# Smartphone-Based Assessment
## *New possibilities for understanding life as it is lived*

Tim Steenbergh, PhD
Jason Runyan, DPhil
Doug Daugherty, PsyD
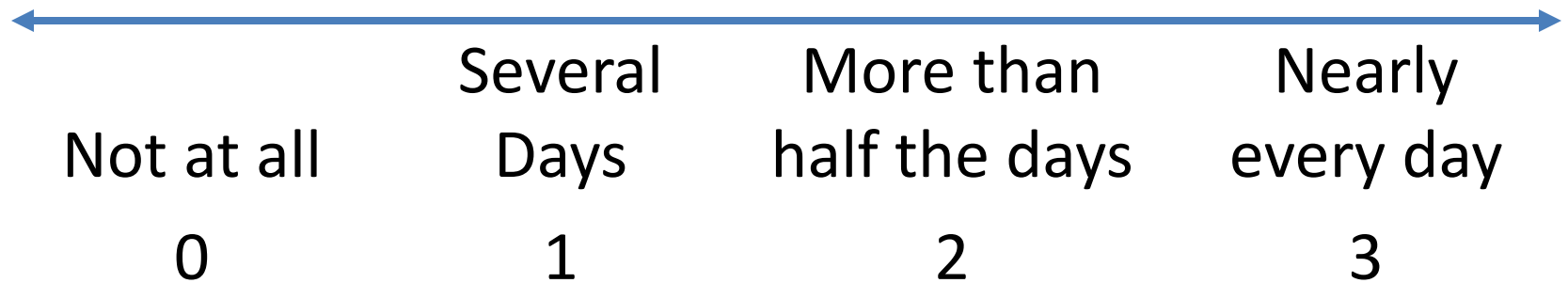
Indiana Wesleyan University

**Life Data**

# Overview

- Traditional Surveys & EMA

- Intensive Longitudinal Designs

- Current Technology

- Introduction to EMI

- Factors influencing EMI efficacy

- Current studies with EMA/EMI

# Survey Example

Over the last two weeks, how often have you been bothered by feeling tired or having little energy?[1]

| Not at all | Several Days | More than half the days | Nearly every day |
|:----------:|:------------:|:-----------------------:|:----------------:|
| 0 | 1 | 2 | 3 |

[1] Adapated from: Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16,* 606-613.

"Individuals' self-reports provide the only window on their inner states. Unfortunately, this window is often foggy…"

Schwarz, 2007

Schwartz, N. (2007). Retrospective and concurrent self-reports: The Rationale for real-time data capture. In: A. Stone, S. Shiffman, A. Atienza, & L. Nebeling (eds.), *The science of real-time data capture: Self-reports in health research.* New York: Oxford University Press.

# Why the fog?

- **Recall Bias**: salience of unusual experiences over mundane; recency effects, effects of current mood

- **Estimation problems**

  - <u>Frequency-</u> frequent events and/or those that occur in irregular patterns are poorly estimated

  - <u>Intensity-</u> we have difficulty estimating intensity (peak and end effects)

- **Inference strategies**

Schwartz, N. (2007). Retrospective and concurrent self-reports: The Rationale for real-time data capture. In: A. Stone, S. Shiffman, A. Atienza, & L. Nebeling (eds.), *The science of real-time data capture: Self-reports in health research.* New York: Oxford University Press.
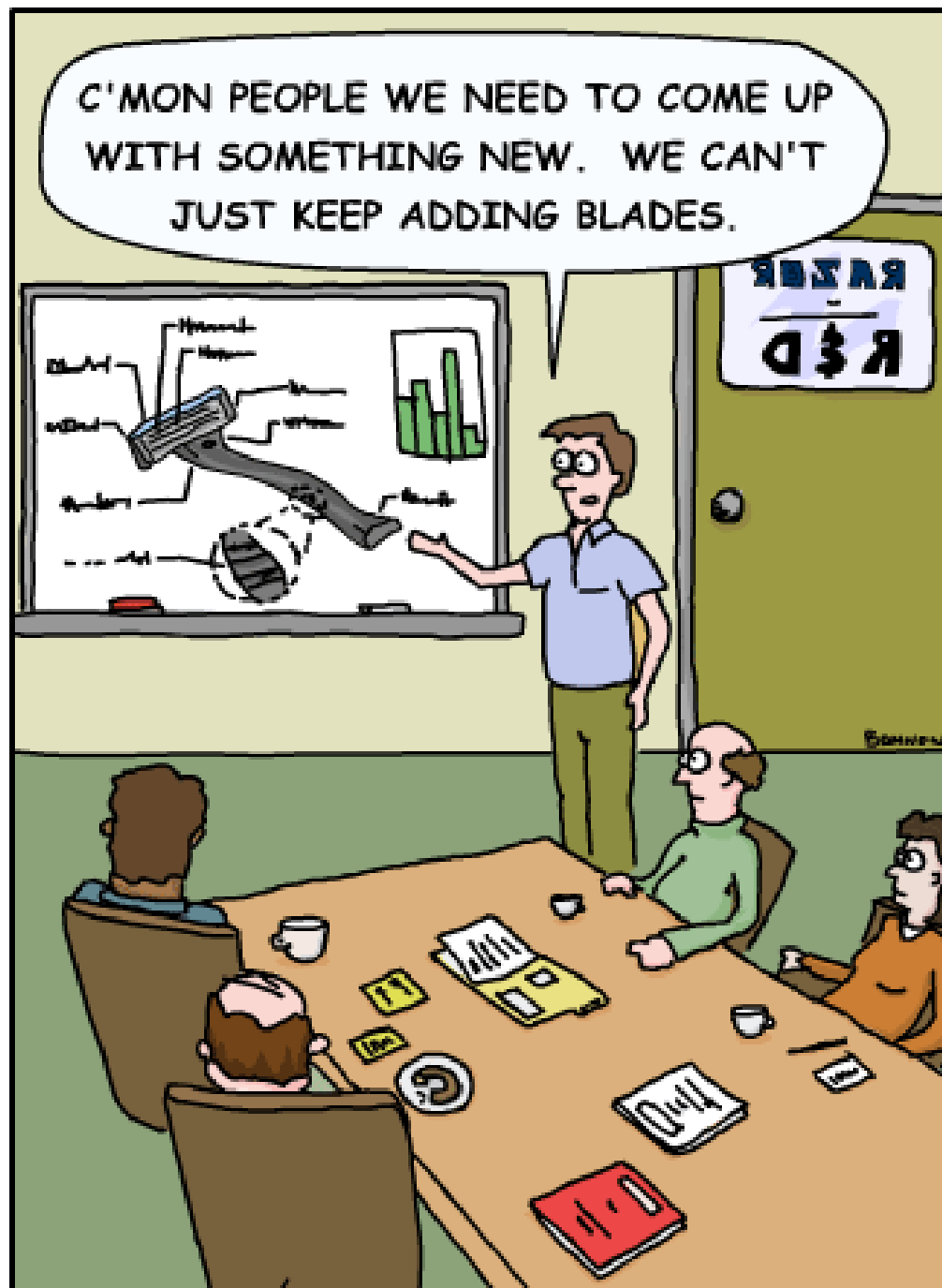
# An EMA Approach
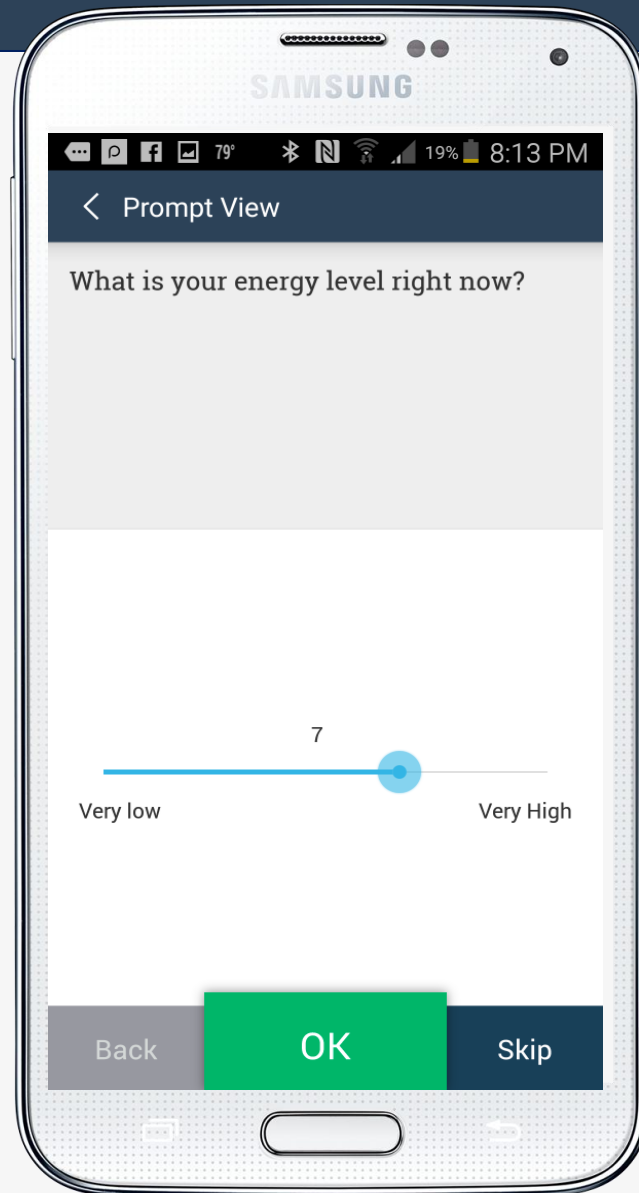
# What is EMA? Data gathering strategies designed to offer greater clarity by repeatedly assessing people in everyday contexts
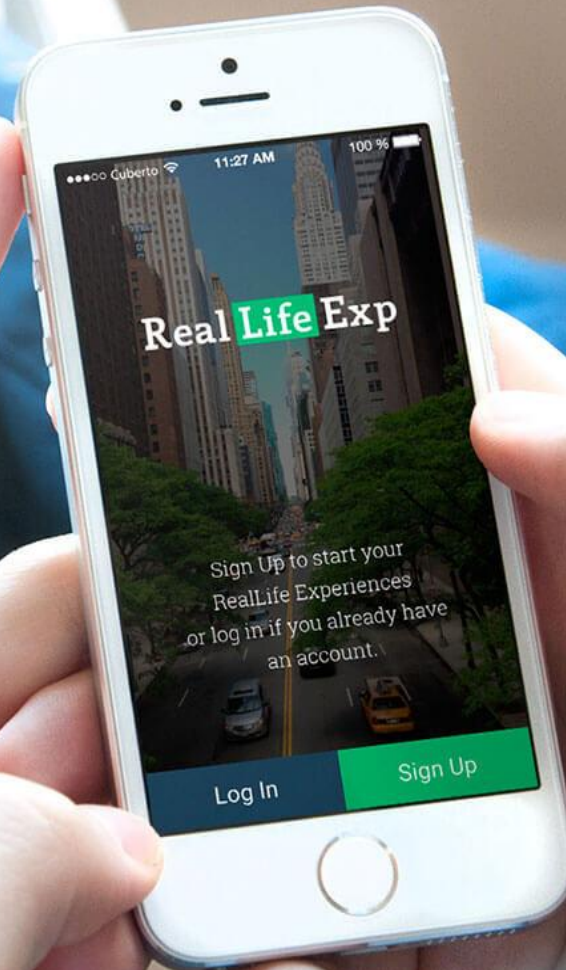
- **Daily diaries**
- **Self-monitoring** (behavioral assessment)
- **Experience Sampling Method** (Csikszentmihalyi & Larson, 1987)
- **Ambulatory Assessment**

