Ch 13. Emotion

Cognitive Neuroscience: The Biology of the Mind, 2nd Ed.,
M. S. Gazzaniga, R. B. Ivry, and G. R. Mangun, Norton, 2002.

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- Issues in the Cognitive Neuroscience of Emotion
- Neural Systems in Emotional Processing
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Issues in the Cognitive Neuroscience of Emotion

Defining Emotion

- Basic emotion
  - Finite set of universal, basic emotions
  - Facial expression
    - anger, happiness, disgust, surprise, sadness, fear
- Dimensions of emotion
  - Valance (good – bad) / Arousal (high – low)
  - Actions & Goal (approach / withdraw)

Fig 13.2 The six basic facial expressions

Manipulating and Measuring Emotion

- Techniques to elicit emotion
  - Mood induction
  - Reward and punishment
  - IAPS (International Affective Picture System)

Fig 13.3 IAPS examples

- Techniques to measure emotion
  - Direct assessment
  - Indirect assessment
    - Choosing among possible actions
    - Facilitation or inhibition of a response
    - Psychophysiological variables: autonomic nervous system, SCR

Emotion and Cognition (1/2)

- Aristotle : the sensitive soul / the rational soul
- Recent debate
  - Robert Zajonc
    - Dissociation between evaluation and awareness
    - **Affective** judgments occurs before, independently of, cognition
    - Cognition: slower mental transformation of sensory input or information processing
  - Richard Lazarus
    - Emotion could not occur without cognitive appraisal.
    - Emotion $\subset$ Cognitive processes
    - Cognition: including early evaluative perception as well as later stages of information processing

Emotion and Cognition (2/2)

- Recent work – Brain systems of emotion
  - Shifting of debate to neural term
  - Example: Amygdala
    - Separate systems for the processing of emotion: Zajonc's idea
    - Neural structures for emotion ⇔ Neural systems for cognitive behavior (The interdependency of emotion and cognition): Lazarus's idea
  - Zajonc – Lazarus debate: Both are right.

Neural Systems in Emotional Processing

Early Concepts: The Limbic System

- A circuit theory of the brain and emotion
  - James Papez(1937) / Network of brain region
- Limbic system
  - Papez circuit + orbitofrontal cortex + portion of basal ganglia

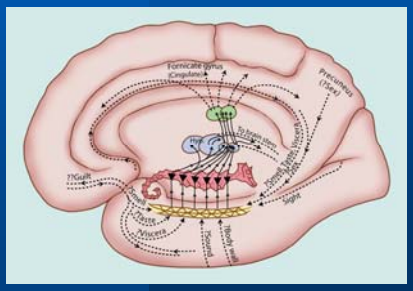


Fig 13.4 Limbic system

  - 'Emotional' brain
  - Limitation
    - Unclear definition
    - Emotion is a multifaceted behavior.
      ⇒ There isn't only one neural circuit.
    - Amygdala & Orbitofrontal cortex

Orbitofrontal Cortex (1/4)

- Decision making
  - Incoming stimuli
  - Our values, goal, **emotional state, social situation**
  - Damage to orbitofrontal cortex impairs the ability to make decisions that require f**eedback** from social or emotional cues.

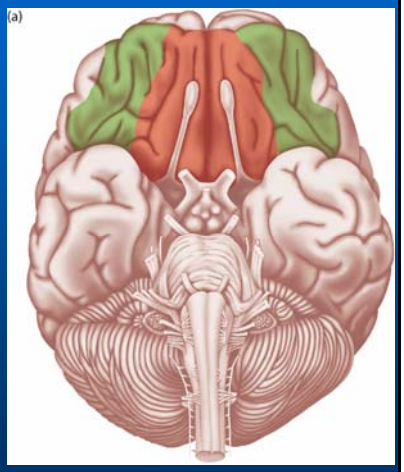


Fig 13.5 a) Orbitofrontal cortex

Orbitofrontal Cortex (2/4)

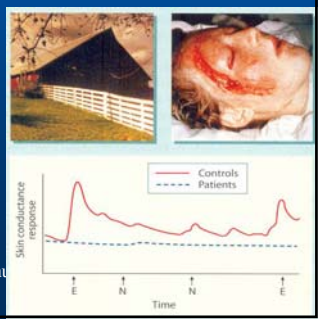
- Social decision making
  - Utilization behavior
    - Lacking of an ability to evaluate the **social context** and to determine if the action is appropriate
  - Imitative behavior
  - Acquired sociopathy
    - Lacking of an ability to monitor and control aggre-ssive impulse

