Opportunities for Technology in the Self-Management of Mental Health
Mental Health Conditions: Devastating & Prevalent

- Debilitating and life-threatening outcomes
- $300 billion per year
- 450 million people (6% of world’s population)
- 4 of 6 leading causes of YLDs
What is Bipolar Disorder? ("BD")

- One of 10 most debilitating illnesses worldwide
- Permanent neurological damage with each relapse
- Poor functional outcomes
- Very high suicide rates
- 60 million people; affects men and women equally
- Chronic — progressively worsens over a lifetime
Mood is Central

**Normal**
- Balanced period

**Bipolar I**
- Depressive period
  - feeling empty, worried
  - inactivity
  - tired
  - changes in sleeping, eating
  - suicidal thoughts
- Manic period
  - very high mood
  - irritability
  - racing thoughts
  - high risk behavior
  - sleeping less
Tracking (to Maintain) Stable Daily Rhythms

Challenges with the Paper-Based SRM

- Paper logs hinder identifying of patterns
- Unreliable retrospective recall
- Least likely to be completed when most valuable
Bipolar Disorder and Smartphone Monitoring: A Natural Match

- Individuals with BD have been early and sustained adopters of smartphone technology
- Smartphones can track (via self-report & sensing) clinically-relevant variables

BD Symptoms

- High or Low Mood
- Increased / Decreased Psychomotor Activity
- Excessive / Reduced Activity
- Increased / Reduced Sleep
- Increased / Reduced Social Activity

Smartphone Measures

- Self-Report
- Microphone
- Accelerometer
- Geo-location
- Social Media Patterns
- Light Sensor
- Smartphone Use
MoodRhythm
Smartphone Application


Participatory Design

• Individuals with BD
• Clinicians
• Professional psychological researchers
MoodRhythm’s Self-Report Screen
MoodRhythm’s Feedback Screen
“I like the rewards”

“I think the badges are kind of cool”

“Yes, I LOVE badges”

“I got the badges. It gives me personal satisfaction that I have completed something. And, that’s good. It keeps motivating.”

...
Informing Design from Extant Practices & Lived Experiences

- Indicators, tools, motives
- Perceived benefits & challenges
- (Un-met) needs


What are people tracking?

- Mood: 45.1%
- Sleep: 43.4%
- Finance: 19.3%
- Exercise: 21.5%
- Sociability: 21.9%
How are people tracking?
Custom Tracking Setups

| J   | K   | L   | M   | N   | O   | P   | Q   | R   | S   | T   | U   | V   | W   | X   | Y   | Z   | AA  | AB  | AC  | AD  | AE  | AF  | AG  | AV  | AW  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Guitar | Spanish | Clean house | 30mi | Training for 8-day bike ride | 10:30 Breakfast | 9:30 AM Wash/Pare | Physical Therapy | 7:30 AM Wake | 7:30 AM Food | 7:30 PM Food | 7:30 PM Wash | Physical Therapy | 7:30 AM Wake | 7:30 AM Food | 7:30 PM Food | 7:30 PM Wash | Physical Therapy | 7:30 AM Wake | 7:30 AM Food | 7:30 PM Food | 7:30 PM Wash | Physical Therapy | 7:30 AM Wake | 7:30 AM Food | 7:30 PM Food | 7:30 PM Wash | Physical Therapy | 7:30 AM Wake | 7:30 AM Food | 7:30 PM Food | 7:30 PM Wash | Physical Therapy |
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How am I doing? (F)

Now is the time to try Your Hardest ~ xox
Why are people tracking?

- Fosters clinical interactions
- Promotes self-awareness, reflection, empowerment
- Enables pro-active condition management
## Design Guidelines