New Possibilities

# Why SmartPhones?

- 64% of Americans own one (Pew Research Center, 2015)
- Smartphones are in the same room 90% of the time
- They are within arm's reach 50% of the time (Dey et al., 2011)
- High penetration among understudied and underserved (Pew Research Center, 2015)
    - Blacks= 70%
    - Hispanics= 71%

# Types of EMA Designs

- **Time Based**
  - Interval Contingent
  - Signal Contingent
- **Event Contingent**
- **Device Contingent**
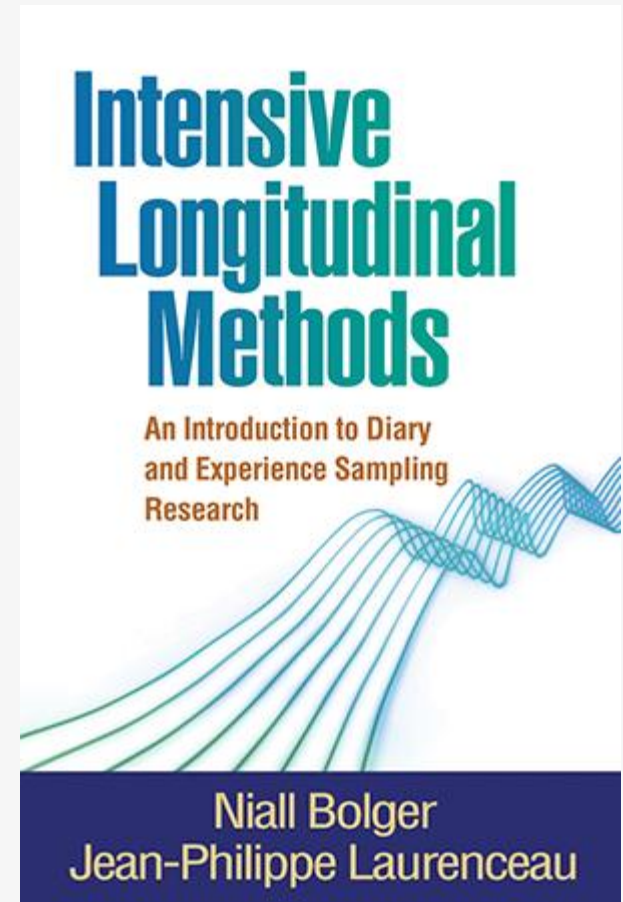
Bolger, N., & Laurenceau, J. P. (2013). *Intensive longitudinal methods: An Introduction to diary and experience sampling research.* New York: Guildford.

# Interval Contingent

- Gather data at regularly scheduled intervals

- Example: Freshman iHabit study

- Regular, fixed intervals offer advantages for data analysis

- Usually 1-2 assessments per day
  - Less intrusive
  - More susceptible to issues with recall

# End of Day Example

Now list three good things that happened today.

Back     OK     Skip
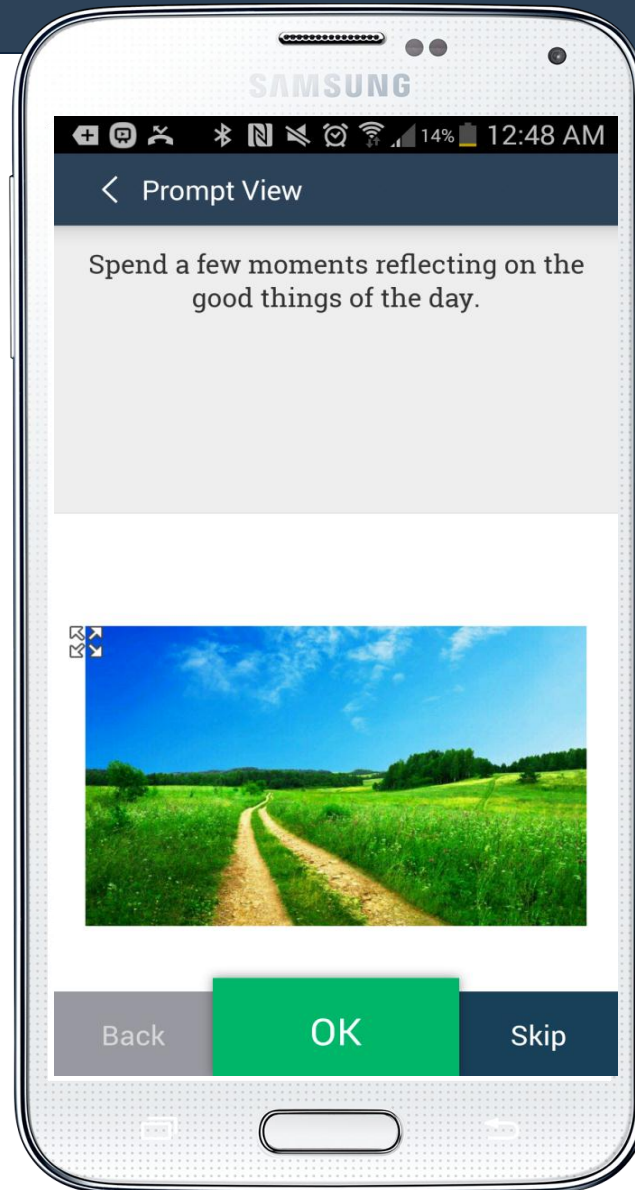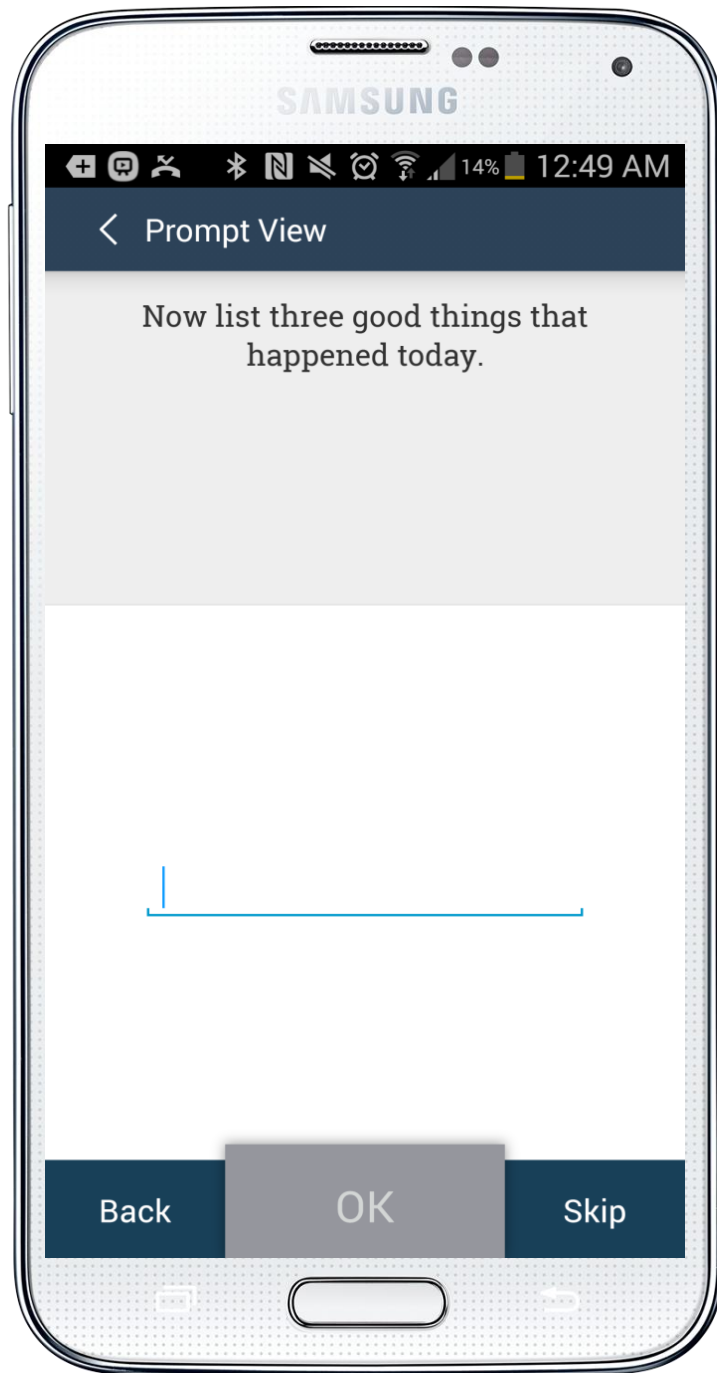
# Signal Contingent

- Person responds when signaled, often at random times (Experience Sampling Method; Csikszentmihalyi et al)

- Gather data on "life as it is lived"

- Usually involves frequent daily assessments
  - Provides "real-time" data, less retrospection
  - More intrusive

