Financial relationships for Rosalind Picard, Sc.D.

• Employed as full-time professor by MIT Media Lab

• MIT Media Lab members include GlaxoSmithKline, Otsuka Pharma, NIH, NSF, Google, and over 75 corporations and foundations that are not primarily pharmaceutical or medical. The full list is at http://www.media.mit.edu/sponsorship.

• Co-founder, Chairman, Chief Scientist and Investor in: Physiio International. Physiio has a business relationship with Empatica Inc. making sensors we use in our research
Physiological Sensor Technology for Objective Clinical Data in Psychiatry

Rosalind W. Picard, Sc.D., FIEEE
Professor, MIT Media Lab
Co-founder, Physiio International

Empatica E3’ sensor
Measuring autonomic arousal in active daily life
Characterize sympathetic nervous system arousal (sensors worn here just above the ankles)

Video
Sympathetic division
Stimulation: “fight or flight”

AUTONOMIC NERVOUS SYSTEM

Parasympathetic division
Inhibitory: “rest and digest”

(Not shown: Enteric division)
Log autonomic data – sympathetic nervous system response 24/7 “in the wild”
Skin conductance analysis of sleep peaks help quantify:

- Non-REM sleep
- Arousals pre-sleep
- Activations/autonomic disruptions during sleep
- Memory consolidation

EDA is best for determining who improved the most on the learning task during sleep ("All" includes EEG: C3, C4, O1 and O2, 100Hz), n=24 adults, 72 nights
Stimulation deep in left brain

Stimulation deep in right brain

Use bilateral EDA for objective measures in anxiety and depression

- Left amygdala gives the most significant EDA response on the left palm; right amygdala gives the most significant EDA response on the right palm.
  
  *Mangina & Beuzeron-Mangina 1996, n=240 stimulations (5 patients x 12 brain regions x 4 stim/region)*

- Direct right amygdala stimulation contributed to significant increases in **fear, anxiety and sadness** ($p<0.05$) while direct left amygdala stimulation was not specific to these.
  
  *Lanteaume et al. 2007, n=69 stimulations (8 patients x 4-9 stim/patient)*
Reasons to collect electrodermal activation (EDA) measured as skin conductance level (SCL)

• The mean resting skin conductance level (SCL) in 31 inpatients with major unipolar depression was 2.63 uS/cm² +/- SD 1.41 compared to 7.81 uS/cm² +/- SD 3.0 in the control group. The best criterion based on SCL gave sensitivity of 87% and specificity of 89%.

• There was a significant difference in SCL between males and females but none between drug-free and medicated patients. SCL was abnormal in all depression subtypes.

• The SCL may represent a biological final common pathway in depression and may prove to be a very effective diagnostic test for depression.

Long term EDA: Could this measure some kinds of depression more objectively and effectively than traditional lab-based measures?

2nd night after receiving news of death of family member

3rd night

... back to normal
Use bilateral EDA for objective measurement in anxiety and depression

• Significant association exists between anxious/depressed symptoms and right amygdala volume \( (r=0.469, \ P=0.002) \) and not with left amygdala volume.

  Juranek et al. 2006, \( n=42 \) children who met criteria for autism spectrum disorders

• Studies of generalized anxiety disorder (GAD) have shown larger right amygdala activation when viewing masked angry faces (and not masked neutral faces). The amount of right amygdala activation correlated positively with GAD severity.

  Monk et al., 2008, \( n=17 \) youth with GAD, \( n=12 \) youth with no psychiatric diagnosis
Reasons to examine EDA as an objective treatment measure in schizophrenia

- Electrodermal response recovery rate has been shown to be an especially valid predictor in some risk studies of schizophrenia. Boucsein 2012.

- Evidence shows disturbances in the hippocampus and amygdala in schizophrenics, structures that elicit EDA. Venables, 1983


- And much more!
Comfortable, unobtrusive, easy, 24/7 data

Analysis of EDA, activity, temperature

Pattern recognition & decision-making

Clustering and comparison with norms

1. Wear sensor

2. Data goes up to the cloud (in real-time or when recharged)

Caregiver and people in vicinity can get real-time alerts via mobile
Today: Objective data to cluster patients.
Finding: Physiological phenotypes.

5 children with ASD
Sensor data from 60 school days for each child
Affect.media.mit.edu
Physiio.com
Empatica.com

These can be used today!
More data provides more validation.

picard@media.mit.edu