Fig 13.7 Imitative behaviors and Utilization behaviors

Orbitofrontal Cortex (3/4)

- Emotional decision making (Processing) - 1
  - On-line, rapid evaluation of stimulus–reinforcement associations
    - Edmond Rolls (1999)
    - **Reversal learning of stimulus-reinforcement associations**
  - Influence of emotion in rational decision making
    - Antonio Damasio (1994)
    - 'Reasoning is guided by the emotional evaluation of an action's consequence.'
    - **Somatic marker :** a mechanism that provides a common metric for evaluating options with respect to their potential (emotional) benefit
      - **Somatic marker focus on restricted possibilities.**

Fig 13.8 SCR of patient and control



Orbitofrontal Cortex (4/4)

- Emotional decision making (Moderation of decision) - 2
  - Emotional response ⇒ decision making ?
    - **Risk-taking task**

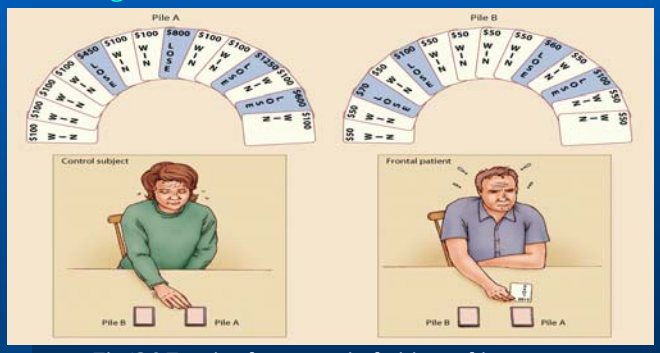


Fig 13.9 Emotional responses in decision making

Amygdala (1/5)

- Kluver-Bucy
  - Psychic blindness / Kluver-bucy syndrome
- Implicit emotional learning - 1
  - Fear conditioning
    - Conditioned stimulus (CS) / response (CR)
    - Unconditioned stimulus (US) / response (UR)
    - CS ⇒ (+ US) = UR ⇒ (- US) = CR
    - Amygdala lesions : CS (+ US) ≠ CR
  - Circuitry of fear conditioning
    - Low road: quick but dirty
    - High road: slow but thorough and complete
    - Fast and Sure