- Example: iHabit freshman study

# Example: iHabit Freshman Study
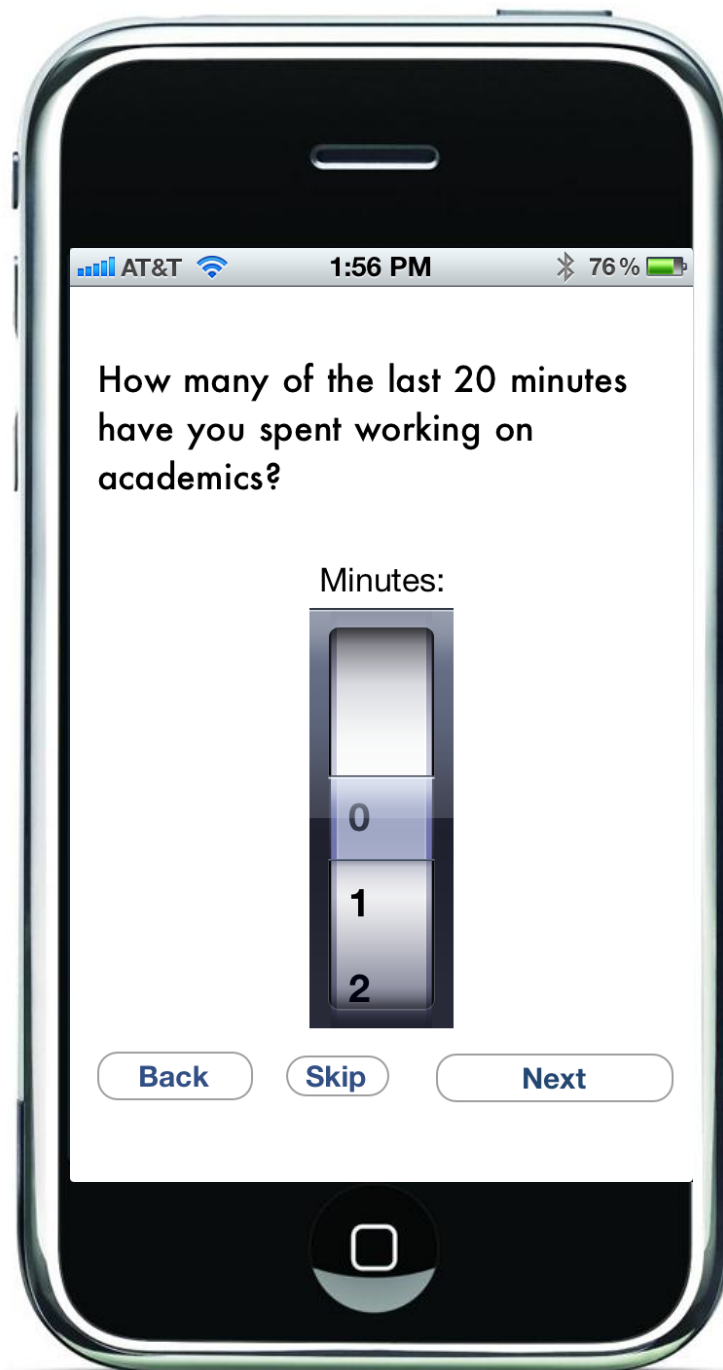
How many of the last 20 minutes
have you spent working on
academics?

Minutes:

0

1

2

Back    Skip    Next

# Event Contingent

- Responding is initiated by the user
- Useful for gathering data on specific events/experiences that might otherwise be missed using ESM
- Examples
  - Smoking lapses
  - Relationship interactions

- Data gathering is initiated by device
- "Passive" Assessment via wearables
    - Heart rate
    - Skin conductance
    - Temperature
    - Ambient sound
    - Activity level/ type
- Geofencing

# Current Technology

1. SMS Text Messaging
2. SMS Text with Hyperlink
3. App-based

Conner, T. S., & Mehl, M. R. (2015).  Ambulatory assessment: Methods for studying everyday life.  In: R. Scott & S. Kosslyn (eds), *Emerging trends in the social and behavioral sciences.*  New York: Wiley & Sons

# SMS Text Messaging

- User answers text messages

- Smartphone not required

- Simple, cheap technology with variety of services available

- Pros and Cons

  **+** cheap, simple tech, max reach by phone

  **-** timing, data management, limited ? space, no event contingent assessment, time zones

# SMS Text with Hyperlink

- User selects hyperlink to online survey
- Use existing online  survey systems
- Pros & Cons
  - \+ cheap, runs on multiple platforms
  - \-  manage 2 software pkgs, requires internet (no offline), time zone & timing issues, no event contingent assessment or sensor integration
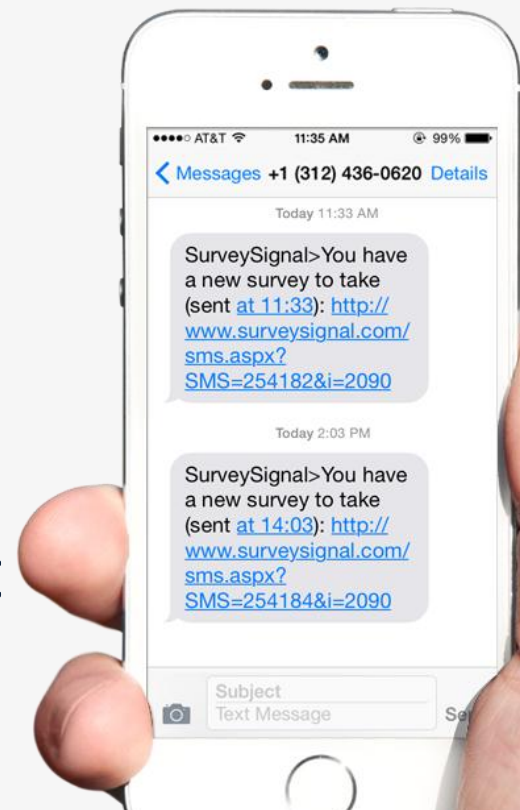
# Smartphone Apps

- User downloads app that delivers notifications/ questions,  gathers data

- Most flexible & rapidly progressing

- Pros & Cons
  - + iOS/Android; run offline; collect time-, event- and device contingent data; easier to manage data; better user interface
  - - requires smartphone, can be costly

# LifeData Example

- Flexible, easy to create EMA/EMI

- Allows 3 modes of user interaction

- All data is time-stamped

- GPS coordinates

- Response times

- Real-Time Dashboard
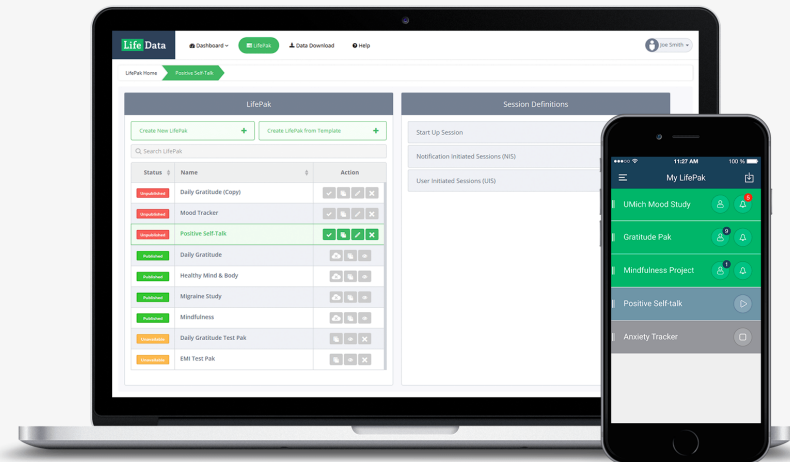
# Step 1: Create LifePak

