EMOTION

9.00

John Gabrieli

EMOTION

- A brief history
- Defining emotion
- Models of emotion
- Burning questions and tentative answers
  - Are emotions universal?
  - Do emotions have unique physiological signatures?
  - Why do we have emotions?
- Brain basis of emotions

happy, sad, angry, **joyful**, moping,
nervous, **mad**, bored, irate
content, raging, awestruck, ***infatuated***
Seething, brave, timid, **DOUBTFUL**, **sorrowful**,
terrified, resentful, heart-broken,
elated, *agreeable*, *scared*, jealous,
exhausted, furious, **grief-stricken**, sorrowful,
captivated, disappointed, **anxious**, disgusted,
frustrated, surprised, enthralled, depressed
(550 words)

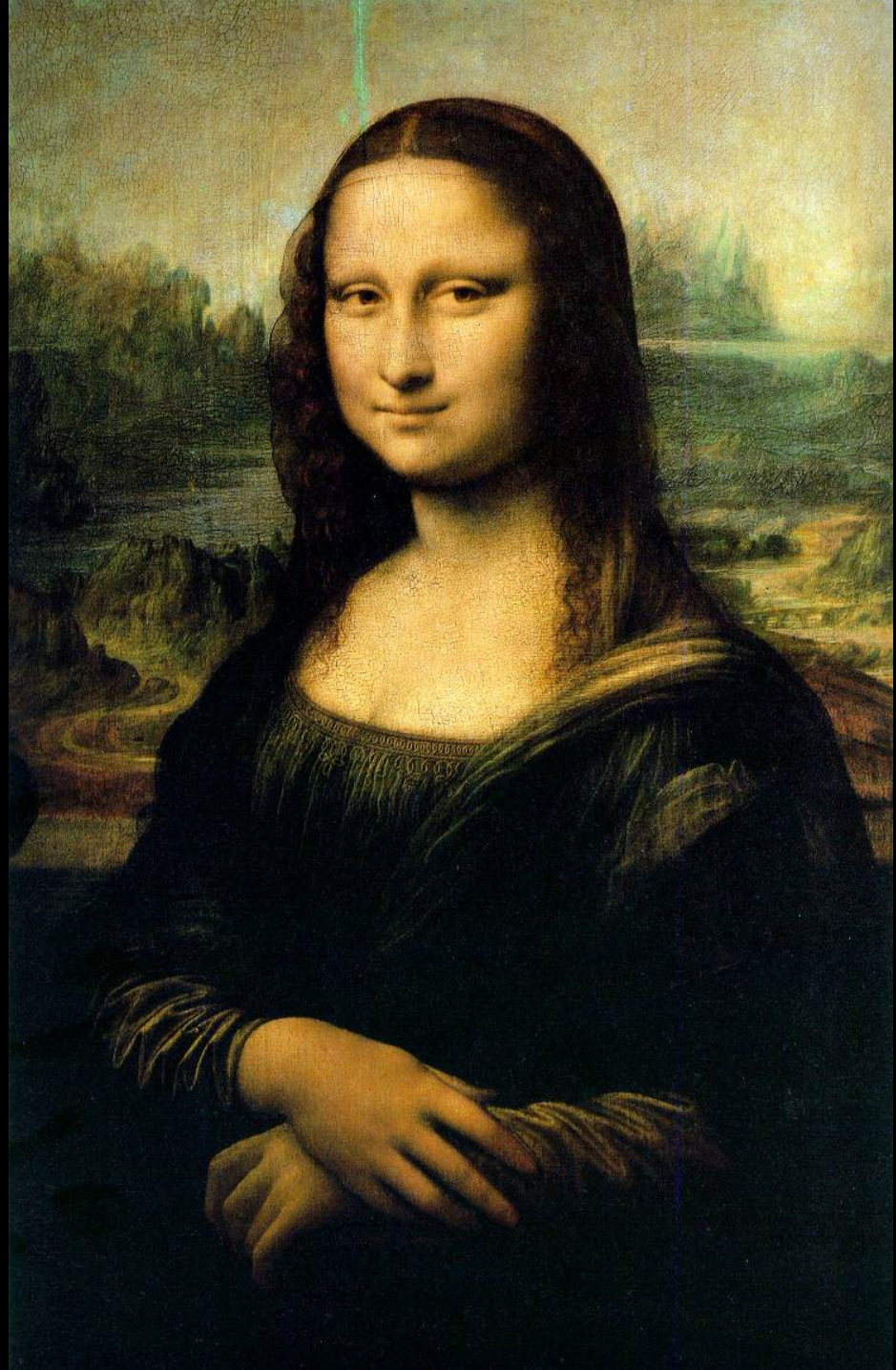
William James
1842 - 1910

Emotion is Important

"If you can conceive of yourself… suddenly stripped of all the emotion with which our world now inspires you… no one portion of the universe would then have importance beyond another; and the whole character of its things and series of its events would be without significance, character, expression, or perspective."

