

# UTILIZING THE “QUANTIFIED SELF” TO MOVE FROM NICHE TO NORM

Strategies for incorporating  
modern technologies into  
assessment and evaluation

ALR 2014 Workshop

Genevieve Dunton

J. Aaron Hipp

Jana Hirsch

Peter James

Jacqueline Kerr



# QUANTIFIED SELF

- The Quantified Self is a movement to incorporate technology into data acquisition on all aspects of an individual's daily life
- These data include diet, physical activity levels, sleeping patterns, and environmental features
  - \$238 million digital fitness device sales in 2013
- Tools could become a powerful approach for collecting/tracking/analyzing data nationwide





# WORKSHOP



- Introduce four technologies:
  - Ecological Momentary Assessment
  - Smart Trackers
  - Smartphone Apps
  - SenseCam
  - Crowdsourcing
- Use for assessment and evaluation
- Critically evaluate benefits and limitations to each technology
- Think about how you could incorporate into your own work

# WORKSHOP SCHEDULE

- 3:05-3:35: Overview of each technology
- 3:35-3:40: Questions
- 3:40-4:10: Form groups to explore how to use these technologies to
  - answer research questions
  - measure the effectiveness of interventions
  - evaluate new policies
- 4:10-4:30: Presentations / Discussion
  - Current challenges and future directions for the implementation of these methods in research and practice

# PRESENTERS

- **Peter James**
  - Harvard School of Public Health
- **Genevieve Dunton**
  - University of Southern California
- **Jana Hirsch**
  - University of Michigan
- **Jacqueline Kerr**
  - University of California San Diego
- **J. Aaron Hipp**
  - Washington University in St Louis

# ECOLOGICAL MOMENTARY ASSESSMENT (EMA)



**ALR 2014 Workshop: Utilizing  
The “Quantified Self” to Move  
from Niche to Norm:  
Strategies for incorporating  
modern technologies into  
assessment and evaluation**

**Genevieve  
Dunton, PhD**

**University of  
Southern  
California**



# SPECIFICATIONS


- **Ecological**
  - ▣ Real-world environments & experience
  - ▣ Provides ecological validity
  
- **Momentary**
  - ▣ Real-time assessment & focus
  - ▣ Avoids recall bias
  
- **Assessment**
  - ▣ Self-report
  - ▣ Repeated, intensive, longitudinal
  - ▣ Allows analysis of physiological/psychological/behavioral processes over time

*(Stone & Shiffman, 1994)*





# SPECIFICATIONS

- Mobile Teen App for Android smartphones
- Downloaded from Google Playstore  Google play
- Programmed to trigger EMA surveys after internal cues (smartphone accelerometer) and external cues (bluetooth).
- Data sent to secure server daily
- Android Galaxy Y, Nexus 4, and MotoG smartphones loaned to participants



# MAIN FUNCTIONS

Type of Trigger	Triggering Rule
1. Physical Activity Bout	15+ min. of high intensity activity followed by 10+ min. of low intensity activity
2. Sedentary Behavior or Device Non-wear	60+ min. of low intensity activity followed by 1+ min. of moderate intensity activity or greater
3. Device Powered Off	10+ min. of no activity data followed by 1+ min. of some activity data



What have you been DOING between 1:35 PM and 2:05 PM?  
(Choose all that apply)

- Reading or doing homework
- Using technology (TV, phone)
- Eating/Drinking
- Sports/Exercising
- Going somewhere
- Hanging out
- Other

Next

# MAIN FUNCTIONS

What type of sports or exercise activity?

- Basketball/Football/Soccer
- Other running/Jogging
- Exercise/Dance/Karate class
- Weightlifting/Strength training
- Walking
- Bicycling
- Swimming
- Other (Baseball, skateboarding, etc.)

Back

Next

How ENJOYABLE was participating in the sport or exercise activity?

- Not at all
- A little
- Moderately
- Quite a bit
- Extremely

Back

Next

Where did you participate in the sport or exercise activity?

- Home
- Work
- School
- Other

Back

Next

While participating in the sport or exercise activity, were you with:  
(Choose all that apply)

