Introduction to Physiological Psychology
Psych 260

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What is an emotion?

- appraisal
- experience
- physiological response
- behavior
- Autonomic & Hormonal
4 ingredients of an emotion

- **Appraisal** or interpretation
  - of some stimulus - event, object, or thought - in terms of well-being
- **Subjective experience** or feeling
  - e.g. Fear
- **Physiological responses**
  - e.g. change in heart rate
- **Overt or observable behaviors**
  - e.g. facial expressions, running away

Emotions as response patterns

- Three components of the emotional response:
  - Behavioral component (e.g. muscle movements)
  - Autonomic component (e.g. heart rate)
  - Hormonal component (e.g. epinephrine)
Communication of Emotions

- Many animal species communicate emotions via postural changes, facial expressions, and nonverbal sounds.

- These expressions inform others about how we feel and especially about what we are likely to do next.

Darwin’s Theory

- Expressions of emotion evolve from indicative behaviors.

- If such signals are beneficial, communicative function will be enhanced.
  - (original function may be lost)

- Principle of antithesis
  “Opposite messages are often signaled by opposite movements”
Darwin’s Theory

- **Threat displays**
  - Originally initial stages of combat
  - Over time, intimidation of display *alone* could be sufficient (and less dangerous!)
  - So... displays became more elaborate, actual combat decreases
  - *Principle of antithesis!*

Are facial expressions innate?

- Research by Ekman provides support to the ideas proposed by Darwin

You see a dead pig that has been lying there for some time
Your child has died Your friend has come and you are happy
You are angry and about to fight
Emotions and Facial Expression

- The meanings of facial expressions appear to be universal.

- Originally, six primary emotions, but now ten are recognized (including contempt, embarrassment, guilt, interest)
  - Naturally occurring expressions are usually variations or combinations of the basic ones
  - Not all pleasant facial expressions are the same (e.g., pride vs. happiness)

The flip side of Ekman’s findings
Facial Expressions

- Facial feedback hypothesis - smiling really makes you happier!
  - facial muscles influence emotional experience

![Facial Expression Diagram]

- Microexpressions - brief facial expressions reveal true feelings; may break through false ones
- Different muscles involved in fake and real (“Duchenne”) smiles

Rutledge & Hupka, 1985
Intuition tells us...

appraisal → experience → physiological response
James-Lange Theory

- Stimulus triggers autonomic/skeletal response which *then* triggers emotion
  - Implication: Autonomic/skeletal response is *necessary* for emotion

Cannon-Bard Theory

- Stimulus triggers autonomic/skeletal response *and* emotion
  - Implication: Autonomic/skeletal response is *independent* of emotion
Bard and sham rage (1929)

- Removal of the cortex results in indiscriminate rage response.

- Hypothalamus must remain intact for ‘sham rage’ to occur.

His conclusion:
- *Subjective experience* relies on cortex, but *coordinated emotional responses* don’t rely on cortex.

James-Lange Theory:
- Stimulus triggers autonomic/skeletal response which then triggers emotion.
  - Implication: Autonomic/skeletal response is necessary for emotion.

Cannon-Bard Theory:
- Stimulus triggers autonomic/skeletal response and emotion.
  - Implication: Autonomic/skeletal response is independent of emotion.
Evidence against...

- Patients whose autonomic and somatic feedback has been greatly reduced can be capable of full range of emotions.
  - Although in some cases they do report a dampening of emotion

- The autonomic and somatic feedback can *influence* the emotional response

Two-factor Theory

- **Schacter and Singer** (1962)
What is an emotion?

- appraisal
- experience
- physiological response

Bottom-up AND Top-down influences!!
The Limbic System

- Broca (remember him?) first named it “le grand lobe limbique”
- Papez described the “Papez circuit” in his model of emotion

The Limbic System

- Circuit implicated in crucial emotions/instincts:
  - Feeding
  - Fighting
  - Fleeing
  - Sexual behavior

- The “four F’s” 😊
Phineas Gage
He seemed *almost* fine...