# Step 2: User Downloads LifePak
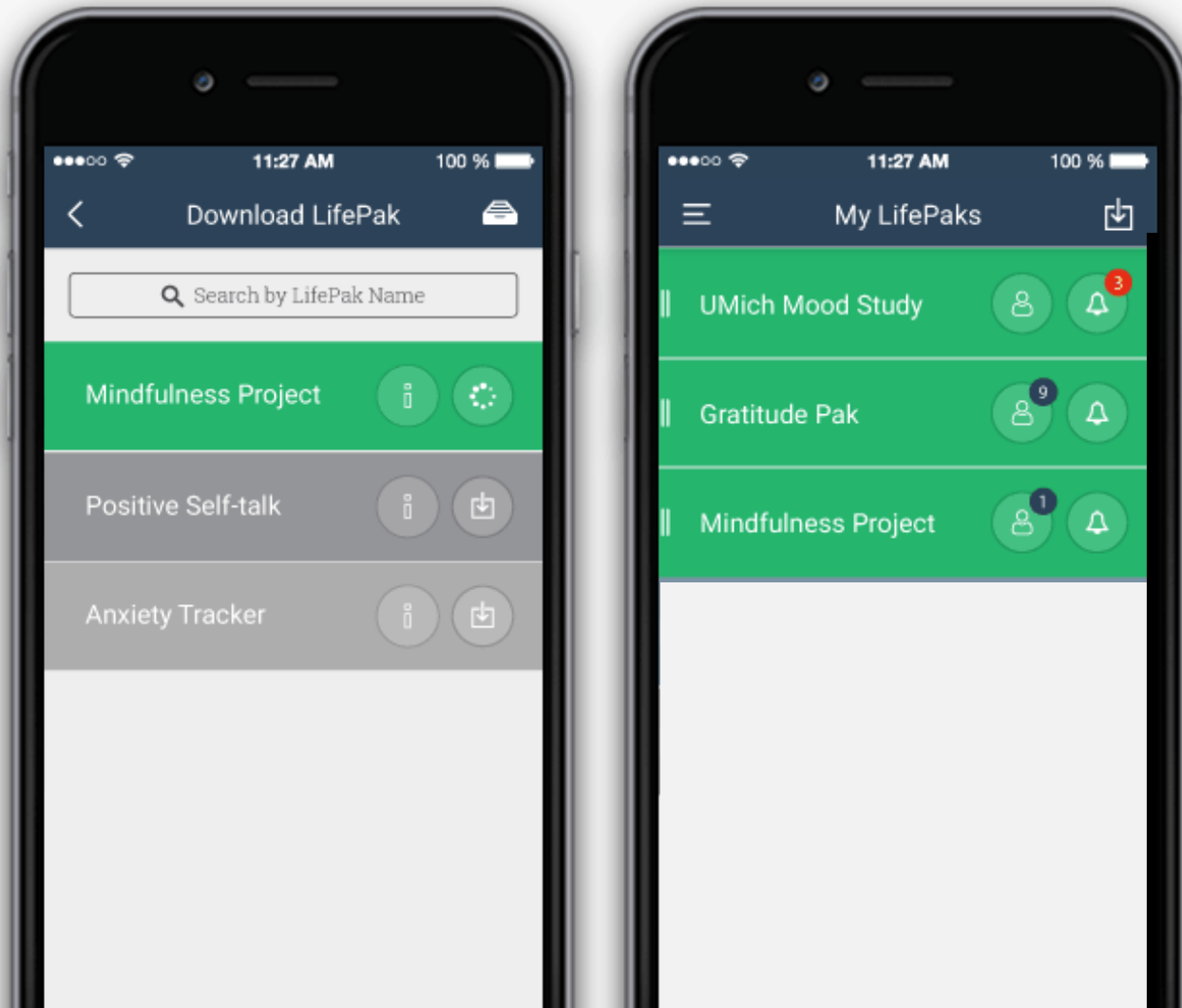
# Step 3: User responds to prompts
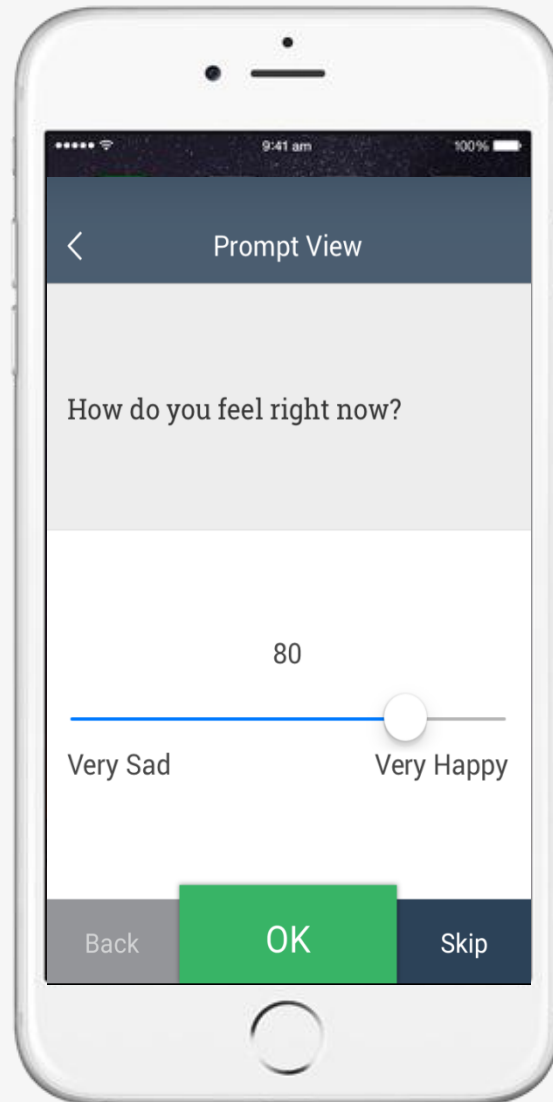
# A. Start-Up Session

- One-time set of prompts delivered upon initiating LifePak

- Helpful for gathering demographic info and delivering instructions
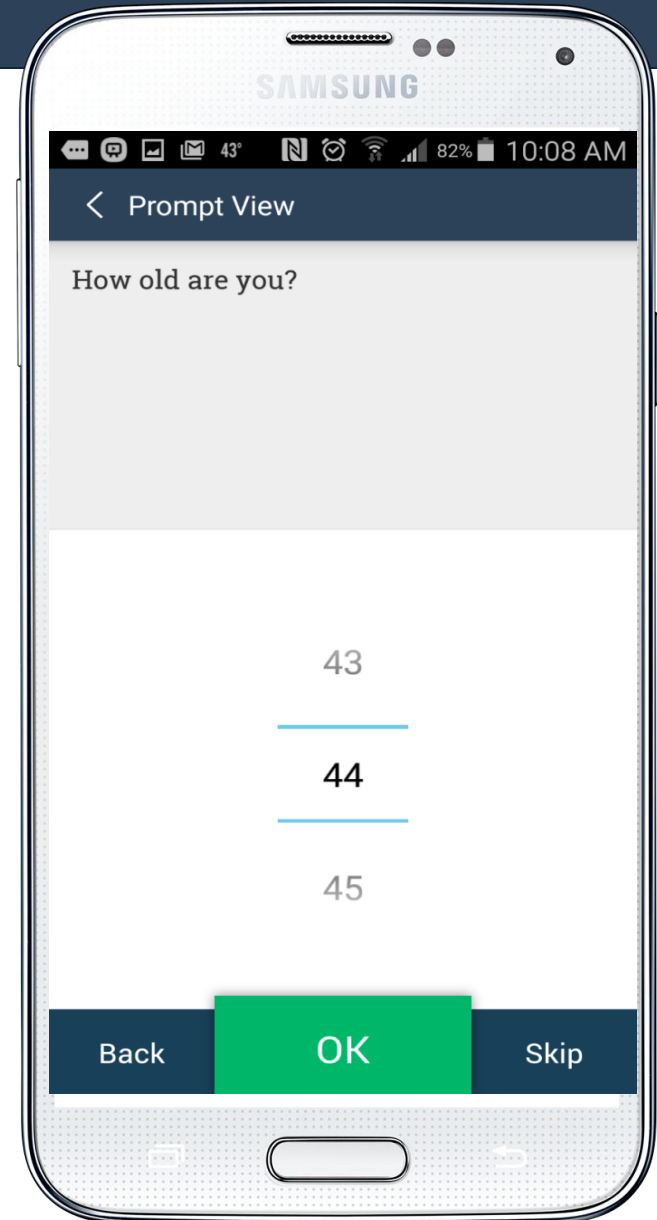
# B. Notification-Initiated Session

- Notification (alarm) signals the user to respond to prompts
- Can be fixed or randomized
- Useful for experience sampling
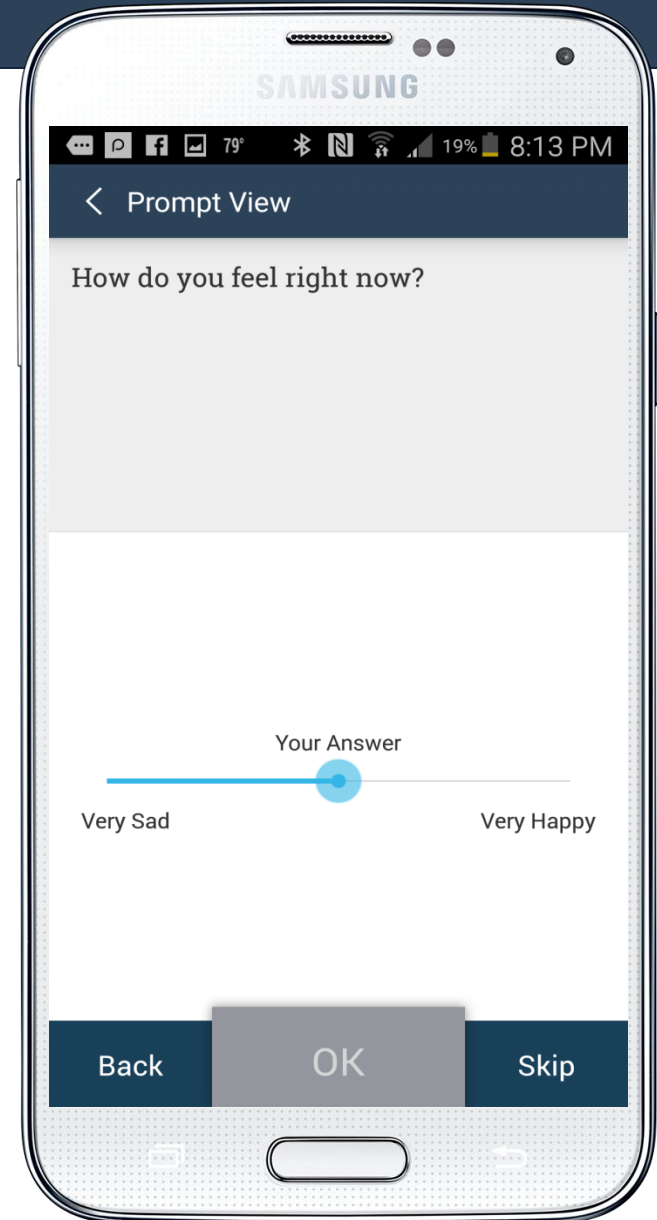
# C. User-Initiated Session