- Friends
- Parents
- Siblings
- Teammates/Classmates
- People You Don't Know

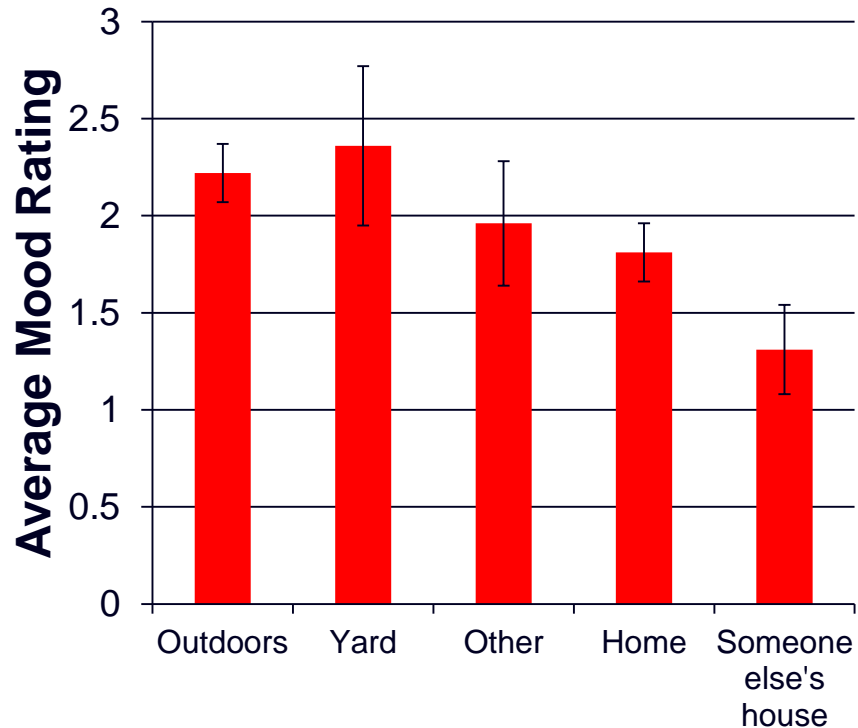
Back

Next

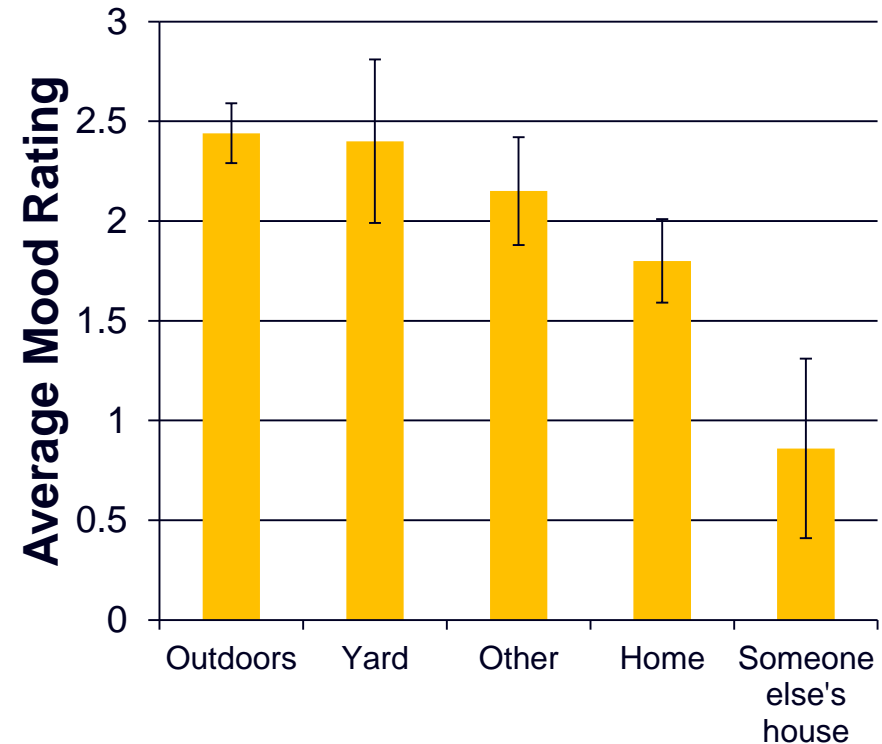
# DATA TYPE AND EXAMPLE

## Mood During Physical Activity by Physical Context

### Positive Affect

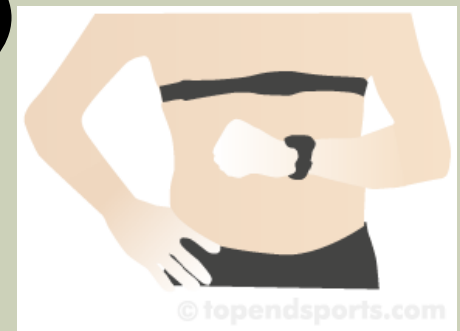


### Enjoyment

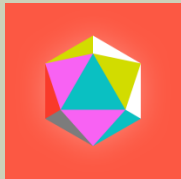


# OTHER TYPES OF SENSOR-ASSISTED CS-EMA

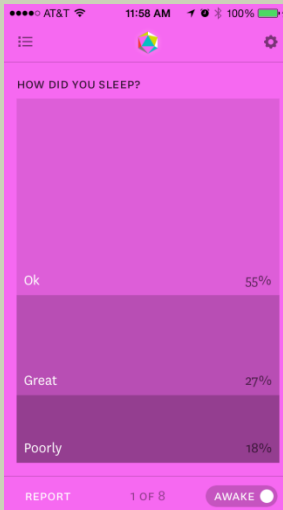
- Location monitors (GPS, Cell towers)
- Heart-rate monitors
- Galvonic skin response
- UV dosimeters
- Portable alpha-amylase readers
- Other smartphones (= people)
- Others ideas??



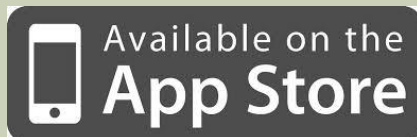
# OTHER AVAILABLE EMA APPS (FOR NON-PROGRAMMERS!)



## Reporter

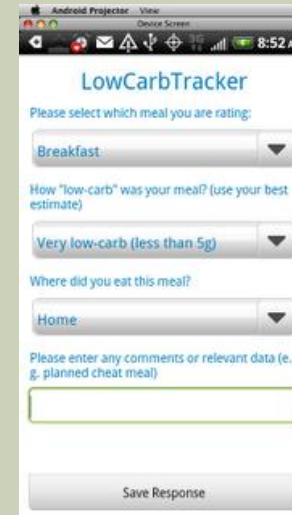


<http://www.reporter-app.com/>



## PACO

### The Personal Analytics Companion



<http://www.pacoapp.com/>



# ACKNOWLEDGMENTS

Stephen Intille, PhD

Marilyn Li, MD

Rob McConnell, PhD

Keito Kawabata, MPA (Project Manager)

Yue Liao, MPH (Research Assistant)

Eldin Dzibur, MS (Research Assistant)

Cesar Aranguri and Alex Lau (Data Collectors)

Brenda Yanez (High School Student Intern)

- NHLBI (1R21HL108018) (Dunton, PI)
- NIEHS(5 P30 ES07048-16) (Dunton, PI on pilot)

# MAPMYFITNESS

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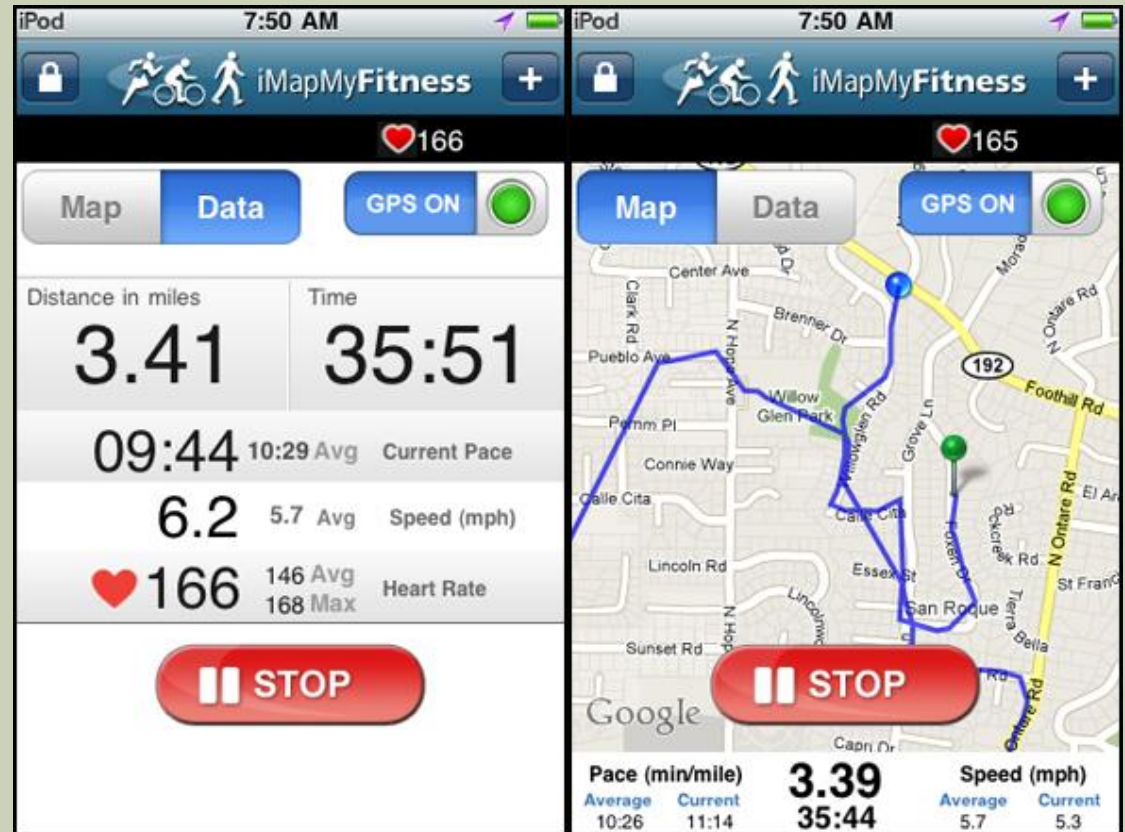
Jana Hirsch,  
University of  
Michigan





