My Brother Ed: Mental illness was not his choice

Andrew T. Campbell, Dartmouth College
ACM UbiComp Workshop on Mental Health and Wellbeing, Heidelberg, September 5, 2016
ca·ve·at
/'kavēˌat,ˈkāvēˌät/
noun

a warning or proviso of specific stipulations, conditions, or limitations.

synonyms: warning, caution, admonition;  More

- LAW

a notice, especially in a probate, that certain actions may not be taken without informing the person who gave the notice.
what is mental illness?
fast forward 30 years
11% of Dartmouth students were diagnosed with depression in 2014.

12% reported depression has having an impact on academic performance.

28% have seen a mental health counselor in 2014.
StudentLife

StudentLife is the first study that uses passive and automatic sensing data from the phones of a class of 48 Dartmouth College students for one academic term to assess their mental health (e.g., depression, loneliness, stress), academic performance (grades across all the classes and cumulative GPA) and behavioral trends (e.g., how stress, sleep, visits to the gym, etc. change in response to college life).
it knows you well
Touch how you feel right now.

Stress
Right now, I am...
A little stressed
Definitely stressed
Stressed out
Feeling good
Feeling great

Save Response

Sleep
How many hours did you sleep last night?
<3

How would rate your overall sleep last night?
Very good

How often did you have trouble staying awake yesterday while in class, eating meals or engaging in social activity?
None

Save Response
attendance rates
sleep

![Bar chart showing the number of instances at different times of day. Peaks are at 1 am to 2 am and 2 am to 3 am, with a significant drop after 4 am.]
depression

- sleep duration *
- conversation frequency (day) **
- conversation frequency (evening) *
- number of co-locations *

*R value:
-0.48
-0.36
-0.24
-0.12
0

*p ≤ 0.05, **p ≤ 0.01
The graph shows the relationship between sleep and the number of deadlines over a period of 64 days. The x-axis represents the day, and the y-axis shows the number of deadlines. The graph indicates a peak in the number of deadlines during the mid-term, which is highlighted in gray. The sleep level is also tracked, showing a pattern that may be related to the number of deadlines.
face-to-face conversation

The graph shows the number of deadlines, conversation duration, and conversation frequency over the course of the semester. The shaded area indicates the mid-term period, which is marked by a significant increase in deadlines and a corresponding decrease in conversation frequency and duration.
stress and affect

mid-term

deadlines
positive affect (PA)
stress
the silent tsunami
Top 10 Leading Disease/Disorder Categories Contributing to U.S. DALYs (2010)

1. Neuropsychiatric Disorders: 13.6%
2. Cardiovascular and Circulatory Diseases: 16.8%
3. Neoplasms: 15.1%
4. Musculoskeletal Disorders: 11.8%
5. Diabetes, Urogenital, Blood, and Endocrine Diseases: 8.0%
6. Chronic Respiratory Diseases: 6.5%
7. Other Non-communicable Diseases: 5.1%
8. Unintentional Injuries (Non-transport): 3.6%
9. Self-harm and Interpersonal Violence: 3.1%
10. Transport Injuries: 3.0%

Percent of Total U.S. DALYs

Data courtesy of WHO
A tragic trend

Suicide rate per 100,000 population

Suicides, United States

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<th>Number</th>
<th>Rate per 100,000 population</th>
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<td>Male</td>
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Main methods

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<th>% of total</th>
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<td>Firearm</td>
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<td>60</td>
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<td>Suffocation</td>
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<td>Poisoning</td>
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Sources: OECD; US Centres for Disease Control and Prevention

*2011-14 Economist estimates using CDC data
he always went off his meds
electroconvulsive therapy (ECT), aka electroshock therapy
Predicting relapse in schizophrenia
• Randomize Control Trail at Zuker Hill Hospital with John Kane, Dror Ben-Zeev, Tanzeem Choudhry
• Smartphone arm (n=75) and treatment as usual arm (n=75).
• 12 months (in the middle now)
• Passive sensing, EMA, monthly BPRS, hospitalization, ER visits, 3 monthly assessmen
Have you been feeling CALM?
Have you been SOCIAL?
Have you been bothered by VOICES?
Have you been SEEING THINGS other people can't see?
Have you been feeling STRESSED?
Have you been worried about people trying to HARM you?
Have you been SLEEPING well?
Have you been able to THINK clearly?
Have you been DEPRESSED?
Have you been HOPEFUL about the future?
is there a relapse signal?
predicting health dimensions

Feature visualization

Sum prediction

EMA
sensing
days

average
average
average

MAE Pearson r

leave one out mix 20% mix 40% mix 60% mix 80% individual
Brief Psychiatric Rating Scale (BPRS)

Patient Name ___________________________________________ Today's Date ________________

Please enter the score for the term that best describes the patient's condition.