(James, 1890)


Emotion



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Journals and Research on Emotion:

- Cognition & Emotion
- Consciousness & Emotion
- ISRE (International Society for Research on Emotion)
- Emotion (APA journal)

Definition of Emotion

Emotions are biologically-based responses to situations that are seen as personally relevant. They are shaped by learning, and usually involve changes in peripheral physiology, expressive behavior, and subjective experience.

EMOTION vs. MOOD

- ***Mood*** **- diffuse, long-lasting emotional states**

- ***Emotion*** **- immediate responses to a specific object or situation**

Dimensions of Emotion

- ***Arousal***

  high - excited, tense

  low - calm, lethargic

- ***Valence***

  positive - elated, contented

  negative - sad, gloomy

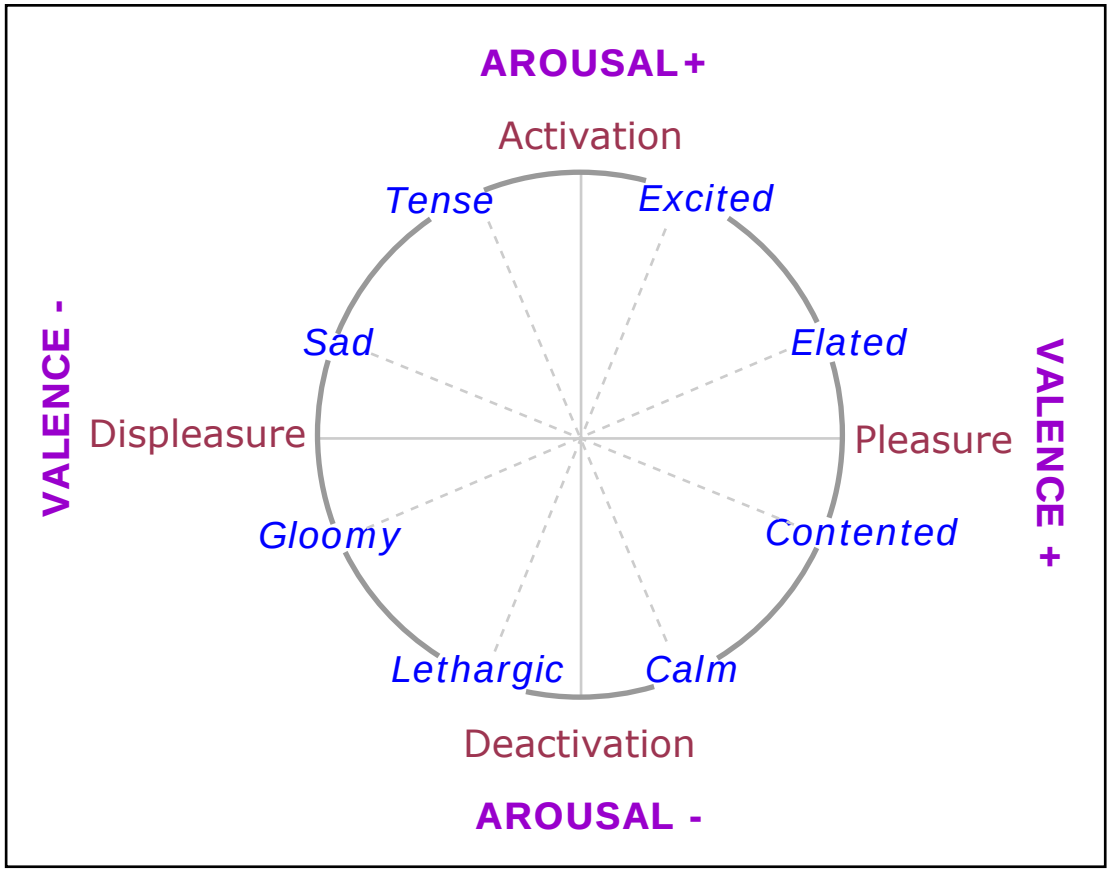


Image by MIT OpenCourseWare.