# SPECIFICATIONS

- Tracks workouts
- Plots routes of walks, runs, bicycle rides+
- Mobile app+GPS (~97%)
- Online interface
- Save and share routes
- Open platform integrating with over 400 fitness tracking devices



# WORLD COVERAGE- 20 MILLION+ USERS

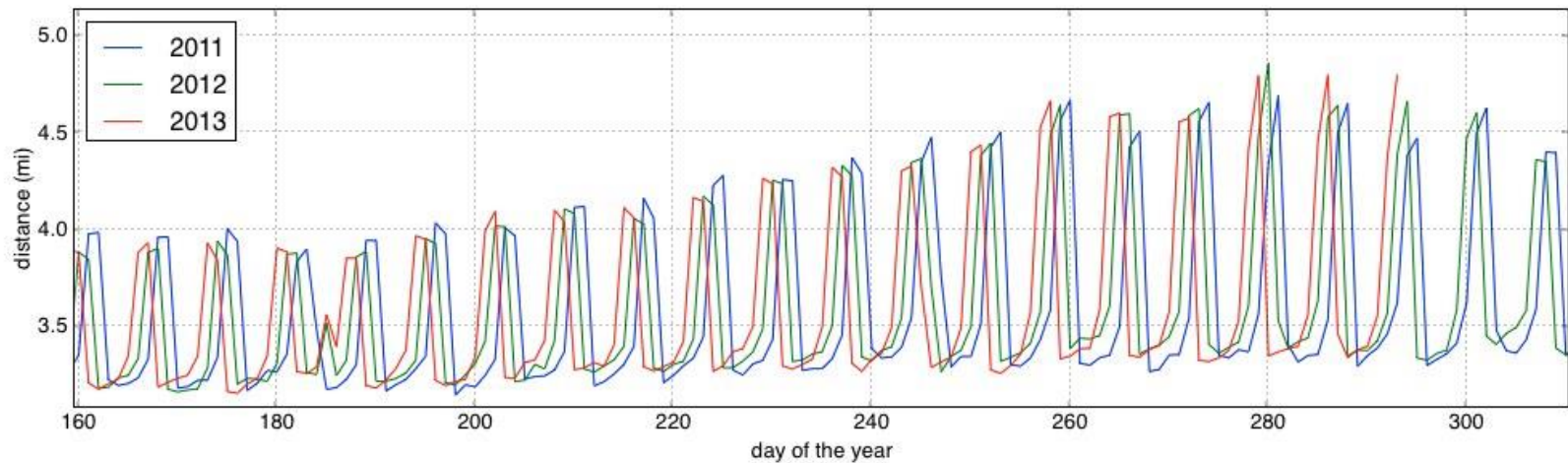
## A GLOBAL MOVEMENT

Where do 20 million people work out?  
Everywhere.



<http://visual.ly/celebrating-20-million-strong>

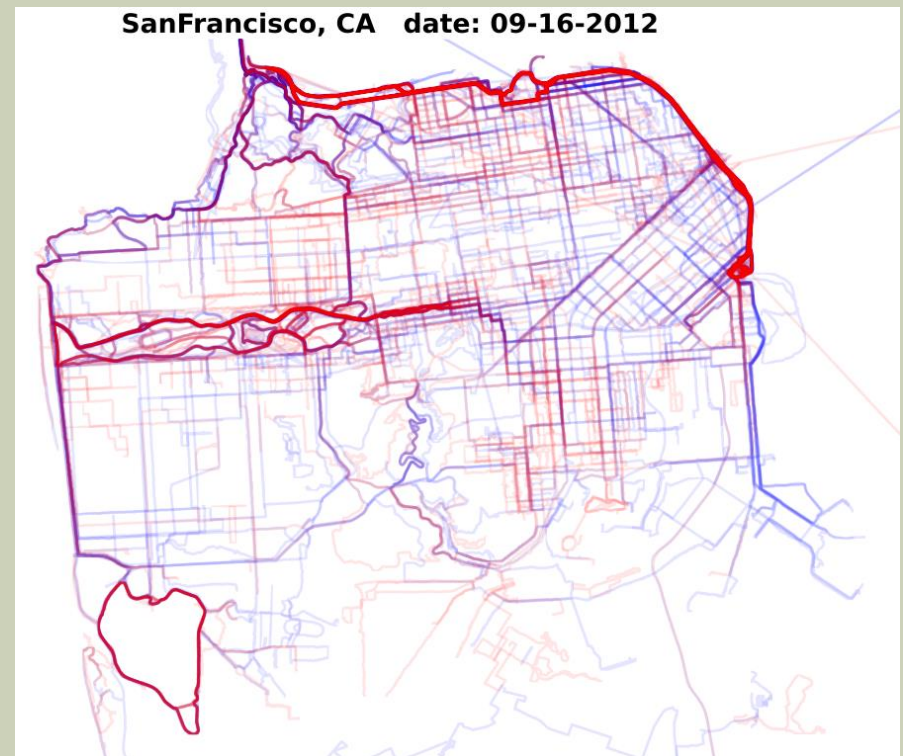
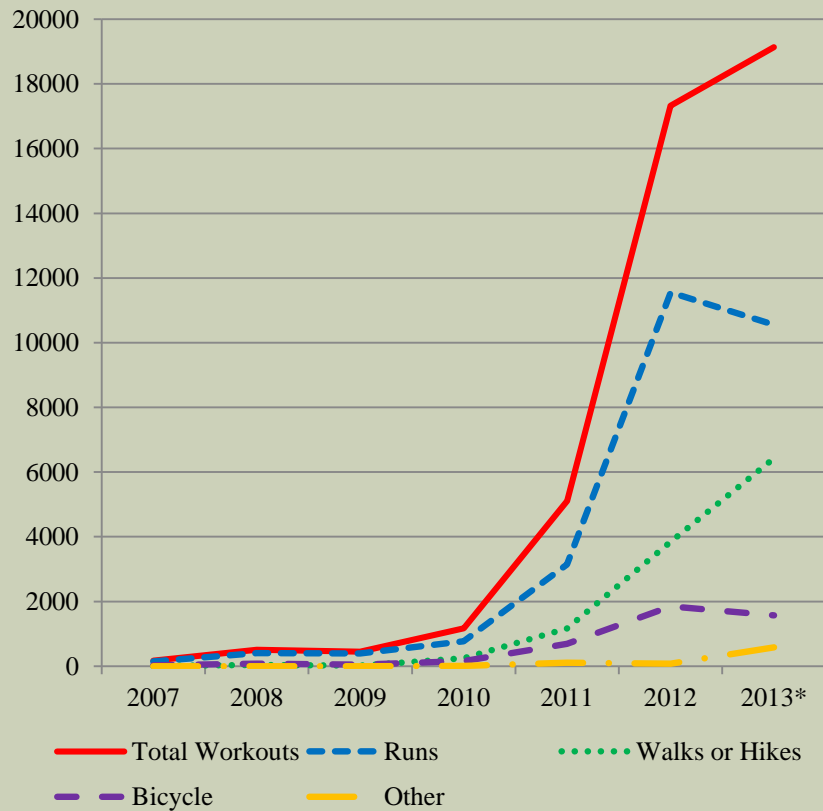
# POTENTIAL FUNCTIONS



