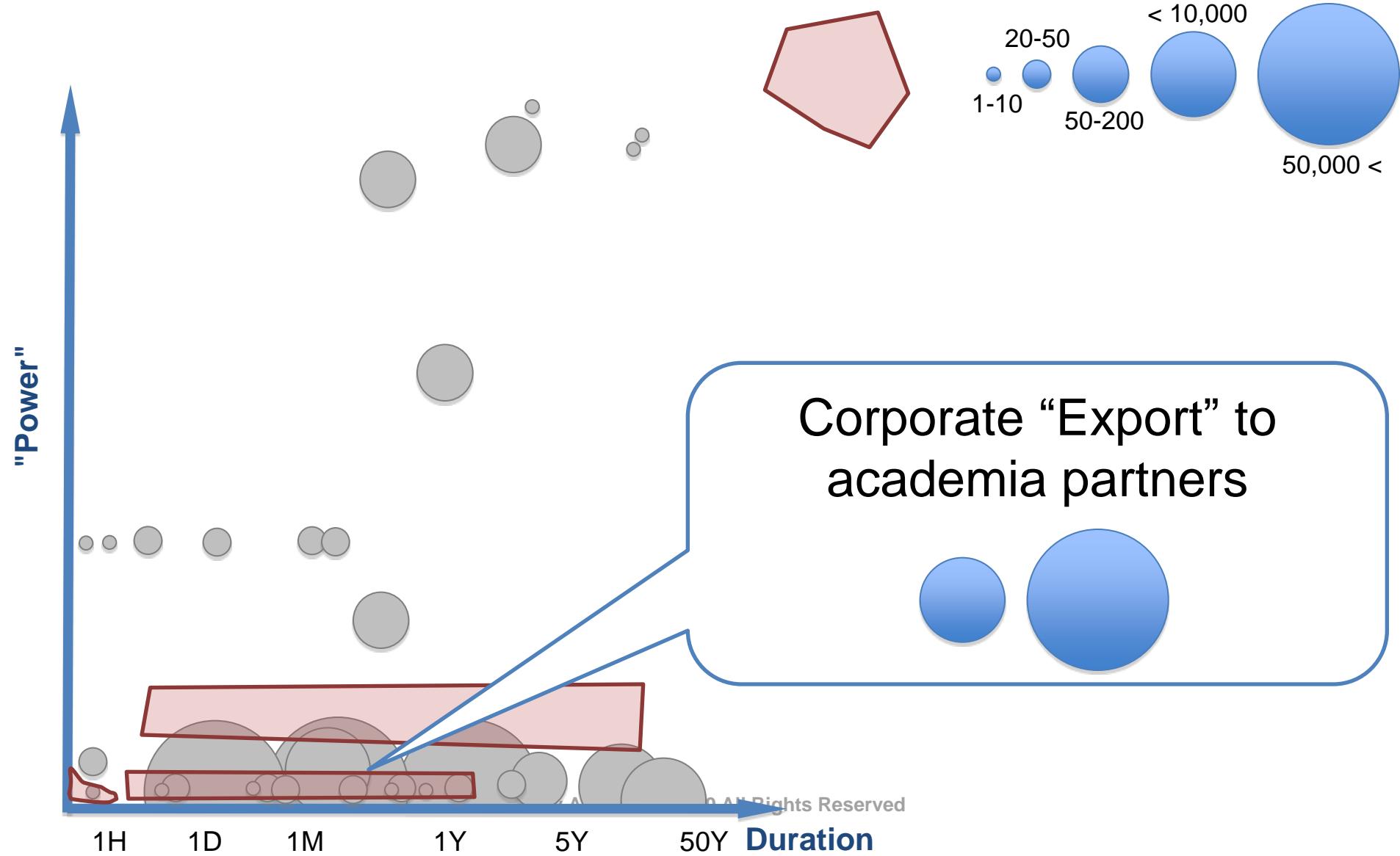


## Additional Trends



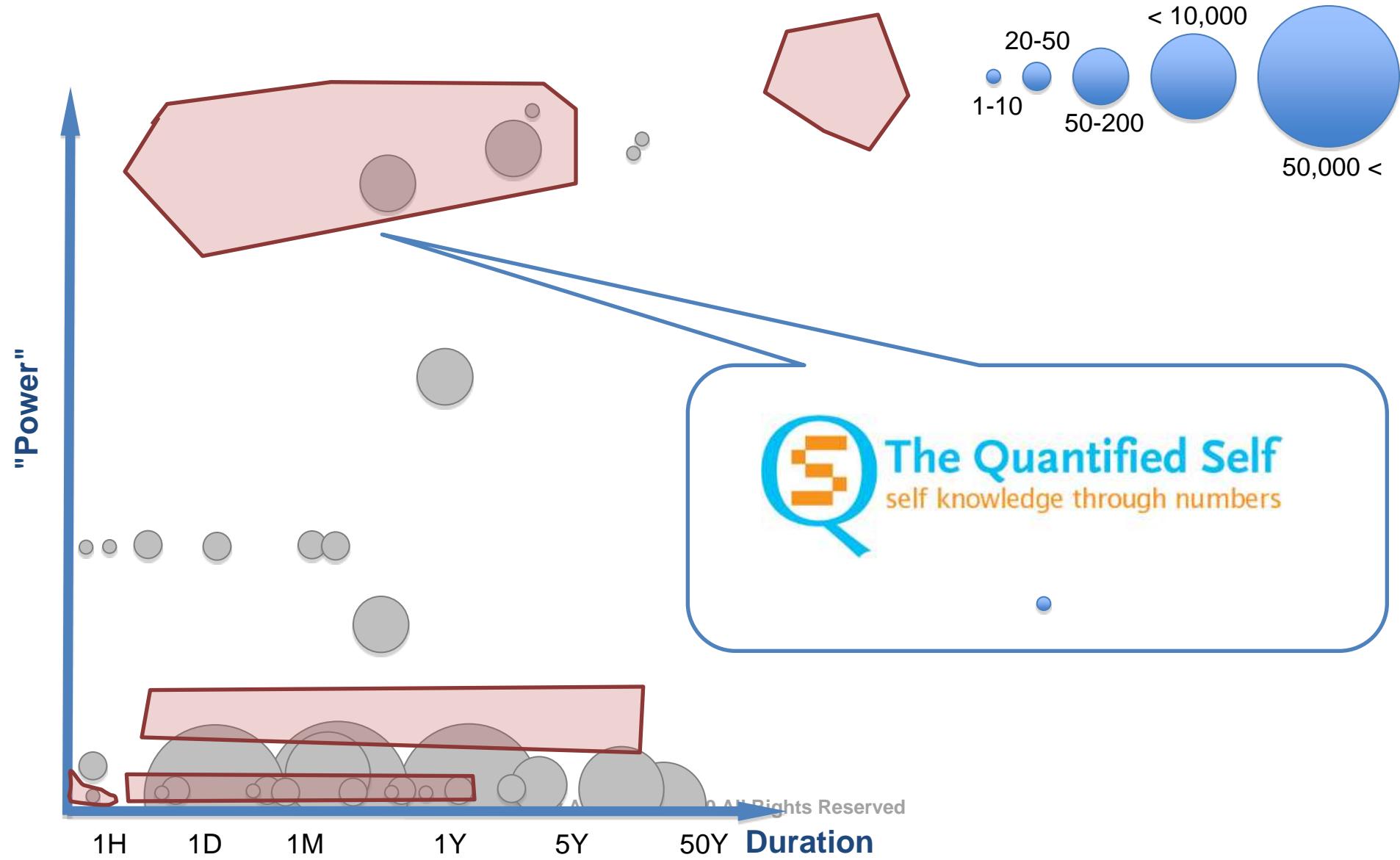


## Additional Trends



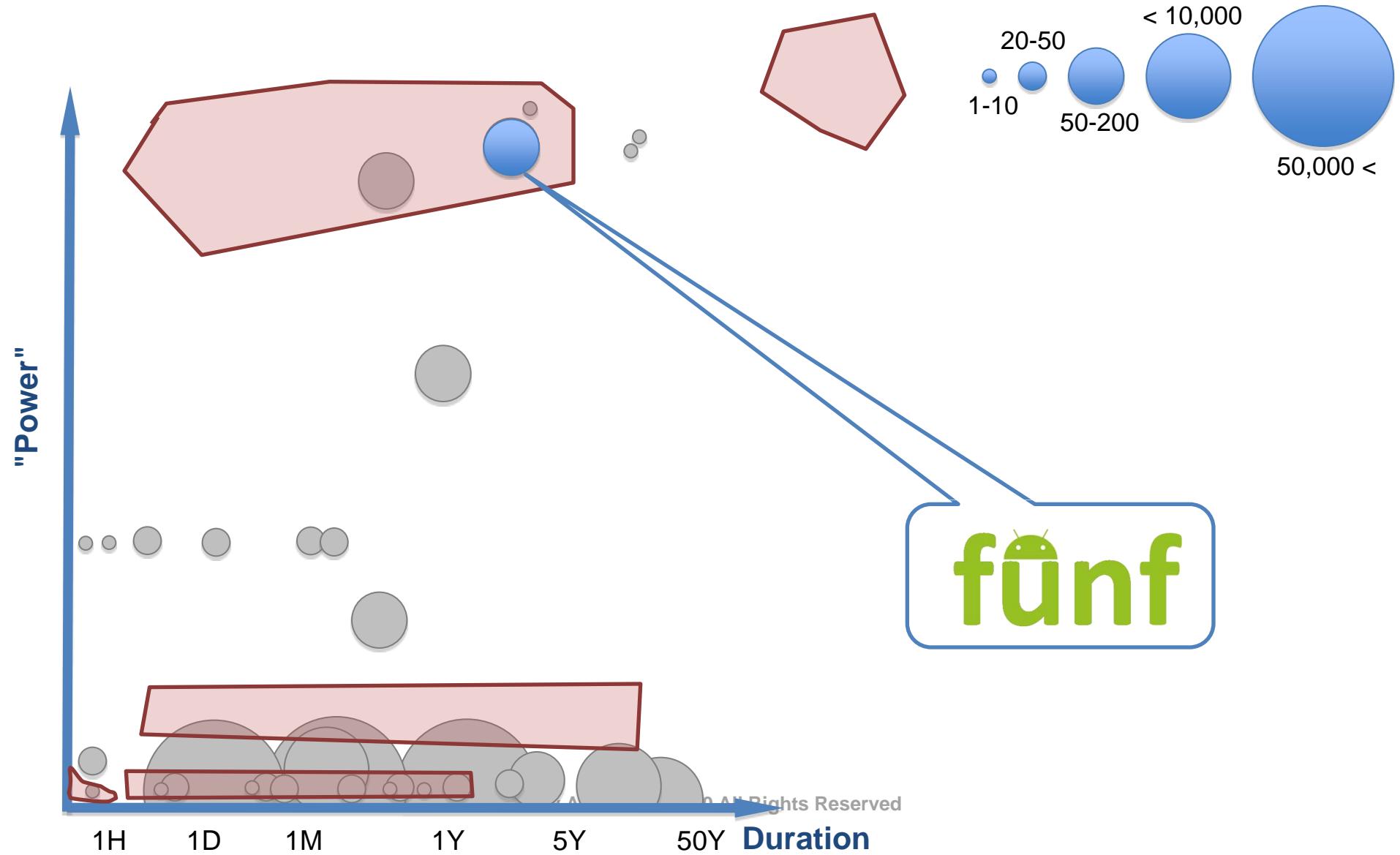


## Additional Trends





## Where Can We Contribute the Most?



- **Depth:**  
Additional “Sensible Communities” Studies
  - Additional cohesive physical communities
  - Different location, country, culture
- **Breadth:**  
Free app on Android Market
  - “Donate your data to science”
  - Selfish motivation: useful functionality in return
- **Developers:**  
Open source platform for mobile data collection and “quantified self” apps.



For updates, register by sending email to:

**funf\_update\_me@media.mit.edu**

Papers

<http://hd.media.mit.edu/TechnicalReportsList.html>

Contact: **pentland@mit.edu**