- Available to the user at any time

- Useful for gathering event contingent data or providing interventions

# Step 4: Track responses with Real-Time Dashboard

# Step 5: Download data for analysis

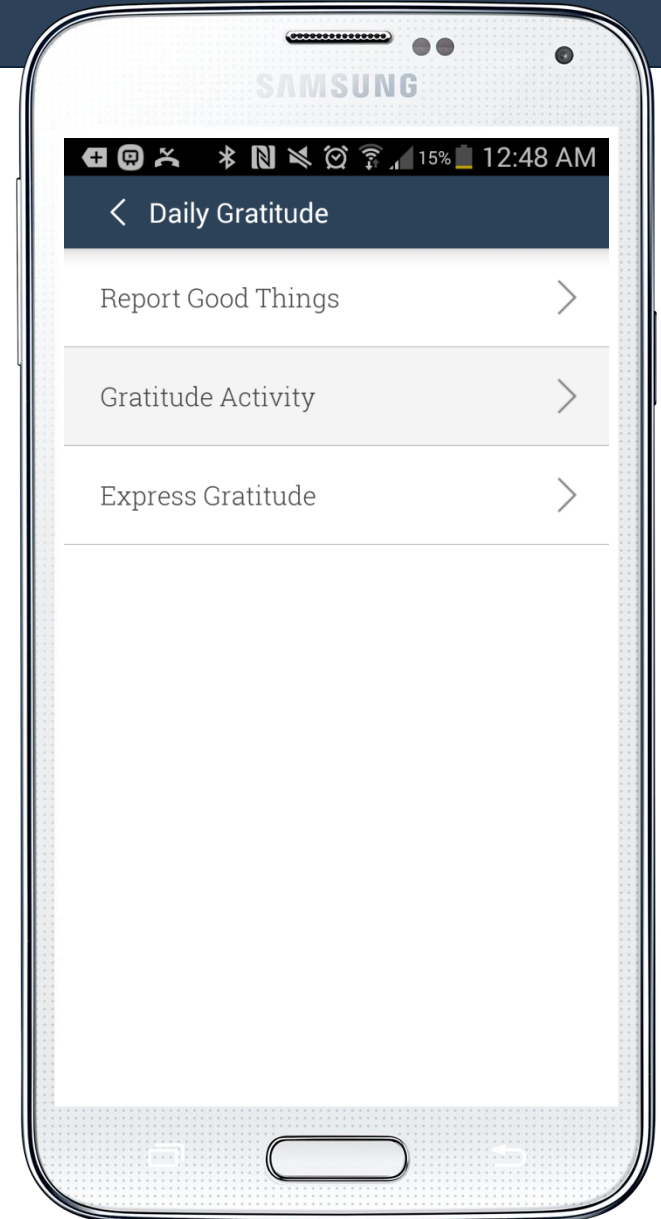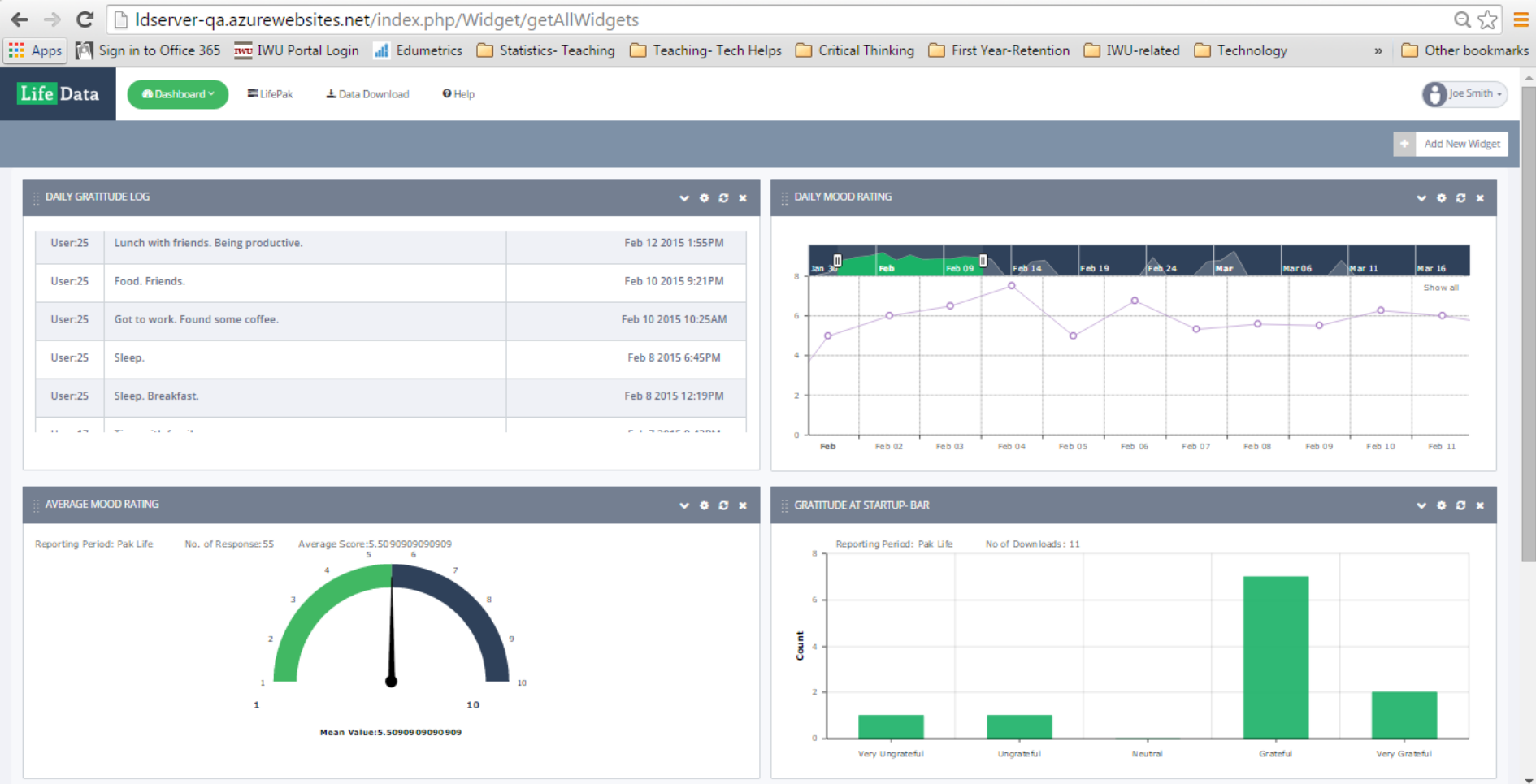| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Question Type | Date | Day | Time | Session Ins | Prompt Re | Participant ID | Device ID | Session | Question | Response | GPS Latitude | GPS Longitud |
| 29 | Free Text Entry | 2/1/2015 | Sunday | 18:59:47 | 0:00:29 | 0:00:18 | 12 | os:androi | Gratitud | What has gotten in the way of gratitude? | anger at a close friend | 37.81328538 | -121.9565943 |
| 30 | Ranger Slider | 3/11/2015 | Wednesday | 10:25:26 | 0:00:58 | 0:00:03 | 17 | os:iOS,ver | Gratitud | How do you feel right now? | 5 | 37.79438334 | -121.9784812 |
| 31 | Ranger Slider | 3/11/2015 | Wednesday | 10:25:21 | 0:00:58 | 0:00:07 | 17 | os:iOS,ver | Gratitud | How much have you expressed gratitude c | 5 | 37.79438334 | -121.9784812 |
| 32 | Rating Scale | 3/11/2015 | Wednesday | 10:25:14 | 0:00:58 | 0:00:05 | 17 | os:iOS,ver | Gratitud | How grateful have you felt over the past h | 3 | 37.79438334 | -121.9784812 |
| 33 | Free Text Entry | 3/3/2015 | Tuesday | 21:46:51 | 0:00:58 | 0:00:29 | 17 | os:androi | Gratitud | What are you learning about gratitude? | patience | 37.79447203 | -121.9782863 |
| 34 | Ranger Slider | 2/6/2015 | Friday | 16:30:20 | 0:00:00 | 0:00:03 | 24 | os:iOS,ver | Gratitud | How do you feel right now? | 8 | 40.5250648 | -85.66822502 |
| 35 | Ranger Slider | 2/6/2015 | Friday | 16:30:16 | 0:00:00 | 0:00:04 | 24 | os:iOS,ver | Gratitud | How much have you expressed gratitude c | 7 | 40.5250648 | -85.66822502 |
| 36 | Rating Scale | 2/6/2015 | Friday | 16:30:11 | 0:00:00 | 0:00:04 | 24 | os:iOS,ver | Gratitud | How grateful have you felt over the past h | 5 | 40.5250648 | -85.66822502 |
| 37 | Ranger Slider | 2/6/2015 | Friday | 11:06:54 | 0:02:06 | 0:00:06 | 25 | os:iOS,ver | Gratitud | How do you feel right now? | 3 | 40.52094807 | -85.66659669 |
| 38 | Ranger Slider | 2/6/2015 | Friday | 11:06:47 | 0:02:06 | 0:00:12 | 25 | os:iOS,ver | Gratitud | How much have you expressed gratitude c | 2 | 40.52094807 | -85.66659669 |
| 39 | Free Text Entry | 2/6/2015 | Friday | 11:06:34 | 0:02:06 | 0:00:20 | 25 | os:iOS,ver | Gratitud | What has gotten in the way of gratitude? | My stomach hurts. | 40.52094807 | -85.66659669 |
| 40 | Rating Scale | 2/6/2015 | Friday | 11:06:12 | 0:02:06 | 0:00:06 | 25 | os:iOS,ver | Gratitud | How grateful have you felt over the past h | 1 | 40.52094807 | -85.66659669 |
| 41 | Free Text Entry | 3/1/2015 | Sunday | 13:47:37 | 0:01:04 | 0:00:31 | 12 | os:androi | Gratitud | What are you learning about gratitude? | it takes effort | 37.81313604 | -121.9996097 |
| 42 | Ranger Slider | 3/1/2015 | Sunday | 13:47:03 | 0:01:04 | 0:00:04 | 12 | os:androi | Gratitud | How do you feel right now? | 6 | 37.81313604 | -121.9996097 |
| 43 | Ranger Slider | 3/1/2015 | Sunday | 13:46:56 | 0:01:04 | 0:00:09 | 12 | os:androi | Gratitud | How much have you expressed gratitude c | 6 | 37.81313604 | -121.9996097 |
| 44 | Rating Scale | 3/1/2015 | Sunday | 13:46:44 | 0:01:04 | 0:00:06 | 12 | os:androi | Gratitud | How grateful have you felt over the past h | 3 | 37.81313604 | -121.9996097 |
| 45 | Free Text Entry | 2/4/2015 | Wednesday | 20:33:29 | 0:00:58 | 0:00:21 | 17 | os:iOS,ver | Gratitud | What are you learning about gratitude? | Joy | 37.79443643 | -121.9784408 |
| 46 | Ranger Slider | 2/4/2015 | Wednesday | 20:33:07 | 0:00:58 | 0:00:20 | 17 | os:iOS,ver | Gratitud | How do you feel right now? | 5 | 37.79443643 | -121.9784408 |
| 47 | Ranger Slider | 2/4/2015 | Wednesday | 20:32:45 | 0:00:58 | 0:00:04 | 17 | os:iOS,ver | Gratitud | How much have you expressed gratitude c | 5 | 37.79443643 | -121.9784408 |
| 48 | Rating Scale | 2/4/2015 | Wednesday | 20:32:40 | 0:00:58 | 0:00:08 | 17 | os:iOS,ver | Gratitud | How grateful have you felt over the past h | 3 | 37.79443643 | -121.9784408 |
| 49 | Ranger Slider | 2/6/2015 | Friday | 15:25:19 | 0:00:21 | 0:00:02 | 25 | os:iOS,ver | Gratitud | How do you feel right now? | 3 | 40.51919467 | -85.6585091 |
| 50 | Ranger Slider | 2/6/2015 | Friday | 15:25:16 | 0:00:21 | 0:00:04 | 25 | os:iOS,ver | Gratitud | How much have you expressed gratitude c | 4 | 40.51919467 | -85.6585091 |

## Download data as a .csv file

## A Smartphone Ecological Momentary Assessment/ Intervention "App" for Collecting Real-Time Data and Promoting Self-Awareness

Jason D. Runyan[1]*, Timothy A. Steenbergh[1], Charles Bainbridge[1], Douglas A. Daugherty[1], Lorne Oke[2], Brian N. Fry[1]

1 Behavioral Science Division, Indiana Wesleyan University, Marion, Indiana, United States of America, 2 The Center for Learning and Innovation, Indiana Wesleyan University, Marion, Indiana, United States of America

- *"How have you been spending your time?"* (5 days, 3 times a day for 3 separate weeks)

- Treatment group reported wasting 2x the amount of time as the control group.