- Large-scale physical activity data
- Historic data back to ~2007
- Geographic patterns of physical activity
- User patterns
- Pre-post policy/intervention assessments

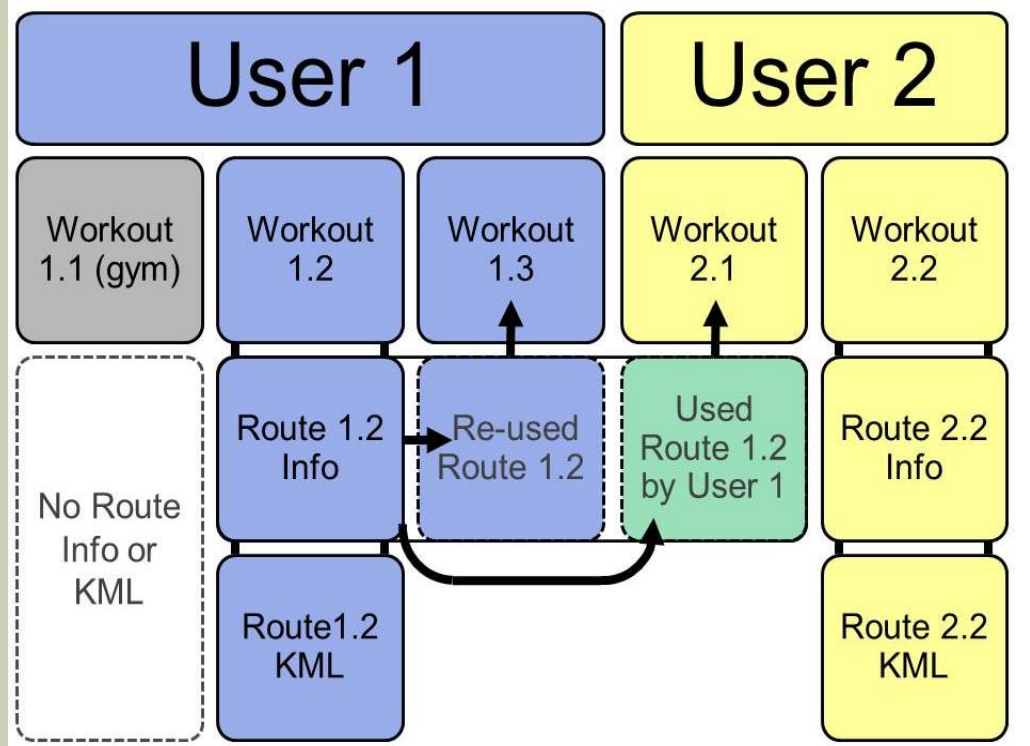
# POTENTIAL FUNCTIONS

Number of MapMyFitness Workouts by Year in Winston-Salem, NC



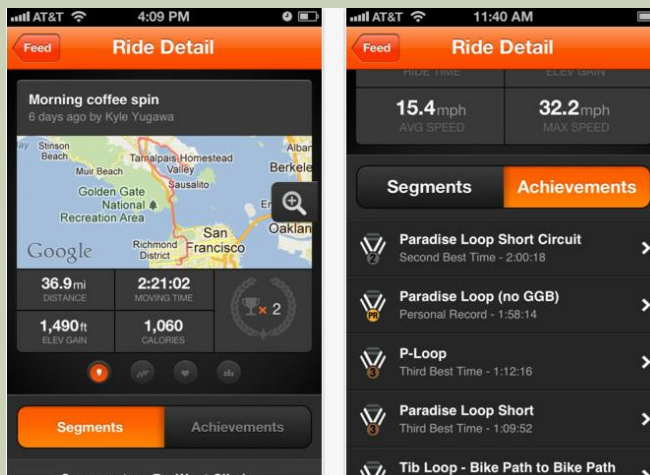
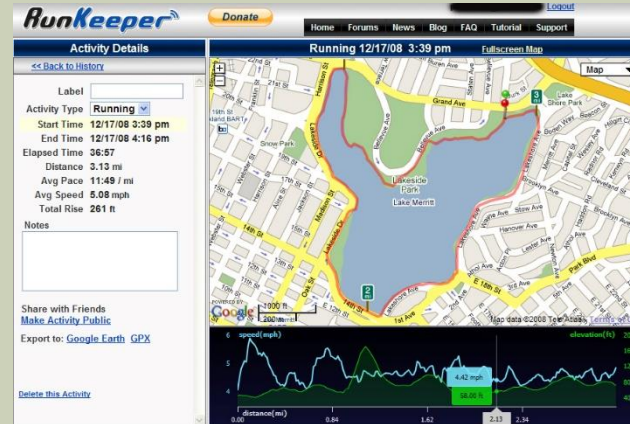
# DATA TYPE AND EXAMPLE

- Routes (KML)
- Workouts (CSV)
- Users (CSV)
- Total database **VERY LARGE** (over 197,000,000 workouts, +++TeraBytes)



