Emotional Brains: Captured in the Laboratory and in Art
12/13/12

Virginia Sturm, PhD

BIOGRAPHY:

Virginia Sturm, PhD, is an Assistant Professor at the UCSF Memory and Aging Center. After undergraduate work at Georgetown University, she received her PhD degree in clinical psychology and at the University of California, Berkeley and subsequently completed her clinical internship and postdoctoral fellowship at UCSF. Her research centers on laboratory measurement of emotion and social behavior in patients with neurodegenerative disease.

Howard Rosen, MD, PhD

BIOGRAPHY:

Howard Rosen is Associate Professor of Neurology at UCSF. He is a behavioral neurologist who received his medical degree from Boston University School of Medicine, trained in internal medicine at the Albert Einstein College of Medicine in New York, and subsequently completed a neurology residency at UCSF. After residency, Dr. Rosen pursued fellowship training in brain imaging at the Washington University School of Medicine, and then returned to UCSF to join the team at the Memory and Aging Center (MAC) in 1999.

Dr. Rosen’s primary research interest is in the effects that atypical neurodegenerative diseases, in particular frontotemporal dementia, have on the brain, especially the emotional systems. His current projects use psychophysiology and imaging to examine how these diseases affect self-awareness, and to determine how imaging and other biological markers can be used to track and to anticipate how these diseases affect the brain over time. He is also director of education and outreach for the education core in UCSF’s Alzheimer’s Disease Research Center.

As part of the MAC and the UCSF Department of Neurology, he participates in the training of medical students, residents and fellows, and participates in the evaluation of new patients in the MAC clinic as well as the continued management of care for some of these individuals in the continuity clinic.

Deborah Aschheim

BIOGRAPHY:

Deborah Aschheim makes installations based on invisible networks of perception and thought. Her work exploring the subject of memory has led her to collaborate with musicians and neuroscientists on projects that are an equal mix of science and poetry. Recent exhibitions featuring work from her longstanding collaboration with musician/composer Lisa Mezzacappa include a five-year survey, "Deborah Aschheim: feeling-of-knowing" with Lisa Mezzacappa” at
San Diego State University Art Gallery (2011), “Nostalgia for the Future” at the Armory Center in Pasadena, CA “Deborah Aschheim + Lisa Mezzacappa: Earworms” at the Pasadena Museum, "Deborah Aschheim: Reconsider" at Laumeier Sculpture Park, Saint Louis, MO. Aschheim has been commissioned to make public artworks for the Los Angeles Police Department, the Sacramento Public Library, Amazon.com and the City of Santa Monica. She has received fellowships from the California Community Foundation, from the City of Los Angeles and from the City of Pasadena (among others.) From 2009-11, Aschheim was the inaugural Hellman Visiting Artist in Memory and Aging at the University of California, San Francisco Department of Neurology.

Lisa Mezzacappa

BIOGRAPHY:

Lisa Mezzacappa is a San Francisco Bay Area-based musician, composer, and curator. An active collaborator and arts organizer in the Bay Area music community for more than ten years, she leads several of her own ensembles and performs in nearly a dozen others. Her music spans raucous garage jazz to ethereal chamber music, scores for experimental film and immersive installation environments. She collaborates frequently on cross-disciplinary projects, most notably on a series of installations with visual artist Deborah Aschheim. Lisa has been artist-in-residence at Djerassi Resident Artists Program, Headlands Center for the Arts, the Banff International Jazz Workshop, and the Painted Bride Arts Center. She holds an MA in ethnomusicology from UC Berkeley, and a BA in music from the University of Virginia. Lisa has recorded on the Tzadik, Clean Feed, NoBusiness, Kadima, Leo, Edgetone, Porto Franco, Odd Shaped Case and Evander record labels, and has performed at countless music venues in the Bay Area, New York, and abroad, including the Earshot, Montreal, Novara and Monterey Jazz festivals. www.lisamezzacappa.com

BIBLIOGRAPHY:

Deborah Aschheim
http://www.deborahaschheim.com/

Suyama Space- upcoming installation
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UCSF Memory and Aging
http://memory.ucsf.edu/blog/interview-with-artist-deborah-aschheim-302/

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http://my.calfund.org/artist-gallery/gallery/year-2011/deborah-aschheim/

John Michael Kohler Art Center
John Michael Kohler Arts Center
http://www.youtube.com/watch?v=HY5r0RQQadw


The Emotional Brain: 
Order and Disorder

Virginia Sturm, PhD
Howard Rosen, MD

"Is emotion a magic product, or is it a physiologic process which depends on an anatomic mechanism?"