- Predicted semester GPA as well as HS-GPA & ACT scores

# Effective approaches to EMI

- Self-monitoring: raising self-awareness
- Increasing self-efficacy/motivation
- Encouraging practices
- Aid in developing new skills
- Raising awareness of environment
- Individualized messages concerning values, goals, and/or progress

(Runyan & Steinke 2015)

**Context is important for learning habitual or automatic responses:** (e.g., Wood & Neal 2007; Rydell & Gawronski 2009)

i. Context can act as an "***occasion-setter***" (e.g., Bouton 2010)

ii. Contextual cues can influence ***preparatory neural states*** ("affordances") (e.g., Dieber et al. 1996)

iii. Habitual responses become ***more stable*** when learned across contexts (e.g., Neal et al. 2006, 2011)

# Two examples

- ## Gratitude (Emmons & McCullough 2003)

- ## Empathy/Compassion (Klimecki et al. 2014)



**Empathy =** 🟥
**Compassion =** 🟦

# An ongoing EMA/I study: Compassion

**Pretest**  **Posttest 1**  **Posttest 2**

EMA
(3 alarms
a day)

Intervention
(2 alarms a day;
3 end-of-day)

**4 DAYS**  **2 WEEKS**

**(N = ~240)**

# Compassion: 4 day EMA

- **Assessment** (Cameron & Payne, 2011)
- Raising self-awareness
- Raising awareness
  of others

**Prompt View**

Have you come across anyone in the past several hours who is experiencing a tough time?

O Yes
O No

Back | OK | Skip

# Compassion: 4 day EMA

# Compassion: 4 day EMA

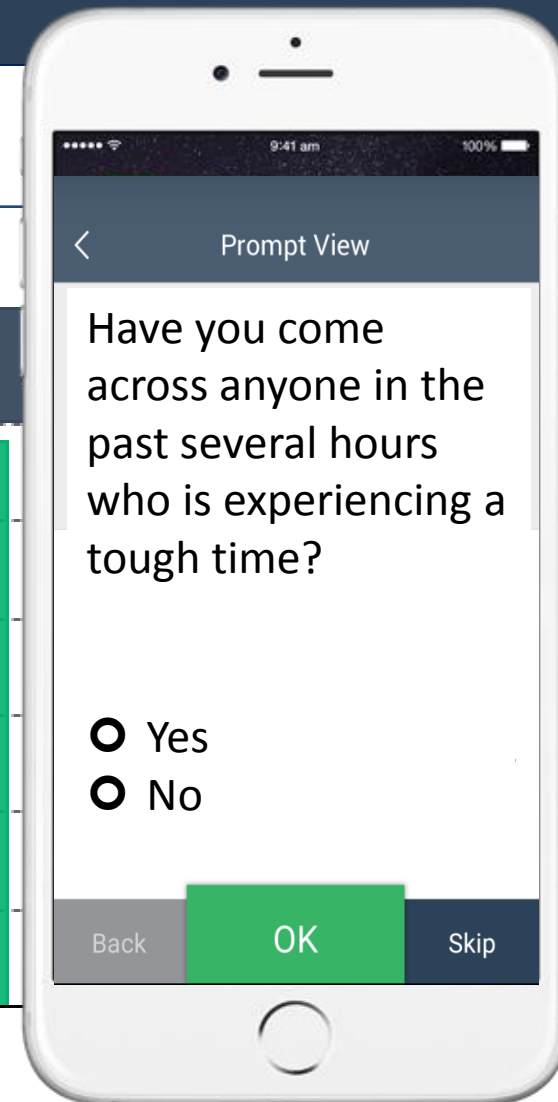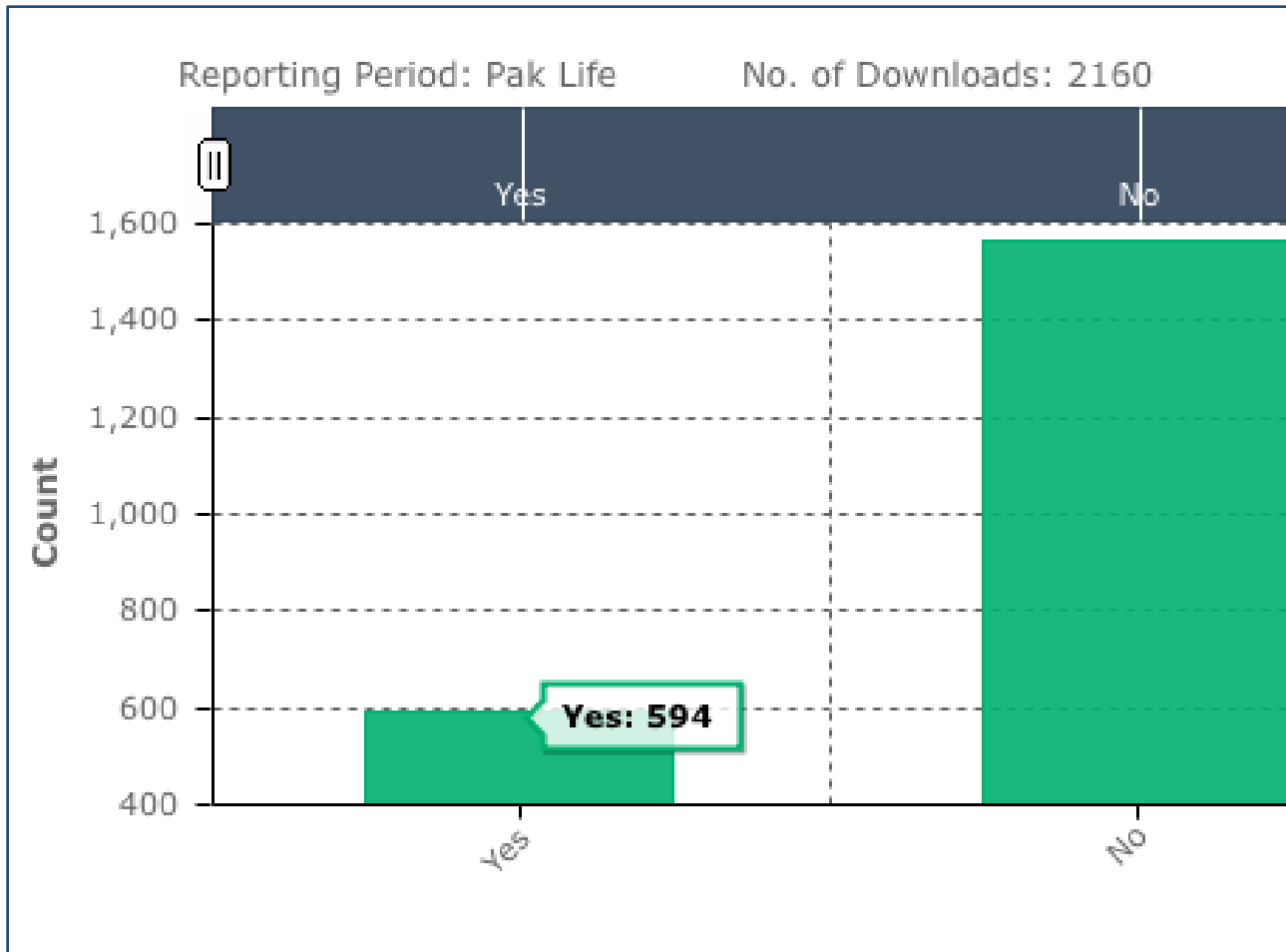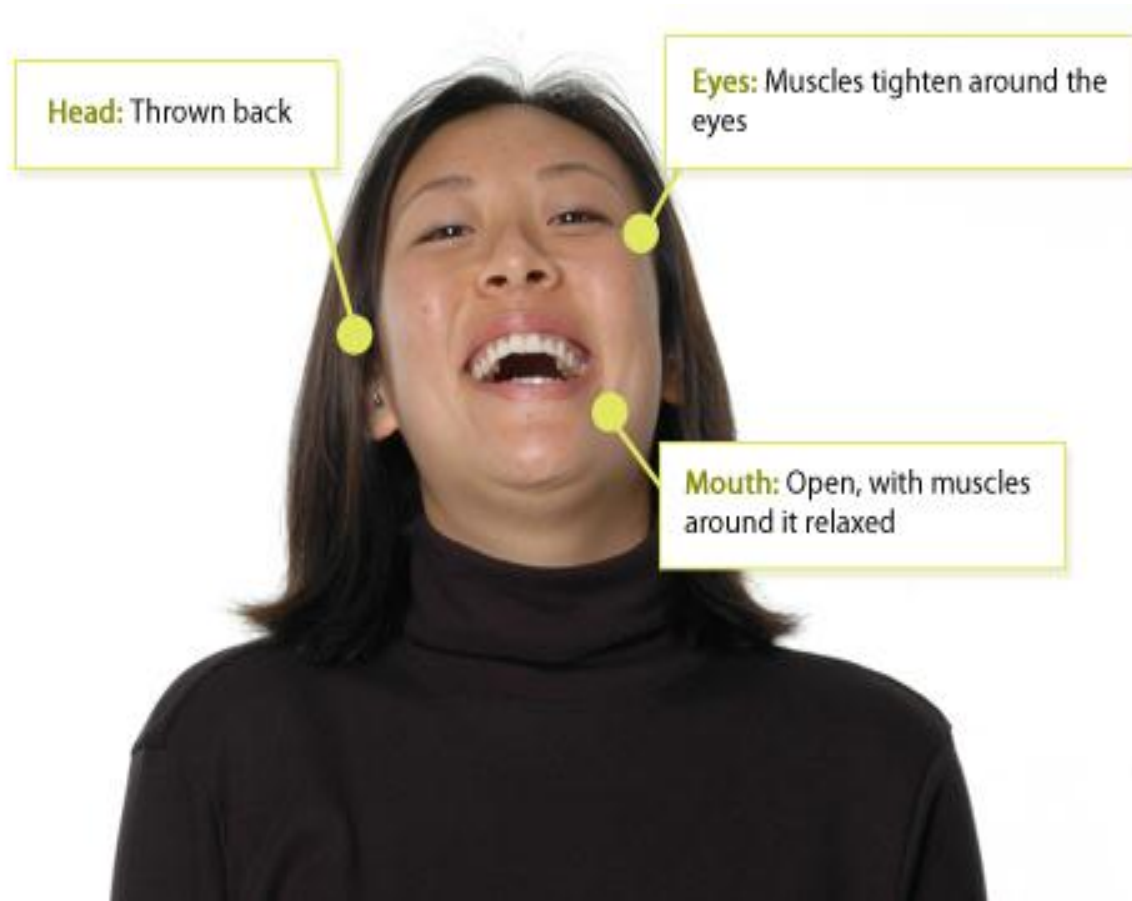| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 23296 | Ranger Slider | 9/25/15 | Friday | 17:14:40 | 0:01:01 | 0:00:06 | 14999 | os:iOS,versio | Attunement | Purpose |
| 23297 | Multiple Cho | 9/25/15 | Friday | 17:14:55 | 0:01:01 | 0:00:03 | 14999 | os:iOS,versio | Attunement | Another |
| 23298 | Ranger Slider | 9/25/15 | Friday | 17:14:45 | 0:01:01 | 0:00:03 | 14999 | os:iOS,versio | Attunement | Happiness |
| 23299 | Ranger Slider | 9/25/15 | Friday | 17:14:51 | 0:01:01 | 0:00:05 | 14999 | os:iOS,versio | Attunement | Good Life |
| 23300 | Ranger Slider | 9/25/15 | Friday | 17:14:59 | 0:01:01 | 0:00:03 | 14999 | os:iOS,versio | Attunement | Warm |
| 23301 | Ranger Slider | 9/25/15 | Friday | 17:15:03 | 0:01:01 | 0:00:03 | 14999 | os:iOS,versio | Attunement | Compassion |
| 23302 | Ranger Slider | 9/25/15 | Friday | 17:15:10 | 0:01:01 | 0:00:06 | 14999 | os:iOS,versio | Attunement | Happy |
| 23303 | Ranger Slider | 9/25/15 | Friday | 17:15:16 | 0:01:01 | 0:00:04 | 14999 | os:iOS,versio | Attunement | Suffer |
| 23304 | Multiple Cho | 9/25/15 | Friday | 17:15:22 | 0:01:01 | 0:00:05 | 14999 | os:iOS,versio | Attunement | Where |
| 23305 | Multiple Cho | 9/25/15 | Friday | 17:15:24 | 0:01:01 | 0:00:01 | 14999 | os:iOS,versio | Attunement | WhoWith |
| 23306 | Multiple Cho | 9/25/15 | Friday | 17:15:30 | 0:01:01 | 0:00:04 | 14999 | os:iOS,versio | Attunement | WhoWith2 |
| 23307 | Ranger Slider | 9/25/15 | Friday | 17:15:34 | 0:01:01 | 0:00:03 | 14999 | os:iOS,versio | Attunement | Overwhelm |
| 23308 | Ranger Slider | 9/25/15 | Friday | 20:44:33 | 0:01:15 | 0:00:04 | 14999 | os:iOS,versio | Attunement | Purpose |
| 23309 | Multiple Cho | 9/25/15 | Friday | 20:44:45 | 0:01:15 | 0:00:04 | 14999 | os:iOS,versio | Attunement | Another |
| 23310 | Ranger Slider | 9/25/15 | Friday | 20:44:36 | 0:01:15 | 0:00:02 | 14999 | os:iOS,versio | Attunement | Happiness |
| 23311 | Ranger Slider | 9/25/15 | Friday | 20:44:39 | 0:01:15 | 0:00:02 | 14999 | os:iOS,versio | Attunement | Good Life |
| 23312 | Ranger Slider | 9/25/15 | Friday | 20:44:47 | 0:01:15 | 0:00:01 | 14999 | os:iOS,versio | Attunement | Warm |
| 23313 | Ranger Slider | 9/25/15 | Friday | 20:44:49 | 0:01:15 | 0:00:01 | 14999 | os:iOS,versio | Attunement | Compassion |
| 23314 | Ranger Slider | 9/25/15 | Friday | 20:44:51 | 0:01:15 | 0:00:01 | 14999 | os:iOS,versio | Attunement | Happy |
| 23315 | Ranger Slider | 9/25/15 | Friday | 20:44:53 | 0:01:15 | 0:00:01 | 14999 | os:iOS,versio | Attunement | Suffer |
| 23316 | Multiple Cho | 9/25/15 | Friday | 20:44:57 | 0:01:15 | 0:00:02 | 14999 | os:iOS,versio | Attunement | Where |
| 23317 | Multiple Cho | 9/25/15 | Friday | 20:45:33 | 0:01:15 | 0:00:04 | 14999 | os:iOS,versio | Attunement | WhoWith |
| 23318 | Multiple Cho | 9/25/15 | Friday | 20:45:36 | 0:01:15 | 0:00:02 | 14999 | os:iOS,versio | Attunement | WhoWith2 |
| 23319 | Ranger Slider | 9/25/15 | Friday | 20:45:41 | 0:01:15 | 0:00:04 | 14999 | os:iOS,versio | Attunement | Overwhelm |
| 23320 | | | | | | | | | | |
| 23321 | | | | | | | | | | |
| 23322 | | | | | | | | | | |
| 23323 | | | | | | | | | | |

