Digital Phenotyping and Mental Health: Hype, Hope, and Hard Work Ahead

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Conflicts of Interest

- Investigator Initiated Study on Abilify MyCite Supported by Otsuka

Outline

- State of Smartphones and Mental Health
- Smartphones Digital Phenotyping
- App Evaluation
- Informed Consent in the Digital Age

Finding Focus in Digital Mental Health

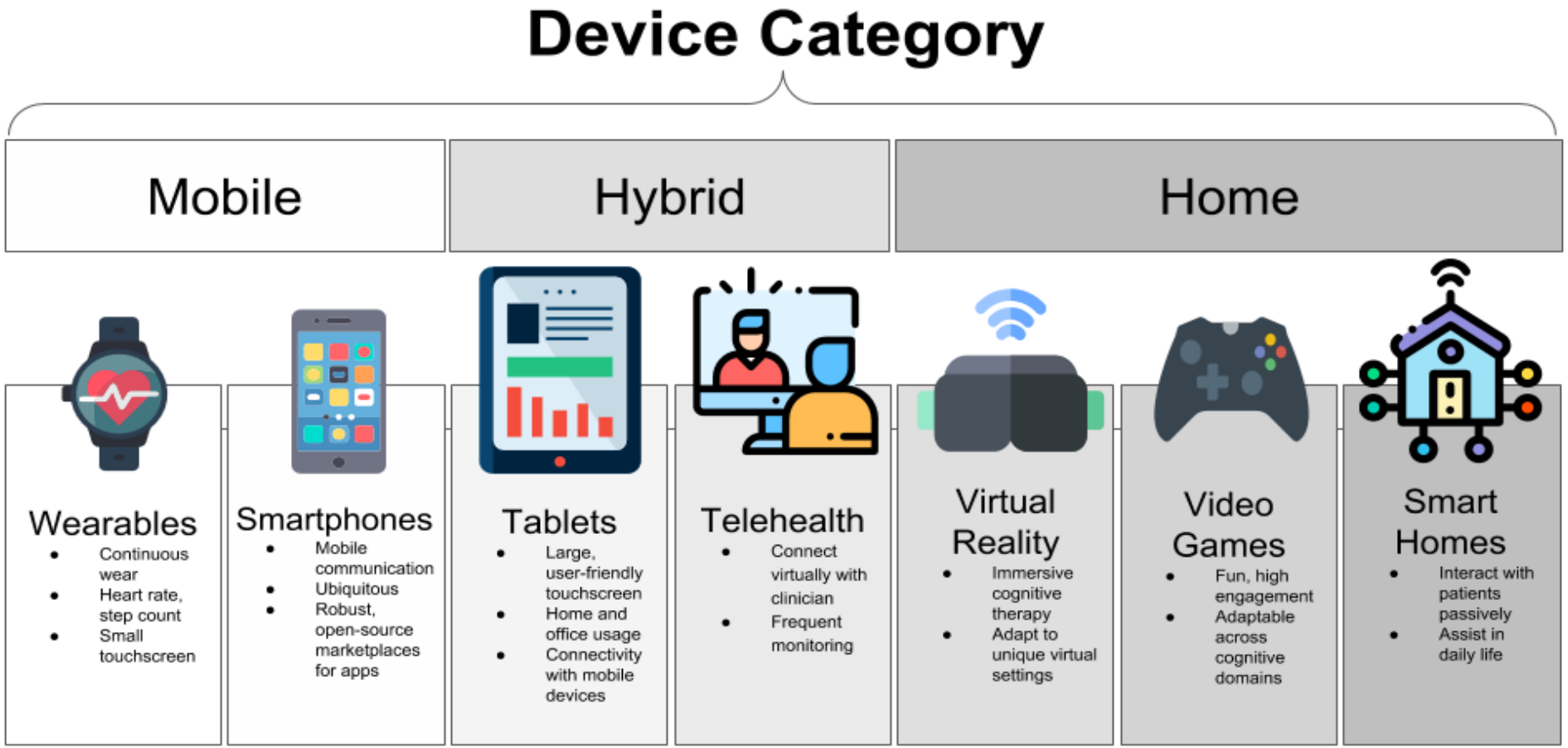

Image by Ryan Hays, BIDMC Digital Psychiatry

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Audience Question #1

The largest breakthrough in smartphone based digital mental health will be in

1- Diagnosis

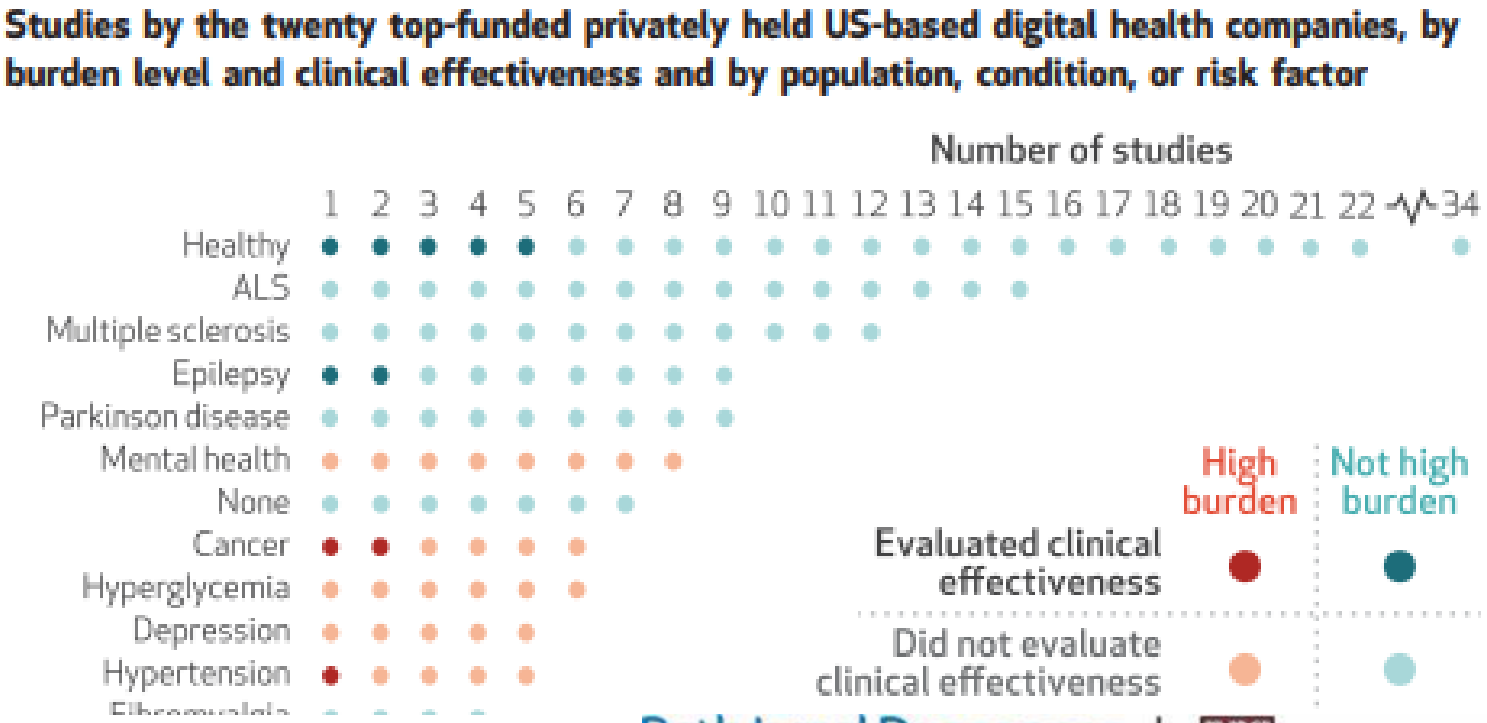
2- Relapse Monitoring

3- Delivering Peer Support

4- Real Time CBT Based Interventions

State of Smartphones and Mental Health in US

- Number of Mental Health Apps: 10,000
- Number of FDA Approved Mental Health Apps: 1
- Industry Studies ->



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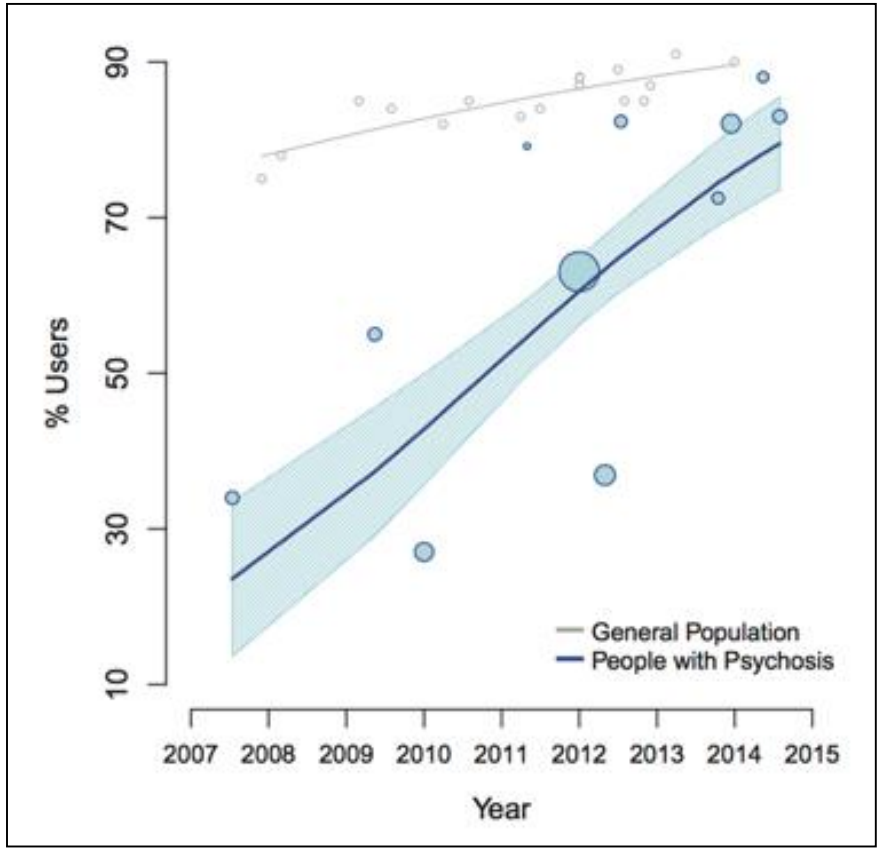
State of Smartphones and Mental Health



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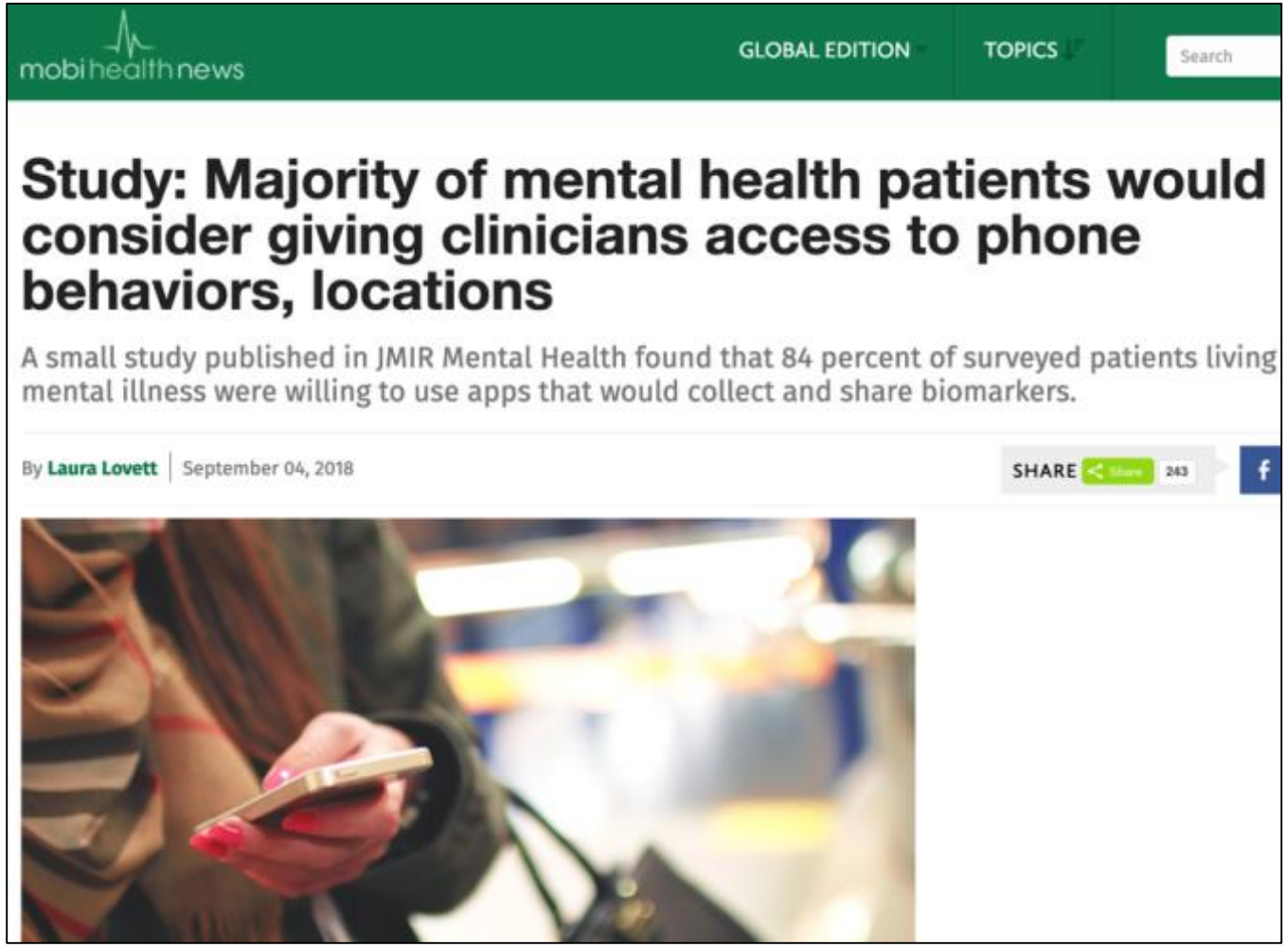

mobihealthnews

GLOBAL EDITION TOPICS Search

Study: Majority of mental health patients would consider giving clinicians access to phone behaviors, locations

A small study published in JMIR Mental Health found that 84 percent of surveyed patients living mental illness were willing to use apps that would collect and share biomarkers.

By Laura Lovett | September 04, 2018

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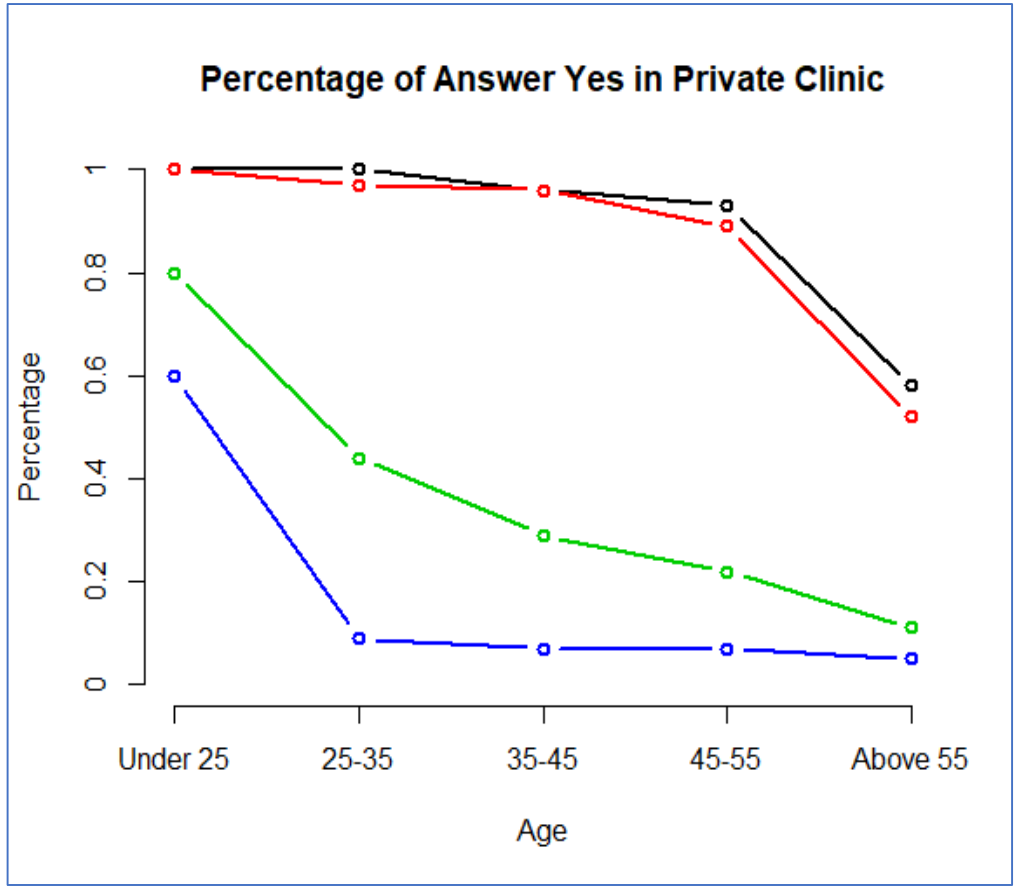
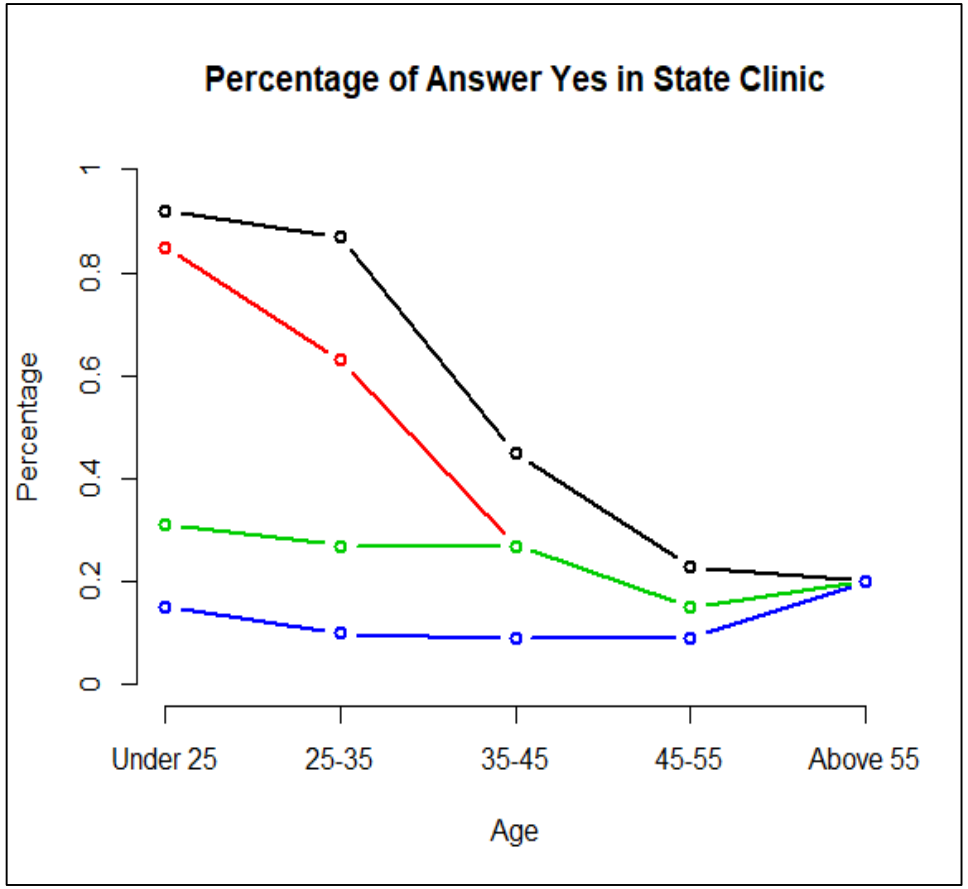
State of Smartphones and Mental Health





