Psych3BN3 Topic 4
Emotion

Readings: Gazzaniga Chapter 9

Bilateral amygdala pathology:
Case of S.M. (fig 9.1)

- SM began experiencing seizures at age 20
- CT, MRI revealed amygdala atrophy, result of genetic disorder
- Performed normally on cognitive tests, IQ etc

S.M. 's ratings of emotional intensity of faces (fig 9.2)
SM’s drawings of faces depicting emotions (fig 9.3)

Outline
- Measuring emotional processing
- The six basic emotions
- The Limbic System concept
- The amygdala
- The hippocampus and higher-level emotional cognition: implicit vs explicit emotional processing
- Facial emotional processing
- Other regions important for emotion: orbital frontal cortex, Anterior Cingulate cortex, insula
- Lateralization of emotional functions

Why Emotion?
- What would we be without emotion?
- Provides the incentives that drive almost everything that we do.
- Provides a critical context for decision making.
- Sorts out the important (biologically significant) stuff from the rest.
Eliciting & Measuring Emotion

• Ask subject to “think about” an emotional situation.
• Present emotionally evocative stimuli.
• Present rewarding or punishing stimuli.
• Measurement: Self-report, consequences of suspected emotional state on action, autonomic responses.
• Limitations.

The six “universal emotions”: anger, disgust, fear, happiness, sadness, surprise (Ekman 1973; fig 9.4)

The neural circuits of emotion: Papez circuit & the Limbic System (Fig 9.5)

• Papez circuit (1937): hypothalamus, anterior thalamus, cingulate gyrus and hippocampus
• The limbic system: McLean (1949,52): extended Papez’ loop to include amygdala, OFC, parts of basal ganglia
The Orbitofrontal Cortex (OFC) and the amygdala (fig 9.6)

- Two major OFC subdivisions: ventromedial and lateral.
- Damage has complex consequences, difficult to characterize. Mainly affects decision making.
- Impaired ability to care about consequences?

Implicit emotional learning: Fear Conditioning in rats (fig 9.7)

(a) Before training
- Light alone (CS): no response

(b) During training
- Foot shock alone (US): normal startle (UR)
- Loud noise alone (US): normal startle (UR)
- Light and foot shock: normal startle (UR)

(c) After training
- Light alone: normal startle (CR)
- Light and sound but no foot shock: potentiated startle (potentiated CR)

Amygdala Circuitry (fig 9.8)

- Inputs: “Low road”/ “high road” (“fast” and “sure”)
- Outputs: Contribute to selection and generation of emotional response.
Amygdala and decision making
(figure 9.9)

- Targets of amygdala output include hippocampus, frontal cortex (Ventromedial prefrontal and anterior cingulate)
- Frontal cortex can then use information to inhibit reflex action and select appropriate response.

Fear conditioning in patient SP
(figs 9.10, 9.11)

- SP underwent lesion to Rt amygdala / hippo
- MR showed prior Lt amygdala damage
- SP showed awareness of contingencies, but no conditioned emotional reaction (SCR)
- HC lesions cause the opposite: conditioning without awareness

Fear conditioning vs instructed fear (fig 9.12)

- Both involve the amygdala in expression of the fear response (startle)
- SP: No startle response to stimulus in instructed fear paradigm
Amygdala response to facial expressions (fig 9.13)

- Most people focus particularly on eyes when looking at faces
- SM shows abnormal eye movements

SM: abnormal face processing (fig 9.13b)

- SM recognizes all facial expressions except fear
- Deficit disappears when SM told to focus on eyes

Eye whites sufficient to cause diffs in left amygdala activn (fig 9.14)
Racial bias and face processing in the amygdala

- Racial bias revealed in the Implicit Association Test
- Phelps et al (2000, 2003): amygdala activation greater when Americans viewed black unfamiliar faces; BUT: SP showed equal bias in spite of amygdala lesions

https://implicit.harvard.edu/implicit

Early and late neural response to black vs white faces (fig 9.15)

- Brief Presn
- Longer presn

a) amygdala, c) dorsolat PFC, d) anterior cingulate, e) ventrolat PFC

fMRI responses to angry facial expressions: Rt OFC, Ant Cingulate (fig 9.17)

(a) (b)
Summary of emotion-related brain areas (fig 9.18)

<table>
<thead>
<tr>
<th>Emotion</th>
<th>Associated Brain Area</th>
<th>Functional Role</th>
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</thead>
<tbody>
<tr>
<td>Fear</td>
<td>Amygdala</td>
<td>Learning, Avoidance</td>
</tr>
<tr>
<td>Anger</td>
<td>Orbitofrontal Cortex, Anterior Cingulate Cortex</td>
<td>Indicate Social Violations</td>
</tr>
<tr>
<td>Sadness</td>
<td>Amygdala, Right Temporal Pole</td>
<td>Withdraw</td>
</tr>
<tr>
<td>Disgust</td>
<td>Anterior Insula, Anterior Cingulate Cortex</td>
<td>Avoidance</td>
</tr>
</tbody>
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Laterality in cognitive style and mood disorders

- Laterality in baseline mid-frontal EEG predicts self-rated mood
- Left-frontal TMS used to treat depression
- Pettigrew’s theory of a sticky inter-hemispheric switch in BPD - see http://www.uq.edu.au/nuq/jack/BipolarDisorder.html