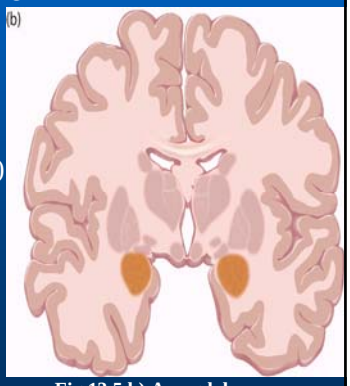


Fig 13.5 b) Amygdala

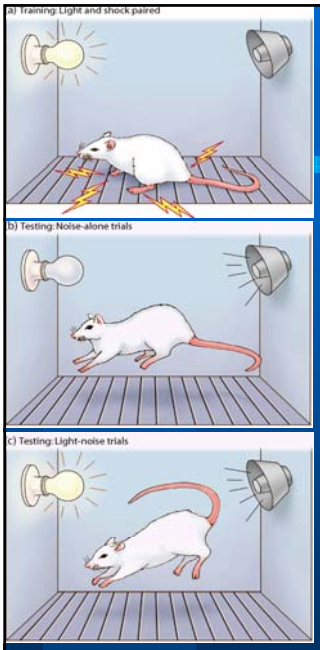


Fig 13.10 Fear conditioning

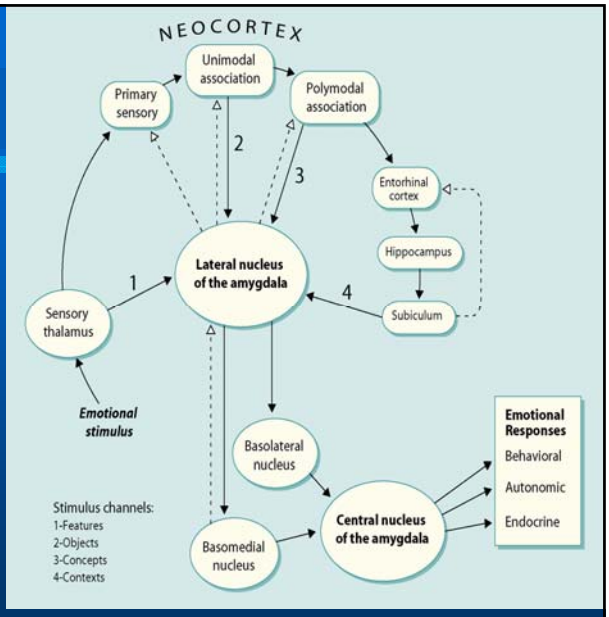


Fig 13.11 Amygdala pathways and conditioning

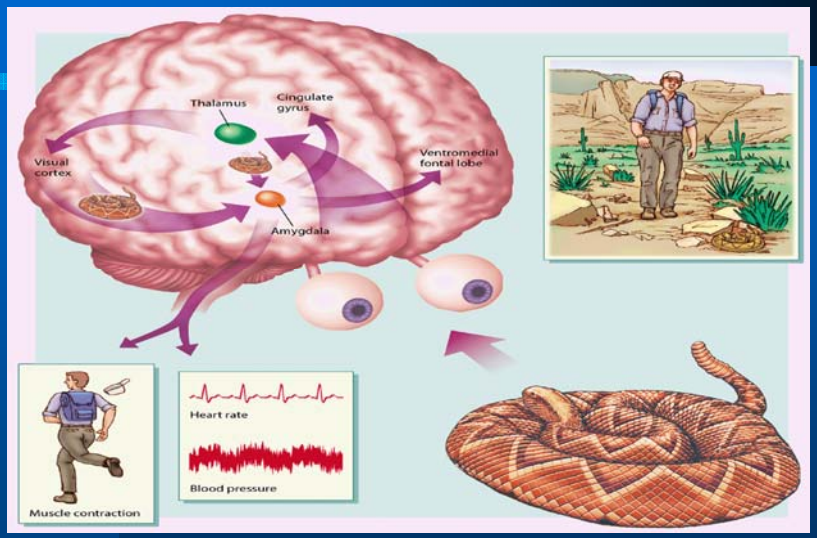
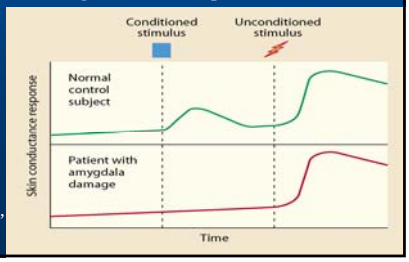


Fig 13.12 Emotional processing in the amygdala

Amygdala (2/5)

- Implicit emotional learning - 2
  - In humans with amygdala lesions
    - Fail to demonstrate an indirect CR
    - But, Can response "directly" (explicitly report)
    - Patient S.P.
      - Dissociation between explicit knowledge and impaired conditioned response
    - Damage to hippocampus
      - The opposite pattern of performance

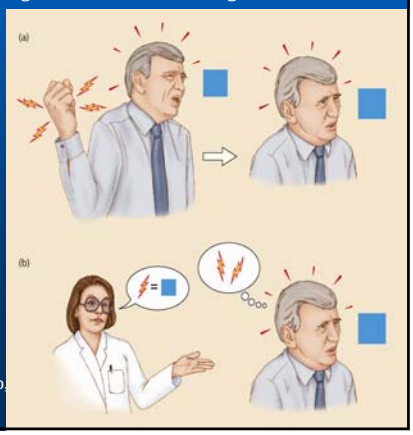
Fig 13.13 SCR of patient and control



Amygdala (3/5)

- Explicit emotional learning and memory - 1
  - Hippocampal-dependent memory interaction of amygdala
    - **Normal indirect emotional response** to stimuli whose emotional properties are learned explicitly
    - Acting **to enhance the strength of explicit or declarative memories** for emotional events by modulating the storage of events

Fig 13.14 Fear conditioning and Instructed fear



Amygdala (4/5)