Basic affects are shown here arranged in a circle in which the vertical dimension represents degree of perceived arousal and the horizontal dimension represents degree of pleasure or displeasure.

Who Else Has Emotions?

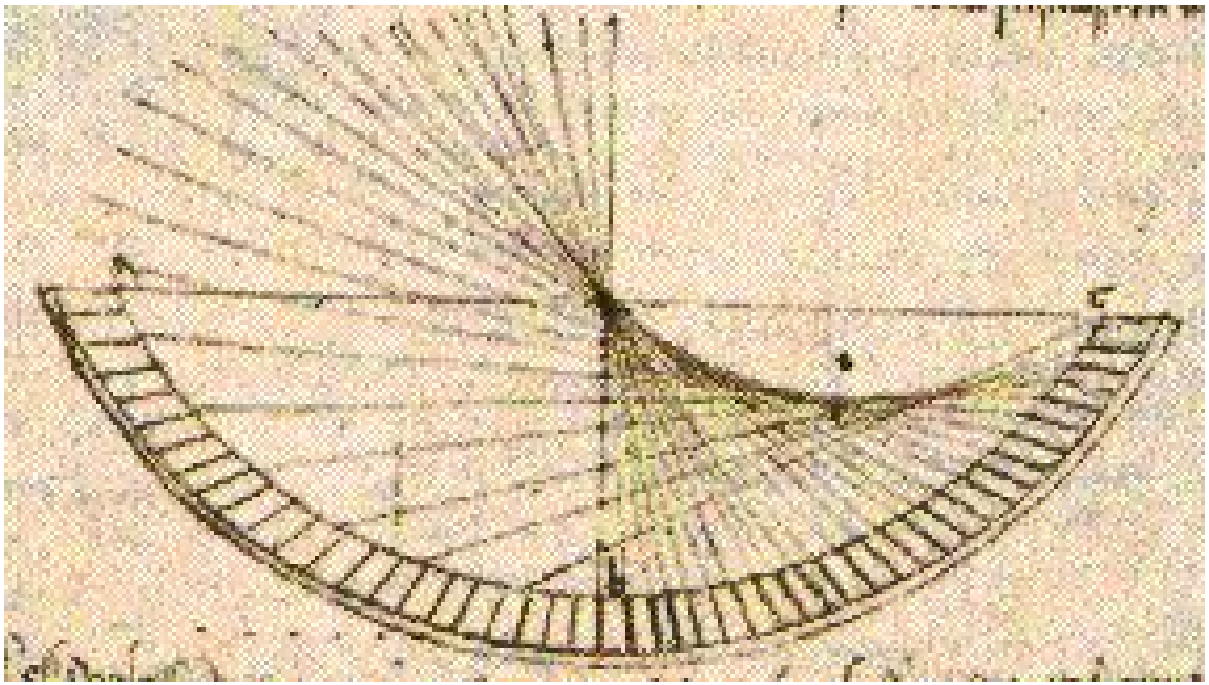
- **Chimps?**
- **Dogs?**
- **Armadillos?**

Images of animals showing emotion removed due to copyright restrictions.

Definition of Emotion

Emotions are biologically-based responses to situations that are seen as personally relevant. They are shaped by learning, and usually involve changes in peripheral physiology, expressive behavior, and subjective experience.

Models of Emotion



Theory	Stimulus	Response	Report
Common sense		 Subjective experience  Body response (arousal)	"My heart is pounding because I feel afraid."

Theory	Stimulus	Response	Report
Common sense		 Subjective experience →  Body response (arousal)	"My heart is pounding because I feel afraid."
James-Lange		 Body response (arousal) →  Subjective experience	"I feel afraid because my heart is pounding."