# OTHER SIMILAR APPS

- Strava
- RunKeeper
- Endomondo



# CURRENT PROJECTS USING THIS TECHNOLOGY

- MapMyFitness working on easy way to give researcher access to data
- Hirsch, James, Robinson, Eastman, Conley, Evenson, and Laden “Using MapMyFitness to place physical activity into neighborhood context” *Frontiers in Public Health Education & Promotion* doi: [10.3389/fpubh.2014.00019](https://doi.org/10.3389/fpubh.2014.00019)
- Adlakha, Hipp, Budd, Sequeira “Does outdoor physical activity in St. Louis, Missouri differ by neighborhood socio-economic status”

# FITBIT

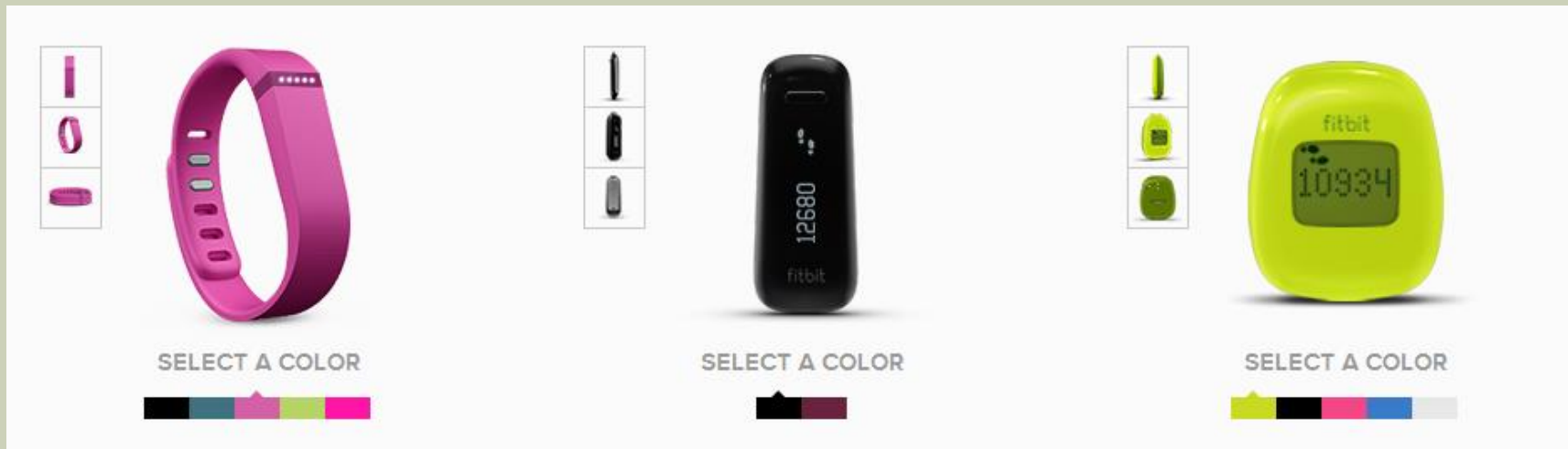
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Jana  
Hirsch,  
University of  
Michigan





# SPECIFICATIONS



- Wearable fitness sensor
  - Steps, distance, estimated calories,
  - Active minutes, stairs climbed, sleep/wake
- Flex, One, Zip (Force recalled)
- Bluetooth sync to phone or computer dongle
- Rechargeable batteries (Flex, One; week); or replaceable (Zip; 4-6 months)

# MAIN FUNCTIONS

- Tracking steps, distance, and stairs
- Tracking sleep duration, and interruptions
- Syncs to both online desktop and app
- Compete against friends, earn badges
- Corporate wellness programs

## An Idea was Born

In 2007, our founders, Eric and James, realized that sensors and wireless technology had advanced to a point where they could bring amazing experiences to fitness and health. They embarked on a journey to create a wearable product that would change the way we move.



## Our Mission

To empower and inspire you to live a healthier, more active life. We design products and experiences that fit seamlessly into your life so you can achieve your health and fitness goals, whatever they may be.



## Friends

Rankings based on 7 day step total

	<b>Kenneth H.</b> 73,717	2
	<b>Grace</b> 66,995	3
	<b>Velma</b> 58,491	4
	<b>You</b> 55,895	5
	<b>Sonia H.</b> 51,060	6
	<b>Christine</b> 43,711	7
	<b>Michelle N.</b> 22,122	8

# LINKING TO APPS/API

## Browse Apps



### Lose It!

by FitNow, Inc.

Sync your meals from Lose It! to Fitbit and extend Lose It! food budget by activities from your Fitbit tracker.

[Learn more >](#)



### MyFitnessPal

by MyFitnessPal, LLC.

Sync your meals and activities to Fitbit and adjust your daily net calorie goal on MyFitnessPal by the data measured by your tracker.

[Learn more >](#)



### SparkPeople™

by SparkPeople, Inc.

Link Fitbit to your SparkPeople account and you can dynamically share and sync data – including weight, fitness and sleep – to your SparkPeople profile.

[Learn more >](#)



### Balance Rewards

by Walgreens

Sync a Fitbit One, Ultra or Zip tracker to Steps with Balance Rewards to earn points for walking, running and tracking your weight.

[Learn more >](#)



### Microsoft HealthVault

by Microsoft

Link your accounts now to share your Fitbit body data with HealthVault.

[Learn more >](#)



### Digitfit

by Digitfit, Inc.

Link Fitbit and Digitfit, and your workouts are "automagically" posted to your Fitbit account and Fitbit activity to My.Digitfit.com.

[Learn more >](#)



### MapMyRun

by MapMyFitness, Inc.

Set goals, track your performance and succeed! Link your account to easily share Fitbit activity with MapMyRun.

[Learn more >](#)



### TactioHealth™

by Tactio Health Group

TactioHealth is multi-user health tracking app that tracks Weight, Body Fat, Steps, BP, Cholesterol, Glucose, and Nutrition on your iOS or Android.

[Learn more >](#)



### Endomondo

by Endomondo

Community based on the free GPS tracking of sports. It's fun, it's social and it's motivating.

[Learn more >](#)

- Developer API
- Link to FitBit user's data
- Existing linked apps

dev.fitbit.com

OVERVIEW REGISTER AN APP MANAGE MY APPS

Log in

api

## Welcome. It's an API

The Fitbit API allows developers to interact with Fitbit data in their own applications, products and services.

The API allows for most of the read and write methods that you will need to support your application. If you have uses or needs that are not currently supported by the API, drop by the Dev Forum and let us know! We look forward to working closely with the development community to make the Fitbit API a system that enables you to do awesome, mind blowing stuff.