J.W. Papez (1937)

What is an emotion?

Short-lived phenomenon (Levenson, 1994)

- Psychological
  - Alter attention, shift certain behaviors upward in response hierarchies, activate memory networks
- Physiological
  - Rapidly organize the responses of disparate biological systems (e.g., facial expression, somatic muscular tonus, voice, ANS)

Components of Emotion

- Autonomic Nervous System Reactivity
- Facial Behavior
- Experience

Process Model of Emotion

model based on modified versions of Levenson, 1999 and Gross, 2002
Types of Emotion

- "Basic"
  - Reactions that are important for physical survival
  - Seen across species
- Social/Self-Conscious
  - Reactions that foster relationships and group dynamics
  - Unique to humans and more evolved species

Interpersonal Functions of Basic Emotions

- DISGUST
- FEAR
- HAPPINESS

Interpersonal Functions of Social Emotions

- PRIDE
- SHAME
- EMBARRASSMENT

Autonomic Changes in Emotion

<table>
<thead>
<tr>
<th>Type</th>
<th>Change</th>
<th>ANS-Mediated Basis</th>
<th>Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloration</td>
<td>Reddening</td>
<td>Vasodilation, increased contractility</td>
<td>Anger</td>
</tr>
<tr>
<td></td>
<td>Blushing</td>
<td>Vasodilation</td>
<td>Embarrassment</td>
</tr>
<tr>
<td>Wrinkles</td>
<td>Sweating, sternum</td>
<td>Sweat glands</td>
<td>Fear</td>
</tr>
<tr>
<td>Salivating, drooling</td>
<td>Salivary glands</td>
<td>Disgust</td>
<td></td>
</tr>
<tr>
<td>Protrusions</td>
<td>Rosation</td>
<td>Muscle fibers at base of hair follicle</td>
<td>Fear, anger</td>
</tr>
<tr>
<td>Appearance of eyes</td>
<td>Constriction</td>
<td>Pupils</td>
<td>Anger</td>
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<tr>
<td></td>
<td>Pupil</td>
<td>Pupils</td>
<td>Anger</td>
</tr>
<tr>
<td></td>
<td>Bulging</td>
<td>Eyelid muscles</td>
<td>Anger, fear</td>
</tr>
<tr>
<td></td>
<td>Twinkling</td>
<td>Lacrimal glands plus contraction of orbicularis oculi</td>
<td>Happiness</td>
</tr>
</tbody>
</table>

Laboratory Measurement of Emotion: Past

Duchenne c.1862
Laboratory Measurement of Emotion: Present

Physiological Reactivity
- Cardiac interbeat interval
- Pulse transmission time to finger
- Finger pulse amplitude
- Pulse transmission time to ear
- Systolic blood pressure
- Diastolic blood pressure
- Finger temperature
- Skin conductance level
- Somatic activity
- Respiration depth
- Inter-cycle interval between breaths
- Pupil diameter

How does the brain support emotion?

Emotional Behavior

**SURPRISE**
- Eyebrows raised (arc)
- Jaw drop

**FEAR**
- Eyebrows up and in
- Lip stretch

**SADNESS**
- Eyebrows up and in
- Lip corners down

**ANGER**
- Eyebrows furrowed
- Lips pressed

**HAPPINESS**
- Eyes crinkled
- Cheeks up
- Lip corners up

**DISGUST**
- Nose wrinkled
- Upper lip raised

Amygdala
- Found in medial temporal lobes
- Fear conditioning
- Emotional memory
- Emotion recognition
- Rapid contextual appraisal (gist)
Orbitofrontal Cortex

- Behavioral inhibition
- Reward and punishment
- Tracking relative value of stimuli

Anterior Cingulate Cortex

- Affective subregion
- Projects to emotion generators

Hypothalamus

- Electrical stimulation in cats leads to defensive reaction (Hess, 1920s)
- Rats self-stimulate (Olds and Milner, 1954)
- Role in emotional behavior, reward, and motivation

