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

Strategies for incorporating modern technologies into assessment and evaluation

ALR 2014 Workshop

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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.
- How many people in the room own a smartphone?
- How many use an app to track their physical activity?
- How many use a device to track their physical activity?
- How many have used these technologies for research/interventions?
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
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
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ECOLOGICAL MOMENTARY ASSESSMENT (EMA)

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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

• 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

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

### 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
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/

Available on the App Store

PACO

The Personal Analytics Companion

http://www.pacoapp.com/

Google play
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- NIEHS(5 P30 ES07048-16) (Dunton, PI on pilot)
Jana Hirsch, University of Michigan

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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
http://visual.ly/celebrating-20-million-strong
- Large-scale physical activity data
- Historic data back to ~2007
- Geographic patterns of physical activity
- User patterns
- Pre-post policy/intervention assessments
Number of MapMyFitness Workouts by Year in Winston-Salem, NC

- Total Workouts
- Runs
- Walks or Hikes
- Bicycle
- Other

San Francisco, CA  date: 09-16-2012
- 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


- Adlakha, Hipp, Budd, Sequeira “Does outdoor physical activity in St. Louis, Missouri differ by neighborhood socio-economic status”
FITBIT

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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

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kenneth H.</td>
<td>73,717</td>
</tr>
<tr>
<td>2</td>
<td>Grace</td>
<td>66,995</td>
</tr>
<tr>
<td>3</td>
<td>Velma</td>
<td>58,491</td>
</tr>
<tr>
<td>4</td>
<td>You</td>
<td>55,895</td>
</tr>
<tr>
<td>5</td>
<td>Sonia H.</td>
<td>51,060</td>
</tr>
<tr>
<td>6</td>
<td>Christine</td>
<td>43,711</td>
</tr>
<tr>
<td>7</td>
<td>Michelle N.</td>
<td>22,122</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LINKING TO APPS/API

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

https://www.fitbit.com/apps

http://dev.fitbit.com/
DATA TYPE AND EXAMPLE

### Activity
- **11,087** steps taken
- **29** floors climbed
  - You have climbed: The Tallest Sailboat Mast
- **5.6** miles traveled
- **2,224** calories burned

#### Top Daily Badge
- **10,000 steps**
- **10,000 floors**

Want to challenge yourself to be more active? Start a free week trial of the Fitbit trainer now!

#### Time active (excluding sleep)
- Sedentary: 11 hrs 5 min (69.3%)
- Lightly active: 1 hr 33 min (8.4%)
- Fairly active: 5 hrs 33 min (29.9%)
- Very active: 21 min (1.8%)

### Sleep
- **4hrs 46min**
- Bed time: 12:38AM
- Fell asleep in: 20 min
- Awakened: 5 times
- In bed time: 5hrs 28min
- Sleep efficiency: 93%
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”

- “Is This Bit Fit? Measuring the quality of the FitBit Step-Counter”

- “Fitbit+: A behavior-based intervention system to reduce sedentary behavior”
  http%3A%2F%2Fieeexplore.ieee.org%2FxplIs%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)

  http://www.annalsthoracicsurgery.org/article/S0003-4975(13)01253-8/abstract
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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
- Social/ Interaction
- Social/ No Interaction
- Not Social

### Pass 2: Indoor/ Outdoor
- Indoor
- Outdoor
- In Vehicle
- Mixed

### Pass 3: Positions/Activities
- 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*
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

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 as an objective tool for evaluating eating patterns** Jacqueline Chen, et al. Proceedings of the 4th International SenseCam & Pervasive Imaging Conference (2013), 34-41
- **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

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SPECIFICATIONS

- 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.

- 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 ≤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

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.

I am done with this step  Start over from step 1

有个诱惑的人在画面中。
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:
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:** Pending
Review: 100% submitted, 100% published

Assignments Completed: 75 / 75
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

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

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

Data- LOTS OF IT!!
Dual use as intervention