<table>
<thead>
<tr>
<th>Design Implications</th>
<th>Needs Addressed</th>
<th>Representative Quotes</th>
</tr>
</thead>
</table>
| Deploy software across platforms, devices, and operating systems | Pervasive accessibility                   | “The easier it is to access the program the more likely I am to use it.” \[\]
|                                                           |                                           | “I like typing on my work computer but use my iPad and iPhone at home.” \[\]
| Deliver proactive notifications                          | Promotes adherence to self-monitoring and behavioral regularity | “I also just found emojis for my smartphone. I am just now starting to like it but I need to set an alarm to do it.” \[\]
|                                                           |                                           | “I am so chaotic I find it difficult to keep track of anything without help and prompting.” \[\]
| Synthesize data and highlight patterns                   | Increases self-awareness and reflection    | “It has helped me see general patterns and to recognize personal triggers. And the more aware I am of the symptoms, the more I can do proactively.” \[\]
| Provide encouragement messages and rewards or (after non-compliance) flexibility and forgiveness | Provides mastery experiences and cultivates self-efficacy and self-compassion | “My first few episodes I felt intensely guilty about failure. It was this intense guilt that made me feel suicidal. Recognizing symptoms of depression has allowed me to be much more forgiving during episodes.” \[\]
| Integrate with clinical care while respecting            | Facilitates improved acceptance, transmission, | “I find that the reports succinctly provide my doctors with a more accurate picture over time that what I can recall at” \[\]
From Paper to Smartphone to Sensor

- Social activity (built-in microphone)
- Physical activity (accelerometers)
- Location (GPS + WiFi + Cellular)
Note: Today I got up late because I woke up in the middle of the night and couldn't fall asleep again. I feel tired all day.
Symptoms Manifest through Usage Patterns

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Manic Manifestations</th>
<th>Depressive Manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer-mediated communication (email, phone, texts, tweets, blog posts)</td>
<td>Repetitively (re)reading and sending messages -- to the point it may be construed as spam; writing an excess of online content</td>
<td>Avoidance of email; dodged phone calls and texts</td>
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<tr>
<td>Social networks (e.g., Facebook, Twitter)</td>
<td>Checking social news feeds repeatedly</td>
<td>Avoidance of social media</td>
</tr>
<tr>
<td>Web searching and browsing</td>
<td>Consumed with performing web searches, and they manage and rapidly switching among multiple browser windows and tabs</td>
<td>Non-use or idle use (e.g., reading websites)</td>
</tr>
<tr>
<td>Streaming media (e.g., Netflix, Hulu)</td>
<td>“Binge watching”</td>
<td>Non-use or “zombie-like” watching</td>
</tr>
<tr>
<td>E-commerce</td>
<td>Compulsive online shopping</td>
<td>Non-use</td>
</tr>
<tr>
<td>Gambling, gaming</td>
<td>Obsessively gambling; playing games on computers or phones for hours -- including multiple games, social games, high-action games</td>
<td>Non-use or solitary, “calming” games (e.g., solitaire)</td>
</tr>
<tr>
<td>Digital calendars</td>
<td>Excessively booking activities</td>
<td>Diminished</td>
</tr>
<tr>
<td>Typing and audio</td>
<td>Faster, more careless (e.g., more typos, more garbled speech)</td>
<td>Slower</td>
</tr>
<tr>
<td>Tech-mediated risky behavior</td>
<td>Increased visitation of dating or pornography sites, sending x-rated photos, using more inappropriate and aggressive language in written content; more risk-oriented web searches (e.g., to find tattoo parlors or research exuberant vacations)</td>
<td>None reported</td>
</tr>
<tr>
<td>Usage timing and frequency</td>
<td>Late night usage; excessively checking phone notifications; paranoidly checking partner’s emails, social media accounts, or cellphone logs</td>
<td>Diminished</td>
</tr>
</tbody>
</table>

Evaluation and Acceptability

- Generalized model predicts SRM score (range 0-7) with Root Mean Square Error (RMSE) = 1.40
- Personalized models: RMSE = 0.92
- Classification (stable vs. unstable): precision = 0.85, recall = 0.86

Evaluation and Acceptability

![Graph showing SUS Score vs. Percentile Rank]

- The graph illustrates the distribution of SUS (System Usability Scale) scores.
- The x-axis represents the SUS Score, ranging from 0 to 100.
- The y-axis represents the Percentile Rank, ranging from 0% to 100%.
- The graph shows a curve that increases from left to right, indicating a positive correlation between SUS score and acceptability.

The image depicts a cumulative distribution function (CDF) of SUS scores, which is commonly used to evaluate the usability of a system.
Closing the Loop: Feedback & Intervention
Take-Aways & Considerations

- Characteristics of mental illness and patient experience can have an important impact on the design of digital interventions
- Smartphone solutions for self-tracking, passive sensing, and tailored intervention
- Weigh design tensions & take a “do no harm” approach
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Thank You! Questions?

- Characteristics of mental illness and patient experience can have an important impact on the design of digital interventions.

- Smartphone solutions for self-tracking, passive sensing, and tailored intervention.

- Weigh design tensions & take a “do no harm” approach.