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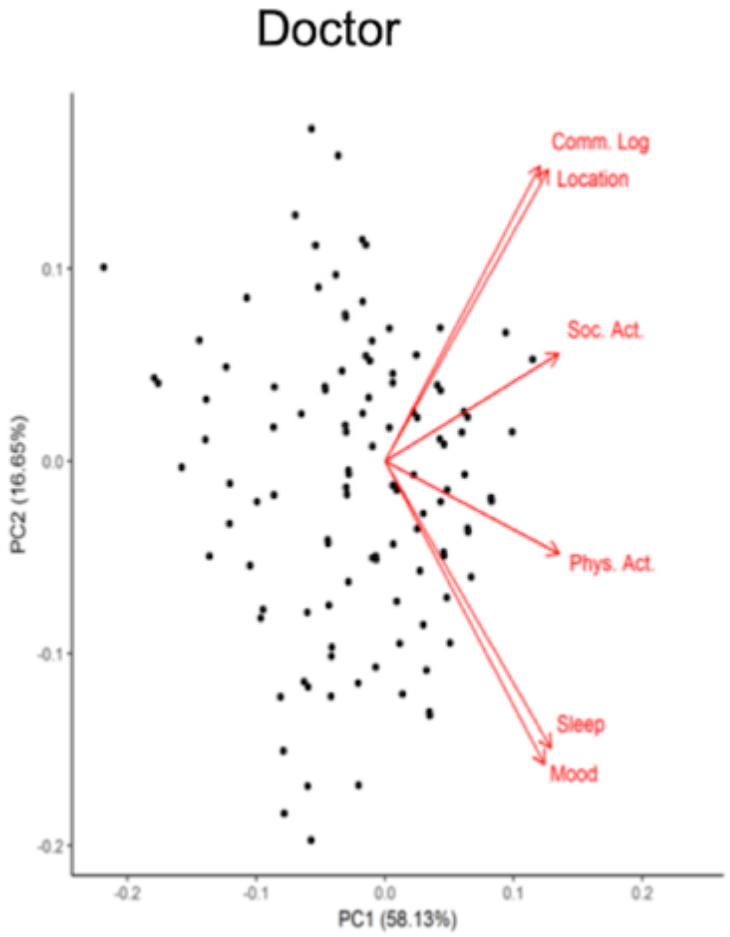
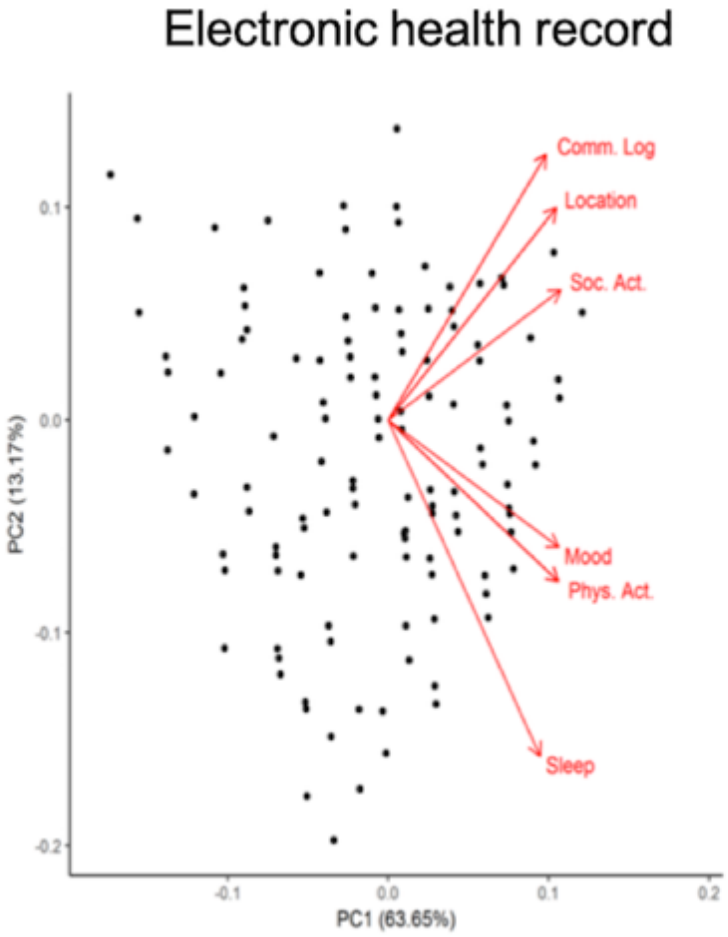
State of Smartphones and Mental Health





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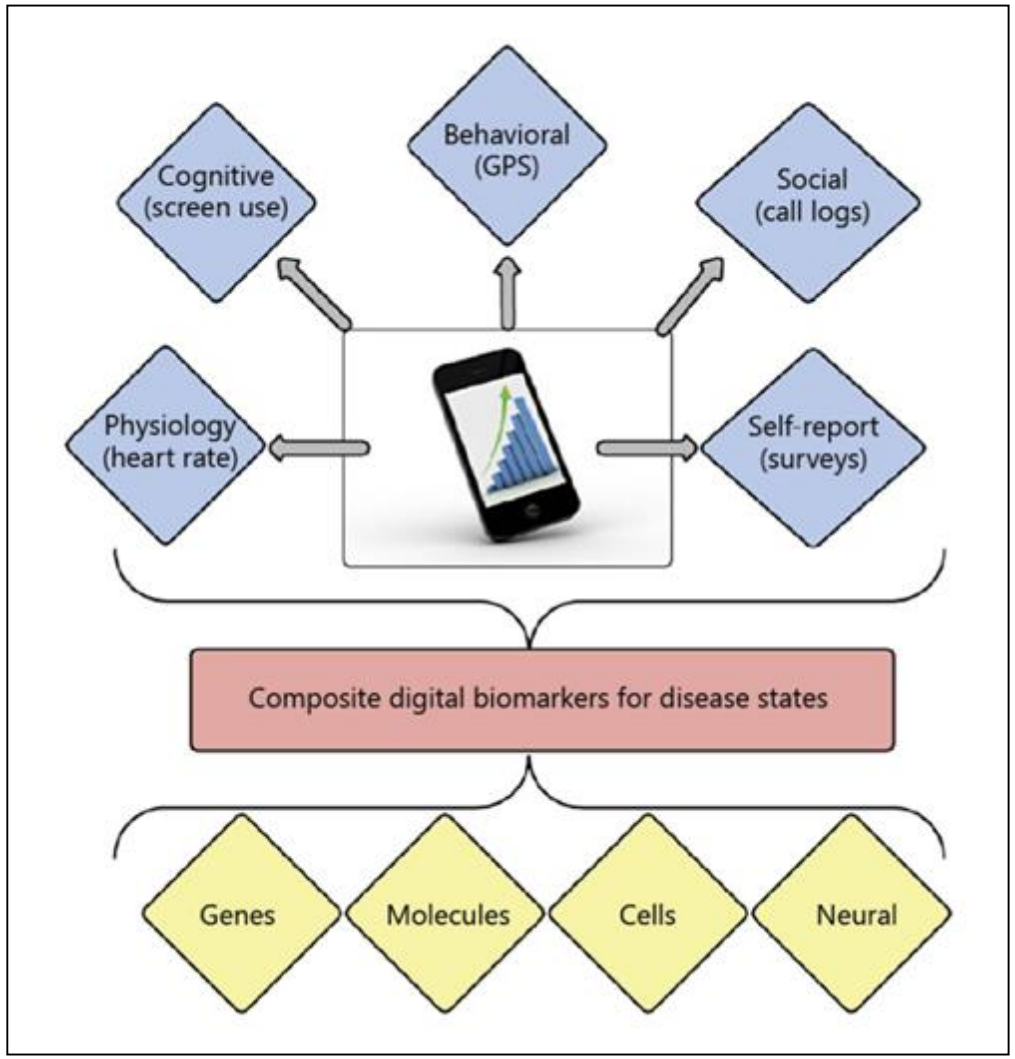
State of Smartphones and Mental Health

Screen	Seen as one of the less invasive ways of seeing interaction patterns and daily routines. Worries about false positives (e.g. screen on due to movement or notification).	P12 "interesting to see if there are correlations between how much screen-time you get versus your ability to sleep and your ability to relax and put it away, because the screen being on and the screen being off, it doesn't bother me for privacy issues."
Keyboard	Highly unacceptable to record keys clicked. Participants do not want their messages or searches tracked. Keyboard events (key press counts etc.) rather than content more acceptable.	P1 "That's a scary one... I definitely don't want them to see what I Google."

Rooksby et al. Student Perspectives on Digital Phenotyping :The Acceptability of Using Smartphone Data to Assess Mental Health. CHI 2019

State of Smartphones and Mental Health



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CALIFORNIA STATE UNIVERSITY, NORTHRIDGE 1958

上海市精神卫生中心 SMHC 1935 SHANGHAI MENTAL HEALTH CENTER

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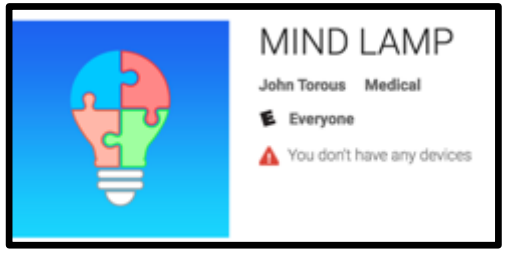
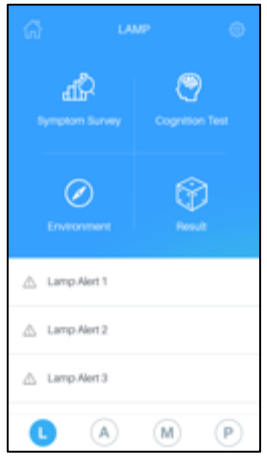
https://github.com/BIDMCDigitalPsychiatry/LAMP-start



Physical Activity



Symptom Surveys

Cognitive Testing

Time Stamps

Geo-Location / GPS

Activity

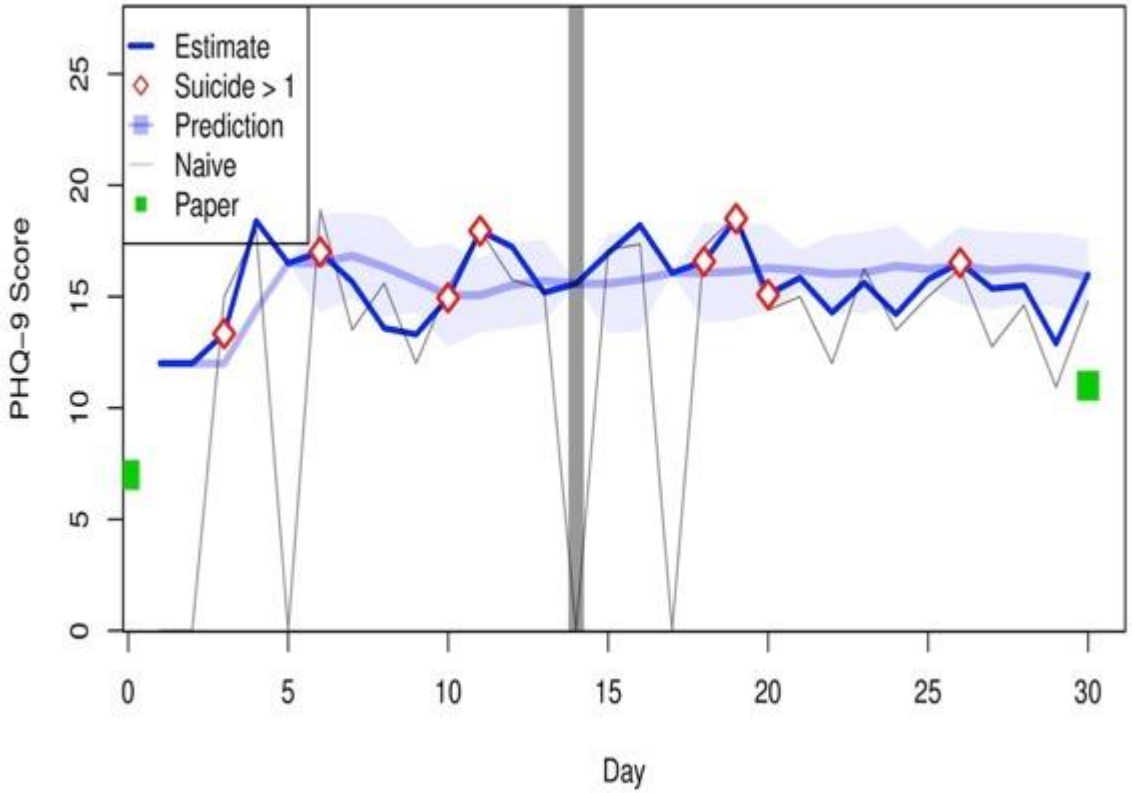
↕

Symptoms

↕

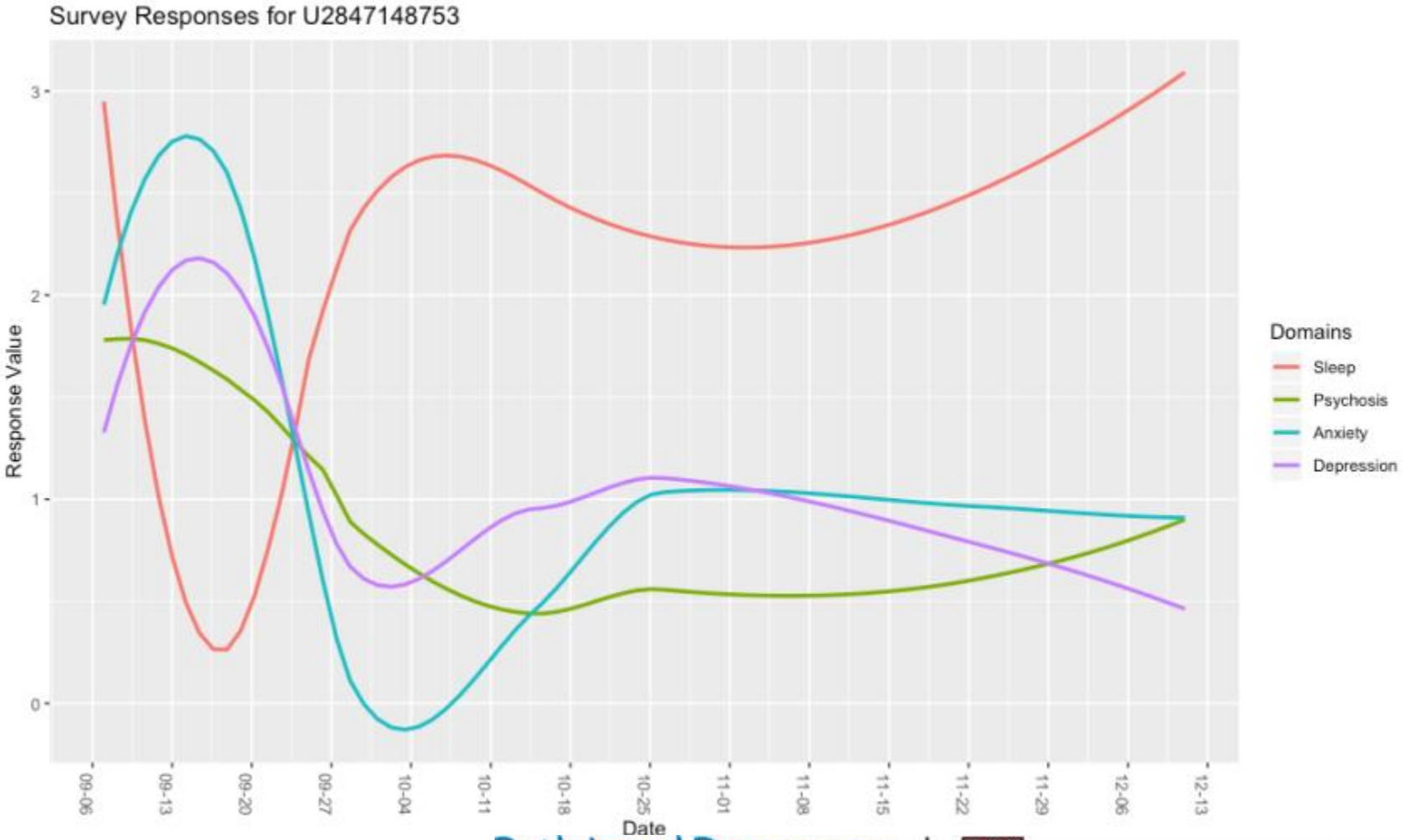
Environment

Smartphones -> New Longitudinal Symptom Data



Torous J, Staples P, Shanahan M, Lin C, Peck P, Keshavan M, Onnela JP. Utilizing a Personal Smartphone Custom App to Assess the Patient Health Questionnaire-9 (PHQ-9) Depressive Symptoms in Patients With Major Depressive Disorder. JMIR Ment Health 2015;2(1):e8

Smartphones -> New Longitudinal Symptom Data



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Smartphones -> New Longitudinal Symptom Data

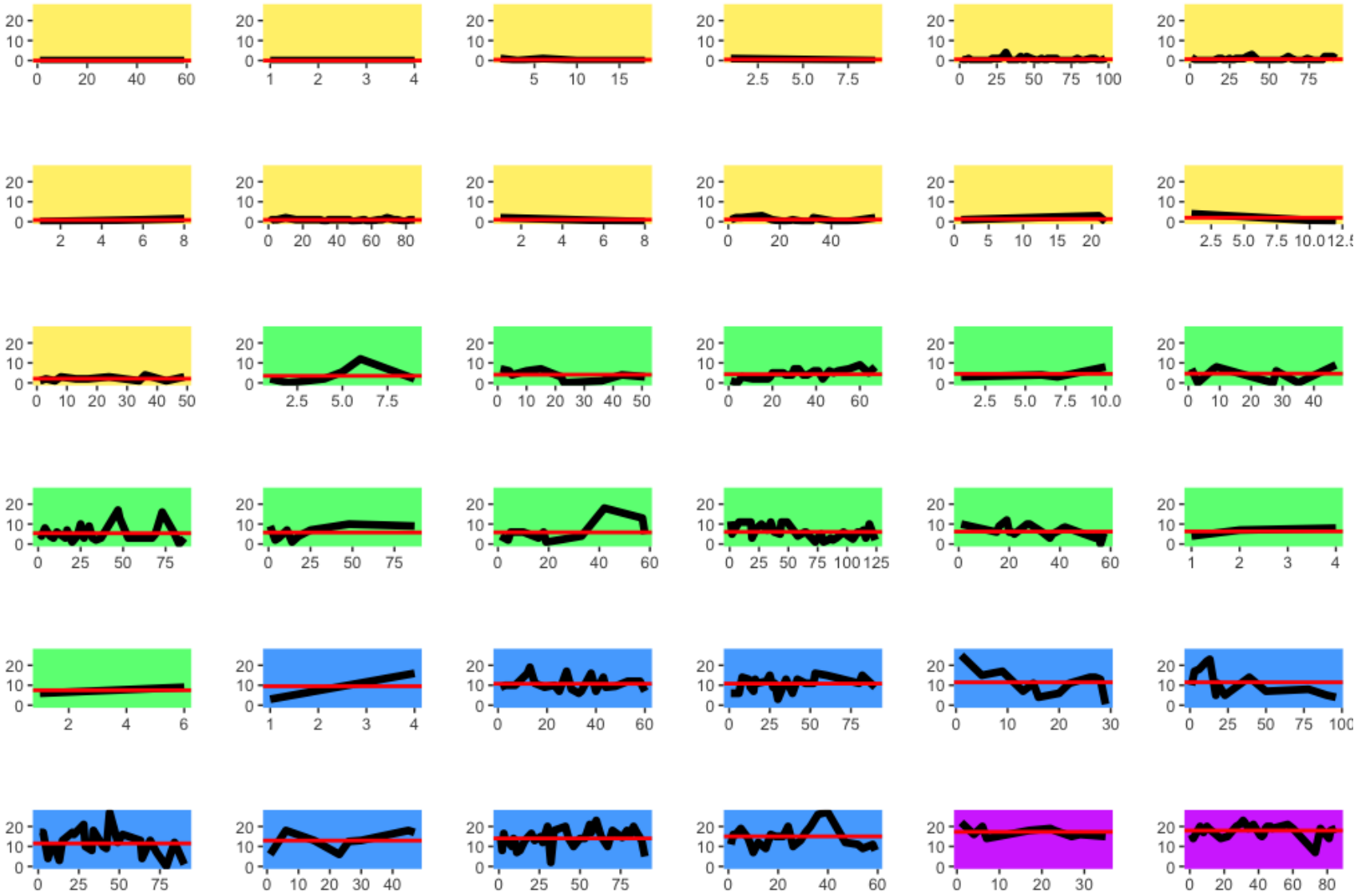
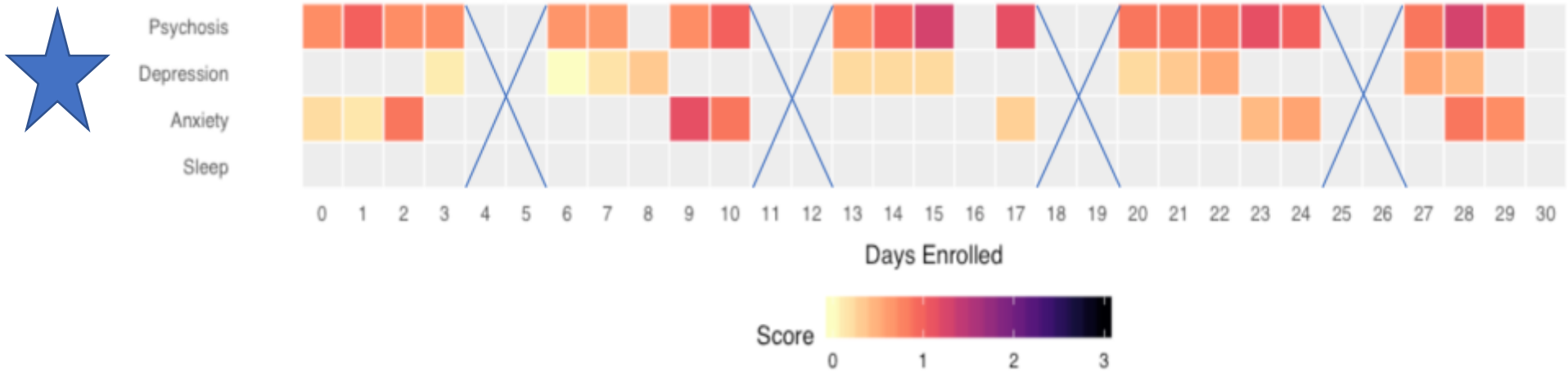
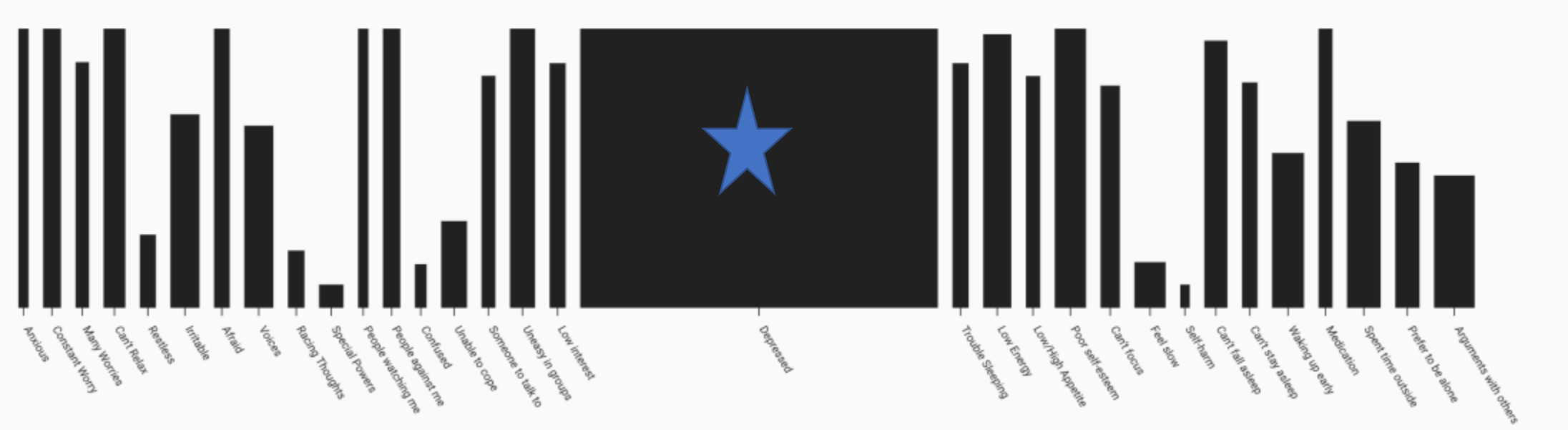