[Visit Dev Forum](#)

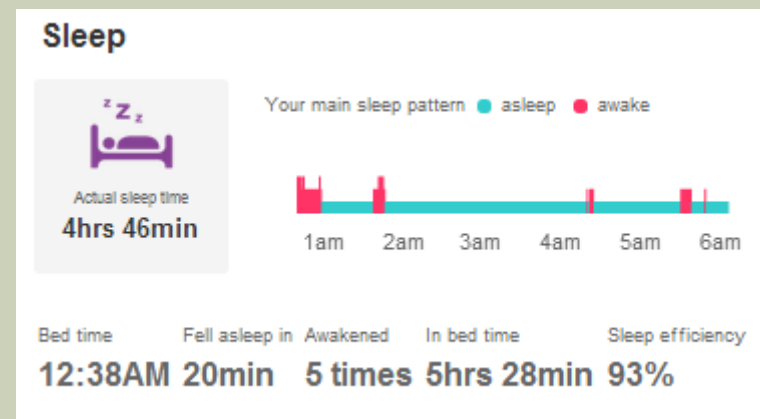
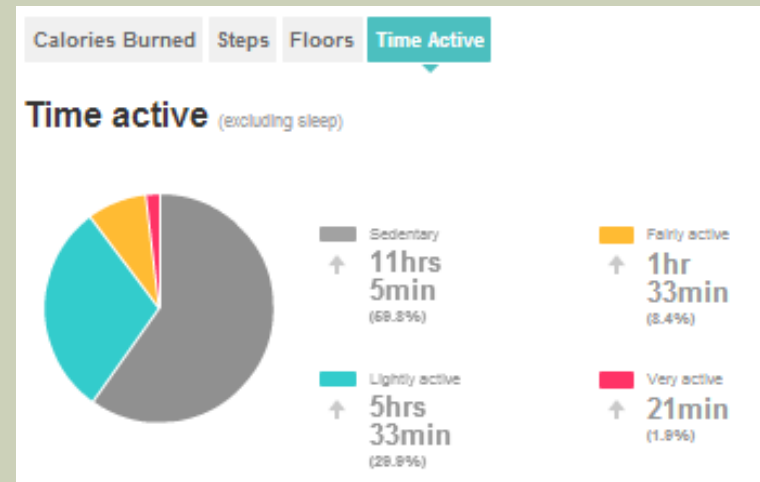
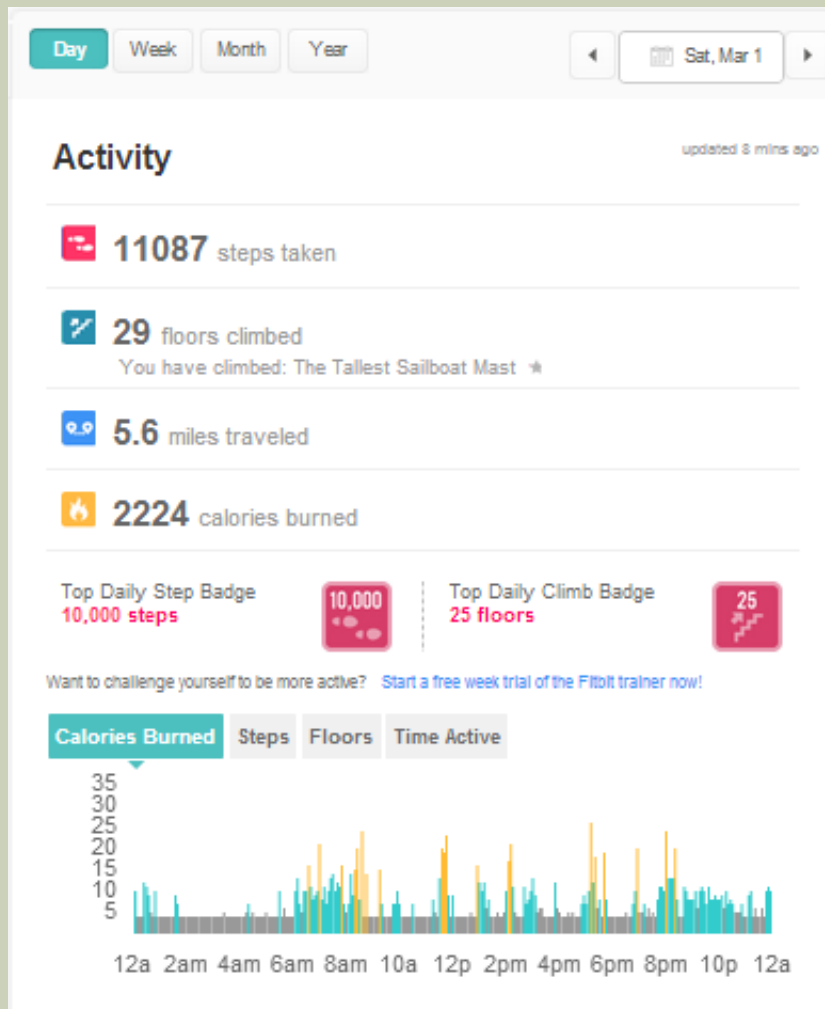
[Read API Docs](#)

**Fitbit Logos**  
Download our logos and read trademark guidelines and terms of service

<https://www.fitbit.com/apps>

<http://dev.fitbit.com/>

# DATA TYPE AND EXAMPLE



# OTHER FITNESS TRACKERS

- Jawbone Up!
- Nike Fuelband
- Withings Pulse
- Garmin Vivofit
- Atlas
- Many more!



# SOME CURRENT PROJECTS USING THIS TECHNOLOGY

- “Movement toward a novel activity monitoring device”  
<http://link.springer.com/article/10.1007/s11325-011-0585-y>
- “Is This Bit Fit? Measuring the quality of the FitBit Step-Counter”  
<http://www.healthandfitnessjournalofcanada.com/index.php/html/article/view/144>
- “Fitbit+: A behavior-based intervention system to reduce sedentary behavior”  
[http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6240381&url=http%3A%2F%2Fieeexplore.ieee.org%2Fexpls%2Fabs\\_all.jsp%3Farnumber%3D6240381](http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6240381&url=http%3A%2F%2Fieeexplore.ieee.org%2Fexpls%2Fabs_all.jsp%3Farnumber%3D6240381)
- Health eHeart <http://www.health-eheartstudy.org/>
- Centre for Hip Health & Mobility (Active Streets Active People; Walk The Talk Team)
- “Functional Recovery in the Elderly After Major Surgery: Assessment of Mobility Recovery Using Wireless Technology”  
[http://www.annalsthoracicsurgery.org/article/S0003-4975\(13\)01253-8/abstract](http://www.annalsthoracicsurgery.org/article/S0003-4975(13)01253-8/abstract)

# SENSECAM

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Jacqueline  
Kerr, UCSD



# SPECIFICATIONS

- Person worn camera
- Automatically takes wide angle low resolution photo
  - With movement change
  - With light change
  - With temperature change
  - With another person
- About 3,000 time stamped images per day
- 18 hr battery