# 1. Emotional recognition game ("Greater Good", Berkeley)

Which emotion is this person expressing...
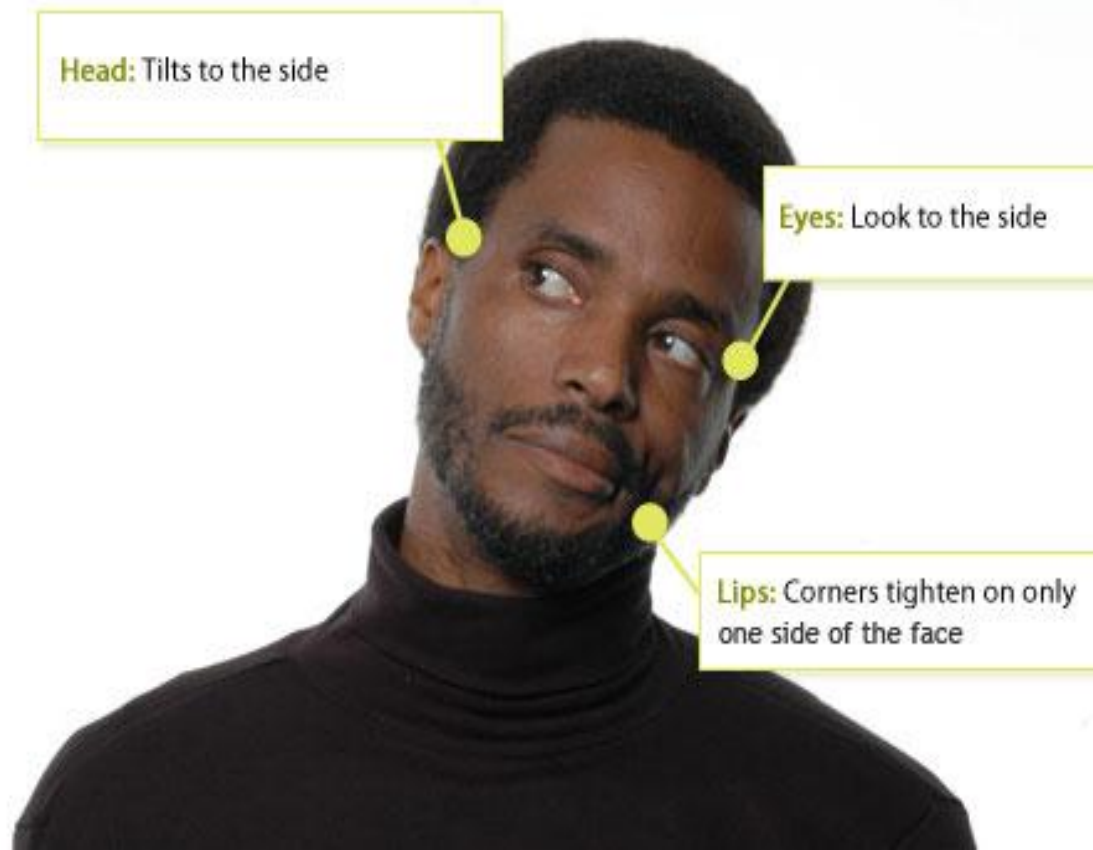Amusement, Desire, Surprise, Excitement

# Amusement

Which emotion is this person expressing...
Sadness, Shame, Disgust, or Contempt

# Contempt

## 2. Perspective-taking vignettes:

*"In February 2014, two unidentified men on the University of Mississippi campus put a noose around the neck of a bronze statue of James Meredith, the first black student to enroll at Ole Miss. The men also left a flag displaying the Confederate emblem. All this happened within a few hundred yards of a monument honoring Confederate soldiers. An editorial in the student paper commented: "'These events continue to happen semester after semester...All our actions seem fruitless and impotent, leaving us broken, scared, humiliated and with burning difficult questions: What...do we do about it? How do we stop these events from transpiring?'"*

# 3. Perspective-taking & action in real-life:

*"Have you come across anyone in the past several hours who is experiencing a tough time?"*

**If No:** *"Think of someone who you know who is experiencing a tough time right now."*

## EMA of EMI:

- Dual Risk Game (Arbuckle & Cunningham 2012)

| SELF | OTHERS |
|------|--------|
| 60 % WIN 10 pts | 20% WIN 1 pt |
| 40 % LOSE 1 pt | 80 % LOSE 7 pts |

**TAKE OR PASS?**

- Focus: broad or narrow *(not too broad)*
- Individualized *(ideal but laborious)*
- Does intervention progress? *(yes)*
- Social component *(minimally; classes are doing it together, dual risk game)*
- How fun, interesting or meaningful/rewarding is it? *(games, helping others)*

- Strategies designed to intervene in the moments of daily life

- "Virtual Coach" or "Therapist-in-Pocket"

- EMI has application for teaching, consulting, coaching, psychotherapy, etc.