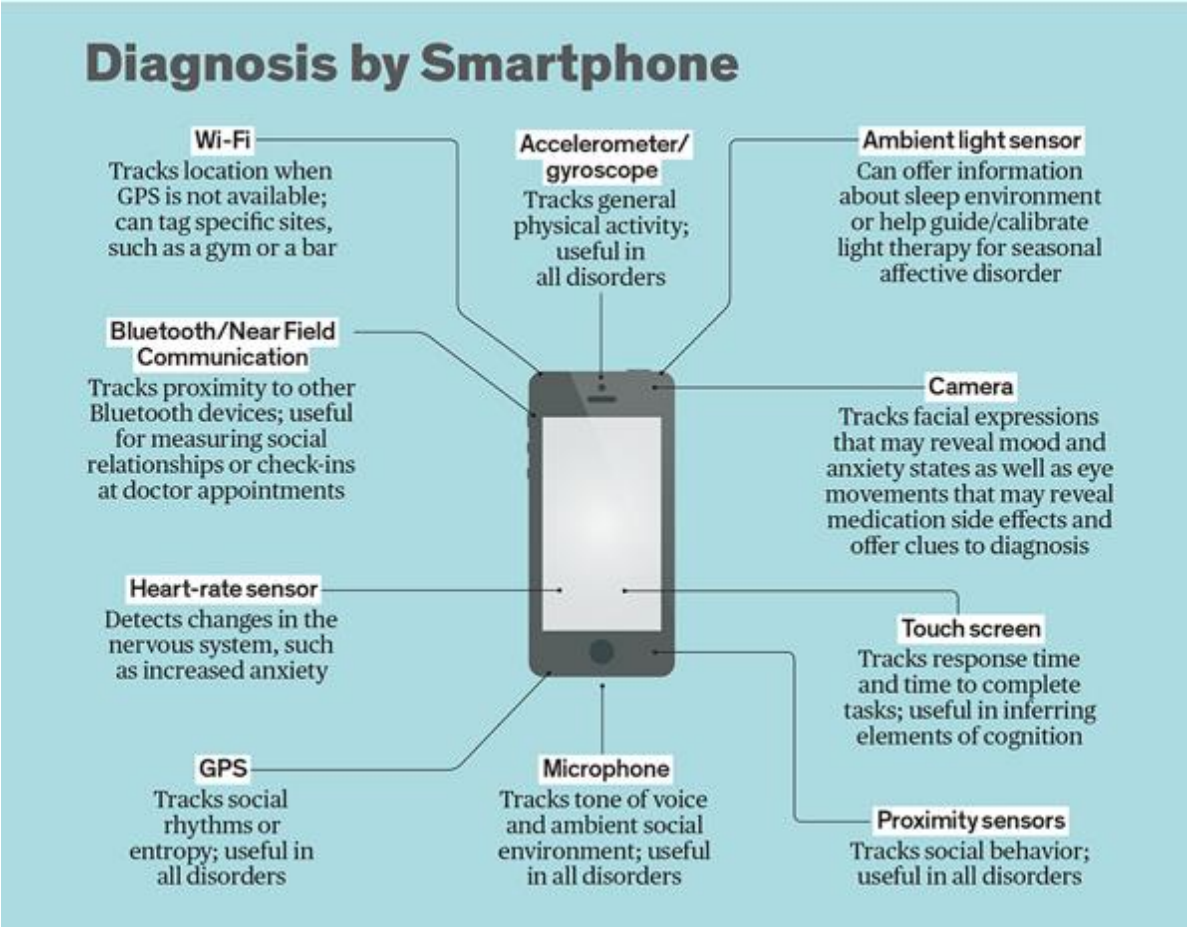
Figure by Philip Henson, BIDMC Digital Psychiatry

Smartphones -> New Longitudinal Symptom Data





Smartphones -> New Functional Data



A Software Shrink: Apps and Wearables Could Usher In an Era of Digital Psychiatry. IEEE Spectrum. 2017.

Active and Passive (n= 1 example)

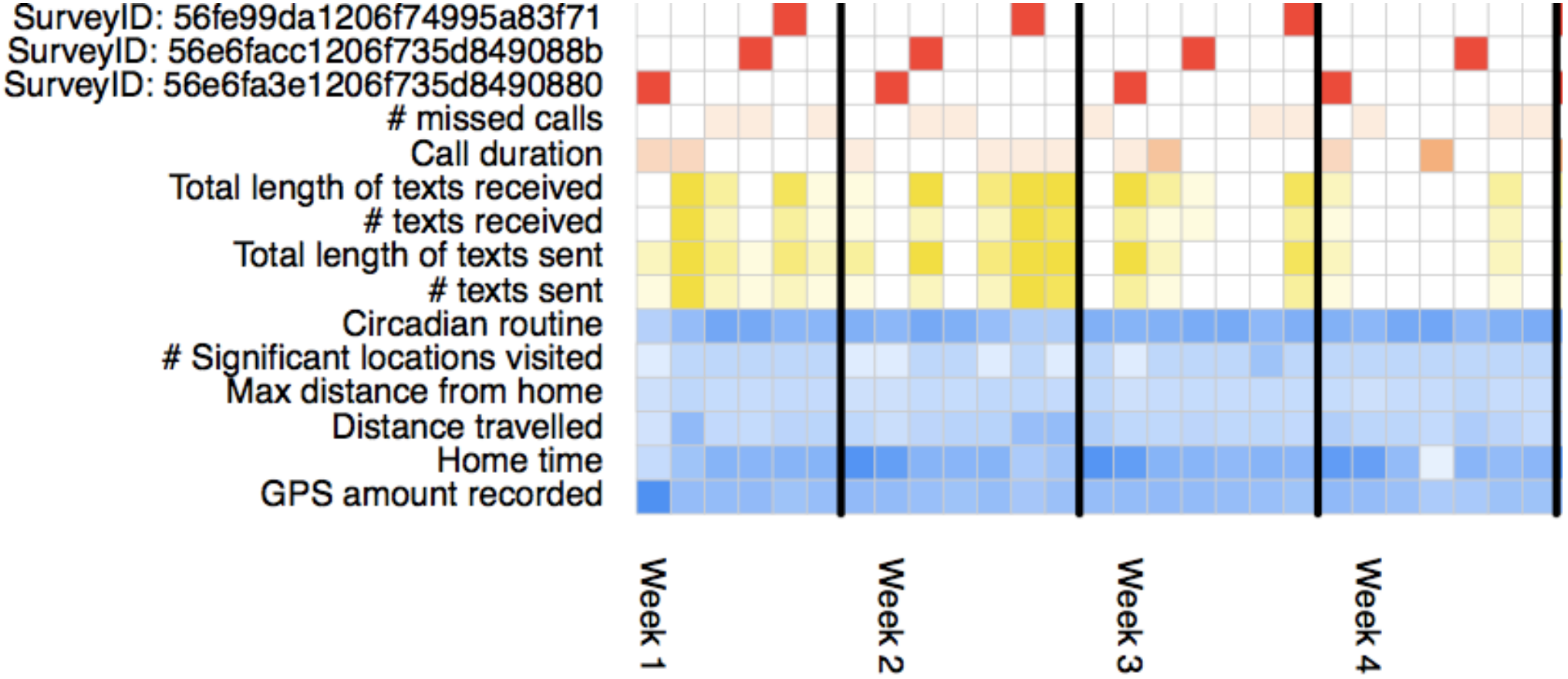


Image by Ian Barnett PhD, UPenn

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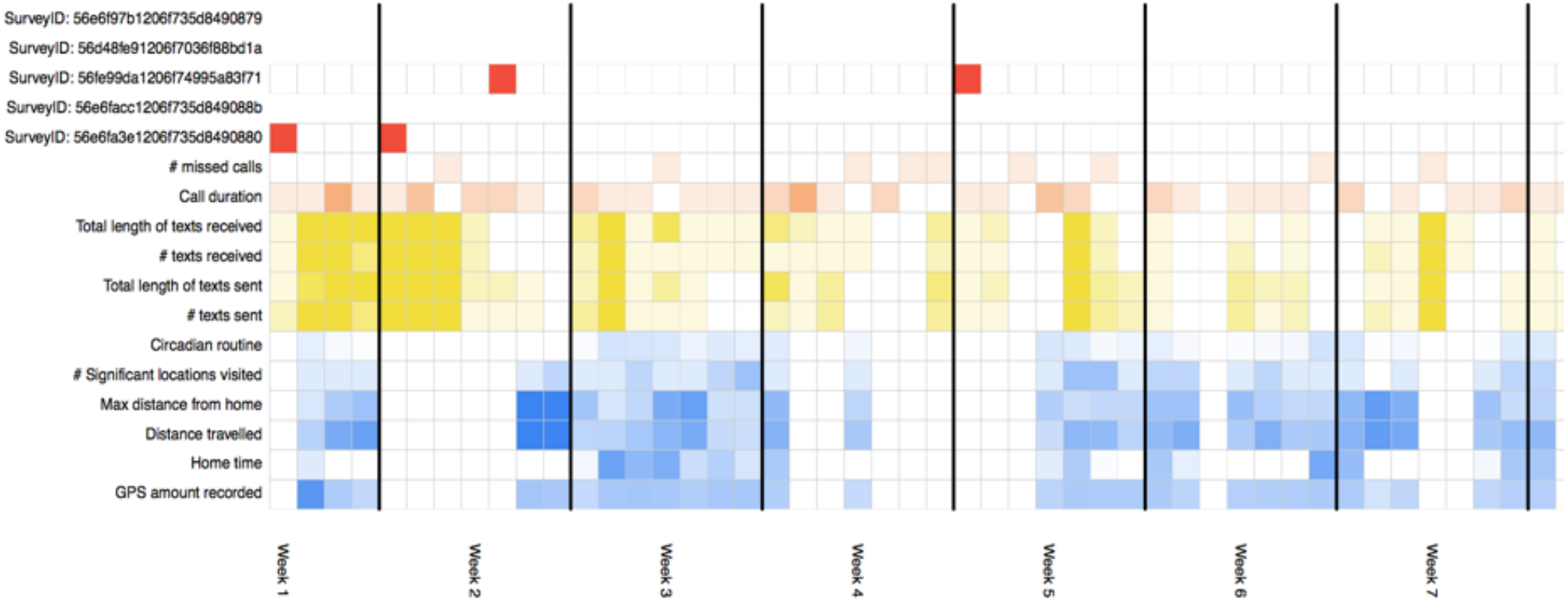
Active and Passive (n= 1 example)



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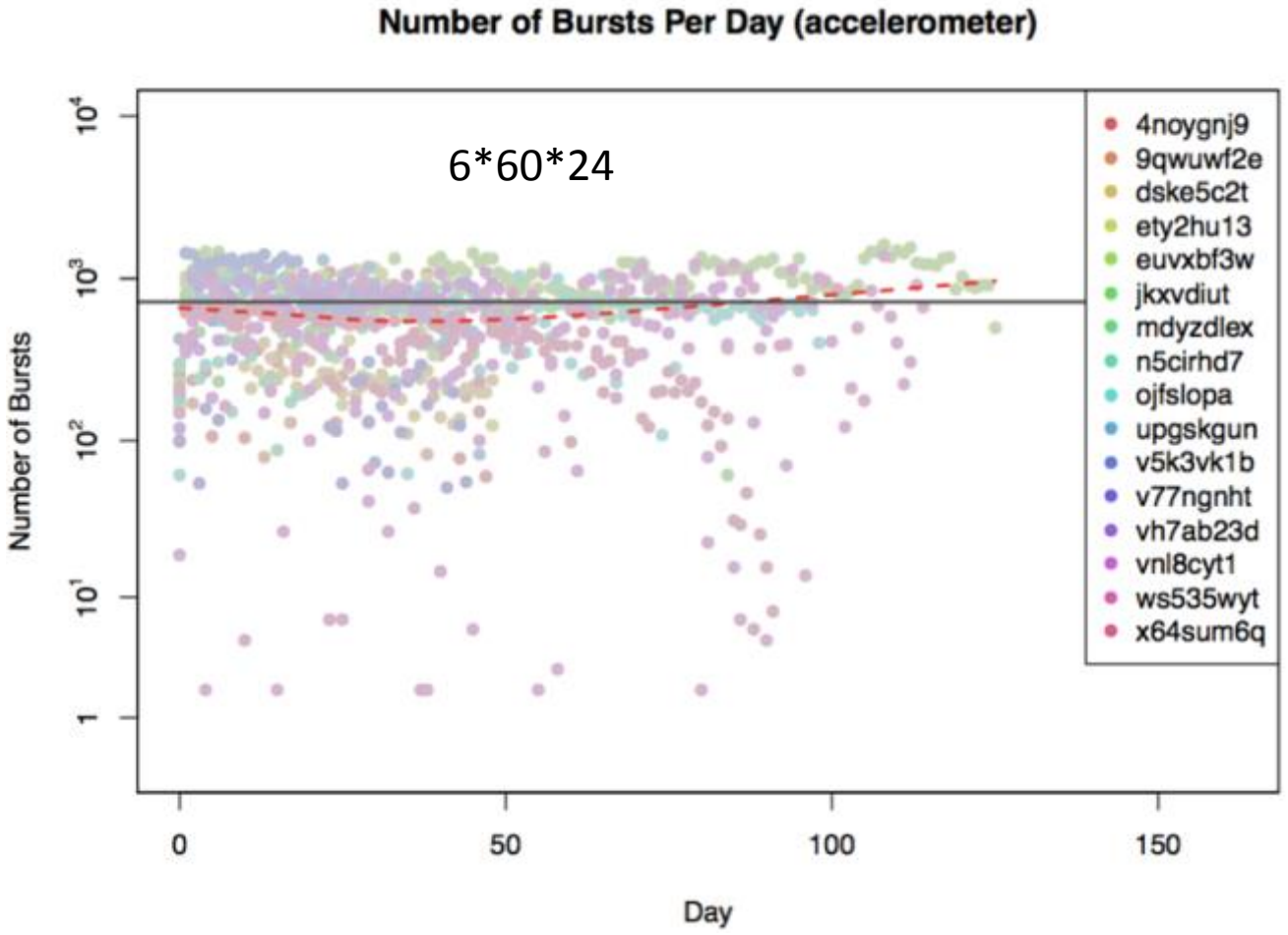
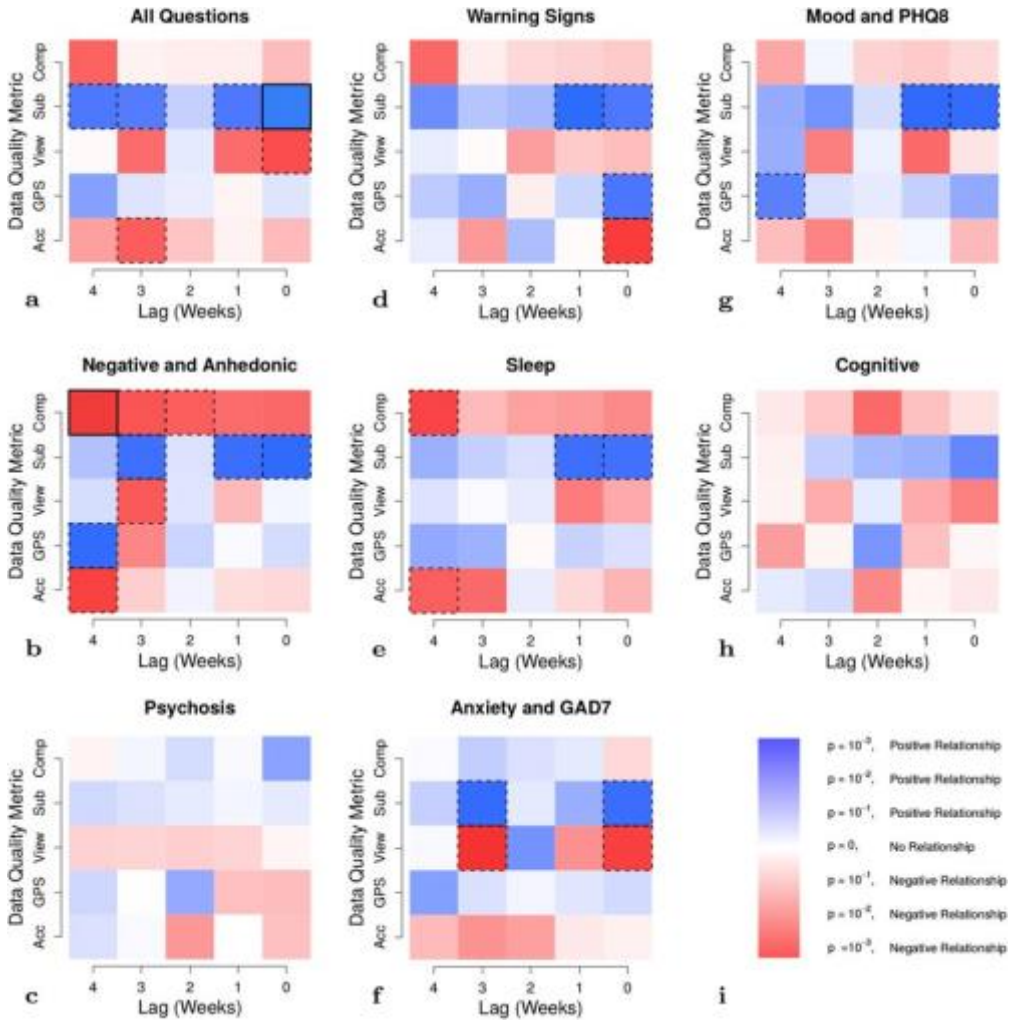
Data Quality