# SENSECAM CODING – 5 IMAGES

**Pass 1: Social Context /Interactions**

**Pass 2: Indoor/ Outdoor**

**Pass 3: Positions/Activities**

## Social Context/ Interactions

Social/ Interaction

Social/ No Interaction

Not Social

## Indoor / Outdoor

Indoor

Outdoor

In Vehicle

Mixed

## Position

Sedentary

Standing Still

Standing Moving

Walking/Running

Biking

Changing Position

## Activity

Household Activity

Self Care

Conditioning Exercise

Sports

Manual Labor

Leisure

Administrative Activity

Car

Other Vehicle

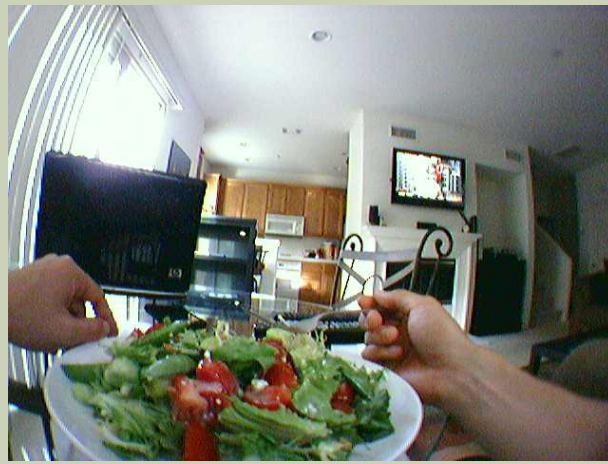
Television \*

Other Screen \*

Eating \*

\*Not exclusive and can be used in addition to other activity codes

# SITTING IMAGES



# STANDING IMAGES



# DATA TYPE AND EXAMPLE

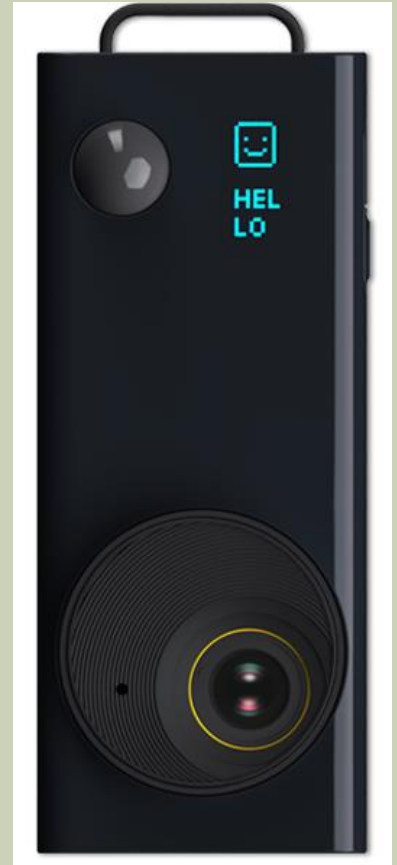
- Data format: images and sensor readings
- Data size: 3000 images per day; potential to code multiple behaviors and environments
- Data issues: coding is time consuming; developing automatic image recognition algorithms
- Device issues: devices keep changing, coding software is no longer compatible, newer devices are NOT better... lots of devices on the market; test, test, test
- Data aggregation: minute level estimates

# OTHER DEVICES

- Autographer
- Memoto
- SenseCam
- Vicon Revue 1.0
- Vicon Revue 3MP
- E-button
- Google glasses



Getnarrative.com



www.autographer.com/



<http://www.google.com/glass/start/> <http://www.lcn.pitt.edu/ebutton/>

# CURRENT PROJECTS USING THIS TECHNOLOGY

- **An ethical framework for automated, wearable cameras in health behavior research** Paul Kelly et al., American Journal of Preventive Medicine (2013), 44: 3: 314
- **Using the SenseCam to improve classifications of sedentary behavior in free-living settings** Jacqueline Kerr, et al. American Journal of Preventive Medicine (2013), 44: 3: 290
- **Using the SenseCam as an objective tool for evaluating eating patterns** Jacqueline Chen, et al. Proceedings of the 4th International SenseCam & Pervasive Imaging Conference (2013), 34-41
- **Physical activity recognition in free-living from body-worn sensors** Katherine Ellis, et al. Proceedings of the 4th International SenseCam & Pervasive Imaging Conference (2013), 88-89
- **Using wearable cameras to categorise type and context of accelerometer-identified episodes of physical activity** Aiden R Doherty, et al. International Journal of Behavioral Nutrition and Physical Activity (2013), 10:1:22
- **Utility of passive photography to objectively audit built environment features of active transport journeys: an observational study** Melody Oliver, et al. International journal of health geographics (2013), 12:1:20
- **The feasibility of using SenseCams to measure the type and context of daily sedentary behaviors** Catherine Marinac, et al. Proceedings of the 4th International SenseCam & Pervasive Imaging Conference (2013), 42-49
- **Using SenseCam images to assess the environment** Suzanne Mavoa et al., Proceedings of the 4th International SenseCam & Pervasive Imaging Conference (2013), 84-85
- **Measuring time spent outdoors using a wearable camera and GPS** Michael S Lam, et al., Proceedings of the 4th International SenseCam & Pervasive Imaging Conference (2013), 1-7

# VALIDATING EATING LOCATIONS



# OPPORTUNITIES

- Multiple behaviors in one tool, concurrent behaviors
- Context: physical environment & social interactions
- Validation tool
- Assessment tool
- Intervention tool
- A PICTURE IS WORTH A 1000 WORDS



# CROWDSOURCES

ALR 2014 Workshop: Utilizing  
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Aaron Hipp,  
PhD  
Washington  
University in  
St. Louis



# SPECIFICATIONS



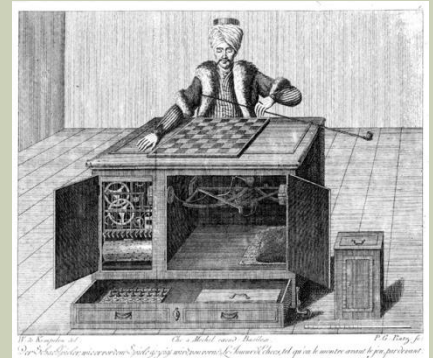
CrowdSource®



CrowdFlower

crowdSPRING

- MTurk
- Online marketplace to complete tasks that a computer cannot yet complete
- Source of human subjects



# MAIN FUNCTIONS

## Mechanical Turk is a marketplace for work.

We give businesses and developers access to an on-demand, scalable workforce. Workers select from thousands of tasks and work whenever it's convenient.