"We feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we strike, cry, or tremble because we are sorry, angry, or fearful"

William James

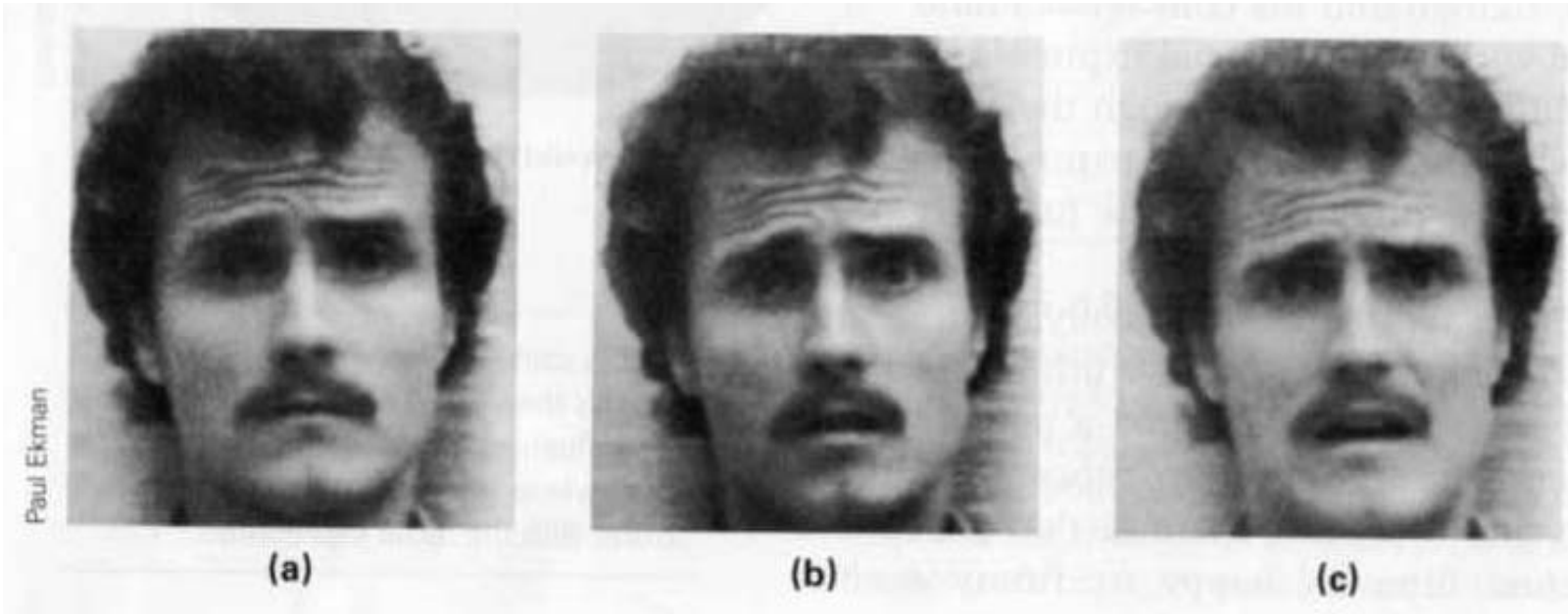
HOW CAN PERIPHERAL BODILY EVENTS INFLUENCE EMOTIONS?

- **hold pencil tightly between teeth (forces smiling expression) or between lips (prevents smiling) while watching funny movie - smiling expression led to more enjoyment**
- **pose facial muscles (into smile or frown) - see pictures - then report feelings - frown expression reported more anger and less happiness**

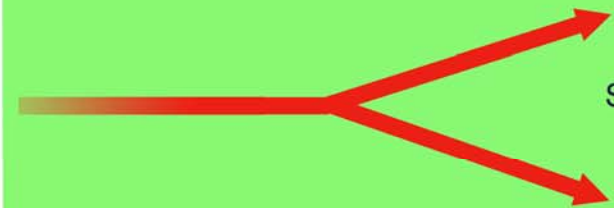
Facial Feedback Hypothesis

Saussignan's (2002) experiment testing the facial feedback theory of emotion asked some subjects to hold a pencil between their teeth in such a way that their lips being pulled back like they would in a full-faced smile, and others were asked to hold a pencil between their lips in a way which prevented smiling.

Alteration of facial expression can lead to changes in the subjective experience of emotions. The person on the left (pen in mouth) is more likely to report feeling happy than the person on the right (pencil on lip).



Video stills from a study by Ekman and his colleagues (1983). They induced a man to make a fearful expression by instructions: (a) "Raise your brows and pull them together," (b) "now raise your upper eyelids," and (c) "now stretch your lips horizontally, back toward your ears."