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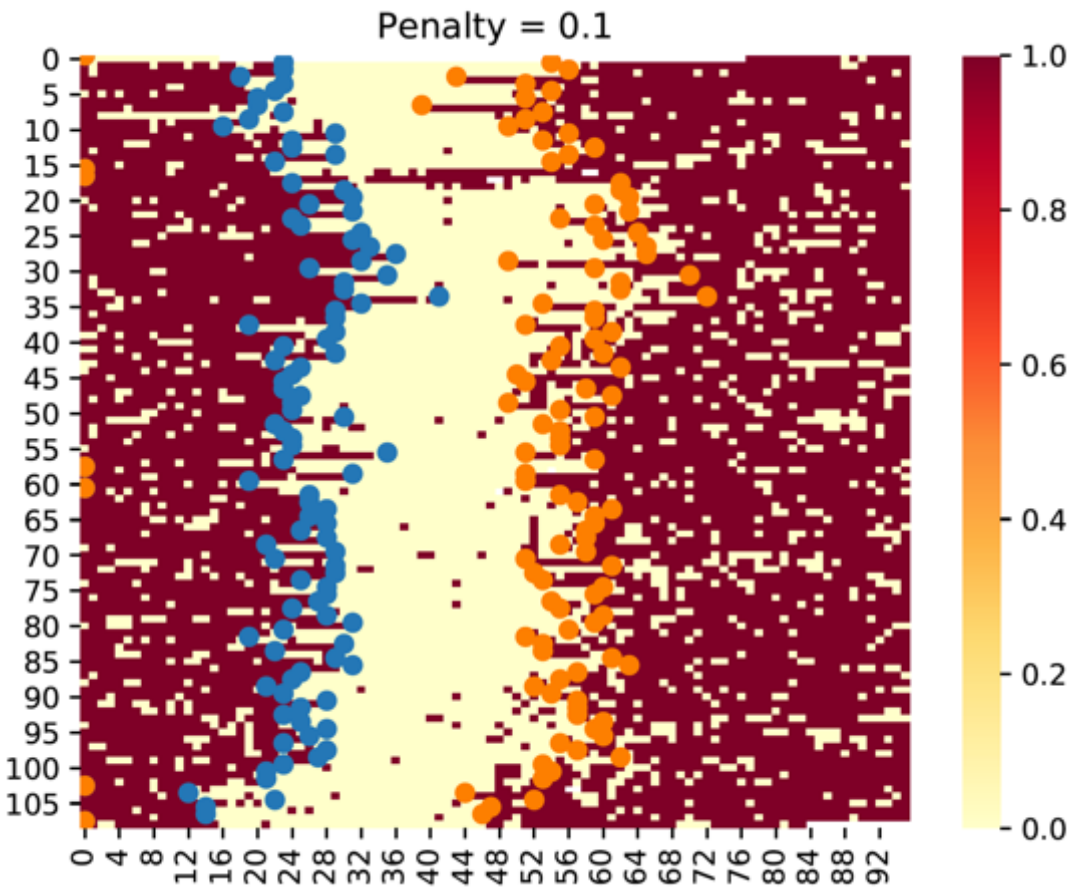
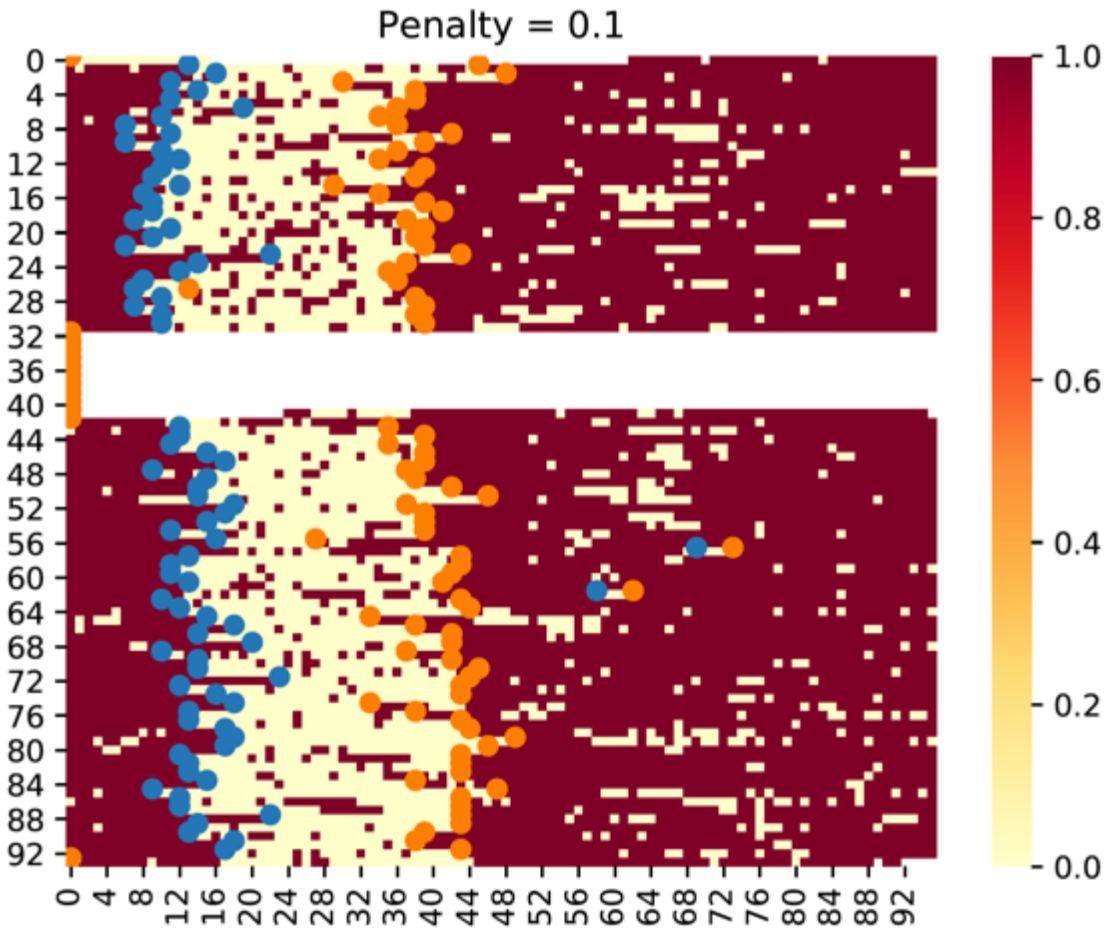
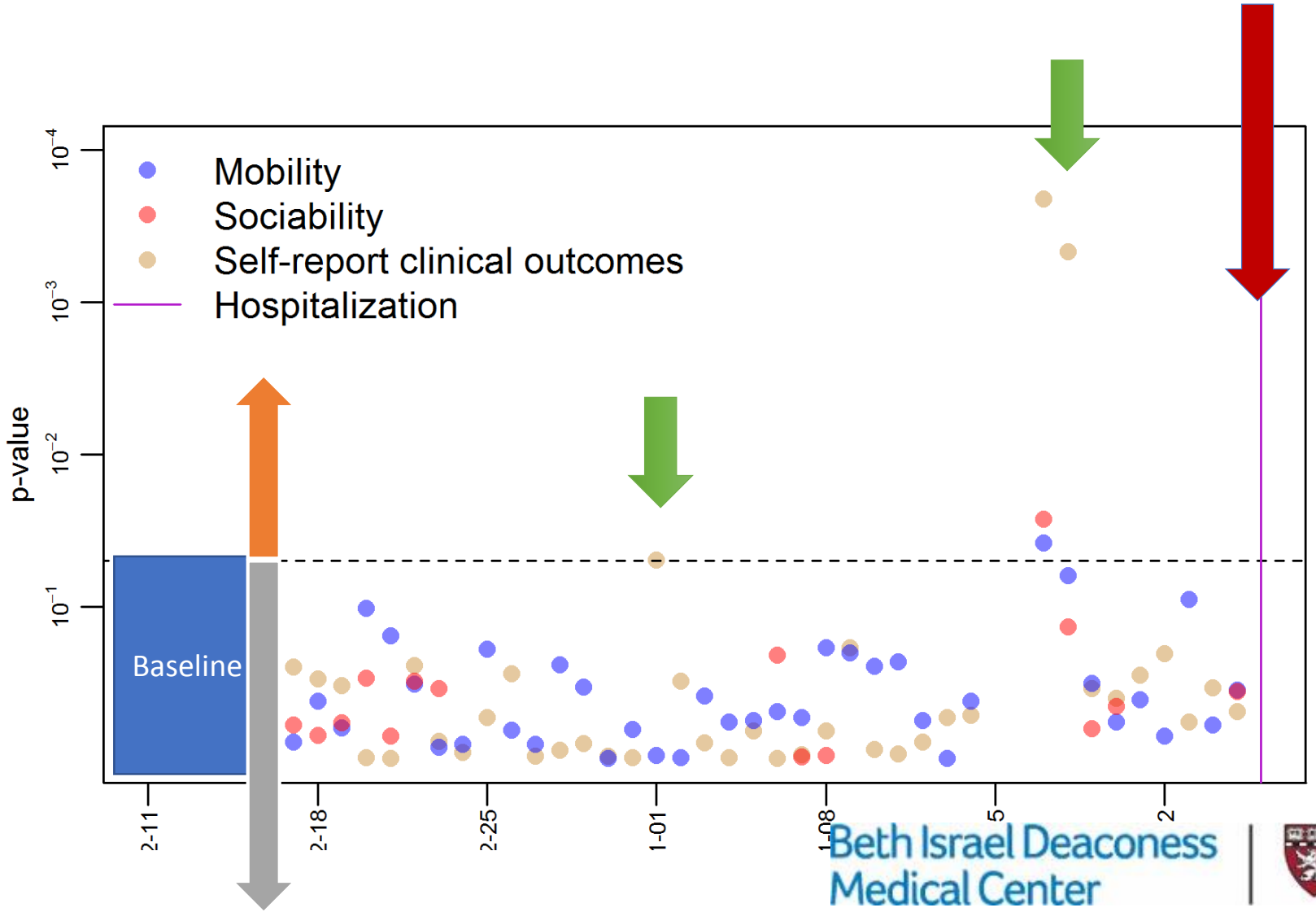
Towards Sleep





Smartphones -> New Functional Data



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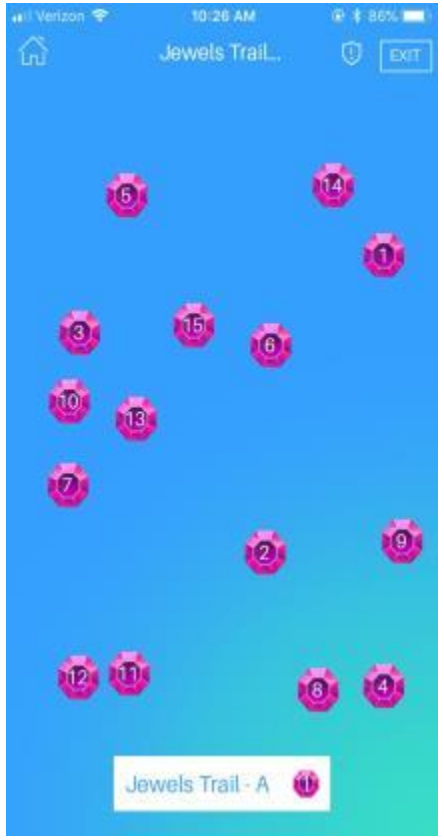
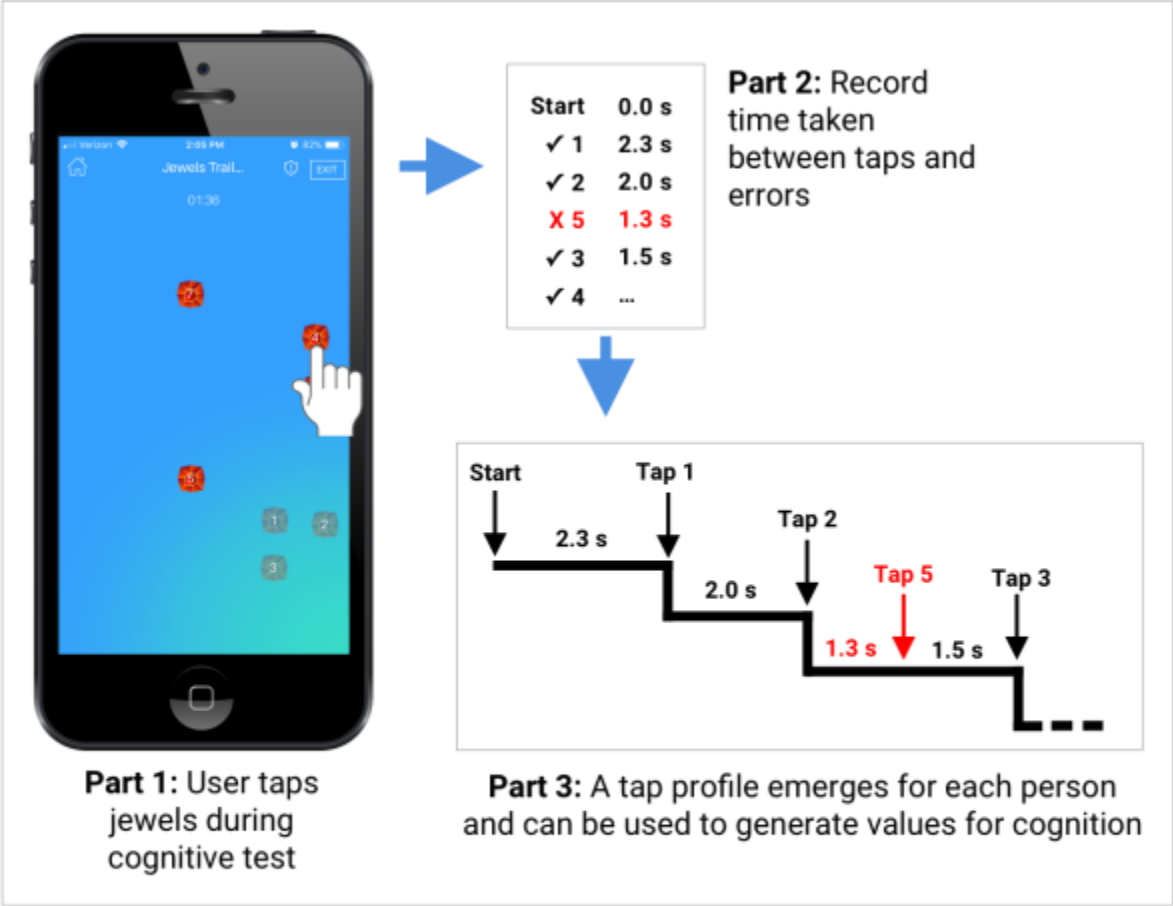
Smartphones -> New ‘Cognitive’ Data





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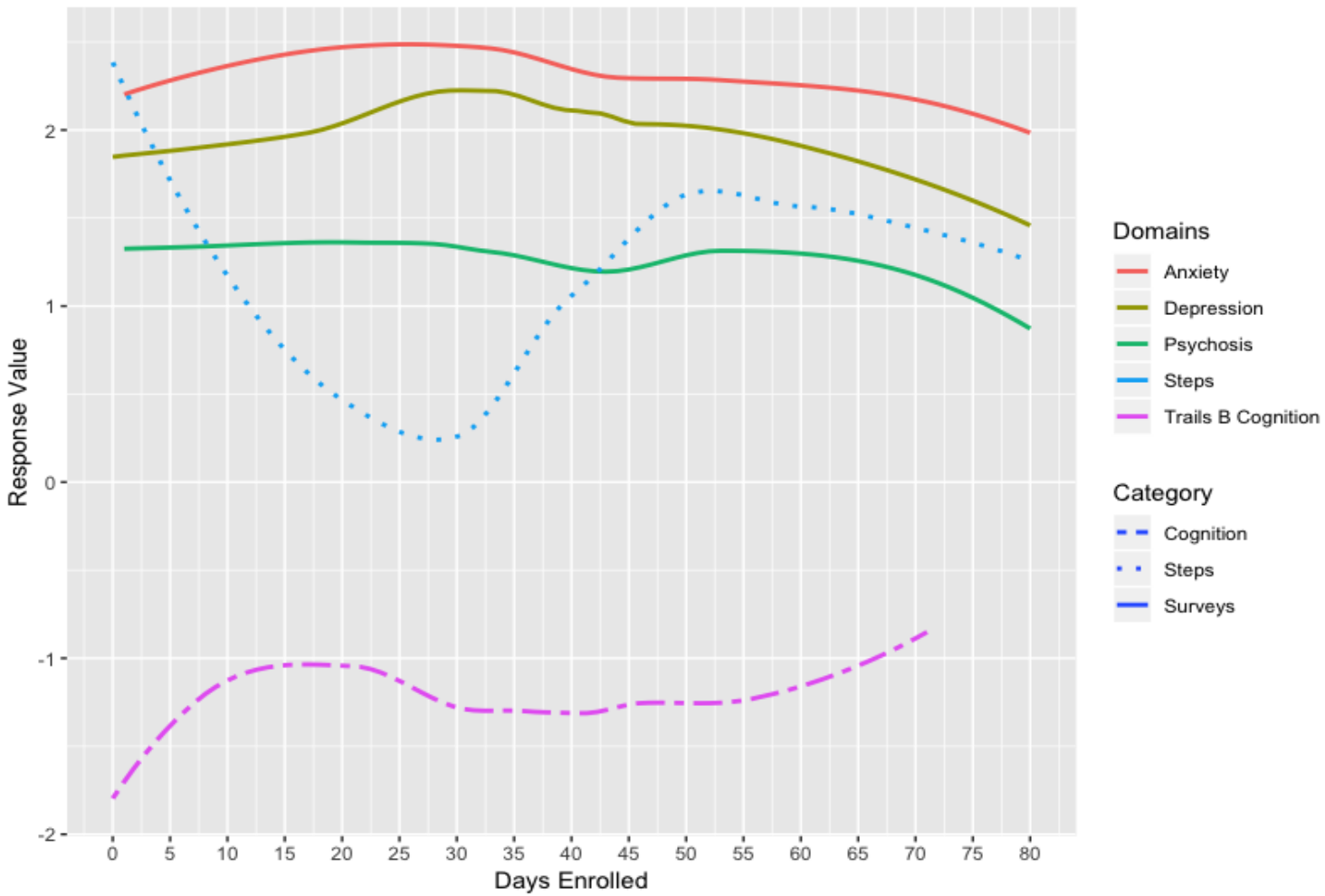
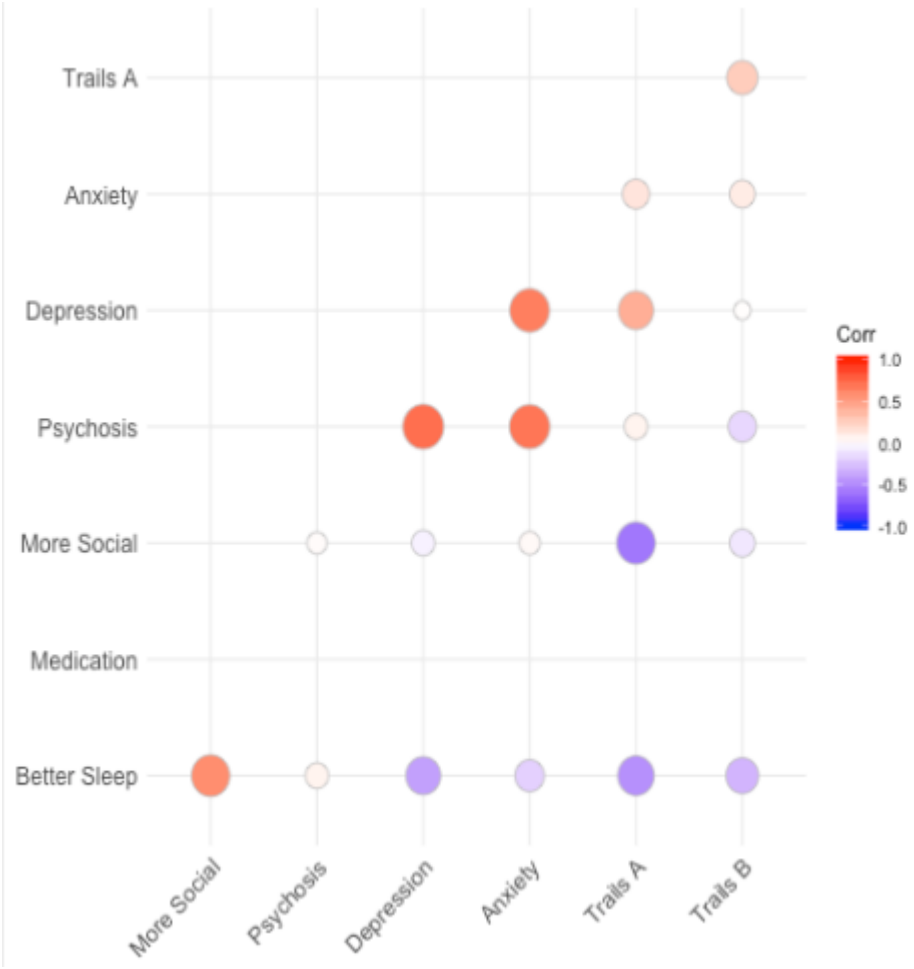
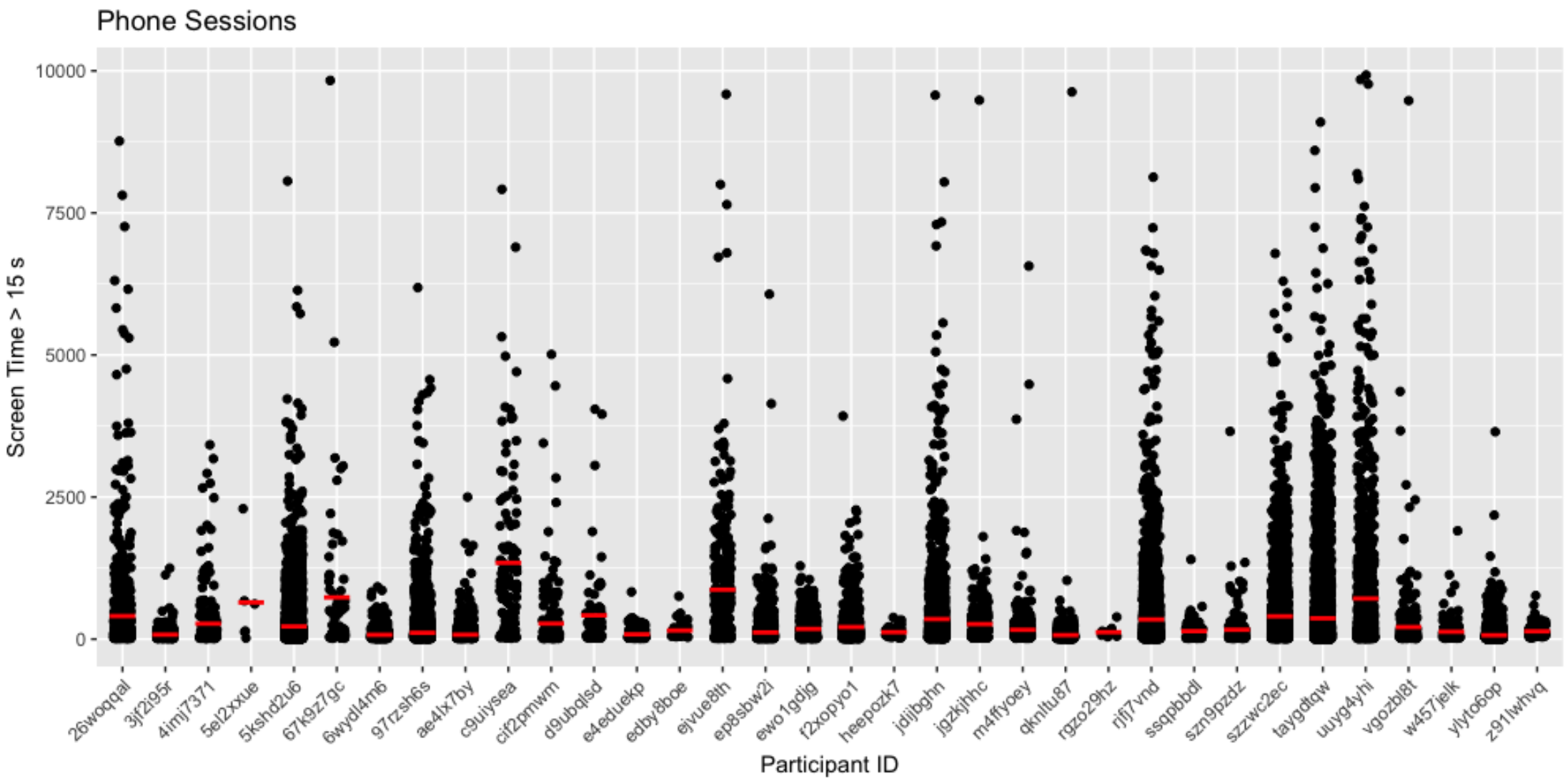
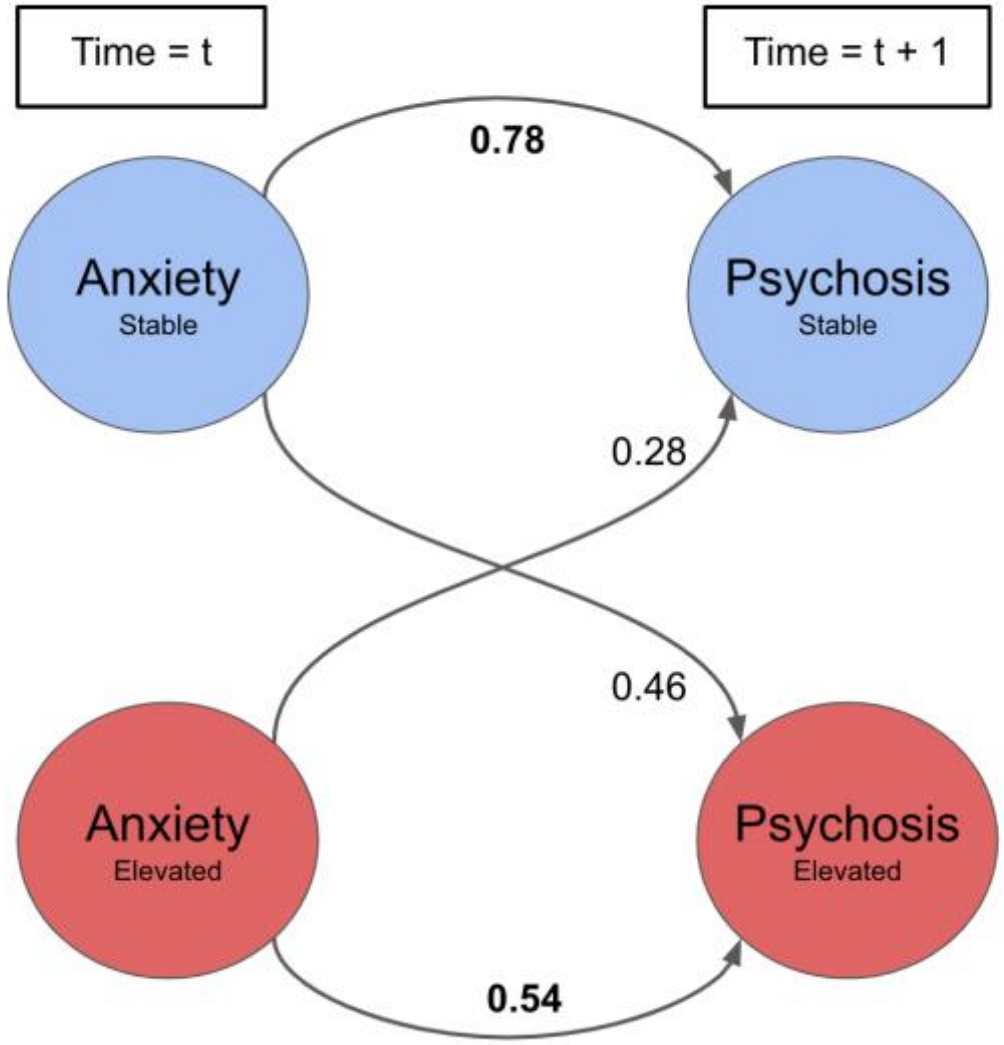