0 = Not assessed, 1 = Not present, 2 = Very mild, 3 = Mild, 4 = Moderate, 5 = Moderately severe, 6 = Severe, 7 = Extremely severe

Score

1. SOMATIC CONCERN
   Preoccupation with physical health, fear of physical illness, hypochondriasis.

2. ANXIETY
   Worry, fear, over-concern for present or future, uneasiness.

3. EMOTIONAL WITHDRAWAL
   Lack of spontaneous interaction, isolation deficiency in relating to others.

4. CONCEPTUAL DISORGANIZATION
   Thought processes confused, disconnected, disorganized, disrupted.

5. GUILT FEELINGS
   Self-blame, shame, remorse for past behavior.

6. TENSION
Prediction Report for 2016-9-7

Model evaluation: MAE=2.30798489712, r=0.385530592478, p=1.98501272357e-06

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<th>User</th>
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<th>Change Since to Last Predicted BPRS</th>
<th>Change Since Last Predicted BPRS</th>
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<th>Second to Last Predicted BPRS</th>
<th>Last BPRS Date</th>
<th>Avg BPRS</th>
<th>Num of BPRS</th>
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mental illness is not black and white, it’s the grey areas that matter
Diagnostic Criteria for Major Depressive Disorder and Depressive Episodes

**DSM-IV Criteria for Major Depressive Disorder (MDD)**
- Depressed mood or a loss of interest or pleasure in daily activities for more than two weeks.
- Mood represents a change from the person's baseline.
- Impaired function: social, occupational, educational.
- Specific symptoms, at least 5 of these 9, present nearly every day:
  1. Depressed mood or irritable most of the day, nearly every day, as indicated by either subjective report (e.g., feels sad or empty) or observation made by others (e.g., appears tearful).
  2. Decreased interest or pleasure in most activities, most of each day
  3. Significant weight change (5%) or change in appetite
  4. Change in sleep: Insomnia or hypersomnia
  5. Change in activity: Psychomotor agitation or retardation
  6. Fatigue or loss of energy
  7. Guilt/worthlessness: Feelings of worthlessness or excessive or inappropriate guilt
  8. Concentration: diminished ability to think or concentrate, or more indecisiveness
  9. Suicidality: Thoughts of death or suicide, or has suicide plan

Diagnostic and Statistical Manual (DSM) of Mental Disorders, 4th Edition
Research Domain Criteria (RDoC)

RDoC is a research framework for new ways of studying mental disorders. It integrates many levels of information (from genomics to self-report) to better understand basic dimensions of functioning underlying the full range of human behavior from normal to abnormal.

What's New with RDoC?

- Webinar: Analyzing and Using RDoC Data in Your Research
- New Funding Opportunities for Psychosis-Related RDoC Projects
- RDoC Launches User-Friendly Matrix Format
- Psychophysiology: Special Issue Features RDoC Initiative

Join the RDoC Discussion

- RDoC Twitterfeed
- RDoC Discussion Forum

Learn More About RDoC
## Negative Valence Systems

<table>
<thead>
<tr>
<th>Construct/Subconstruct</th>
<th>Genes</th>
<th>Molecules</th>
<th>Cells</th>
<th>Circuits</th>
<th>Physiology</th>
<th>Behavior</th>
<th>Self-Report</th>
<th>Paradigms</th>
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</table>

### Domains

- Negative Valence Systems
- Positive Valence Systems
- Cognitive Systems
- Social Processes
- Arousal and Regulatory Systems

### Units of Analysis

- Genes
- Molecules
- Cells
- Circuits
- Physiology
- Behaviors
- Self-Reports
- Paradigms

### Physiology

- BP
- Context Startle
- EMG
- Eye Tracking
- Facial EMG
- Fear Potentiated Startle
- Heart Rate
- Pupillometry
- Respiration
- Response accuracy
- Skin Conductance

### Behavior

- Analgesia
- approach (early development)
- Avoidance
- Facial expressions
- Freezing
- Open field
- Response inhibition
- Response time
- Risk assessment
- Social approach

### Self-Report

- Albany Panic and Phobia
- BAI
- Eilam Ethogram
- Fear Questionnaire
- Fear survey schedule
- STAI
- Structured Diagnostic and Assessment scales
- SUDS
- Trait Fear Inventory
promise of wearables
depression state transitions based on weekly PHQ4 data

![Transition Matrix]

- Normal to Normal: Lighter shade
- Normal to Mild: Medium shade
- Normal to Moderate: Darker shade
- Normal to Severe: Lightest shade
- Mild to Normal: Medium shade
- Mild to Mild: Lighter shade
- Mild to Moderate: Darker shade
- Mild to Severe: Lightest shade
- Moderate to Normal: Medium shade
- Moderate to Mild: Lighter shade
- Moderate to Moderate: Darker shade
- Moderate to Severe: Lightest shade
- Severe to Normal: Medium shade
- Severe to Mild: Lighter shade
- Severe to Moderate: Darker shade
- Severe to Severe: Lightest shade
• validity of sensors and diagnostic predictive models
• flaky signals, real-world noise
• interventions
• over burdened clinicians
• privacy, privacy, privacy
we have a mountain to climb
Welcome to Calm
Relax with Calm, a simple mindfulness meditation app that brings clarity and peace of mind into your life.

Begin
buddhify is the mindfulness app for modern life
How do you feel?

Feel recognizes and tracks your emotions throughout the day and provides you with personalized coaching to help you achieve your emotional wellbeing goals.

RESERVE NOW
randomized control trails
#BigThankYou
Ethan Berke, Dror Ben-Zeev, Tanzeem Choudhury, Randy Colvin, John Kane, Sam Gosling, Gabriella Harari, Catherine Norris, Rui Wang, Varun Mishra, Weichen Wang, Xia Zhou, Susan Zak, Gregory Abowd, Emily A. Schere, Rachel M. Brian, Tom Insel, Min S. H. Aung, Mi Zhang, Todd Heatherton, Bill Kelley, Virginia Brack, Ann Bracken, Sarah Lord, Lorie Loeb
peace brother