# Ecological Momentary Intervention (EMI)

- On-time, in-time & over-time interventions

- mHealth: any psychological or MH intervention delivered by smartphone. (Clough & Casey, 2015)
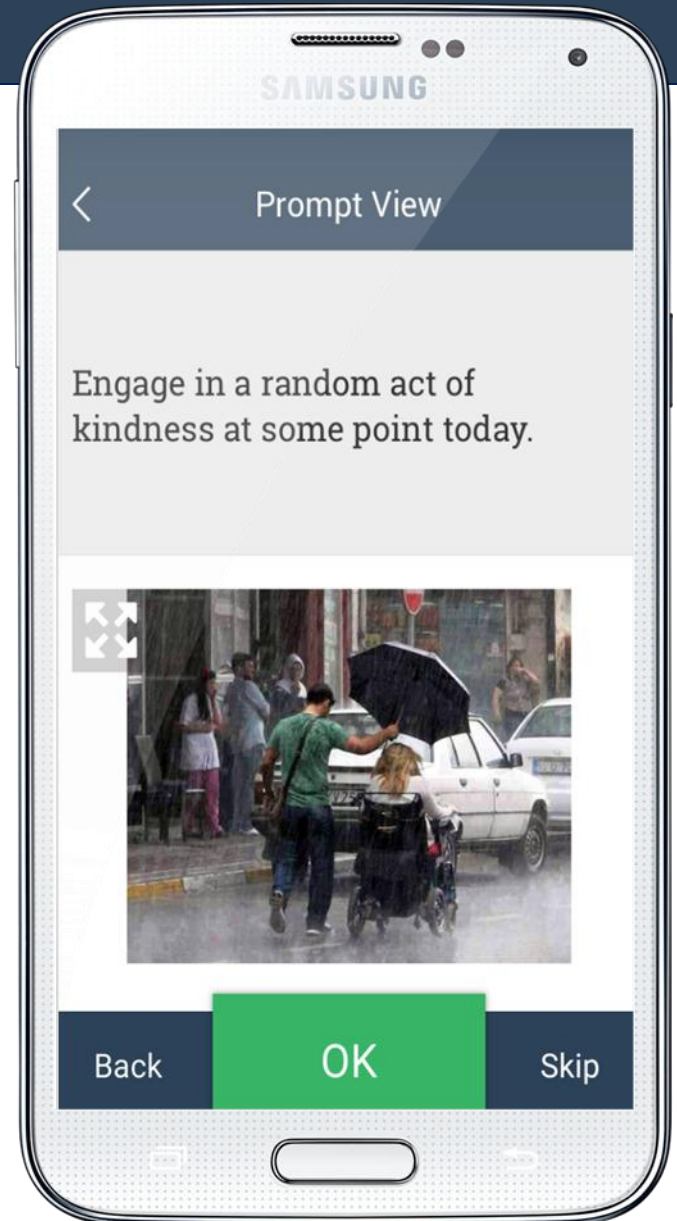
# EMI: mHealth Acceptability & Demand



- Multiple capacities: camera, audio input/output, internet access, text/picture messaging, app-capacity, GPS, sensor integration

- **Users have personal relationship with device. Smartphones as extensions of evolving self – essential to one's personal and social life.**

"Our phones are not accessories, but psychologically potent devices that change not just what we do but who we are."

S. Turkle

# EMI: mHealth Acceptability & Demand

- Generally high patient acceptability & engagement (Monney et al 2015; Bauer et al, 2012; Aguilera & Munoz, 2011; Laursen, 2010, Mathews et al, 2008).

- Response rates typically in the 55%-65%  range (Clough & Casey, 2015) or better.

- More than 10k MH apps
  (Ben-Zeev et al, 2013)

# EMI: mHealth Population Interventions

- ### Expanded Reach
  - Ease of dissemination and access
  - Cost-effective

- ### Examples of Population Interventions
  - Youth resilience
  - University retention
  - Adolescent/adult substance use
  - Stress, mood and coping

# EMI: mHealth Individualized Interventions

- ## Person-Centered Reach

  - What app experience for this person/time?

  - EMA informed, collaborative development of app experiences

  - Sensitive to client culture/language, motivation, goals/stage, strengths and preferences

  - Progressive app experiences

  - Adjunct to in-person interventions: between sessions, continuing care, and follow-up

  - Improve treatment outcomes; reduce risk of relapse

# EMI mHealth Research Challenges/Opportunities

- RCT as gold standard, but average 7 years from grant app to publication (Ioannidas, 1998).

- **Research needs to be rapid, responsive and relevant (Riley et al, 2013).**

- Single-subject experiment multiple baseline designs.

- **N=1 to foster timely innovations**

- Is this app experience engaging, fitting, helpful and promising? How can it be improved?

**"…. the marketplace and consumers are not waiting for scientific validation before adopting mHealth technologies (Clough & Casey, 2015, p. 5)."**

# EMI Considerations/Recommendations

- **Ethical considerations**
  - Recognize large amount of personal info
  - Get consent – participants/clients need to know the type of info being collected and purposes
  - Secure, encrypted data transmission and storage
- **Recommendations**
  - Engagement
  - Vary notifications, content & desired response; NIS/UIS
  - Balance dose/demand
  - Generally maximum 3-4 notifications per day, with minimum dose of 3-4 weeks.
  - Avoid errors & add humor

# EMI: Freshmen Retention Study

- Growth mindset & social belonging interventions for first-year college students (Dweck & Walton, 2014)
- App-delivery:
  - Start-Up & End of Study Survey
    - 17 Social-belonging questions
    - 16 Growth mindset questions
  - NIS: 2 notifications per day with 3 prompts, 6 days a week for 12 days
  - UIS: Success stories, Academic Tips, IWU Resources

# Freshmen Retention Study: Success Stories

# EMI: Freshmen Retention Study

- **mSuccess: Student success interventions delivered by means of a smartphone.**

- Growth Mindset:

    "Some people assume that a person is born smart, average, or dumb. But research shows that the brain is more like a muscle - it gets stronger when you exercise it."

- Social Belonging:

    "Almost all freshmen at IWU and other schools worry about fitting in and being accepted by other students.  So this is a common concern."

"Upon my arrival at IWU, I was faced with the reality that there weren't many students who shared my racial background... Vulnerability with people who shared, at some level, in my racial and cultural experiences was vastly beneficial for me. This, in turn, gave me the strength, confidence, and self-assurance to socially flourish at IWU."
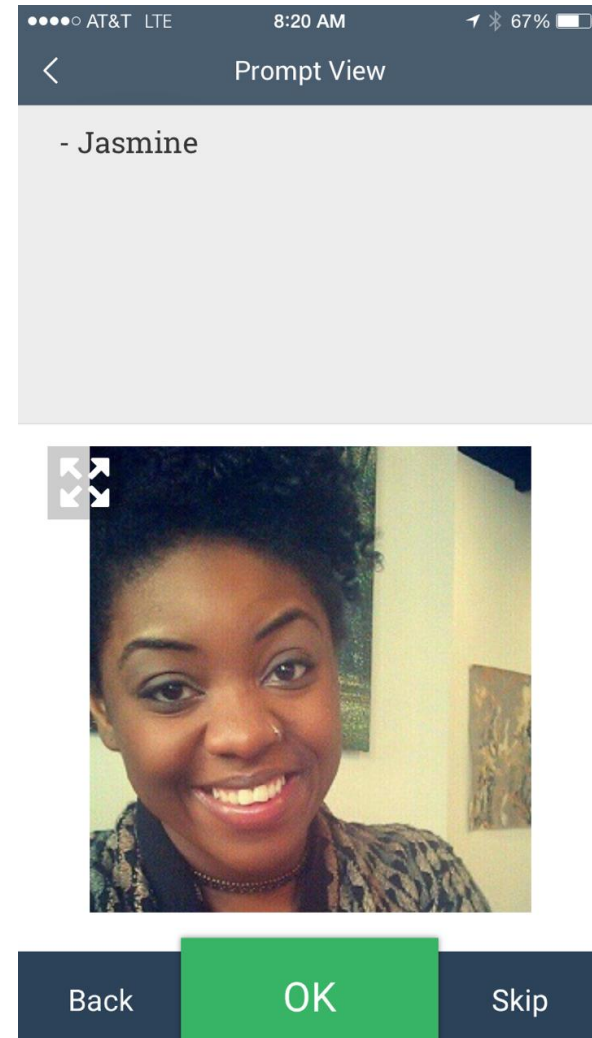
tim.steenbergh@indwes.edu

jason.runyan@indwes.edu

doug.daugherty@indwes.edu

# Helpful Resources

Bolger, N. & Laurenceau, J. P. (2013). *Intensive longitudinal methods: An Introduction to diary and experience sampling research.* New York: Guilford Press. More info available here: http://www.intensivelongitudinal.com/

Dey, A. K., Wac, K., Ferreira, D., Tassini, K., Hong, J., & Rojas, J. (2011). Getting closer: An Empirical investigation of the proximity of user to their smart phones. In Ubicomp '11: Proceedings of the 13th International Conference on Ubiquitous Computing. New York: Association for Computing Machinery. Available here: Dey et al (2011)

Mehl, M. R. & Conner, T. S., Eds. (2012). *Handbook of Research Methods for Studying Daily Life*. New York: Guilford. Available here: Mehl & Conner (2012)

Miller, G. (2012). The smartphone psychology manifesto. *Perspectives on Psychological Science, 7*, 221-237. Available here: Miller (2012)

Pew Research Center (April, 2015) *U. S. smartphone use in 2015*. Available here: Pew Research Center (2015)

Shiffman, S., Stone, A. A., & Hufford, M. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology, 4*, 1-32. Available here: Shiffman et al (2008)

Stone, A. A., Shiffman, S. Atienza, A. A. & Nebeling ,L., Eds. (2007). *The science of real-time data capture: Self-reports in health research.* New York: Oxford University Press. Available here: Stone et al (2007)