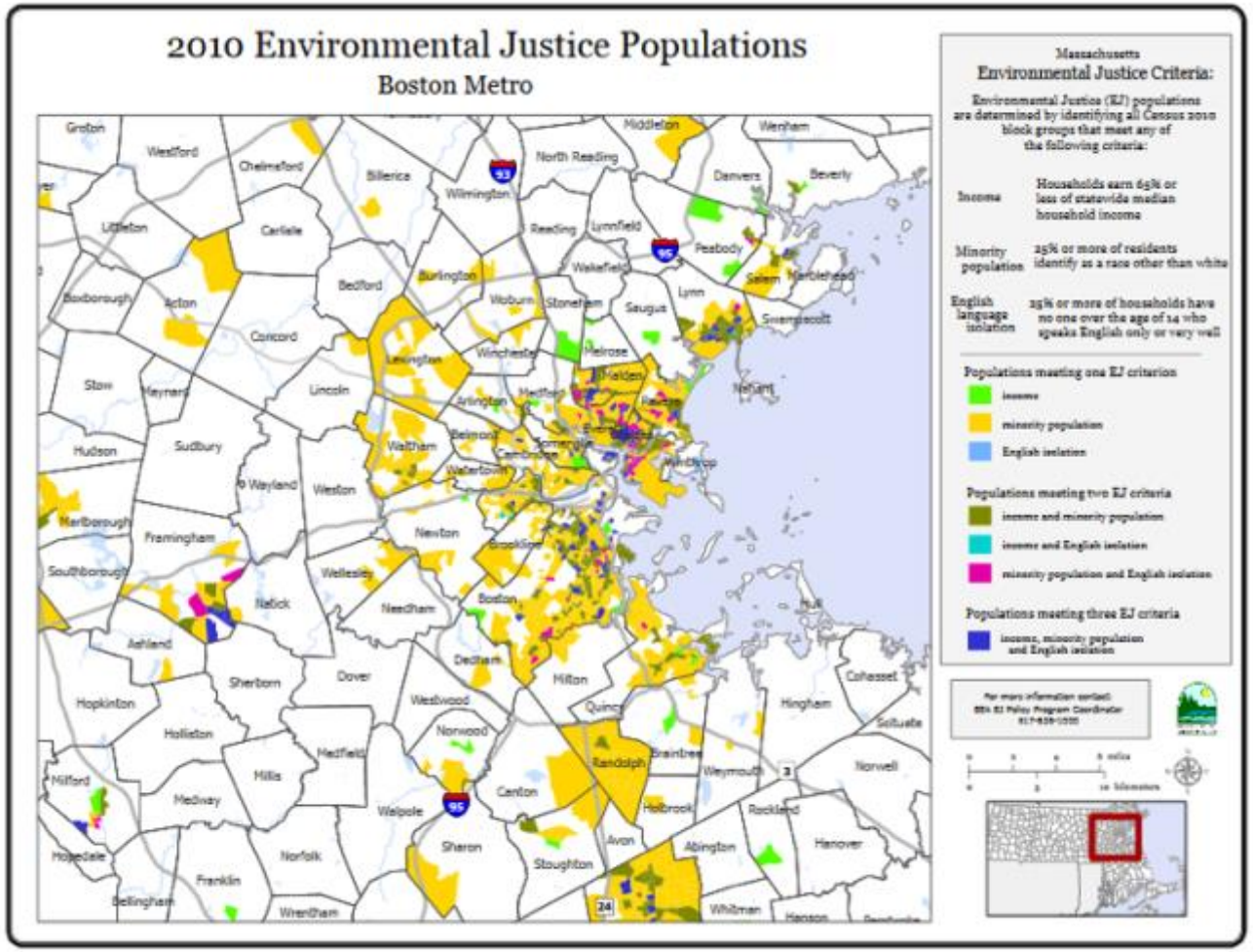
Smartphones -> New New Data

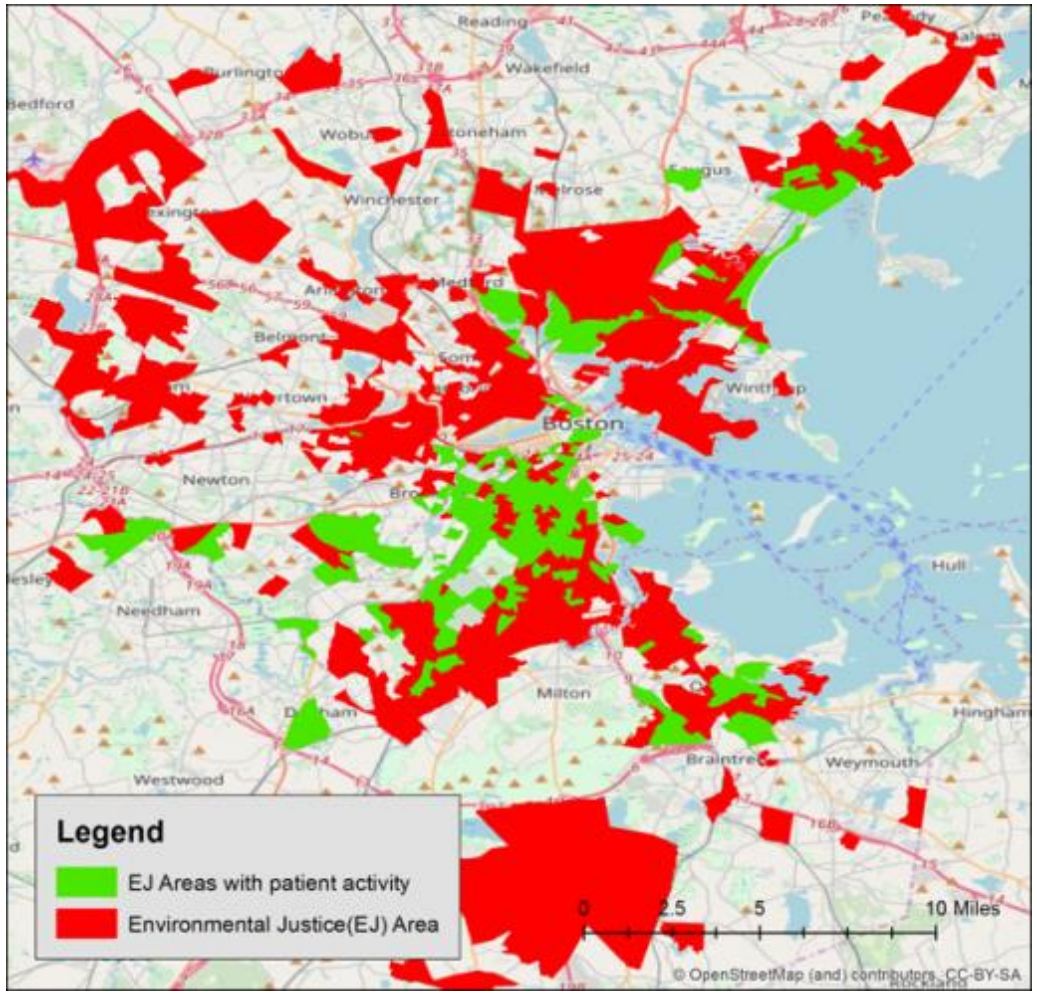


Prediction of Future Clinical State

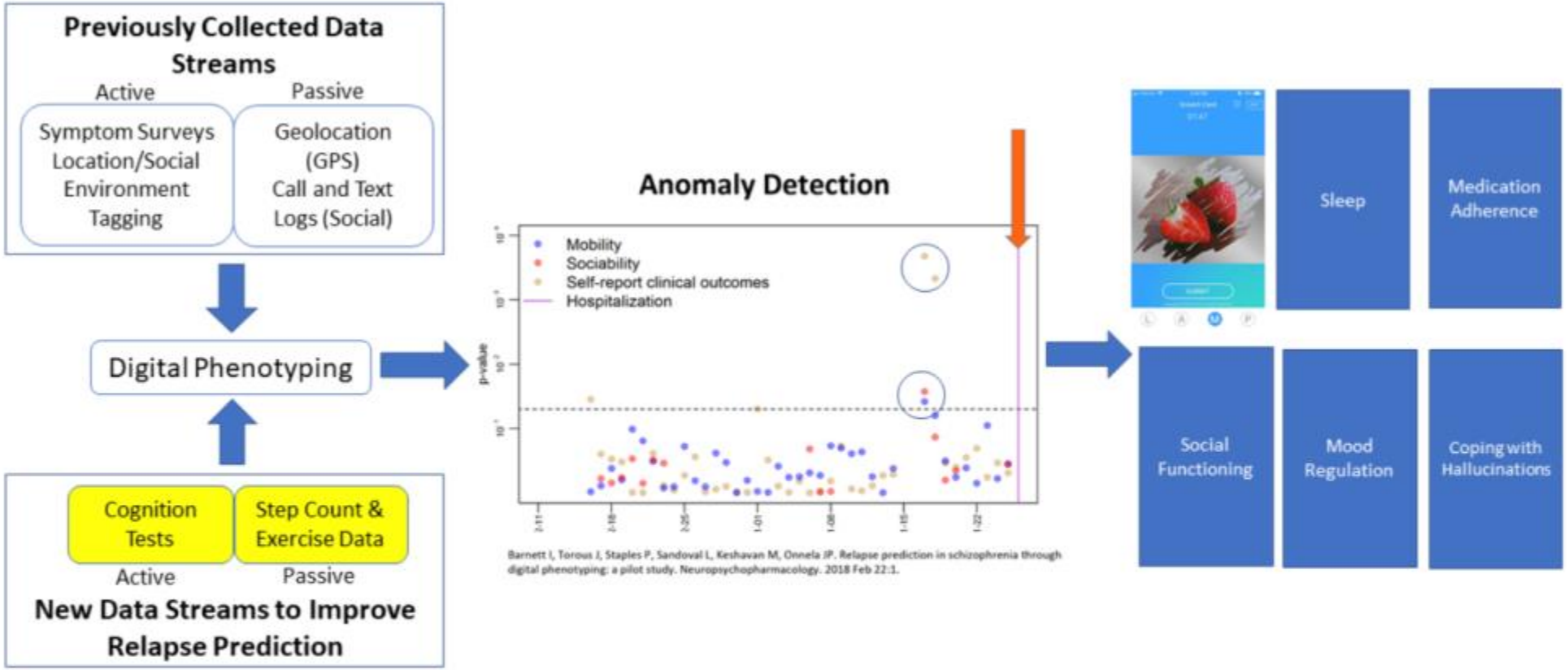


Towards Population Level Mental Health





Towards Global Mental Health



1. LAMP creates a baseline digital phenotype for users based on active + passive data. New data to improve phenotyping will be added to the model.

2. LAMP monitors users' digital phenotype at all times for anomalies in surveys, behaviors, cognition, and activity patterns, and identifies relapse risk.

3. LAMP prompts users to complete intervention activities to reduce relapse risk. Intervention will be based on published evidence and created via co-design at all study sites.

Towards Digital Skills Groups

DOORS
DIGITAL OPPORTUNITIES FOR
OUTCOMES IN RECOVERY SERVICES

Session 1: Smartphone Fundamentals and Your Health Goals

Learn how apps may help you towards your health goals // Learn about mental health apps and other digital resources // Access and download apps // Keep your personal data secure //Remove harmful apps // Use alarms, maps, and reminders on the phone available for

Session 2: Smartphones for Health and Wellness

Set up mental health apps // Collect your own data on mood, anxiety, sleep, and steps // Learn to use wearables and smartwatches // Learn to explore and discover local services via apps // Learn how to connect with peers and family with apps (without a data plan)

Session 3: Smartphones for Personal Health

Access and learn from your personal data // Learn how to share your data with who you want and how to protect what you don't want to share // Customize apps to your needs // Develop a digital mental health toolkit to support your recovery // Evaluate apps that may be of help

Session 4: Smartphones for Your Recovery

Develop insights into your recovery with digital data and smartphone tools // Finalize your digital toolkit // Help peers with technology // Use apps to access community resources and services // Action planning with apps // Identify barriers and solutions to technology use

Towards Digital Skills Groups

Modules

Session 2: Capturing Lived Experience

In this session, group members will explore the ways in which smartphone technology can be used to illuminate connections between behaviors, symptoms, and mood. Participants will consider how capturing their lived experience can help them understand their own patterns and make health-related goals based on the insights they derive from their personal data. Staff members will help group members download the LAMP app and demonstrate how to use the survey function to track various elements of participants' lived experience (e.g. mood, anxiety, psychosis, sleep, medication). During the session wrap-up, participants will discuss what aspect of their lived experience they would like to monitor over the next week and what they hope to learn from using this digital tool.

Time: 1 hour

Session outline:
1) Review group purpose
2) Check-in: Stop, Breathe, & Think
3) Connections between behaviors, symptoms, and mood
4) Monitoring behaviors, symptoms, and mood
5) Using smartphone apps (LAMP) to capture lived experience
6) Action planning and wrap-up

Facilitator pre-session preparation:
- Confirm Wi-Fi access or being hotspot device if Wi-Fi is limited in the building
- Confirm access to large screen to share survey results (e.g. TV screen, projector, monitor)
- Confirm ability to connect staff smartphone to monitor for LAMP demo
- Download LAMP onto multiple iPads for use during group session (optional)
- Practice using LAMP prior to group session to increase comfort in assisting participants in navigating through the app
- Create LAMP study ID's for group participants
- Create digital poll and print link/instructions for participants (www.directpoll.com)

Materials needed: 5-7 iPads, Large screen and/or projector

1) Review group purpose

"Hello everyone. Before we get started, I wanted to provide a quick review of what we're doing in this group for those of you who may not have been here last week. The purpose of this group is to learn about how you can use your smartphone to better understand your own experience and to find out how things like sleep, exercise, and socializing might be connected to your mood and how you feel overall. We'll work together to identify some good apps that fit your needs and how these apps might support you in reaching your health goals.

Before I go any further, does anyone have any questions or comments from our last group meeting?"

LAMP Screenshots

Now we'll split into small groups and help each one of you to download the app."

→ Provide each patient with a study ID and assist them with the download process (See Appendix B)
→ Record participant name and study ID

Tip: If participants are not able/interested in downloading the LAMP app, staff can assist them with locating the step count feature on their smartphones. This feature is located within the Healthkit applications for iPhones and within the Google Fit application for Android.

6) Action planning and wrap-up

"Now that all of you have downloaded the app, we want to think about what you're most interested in keeping track of throughout the week. Through LAMP you can track sleep, step count, psychosis symptoms, anxiety, and depression."

Discussion prompts:
- What surveys are you thinking of taking?
- What do you want to learn about yourself?
- How might this info be helpful for you?

"Next week, we're going to bring in graphs that will show you how you've been doing each day of the week"

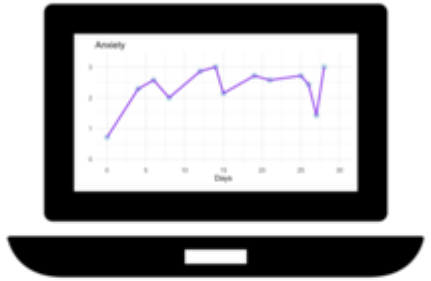
Tip: The group facilitator can show a graph directly from LAMP or create another data visualization that captures the weekly results from one survey (e.g. sleep, psychosis, anxiety, etc.).

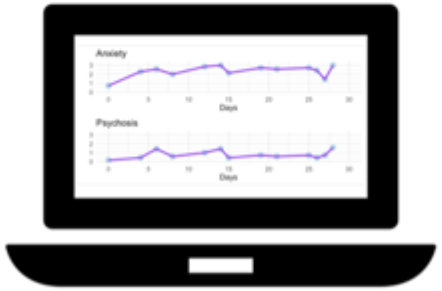
"The more surveys you do the better your graph will be, so please try to take some every day if you can. Any other questions or comments as we wrap up?"