Theory	Stimulus	Response	Report
Common sense		 Subjective experience →  Body response (arousal)	"My heart is pounding because I feel afraid."
James-Lange		 Body response (arousal) →  Subjective experience	"I feel afraid because my heart is pounding."
Cannon-Bard		  Subjective experience  Body response (arousal)	"The bear makes me feel afraid and my heart pounds."

HOW CAN PERIPHERAL BODILY EVENTS INFLUENCE EMOTIONS?

- **perception/thought influences TYPE of emotion**
- **sensory feedback influences INTENSITY of emotion**

HOW CAN PERIPHERAL BODILY EVENTS INFLUENCE EMOTIONS?

- **Schacter, 1971 injected people with adrenaline (raises heart rate, arousal) or placebo**
- **little effect of adrenaline (jumpy)**
- **emotion eliciting situation - more fear for a horror movie, more anger when insulted, more laughter for comedy with adrenaline (but not if informed about the adrenaline)**

Creaky Bridge Experiment

- **Dutton & Aron**
- **Capilano Canyon, North Vancouver**

  - flimsy suspension bridge, 5 ft wide, sways & wobbles 320 ft over jagged boulders and river rapids

  - upstream, steady, low, broad bridge

Creaky Bridge Experiment

- Dutton & Aron - male subjects
- in the middle of each bridge is an attractive female (confederate) asks each male subject to fill out a questionnaire, casually mentions that if subjects has more questions, he can call her at home and provides phone number
- dangerous bridge more calls
- safe bridge fewer calls

Creaky Bridge Experiment

- **Dutton & Aron - male subjects**
- **dangerous bridge produces high arousal (increased adrenaline) interpreted as attraction (physiology interpreted as emotion of attraction)**

Theory	Stimulus	Response	Report
Common sense		FEAR → Subjective experience →  Body response (arousal)	"My heart is pounding because I feel afraid."
James-Lange		 Body response (arousal) → FEAR Subjective experience	"I feel afraid because my heart is pounding."
Cannon-Bard		FEAR Subjective experience  Body response (arousal)	"The bear makes me feel afraid and my heart pounds."
Two-factor		 Body response (arousal) →  Interpretation → FEAR Subjective experience	"My pounding heart means I'm afraid because I interpret the situation as dangerous."

Three Burning Questions

- Are emotions universal (inborn)?
- Do emotions have unique physiological signatures?
- Why do we have emotions?

Are Emotions Universal?

Charles Darwin (1809-1882)

Emotions in Animals

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Emotions in Infants

Images of infants showing emotion removed due to copyright restrictions.

Early Displays of Emotion

Infants display emotions that are distinguishable and similar to facial displays among adults such as joy, disgust, surprise, sadness, anger, and fear.

Emotions in the Deaf and Blind

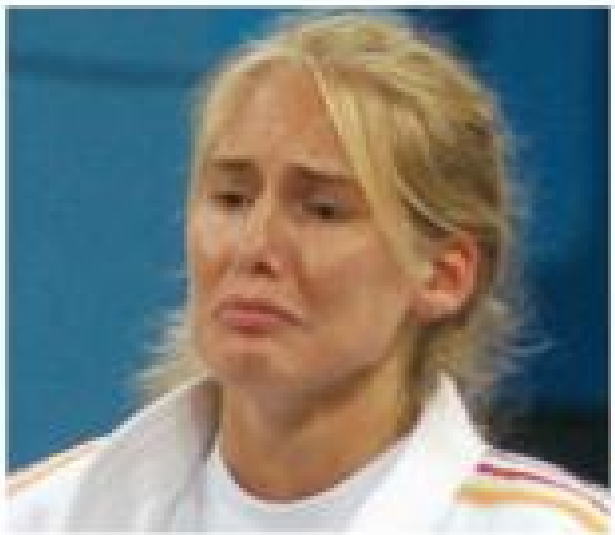
Spontaneous Facial Expressions of Emotion in Athletes

- **2004 Olympics and Paralympic Games**
- **congenitally blind, noncongentially blind, sighted athletes**
- **analyzed expressions after winning and losing**

(Matsumoto & Willingham, 2009)

Comparison of Blind and Sighted Athletes Who Just Lost a Match for a Medal

Blind athlete



Sighted athlete

Emotions Across Cultures

“A smile means friendship to everyone?”