- Explicit emotional learning and memory – 2
  - Patient with amygdala lesions
    - Patient can learn and explicitly report the stimulus-response pair.
    - But, they did not show the '**indirect expression**'.
    - Amygdala may play a role in the indirect expression of the fear response to aversive events.
  - Modulation of the strength of explicit memories
    - An arousal response ⇒ Enhancing performance on memory task
    - modulatory (not learning)
    - The retention interval (not initial encoding) / hippocampal consolidation

Amygdala (5/5)

- Social responses
  - Only '**facial expression**'.
    - Impairment is pronounced for **fear**.
    - No <non-emotional facial recognition / generating, communicating> deficits
- Vigilance
  - Emotional sensitivity
    - Greater sensitivity to emotional information
      - Basal forebrain : acetylcholine
    - **Rapid serial visual presentation**

Fig 13.15 Fearful facial expression in amygdala

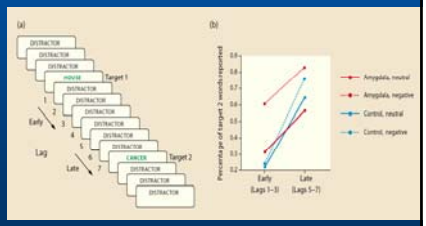


Fig 13.16 Emotional sensitivity in amygdala

Laterality

Emotion Communication

- Right hemisphere > Left hemisphere
  - Two types of emotional stimuli
    - Emotional prosody / facial expression
  - Damage of each hemisphere
    - Left hemisphere damage: understanding problem
    - Right hemisphere damage: emotional prosody problem
    - Interpreting of facial expression
    - Exception in producing emotional expression
      - Voluntary facial expression: half of the face
      - Spontaneous facial expression: Parkinson's disease

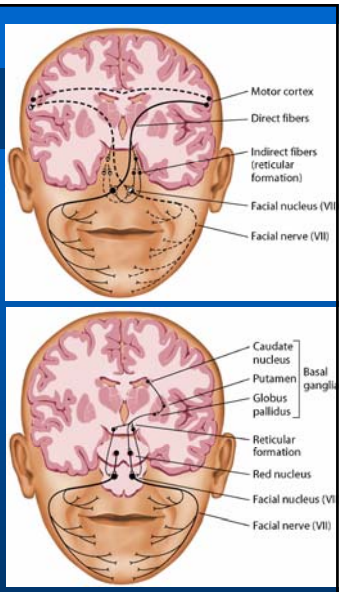
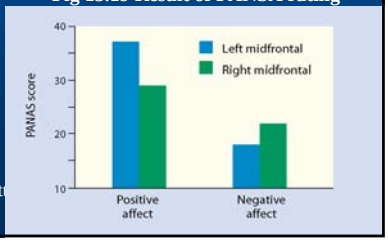


Fig 13.17 The neural pathways of facial expression

Affective Style

- Affective style (Richard Davidson)
  - Differences in emotional tendencies
  - Different contributions of each hemisphere (damage)
    - Right hemisphere: not sufficiently upset or concerned about their injury
    - Left hemisphere: overly catastrophic and weepy in reaction to their injury
  - PANSA (Positive and Negative Affect Scale)
    - Measuring EEG responses & self-rating
  - Approach & withdraw
    - Left & right

Fig 13.19 Result of PANSA rating



Summary

- Early research and theories
  - Tendency treats emotion as a separate from cognition
- Research in neuroscience of emotion
  - 'There is not a clear emotion-cognition dichotomy.'
- Orbitofrontal cortex
  - Evaluation, inhibition and selection of social and emotional information
- Amygdala
  - Fear conditioning, explicit emotional learning and memory, social response and vigilance
- Contribution of each hemisphere (laterality)
  - Emotional communication & Affective style

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Key Terms

Affective	Autonomic nervous system	Emotion communication	Orbitofrontal cortex
Affective style	Decision making	Facial expressioin	Reinforcenent
Aggression		Fear conditioning	Somatic marker
amygdala	emotion	Limbic system	

Thought Questions

1. Briefly describe the limbic system hypothesis and its historical role in the cognitive neuroscience of emotion.
2. What are three possible impairments in social decision making that result from damage to the orbitofrontal cortex?
3. Explain the amygdala's role in fear conditioning. Be sure to include what is known about the neural pathways for emotional learning based on nonhuman animal models and also why the amygdala's role in emotional learning is said to be implicit.
4. In what two ways do the amygdala and hippocampus interact in emotional learning and memory?
5. What is the relation between affective style and laterality?