Lateral Prefrontal Cortex

- Emotion regulation
  - Suppression
  - Reappraisal

Insula

- “Island” found in between frontal and temporal lobes
- Important for interoception and subjective emotional experience

How can emotions go wrong?
Alterations in Emotion are a Common Feature of Mental Illness

• Psychopathy
• Depression
• Bipolar Disorder
• Schizophrenia
• Panic/Specific Phobias
• Obsessive-Compulsive Disorder

Alterations in Emotion are a Common Feature of Neurological Disease

• Alzheimer’s disease
• Frontotemporal dementia
• Amyotrophic lateral sclerosis (Lou Gherig’s)
• Multiple sclerosis
• Traumatic brain injury

What goes wrong in the brain to give rise to emotional symptoms?

Frontotemporal Dementia (FTD)

• Primary social and emotional impairment
  – Loss of empathy, disinhibition, compulsions
• Anterior atrophy: medial frontal, anterior temporal, and insula
• Studying patients with lesions can help us to identify neural correlates of specific deficits

FTD affects most of the regions involved in emotion

Insula  Anterior Cingulate  Amygdala

Emotional Response

Antecedent Event

Appraisal

Reactivity

Reappraisal

Emotional Response Tendency

Suppression

Amplification

Substitution

Regulation

Dorsolateral PFC  Ventrolateral PFC
Fear conditioning and the amygdala

Neutral Cue (CS) no freezing
Cue-Shock (CS-US) pairing freezing
Conditioned cue (CS) freezing

Fear conditioning paradigm

SCR
CS-
US (w. noise)
SCR
SCR

Habituation
Acquisition
Extinction

Both Alzheimer’s Disease and FTD show impairments in fear conditioning, measured with Skin Conductance

Emotional comprehension in FTD

Emotional comprehension: Florida Affect Battery

Anterior temporal cortex
Amygdala
Ventromedial frontal cortex

Florida Affect Battery:
Emotion Recognition in FTD

Correlation of emotional comprehension and amygdala volume in FTD
Self-Conscious Emotions Serve Interpersonal Functions

- Social emotions
  - Guilt, pride, shame, and embarrassment
  - Social evaluation

- Embarrassment
  - Emerges after violation of a social convention
  - Characteristic facial display and physiological activation
  - Promotes repair of disrupted social bonds

Emotional Reactivity In FTD

Basic Emotional Reactivity is Preserved in FTD

Self-Conscious Emotions are Impaired in FTD

Karaoke Task

- Participants: 24 FTD patients and 16 controls

(Sturm, Ascher, Miller, & Levenson, Emotion, 2008)
Loss in Anterior Cingulate Cortex is Associated with Loss of Embarrassment

- Smaller right pregenual ACC volume is associated with:
  - lower autonomic reactivity
  - embarrassment behavior
- True in patients and controls

ALS

- Disease of the motor system
  - Upper motor neurons in primary motor cortex
  - Lower motor neurons in spinal cord
  - Progressive weakness and stiffness
  - Involvement of muscles for swallowing and breathing

Pseudobulbar affect

- Symptoms:
  - Bursts of "unwanted" emotional displays
  - Usually crying and/or laughing
  - Usually very strong
  - Often unpredictable
  - Said to be inconsistent with real feelings
  - Always a consequence of neurological disease
- Multiple names: Pathological Laughing and Crying, Inappropriate Emotional Display Disorder, Emotional Incontinence

Emotion Regulation

**Suppression:** “Hide your feelings; pretend that someone is watching you and you do not want them to be able to tell that you are feeling anything about the film”

**Reappraisal:** “Adopt a detached and unemotional attitude, and try to think about what you are seeing in such a way that you feel less emotion”

PBA session

- Interview
- Watch: Amusing, Sad
- Suppress: Amusing, Sad
- Reappraise: Amusing, Sad
Facial behavior for amusement in PBA was normal in the watch condition, but elevated in the regulation trials compared with non-PBA.

**Take Home Points**

- Emotions can be studied with scientific methods
- Alterations in emotion are a common feature of psychiatric and neurologic illnesses
- Emotions are supported by the brain
- Emotions are there to help us: use them!