Appendix C

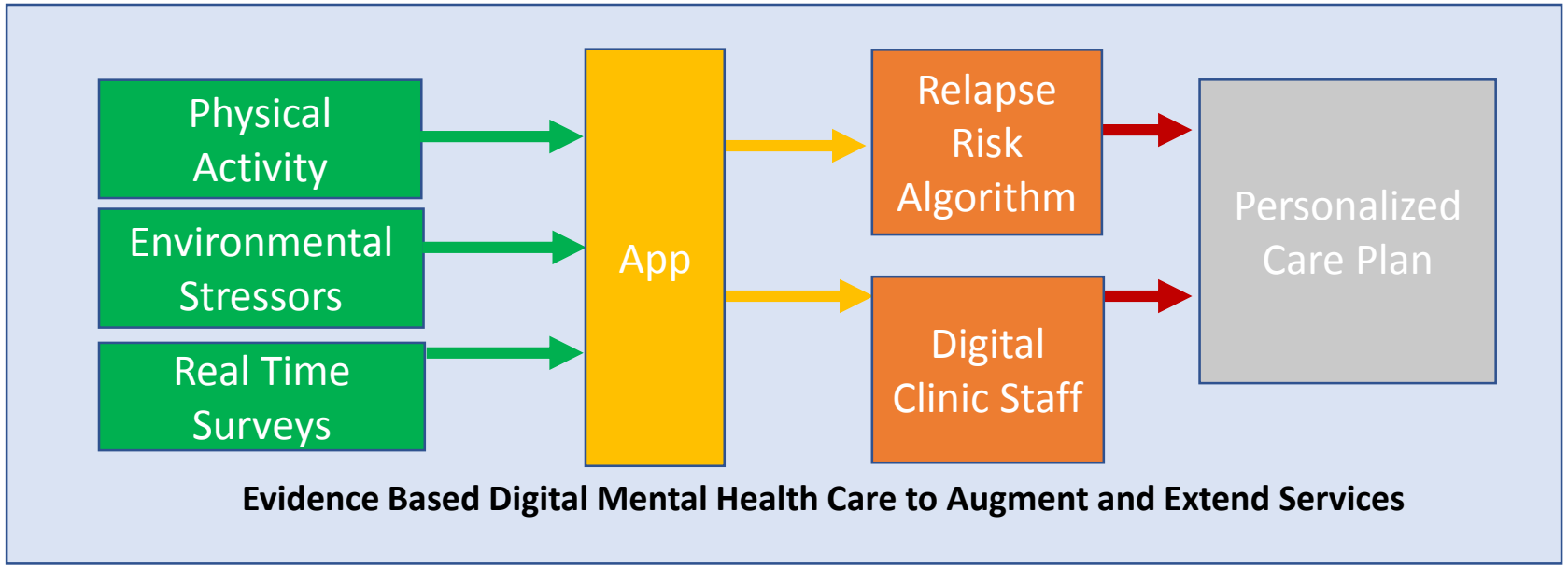
Session 3: Understanding lived experience and enhancing self-management strategies

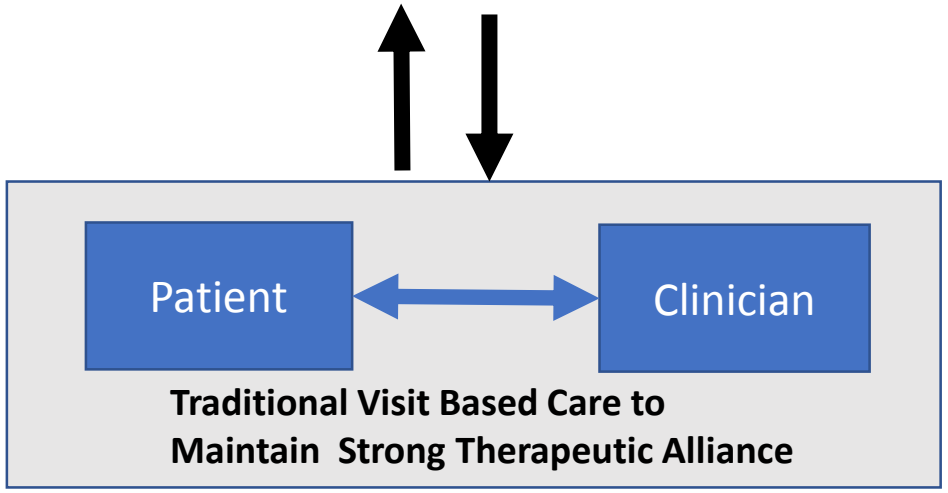
Data Visualizations





Towards a Digital Clinic





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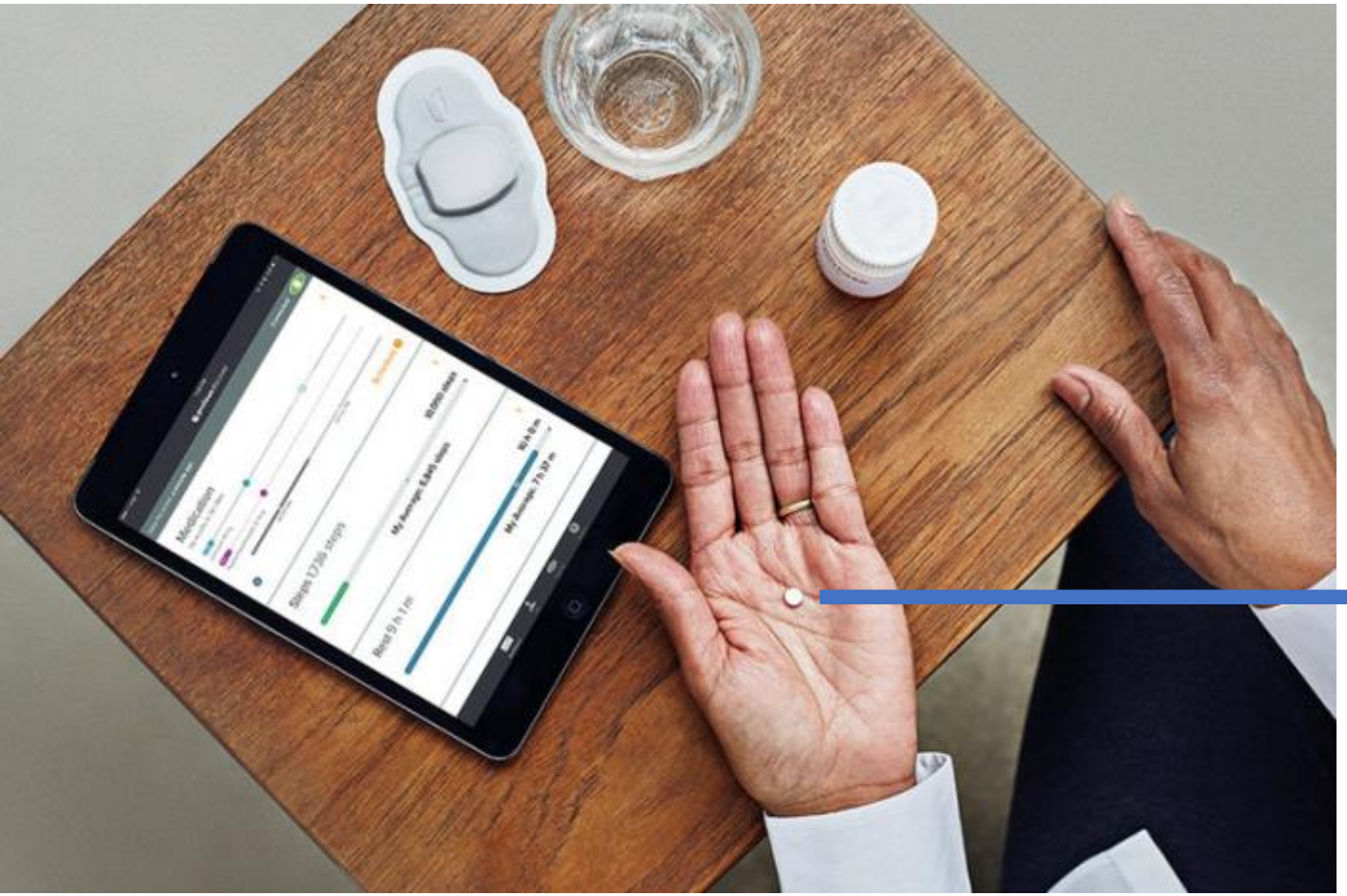
Towards New Questions

Digital Pills <-?-> Digital Phenotyping

Towards Digital Pills



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Smartphone Apps Today

- Estimate to be over 10,000 mental health related apps

Torous J, Roberts LW. Needed innovation in digital health and smartphone applications for mental health: transparency and trust. Jama psychiatry. 2017 May 1;74(5):437-8.

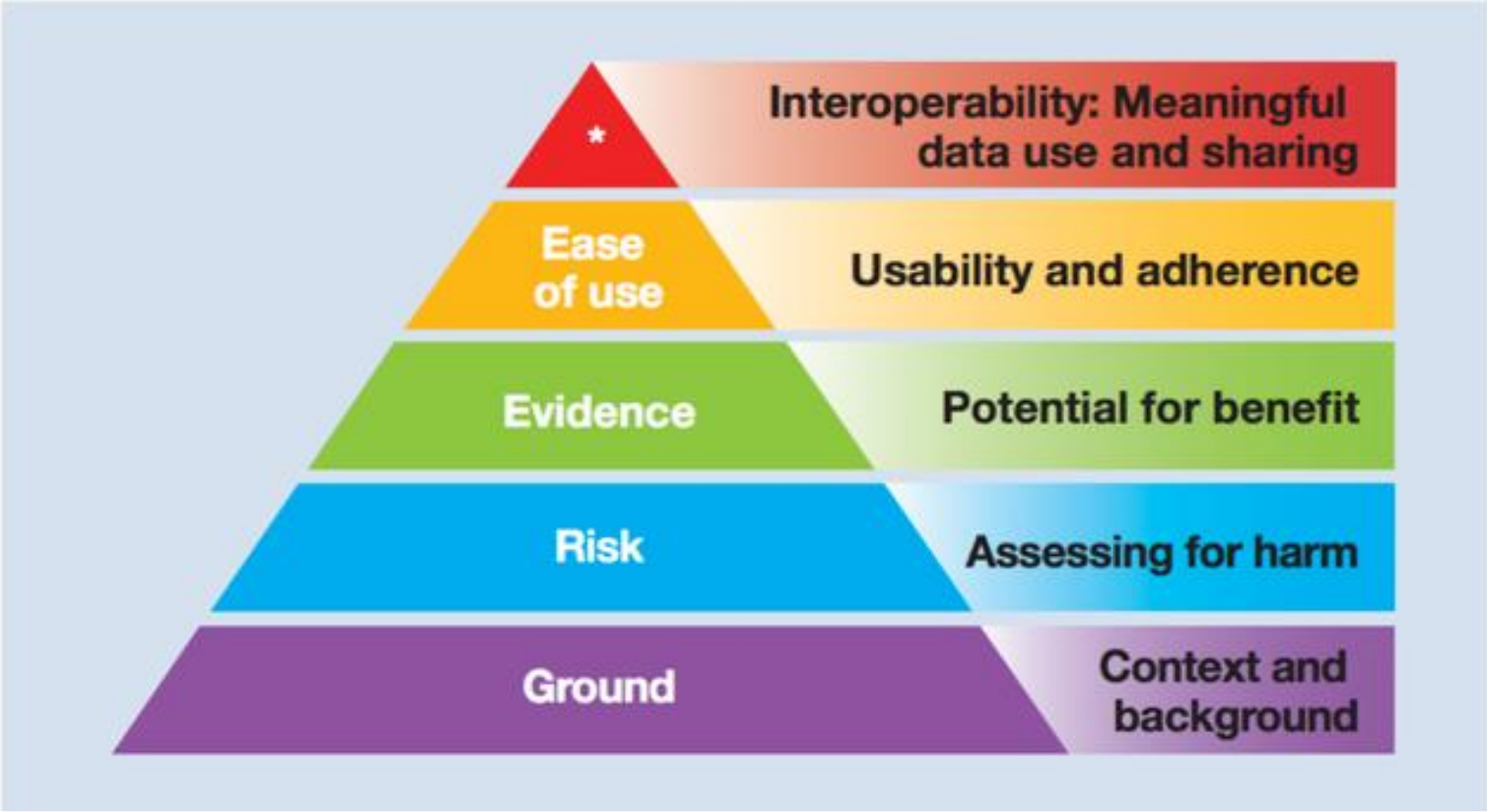
Informed Decision Making Around Apps


Current Psychiatry

Mental health apps: What to tell patients

An evaluation model created specifically for such apps can help inform your discussions

For most apps, evidence of efficacy is limited



Torous JB, Chan SR, Gipson SY, Kim JW, Nguyen TQ, Luo J, Wang P. A hierarchical framework for evaluation and informed decision making regarding smartphone apps for clinical care. Psychiatric Services. 2018 Feb 15;69(5):498-500.

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Audience Question #2

How comfortable would you be using a digital phenotyping app that captured GPS, call/text logs, acceleromoter, and surveys from your personal smartphone. (1 star = not, 5 stars = very comfortable)

Informed Decision Making Around Apps

AMERICAN PSYCHIATRIC ASSOCIATION

PSYCHIATRISTS | RESIDENTS & MEDICAL STUDENTS | PATIENTS & FAMILIES

> Psychiatrists > Practice >

- Psychiatrists
  - Education
  - Practice
    - Practice Management
    - Professional Interests
    - DSM
    - Telepsychiatry
    - Risk Management
    - Clinical Practice Guidelines
    - Ethics
    - Quality Improvement
    - Parity
    - Research
    - Transition to Practice
    - **Mental Health Apps**
      - Why Rate Mental Health Apps

Mental Health Apps

The expanding use of mobile health (mHealth) technologies is unprecedented in the history of medicine. Every month, companies and researches release new smartphone apps, smart watches, and sensor technologies for the healthcare market. Psychiatry has been no exception to this trend. There has also been growing patient, clinical, government, and payer interest in the potential of mHealth technologies for psychiatric clinical care. Psychiatrists, clinical psychologists, psychotherapists, and other mental health clinicians are increasingly faced with questions regarding the efficacy and risks of mobile and online apps.

APA is helping Psychiatrists and other mental health professionals navigate these issues to ensure all important factors are considered and ultimately determine whether an app works for you and your patients. The material provided here covers why it is critical to rate an app, how best to evaluate an app and an opportunity to seek additional guidance on apps and/or the evaluation process.

Why Rate Mental Health Apps?

Learn why it is important to rate mental health apps for you and your patients.

Learn More >

Explore Mental Health Apps

- Why Rate Mental Health Apps?
- App Evaluation Model
- App Evaluation Example

Need help rating apps?

Please contact us if you need assistance in rating an app.

Contact Us

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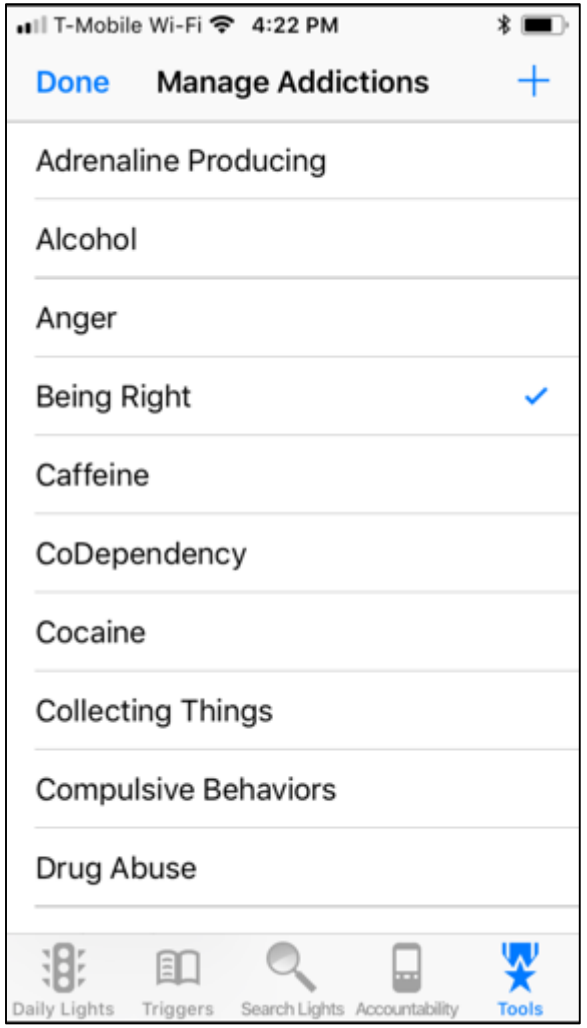
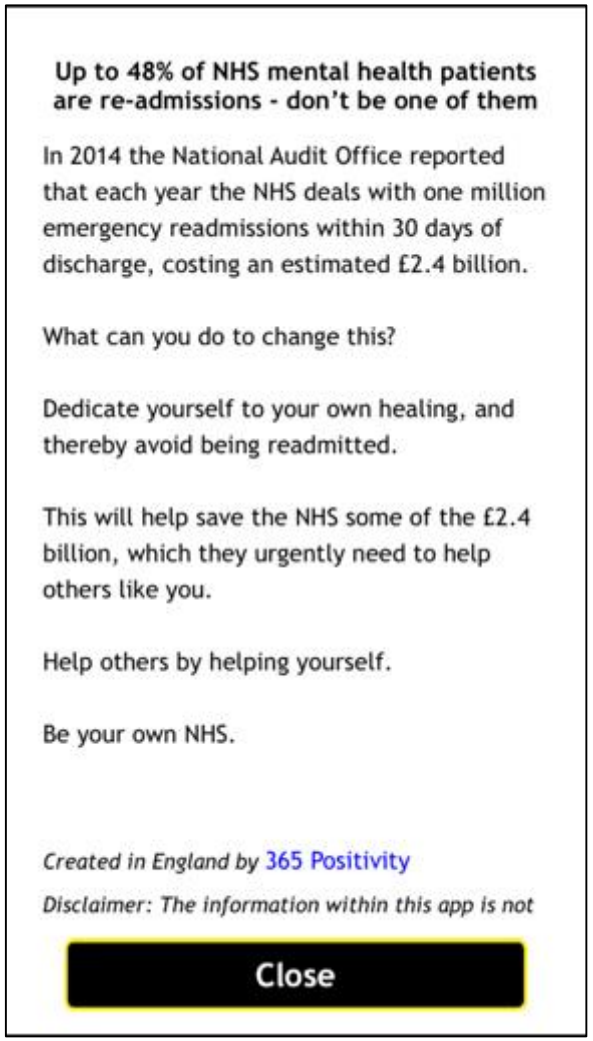
Informed Decision Making Around Apps: Level 1





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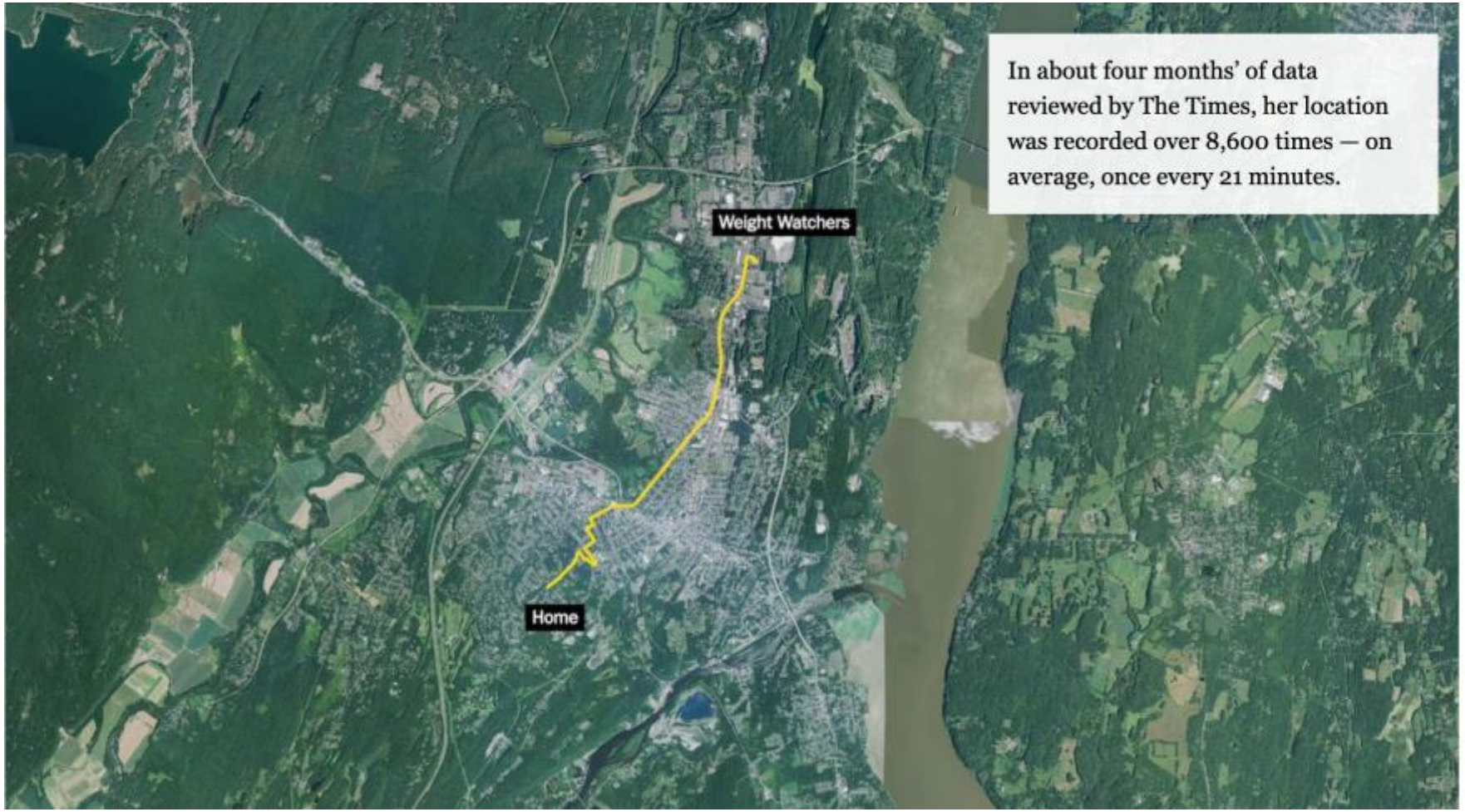
Informed Decision Making Around Apps: Level 1



https://www.nytimes.com/interactive/2018/12/10/business/location-data-privacy-apps.html

Informed Decision Making Around Apps: Level 1

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Informed Decision Making Around Apps: Level 1

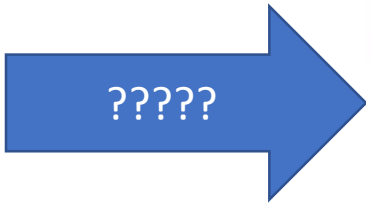

Table 2. Counts and Proportions of Apps Transmitting Data to a Third Party and Whether This Was Disclosed in a Privacy Policy

	No. (%)			
	Apps With Privacy Policy			Apps Without Privacy Policy
Destinations	Transmission Occurred, Disclosed in Policy	Transmission Occurred, Not Disclosed in Policy	Transmission Occurred, Policy States Won't	Transmission Occurred
Any destination type[a]	16 (44)	5 (14)	3 (8)	9 (25)
Advertising or marketing services	10 (28)	2 (6)	2 (6)	8 (22)
Analytics services	14 (39)	5 (14)	1 (3)	4 (11)
Google destinations	13 (36)	5 (14)	3 (8)	7 (19)
Google advertising services[b]	6 (17)	2 (6)	1 (3)	6 (17)
Google analytics services[c]	12 (33)	5 (14)	1 (3)	4 (11)
Facebook analytics	9 (25)	2 (6)	0 (0)	1 (3)
Others	15 (42)	1 (3)	0 (0)	4 (11)
Mixpanel	3 (8)	0	1 (3)	0
AppNexus	2 (6)	0	0	1 (3)
Twitter Mopub	3 (8)	0	0	0
Yahoo Flurry Analytics	3 (8)	0	0	0
AdColony	1 (3)	0	0	1 (3)
AppsFlyer	1 (3)	0	1 (3)	0
Kiip	1 (3)	0	0	1 (3)
Branch	1 (3)	0	0	0
AddThis	1 (3)	0	0	0
Amplitude	1 (3)	0	0	0
Manage.com	1 (3)	0	0	0
Singular/Apsalar	1 (3)	0	0	0
UserVoice	1 (3)	0	0	0
Unknown destination[d]	0	0	0	1 (3)

[a] Percentage of apps included in study (n = 36).

[b] Identified services were AdSense, AdWords, and DoubleClick.

[c] Identified services were Google Analytics and Crashlytics.

[d] Identity or ownership information for the domain startappexchange.com could not be established.

JAMA Network Open. 2019;2(4):e192542. doi:10.1001/jamanetworkopen.2019.2542

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Huckvale K, Torous J, Larsen ME. Assessment of the data sharing and privacy practices of smartphone apps for depression and smoking cessation. JAMA network open. 2019 Apr 5;2(4):e192542-.