- I first noticed the wound upon the head before I alighted from my carriage, the pulsations of the brain being very distinct. Mr. Gage, during the time I was examining this wound, was relating the manner in which he was injured to the bystanders. I did not believe Mr. Gage's statement at that time, but thought he was deceived. Mr. Gage persisted in saying that the bar went through his head(...). Mr. Gage got up and vomited; the effort of vomiting pressed out about half a teacupful of the brain, which fell upon the floor. (Williams, from Bigelow, 1950)

Phineas Gage

- Extensive damage to *medial prefrontal and orbitofrontal cortex*
  - Responsible for...
The equilibrium or balance, so to speak, between his intellectual faculties and animal propensities, seems to have been destroyed. He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows[...]. A child in his intellectual capacity and manifestations, he has the animal passions of a strong man. Previous to his injury, although untrained in the schools, he possessed a well-balanced mind, and was looked upon by those who knew him as a shrewd, smart businessman, very energetic and persistent in executing all his plans of operation. In this regard his mind was radically changed, so decidedly that his friends and acquaintances said he was “no longer Gage.”

Harlow

The balance

Gage lacked the cortex necessary to inhibit his emotional responses...

But it is also possible to not have emotional responses at all if they lack access to the cortex!

- Damasio’s patient “Elliott”
- “I know this is horrible, I just don’t feel the horror”
Elliott

- Operation to remove tumor also severed connections between frontal cortex and limbic system
  - Normal IQ
  - Normal Memory
  - Ability to do calculations and deductions
  - ... but completely unable to function!
    - Deprived of his feelings, he couldn’t evaluate choices.
The job of the cortex may be to prevent inappropriate responses rather than to produce appropriate ones!

Two pathways

- High road: 30-40 ms
- Low road: 12 ms

Emotional stimulus

Emotional response
(Some) **Inputs** and **Outputs** of the Amygdala

- Visual
- Olfactory
- Gustatory
- Auditory
- Cortices

Amygdala → Hippocampus

Neocortex (Frontal Lobes)
Brainstem (ANS)

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**Morality and the vmPFC**
Effects of vmPFC damage on morality

Purple  Red  Green  Blue
Green  Yellow  Red  Brown
Black  Purple  Blue  Red
Blue  Blue  Green  Green
Yellow  Red  Green  Yellow
Green  Black  Yellow  Red
Red  Yellow  Red  Yellow
Purple  Orange  Yellow  Orange
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Emotion Research

- A majority of emotion research (esp. in animals) has focused on fear

Communication of Emotions

- Several studies have found that damage to the amygdala impairs people’s ability to recognize facial expressions of emotion, especially expressions of fear.
Recognition of Emotions

- The rapid response suggests that visual information that the amygdala receives directly from the subcortical visual system (which conducts information very rapidly) permits it to recognize facial expressions of fear.

Recognition of Emotions

- We recognize other people’s feelings by means of vision and audition—seeing their facial expressions and hearing their tone of voice and choice of words.

- Many studies have found that the right hemisphere plays a more important role than the left hemisphere in comprehension of emotion.
Recognition of Emotions

- Adolphs et al. (2000) discovered a possible link between somatosensation and emotional recognition.

- Examined the locations of brain damage in ~100 patients with localized brain lesions and correlated this information with the patients’ ability to recognize and identify facial expressions of emotions.

- They found that this ability was most compromised by damage to the somatosensory cortex of the right hemisphere.

Lateralization of Emotion

- Two theories
  - Right-hemisphere model - the right hemisphere is dominant for all aspects of emotion
  - Valence model - the right hemisphere specializes in negative emotions, and the LH...

- Both theories are probably too general
Individual Differences in the Neural Mechanisms of Emotion

- Most (but not all) of nine patients with bilateral amygdalar lesions had difficulty recognizing fear in facial expressions (Adolphs et al, 2003)

- Personality differences:
  - both high extraversion and high neuroticism healthy subjects showed higher amygdalar activity while viewing fearful faces; only extraverts showed higher amygdalar activity while viewing happy faces (Canli et al, 2002)

Figure 10.11
Perception of Emotions. The PET scans indicate brain regions activated by listening to emotions expressed by tone of voice (green) or by meanings of words (red).
Communication of Emotions

- **Volitional facial paresis:**
  - Difficulty in moving the facial muscles voluntarily; caused by damage to the face region of the primary motor cortex or its subcortical connections.

- **Emotional facial paresis:**
  - Lack of movement of facial muscles in response to emotions in people who have no difficulty moving these muscles voluntarily; caused by damage to the insular prefrontal cortex, subcortical white matter of the frontal lobe, or parts of the thalamus.