**526,762 HITs** available. [View them now.](#)

### Make Money by working on HITs

HITs - *Human Intelligence Tasks* - are individual tasks that you work on. [Find HITs now.](#)

#### As a Mechanical Turk Worker you:

- Can work from home
- Choose your own work hours
- Get paid for doing good work



### Get Results from Mechanical Turk Workers

Ask workers to complete HITs - *Human Intelligence Tasks* - and get results using Mechanical Turk. [Register Now](#)

#### As a Mechanical Turk Requester you:

- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results



## Workers/Turkers

- Over 18 years of age
- Amazon.com account
- Can be listed as a 'Master'

## Requester

- Post Human Intelligence Tasks (HITs) or Tasks
- Photographs, video, audio, surveys
- Costs  $\leq 10\%$  of total dollar amount distributed to Workers

# DATA TYPE AND EXAMPLE

Complete the following five steps to finish the HIT:

1. FIND PEOPLE

2. FIND BIKES

3. FIND CARS

4. MATCH SCENES

5. ANSWER QUESTIONS

## Step 1: Find all the people in this scene



There are no people in this scene.

I am done with this step

Start over from step 1

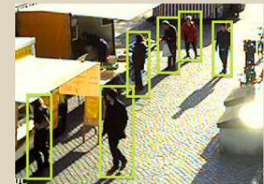
### Instructions:

- Left-click to place a dot.
- Double-click on dot to remove it.
- Drag a dot to move it around.
- Place just one dot per person, at the approximate center of the person.
- Do NOT label people who are not entirely visible.
- If there is no person, select the check box below the image
- To return to a previous step, select the step from the navigation menu on the left.
- Please remember to accept the HIT before beginning work.

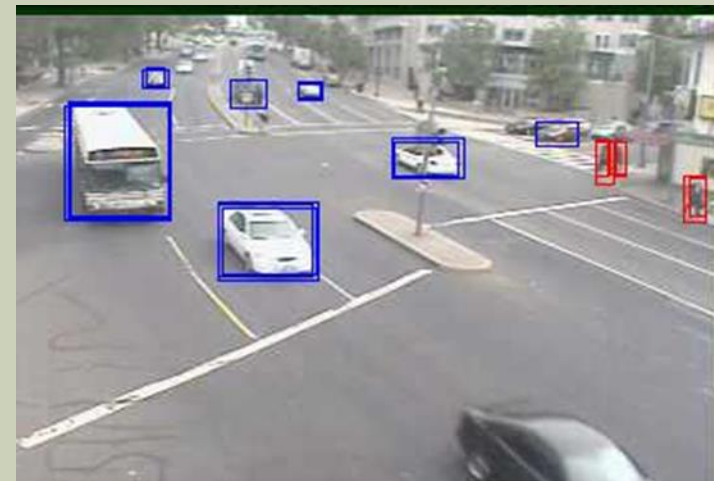
### Outline Guidelines and Examples

Your outlines at each step should follow the guidelines below to avoid being rejected. The same guides apply to bicycles and vehicles.

GOOD: This shows correctly outlined people.



BAD: Too many people per outline.



# DATA TYPE AND EXAMPLE

## Answer a short survey

This is a research study. The purpose of this study is to better understand factors that influence park users' behavior in parks. We hope to use this information to better design parks and promote improved community health.

Completing this survey implies that i) you are over the age of 18 years, and ii) you have consented to participate in this study. The survey will take approximately 1-3 minutes of your time (depending on your responses to certain questions). You are free to skip any questions you do not feel comfortable asking and to cease participation at any time, and all of the information you provide will be anonymous. If you have any questions about this study, you may contact Sonja Wilhelm Stanis at 573-882-9524.

For best viewing results, please open the link in a new tab or window.

Survey link: <http://www.surveymonkey.com/s/GKY886C>

Provide the survey code here:

Submit

# DATA TYPE AND EXAMPLE

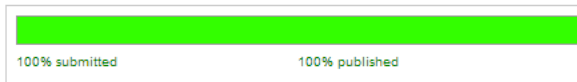
This is a research study. The purpose of this study is to better understand factors that influence park users' behavior in parks. The survey will take under 2 minutes.

## Status

[Delete](#)

**Status:** Pending

Review



Assignments Completed: 75 / 75

Average Time per Assignment: 1 minute 26 seconds

Average Hourly Rate: \$10.465

Creation Time: May 31, 2013 9:54 AM PDT

Completion Time: May 31, 2013 12:15 PM PDT

## Settings

### Brief survey: factors that influence park user

**Description:** This is a research study. The purpose of this study is to better understand factors that influence park users' behavior in parks. The survey will take under 2 minutes.

**Keywords:** survey, parks, photo, brief

**Qualification Requirement:** Location is UNITED STATES

**Number of Assignments per HIT:** 75

**Reward per Assignment:** \$0.250

**Input File:**

**HIT expires on:** EXPIRED

**Assignment duration:** 10 minutes

**Auto Approval Delay:** 30 minutes

## Results

[Results](#)

Assignments pending review: 0

Assignments approved: 75

Assignments rejected: 0

## Cost Summary

Estimated Total Reward: \$18.750

Estimated Fees to Mechanical Turk: \$1.875 ([fee details](#))

Estimated Total Cost: \$20.625

These costs are only an estimate until all of the assignments have been submitted and reviewed.

# THANKS!



**all tech considered** TECH, CULTURE AND CONNECTION

[behavior](#)

[privacy & security](#)

[social web](#)

[innovation](#)

[the industry](#)

## Post A Survey On Mechanical Turk And Watch The Results Roll In

by GABRIELLE EMANUEL

March 05, 2014 4:00 PM



**Listen to the Story**

All Things Considered



5 min 32 sec

- + Playlist
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**QUESTIONS?**



# GROUP BREAKOUT BRAINSTORM

## (3:40-4:10)

- 1. Community Transformation Grants
  - 2. State-level Complete Streets
  - 3. New Park Infrastructure
  - 4. Physical Activity Education Intervention
  - 5. Workshop Attendee's Choice!
- BRIEFLY introduce yourselves
  - Brainstorm:
    - What questions are you trying to answer?
    - What is the scope of the potential project? Population? Time?
    - New technology to measure the environment?
    - New technology to measure behavior or health outcomes?
    - Three advantages; Three disadvantages
  - Presentations
    - 4 min per groups

# DISCUSSION NOTES FROM GROUP WORK

## Advantages:

- Interface with multiple data sources
- Less intrusive
- “Cool!”-attract participants
- Objective (less recall bias)
- Empowering
- Double-check

Data- LOTS OF IT!!

Dual use as intervention

## Disadvantages

- Cost
- Sample selection
- IRB/Privacy (Ethics)
- User familiarity
- Who is the control?
- Accommodating special populations (i.e. vision impairment, language)

# VIDEO EXAMPLE