Informed Decision Making Around Apps: Level 2

Search term	Identified in searches (n=1435)		Screened (n=350)	
	Android	iOS	Android	iOS
Anxiety	249	200	40	40
Depression	250	200	40	40
Schizophrenia	250	32	40	32
Self-harm	85	29	40	29
Substance use	131	9	40	9
Total	**965**	**470**	**200**	**150**

Coding element	n (%) of apps
3. Positive claims	**59 (81%)**
3.a. Claims of effectiveness	47 (64%)
3.a.i. Detection or diagnosis	7 (10%)
3.a.ii. Improvement in symptoms or mood	22 (30%)
3.a.iii. Improvement in self-management	26 (36%)
3.b. Claims of acceptability	33 (45%)
[illegible]	[illegible]
4.a. Scientific language	32 (44%)
4.a.i. Specific technique described	24 (33%)
4.a.ii. Evidence from study using app	2 (2.7%)
4.a.iii. Citation to scientific literature	1 (1.4%)
4.b. Technical expertise	23 (32%)
4.b.i. Certification or accreditation	0
4.b.ii. Prizes or awards	2 (2.7%)
4.b.iii. Credible developers	18 (25%)
4.b.iv. Credible endorsements	3 (4.1%)
4.c. Lived experience design	10 (14%)
4.c.i. Lived experience involvement	6 (8.2%)
4.c.ii. Lived experience developer	5 (6.8%)
4.d. "Wisdom of the crowd"	14 (19%)
4.d.i. Download, usage or popularity statistics	11 (15%)

Larsen ME, Huckvale K, Nicholas J, Torous J, Birrell L, Li E, Reda B. Using science to sell apps: Evaluation of mental health app store quality claims. npj Digital Medicine. 2019 Mar 22;2(1):18.

Informed Decision Making Around Apps: Level 2

Meta-Analysis of Smartphone Apps for Anxiety

Firth & Torous et al., April 2017

JOURNAL of AFFECTIVE DISORDERS

9 RCTs for Anxiety:
1,837 participants

Effects on Anxiety	Hedge's (g)	P-value
All RCTs	0.33	<0.001
Smartphone vs. Waitlist	0.45	<0.001
Smartphone vs. Active Control	0.19	0.003

Eligibility Criteria
(i) RCT's in any population
(ii) Smartphone-based psychological interventions
(iii) Assessed changes in anxiety/depression

Meta-Analysis of Smartphone Apps for Depression

World Psychiatry

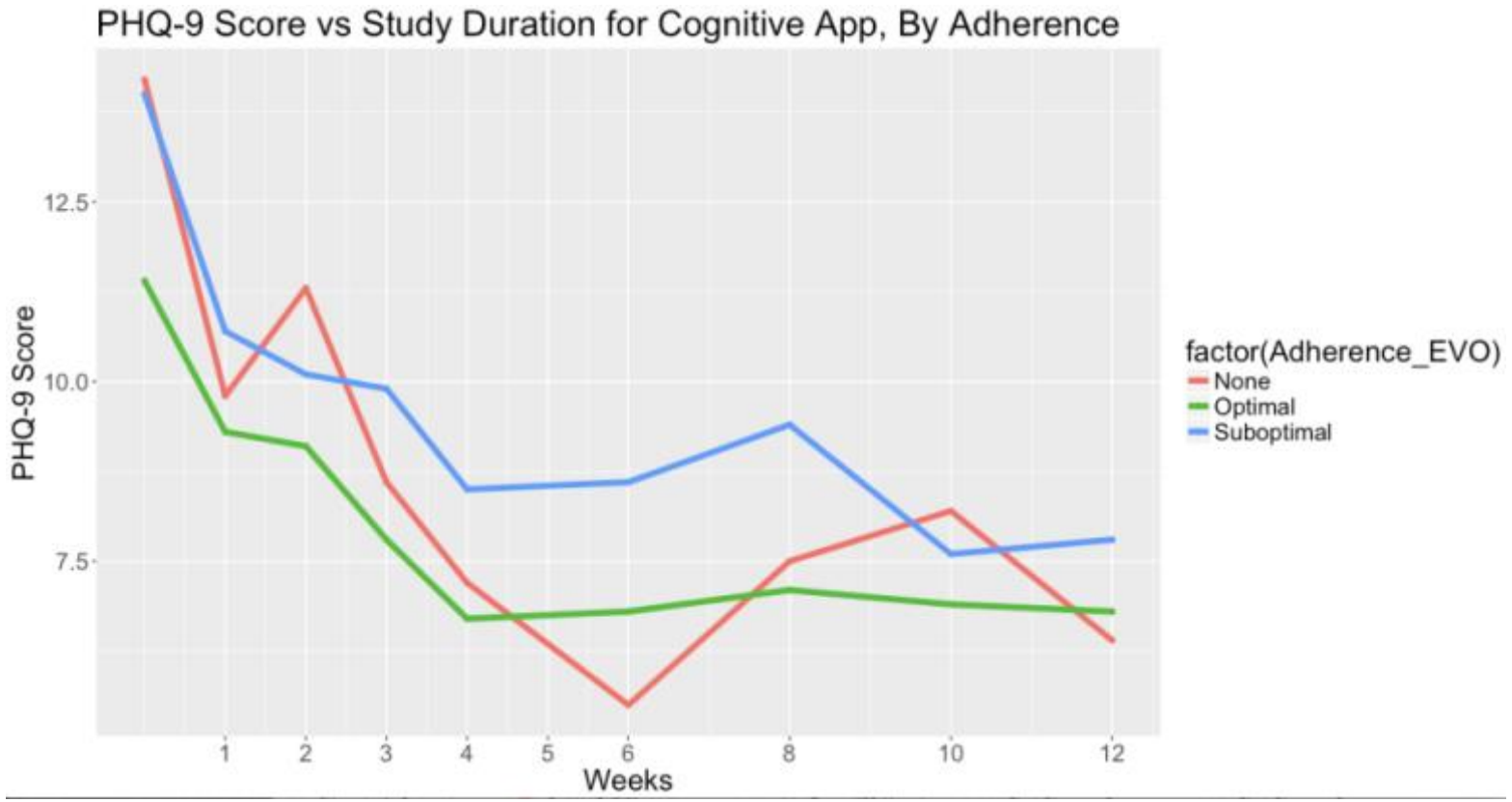
Firth & Torous et al., October 2017

18 RCTs for Depression:
3,414 participants

Effects on Depression	Hedge's (g)	P-value
All RCTs	0.38	<0.001
Smartphone vs. Waitlist	0.56	<0.001
Smartphone vs. Active Control	0.22	<0.001

Firth J, Torous J, Nicholas J, Carney R, Pratap A, Rosenbaum S, Sarris J. The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials. World Psychiatry. 2017 Oct 1;16(3):287-98.

Informed Decision Making Around Apps: Level 2



Arean PA, Hallgren KA, Jordan JT, Gazzaley A, Atkins DC, Heagerty PJ, Anguera JA The Use and Effectiveness of Mobile Apps for Depression: Results From a Fully Remote Clinical Trial J Med Internet Res 2016;18(12):e33

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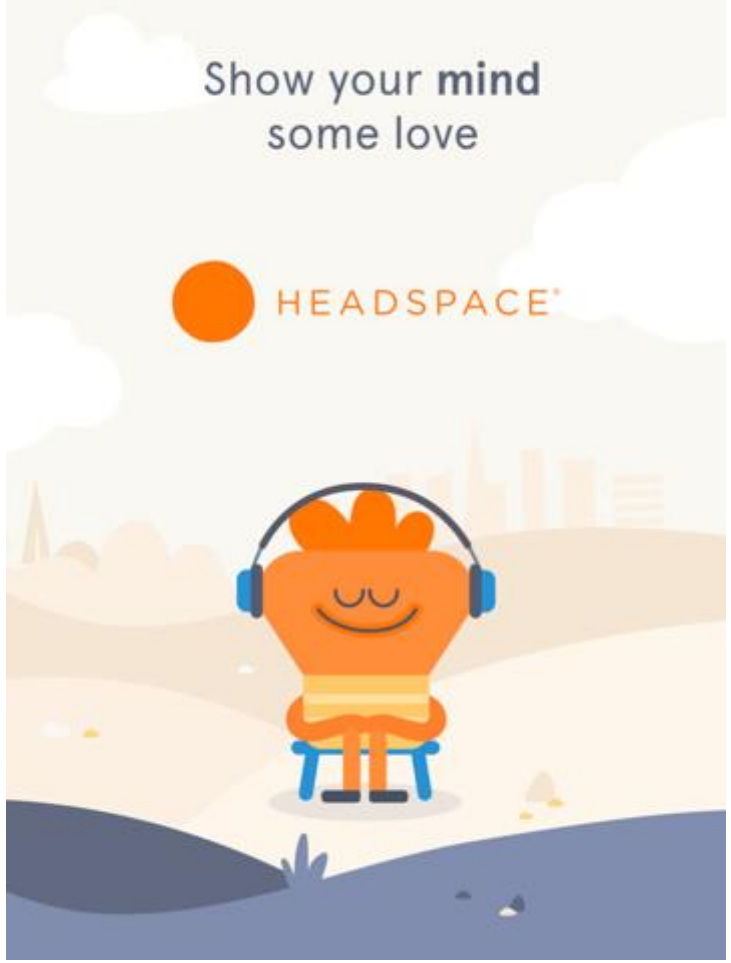
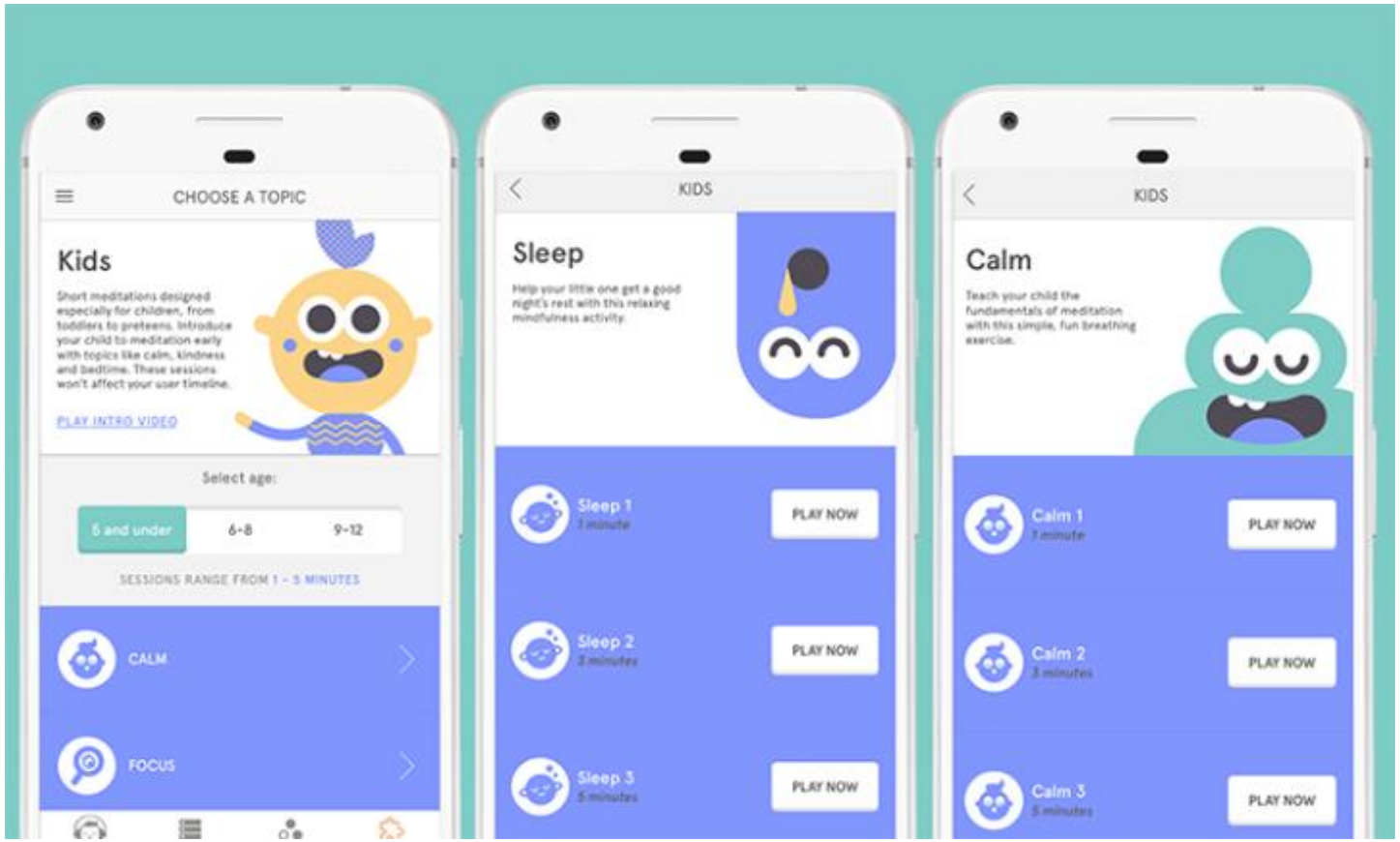
Informed Decision Making Around Apps: Level 2





Noone and Hogan. A randomised active-controlled trial to examine the effects of an online mindfulness intervention on executive control, critical thinking and key thinking dispositions in a university student sample. BPJ Psychology. 2018

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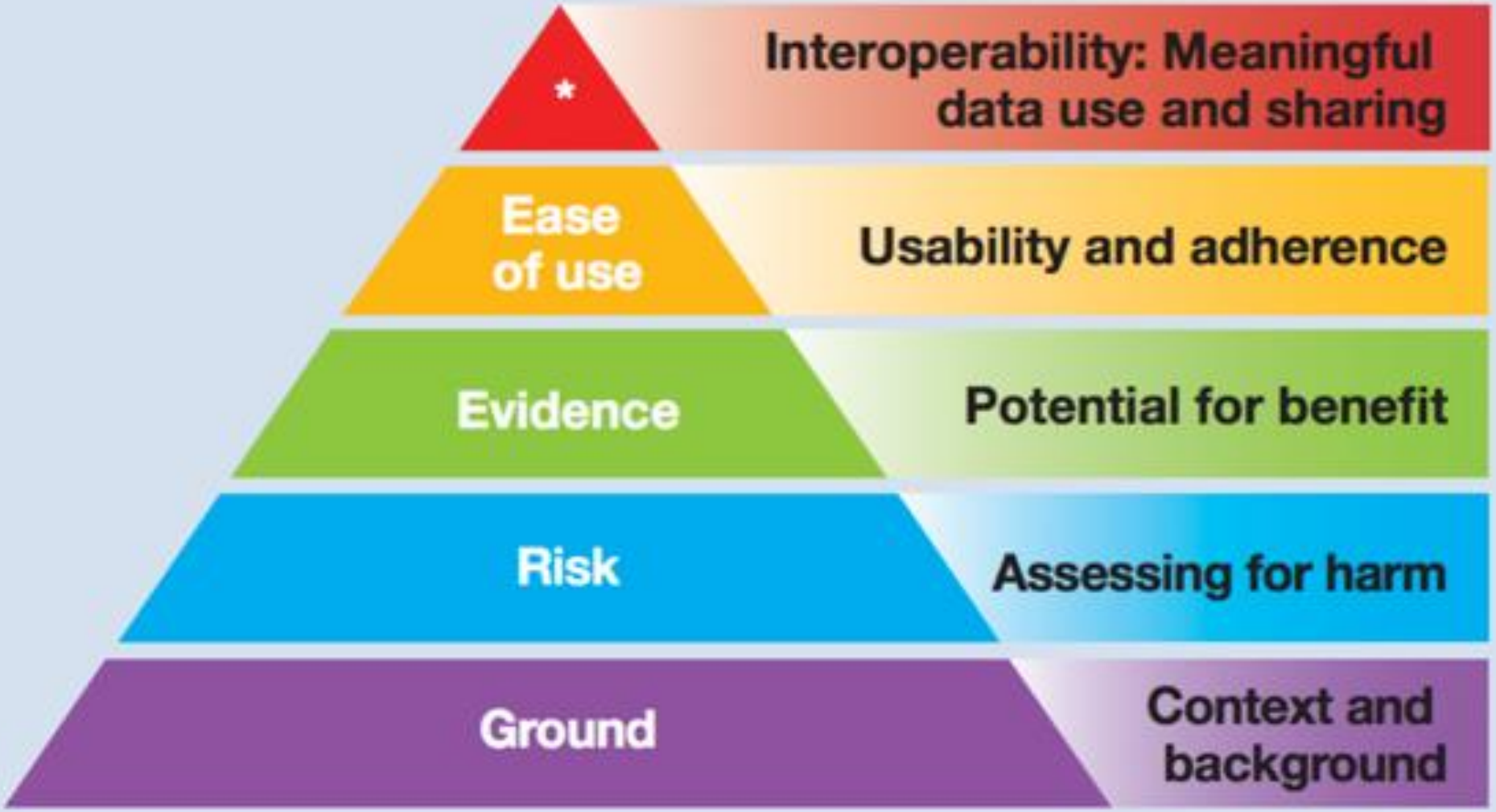

*
Interoperability: Meaningful data use and sharing
Ease of use
Usability and adherence
Evidence
Potential for benefit
Risk
Assessing for harm
Ground
Context and background

Informed Decision Making Around Apps: Level 3

VA » Health Care » PTSD: National Center for PTSD » Public » Mobile App: PTSD Coach

PTSD: National Center for PTSD

- PTSD
  - PTSD Home
  - For the Public
    - Public Section Home
    - PTSD Overview
    - Types of Trauma
    - Is it PTSD?
    - Treatment and Coping
    - Other Common Problems
    - Family and Friends
    - PTSD and Communities
    - Paginas en Espanol
    - Apps, Videos and More
      - Mobile Apps

PUBLIC *This section is for Veterans, General Public, Family &*

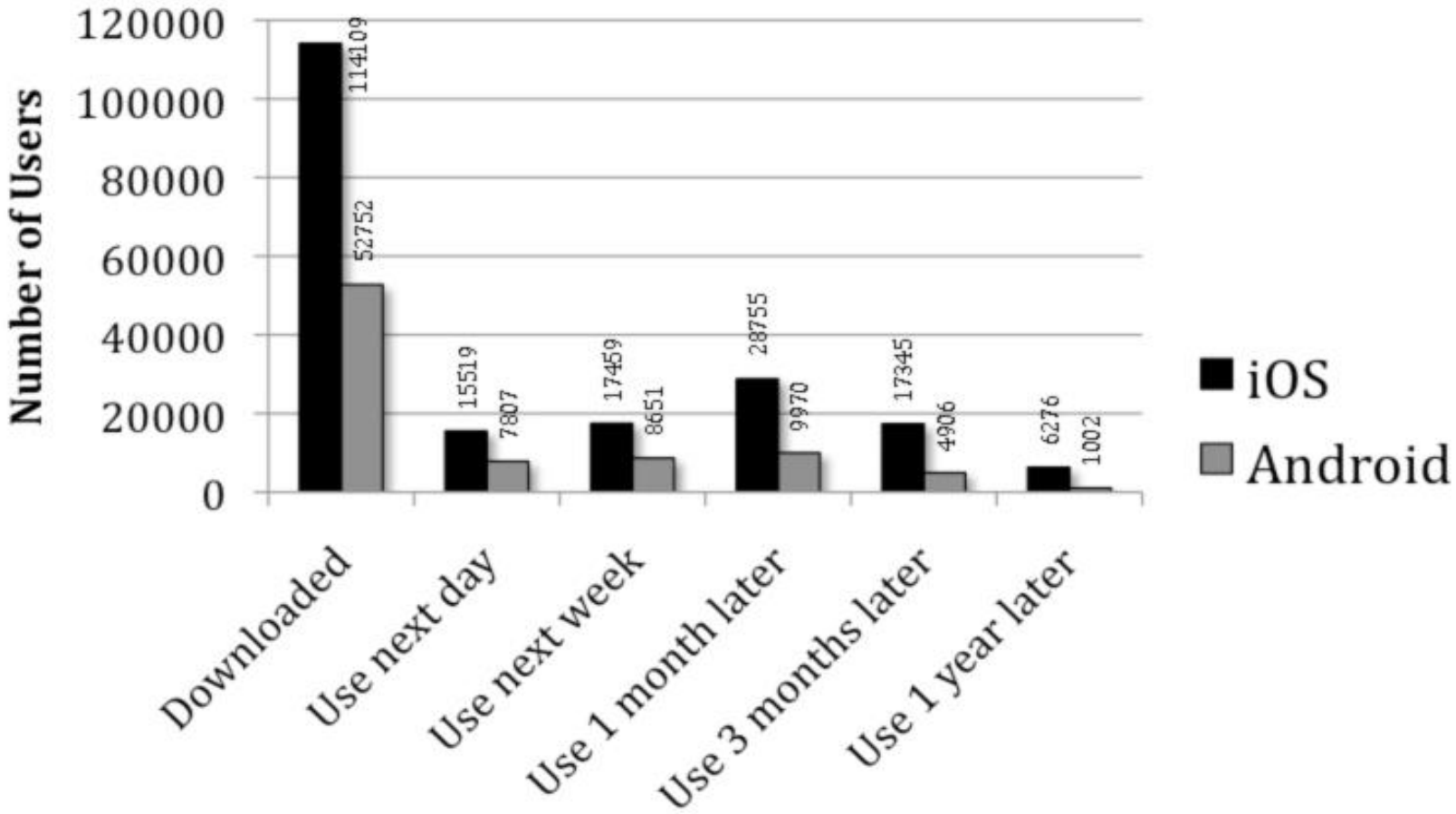
Mobile App: PTSD Coach

PTSD Coach has now been downloaded over 100,000 times in 74 countries around the world.

The PTSD Coach app can help you learn about and manage symptoms that often occur after trauma. Features include:

- Reliable information on PTSD and treatments that work
- Tools for screening and tracking your symptoms
- Convenient, easy-to-use tools to help you handle stress symptoms
- Direct links to support and help
- Always with you when you need it

Informed Decision Making Around Apps: Level 3



Owen et al. mHealth in the Wild: Using Novel Data to Examine the Reach, Use, and Impact of PTSD Coach. JMIR Mental Health. Dec 2015

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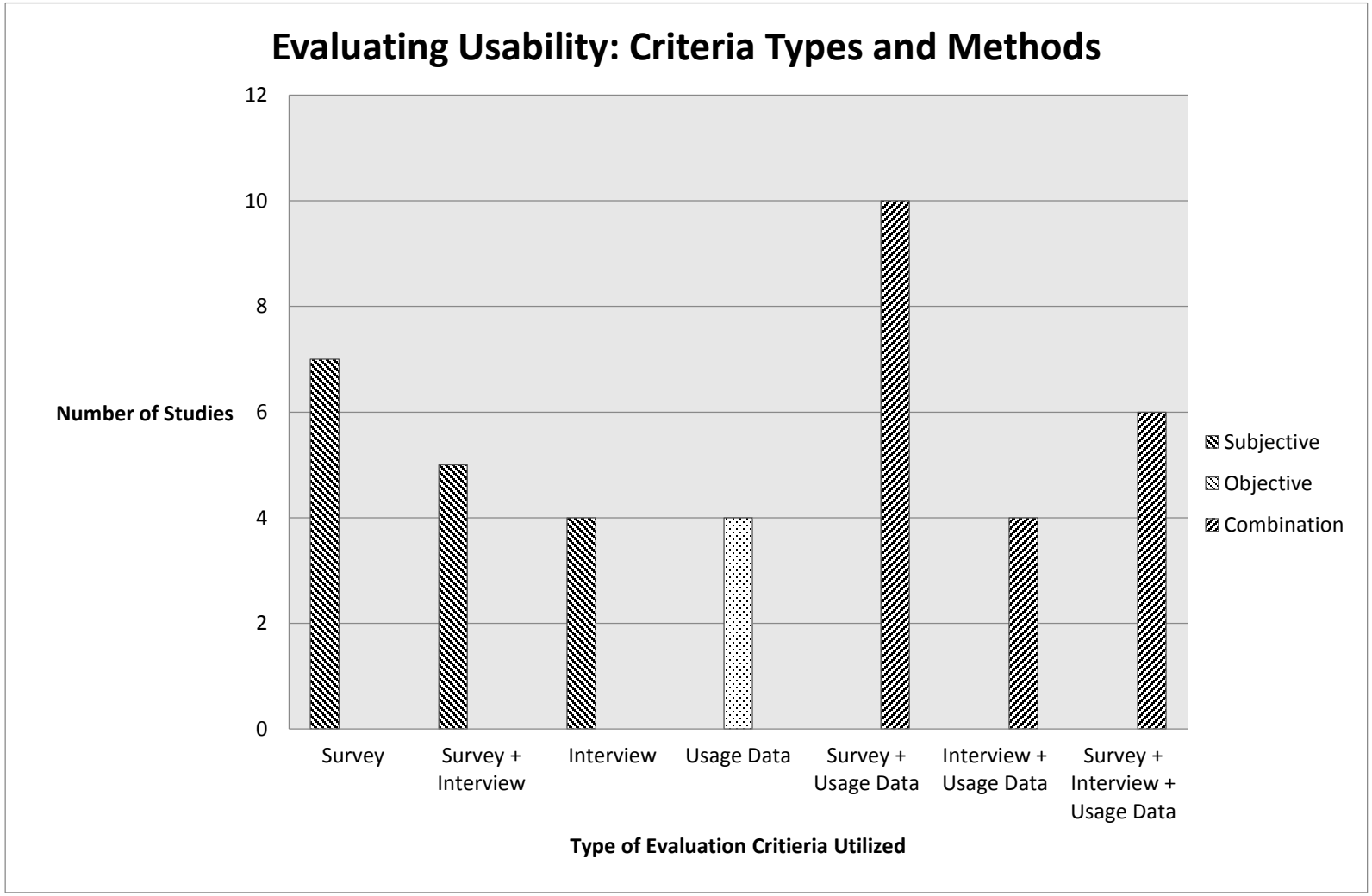
Informed Decision Making Around Apps: Level 3



Ng, Firth, and Torous. Accept and in Press with Psychiatric Services

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Informed Decision Making Around Apps: Level 4

Informed Decision Making Around Apps: Level 4

BJPsych open
BJPsych Open (2019)
5, e15, 1–5. doi: 10.1192/bjo.2018.86

Review

Digital mental health apps and the therapeutic alliance: initial review

Philip Henson, Hannah Wisniewski, Chris Hollis, Matcheri Keshavan and John Torous

Background
As mental healthcare expands to smartphone apps and other technologies that may offer therapeutic interventions without a therapist involved, it is important to assess the impact of non-traditional therapeutic relationships.

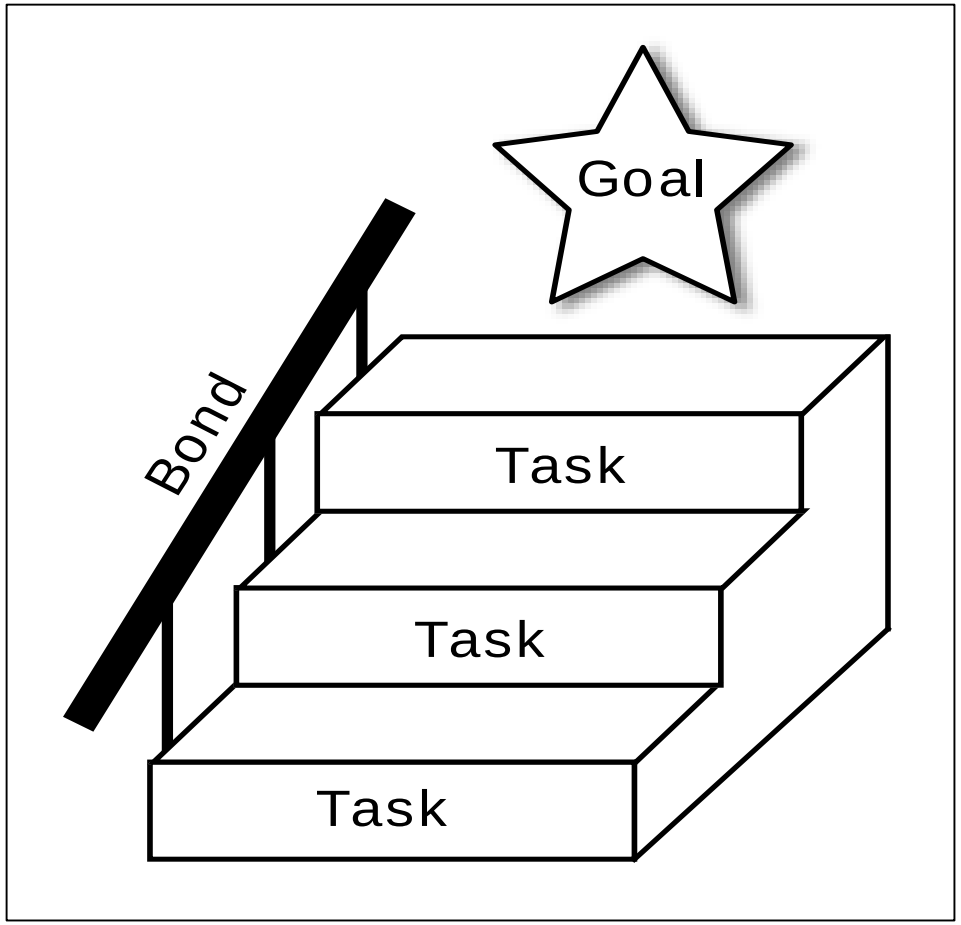
Aims
To determine if there were any meaningful data regarding the digital therapeutic alliance in smartphone interventions for serious mental illnesses.

Method
A literature search was conducted in four databases (PubMed, PsycINFO, Embase and Web of Science).

Results
There were five studies that discuss the therapeutic alliance when a mobile application intervention is involved in therapy. However, in none of the studies was the digital therapeutic alliance the primary outcome. The studies looked at different mental health conditions, had different duration of technology use and used different methods for assessing the therapeutic alliance.

Conclusions
Assessing and optimising the digital therapeutic alliance holds the potential to make tools such as smartphone apps more effective and improve adherence to their use. However, the heterogeneous nature of the five studies we identified make it challenging to draw conclusions at this time. A measure is required to evaluate the digital therapeutic alliance.

Keywords
Smartphone; alliance; Individual Psychotherapy.



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Informed Decision Making Around Apps

Evaluation (n=13)
Breathe2Relax
CBT-iCoach
Mindfulness Coach
MoodTools
Mindshift
Relief Link
T2 MoodTracker
Self-Help for Anxiety Managment (SAM)
ACT Coach
My3
PTSD Coach
quitStart
StayQuit Coach

Pilot (n=9)
Breathe2Relax
CBT-iCoach
Mindfulness Coach
MoodTools
Mindshift
Relief Link
T2 MoodTracker
Self-Help for Anxiety Managment (SAM)
quitStart

Post-Pilot (n=7)
Breathe2Relax
CBT-iCoach
Mindfulness Coach
MoodTools
T2 MoodTracker
Self-Help for Anxiety Managment (SAM)
Quit Guide*

Behavioral Health Self-Help Guide

Free Apps & Websites*

The following tools have been used and selected as a result of positive feedback from CHA patients.

App:	Used for:	Recommended for:	Key Features:
Breathe2Relax	Stress & Anxiety	Learning to deep breathe with some initial guidance.	• Guided breathing exercises • Stress tracking tool • Information about stress
Stop, Breathe & Think	Stress & Anxiety Mindfulness Sleep	A fun and easy intro to mindfulness practice through short, guided meditations.	• 30+ free guided mindfulness meditations and yoga videos • Interactive tool to track your emotional/ physical experience **Note:** Requires monthly subscription to unlock premium features.
Self-Help for Anxiety Management (SAM)	Stress & Anxiety	Support in managing stress/anxiety through mental and physical relaxation tools.	Educational, interactive and fun tools for: • Deep breathing • Muscle relaxation • Changing thinking patterns • Tracking anxiety over time **Note:** The "Social Cloud" feature is unmonitored; CHA does not recommend using it for this reason.
CBT-iCoach	Stress & Anxiety Mindfulness Sleep	Improving sleep through mental and physical relaxation strategies.	• Information on healthy sleep habits • Guided relaxation exercises • Sleep tracking tool • Exercises for managing unhelpful thoughts/ emotions.
MoodTools	Mood Management	Education about depression symptoms & treatment as well as strategies for boosting mood.	• Informative TED talk videos • Mood tracking tools • Thought and activity logs

MIT Relaxation Tip Phone Line

Relaxation by phone (no smartphone required)
Guided three-minute relaxation exercise:
Call 617-253-CALM (2256) for 24/7 access to this pre-recorded exercise

For questions or comments, email BHSELFHELP@challiance.org

CHA Cambridge Health Alliance | AFFILIATED WITH Beth Israel Deaconess Medical Center

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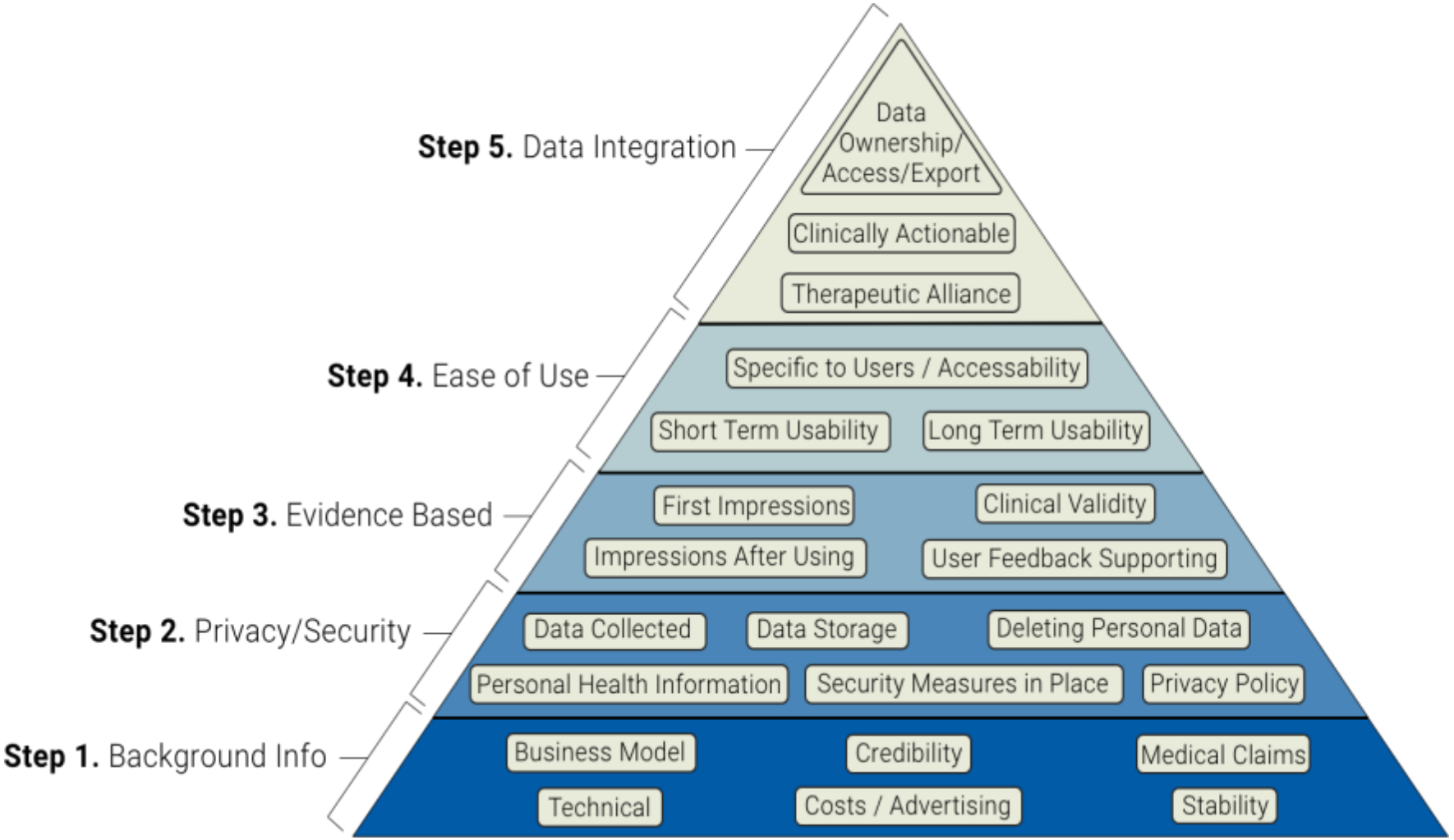
Hoffman L, Benedetto E, Huang H, Grossman E, Kaluma D, Mann Z, Torous J. Augmenting Mental Health in Primary Care: A One-Year Study of Deploying Smartphone Apps in a Multi-Site Primary Care/Behavioral Health Integration Program. Frontiers in psychiatry. 2019;10:94.

Informed Decision Making Around Apps:



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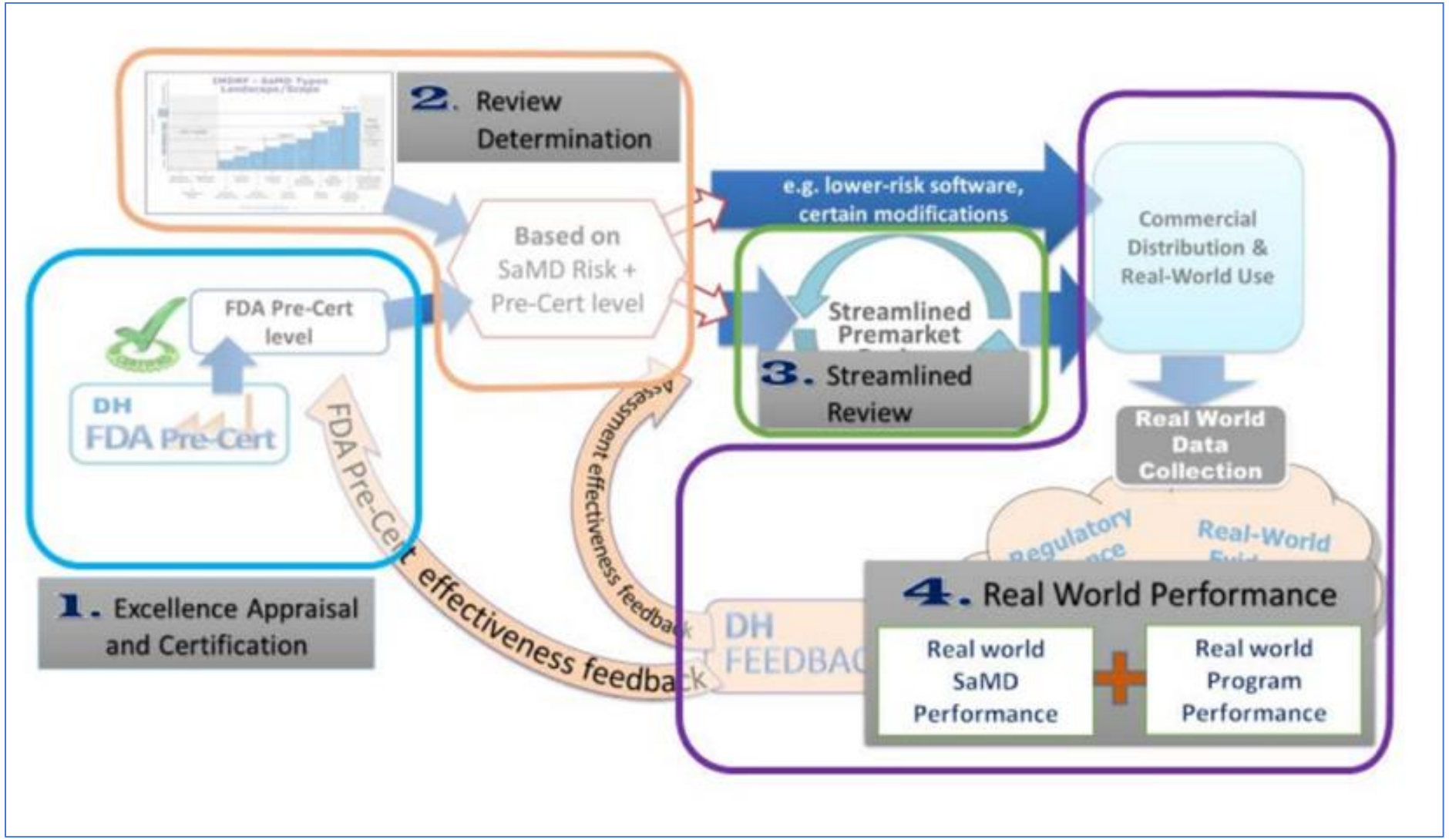
The FDA To the Rescue in the US ?



Informed Consent in the Digital Age

The New York Times

In Screening for Suicide Risk, Facebook Takes On Tricky Public Health Role

January 1, 2019

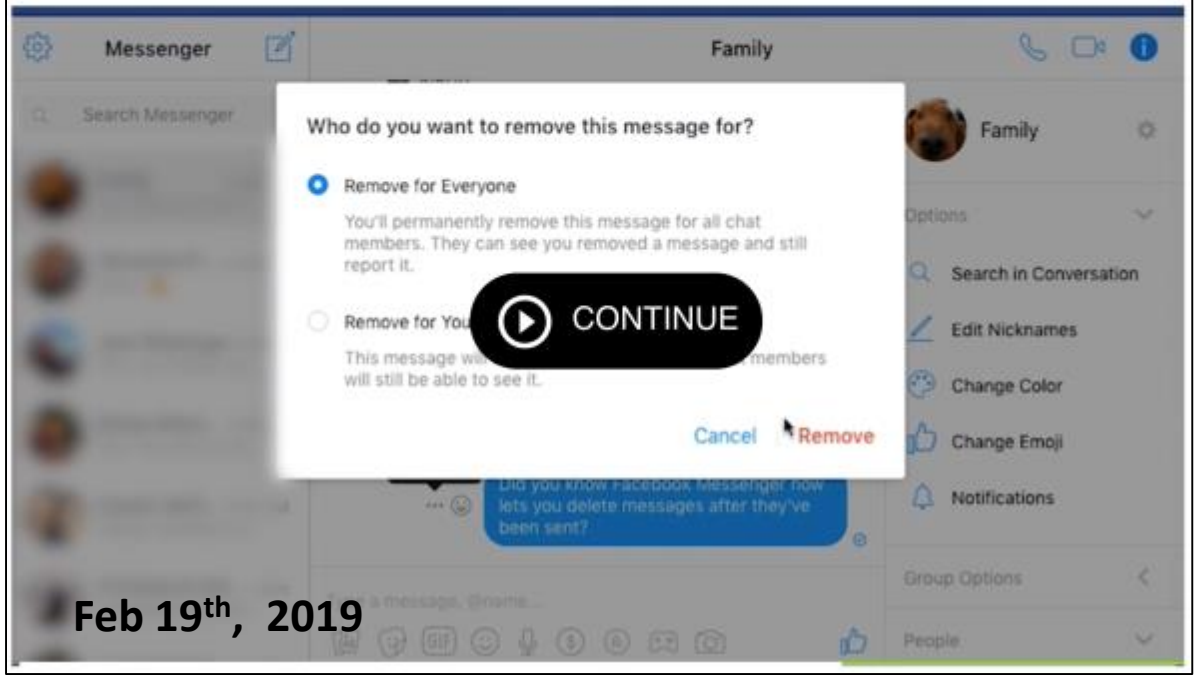
Medical Daily

VITALITY UNDER THE HOOD INNOVATION THE HILL

SCIENCE/TECH

FTC Accuses Facebook Of Revealing Sensitive Health Data In Group

Feb 19, 2019 05:42 AM By Sarah Tejares



Feb 19th, 2019

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Thank You

Digitalpsych.org ; ***jtorous@bidmc.harvard.edu***