Paul Ekman

Professor of Psychology
Department of Psychiatry
UCSF Medical School

Carl Izard

Professor of Psychology
University of Delaware

Six Basic Emotions

Happy

Sad

Fear

Anger

Surprise

Disgust

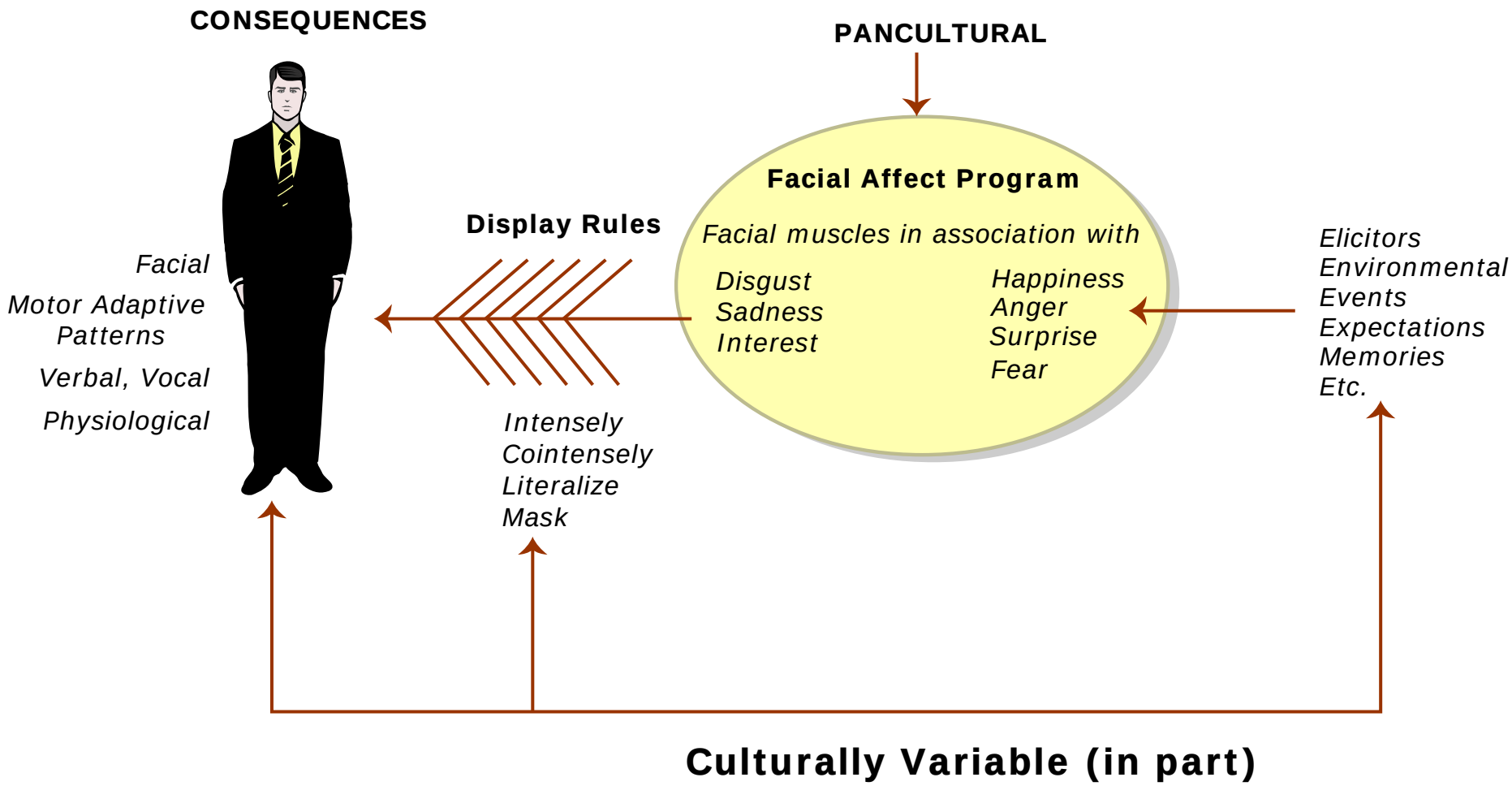
Recognition of Emotions

	Western	Non-Western
Anger	79%	62%
Disgust	81%	69%
Fear	77%	63%
Happy	95%	87%
Sadness	87%	75%
Surprise	87%	78%

Fore Tribe in New Guinea

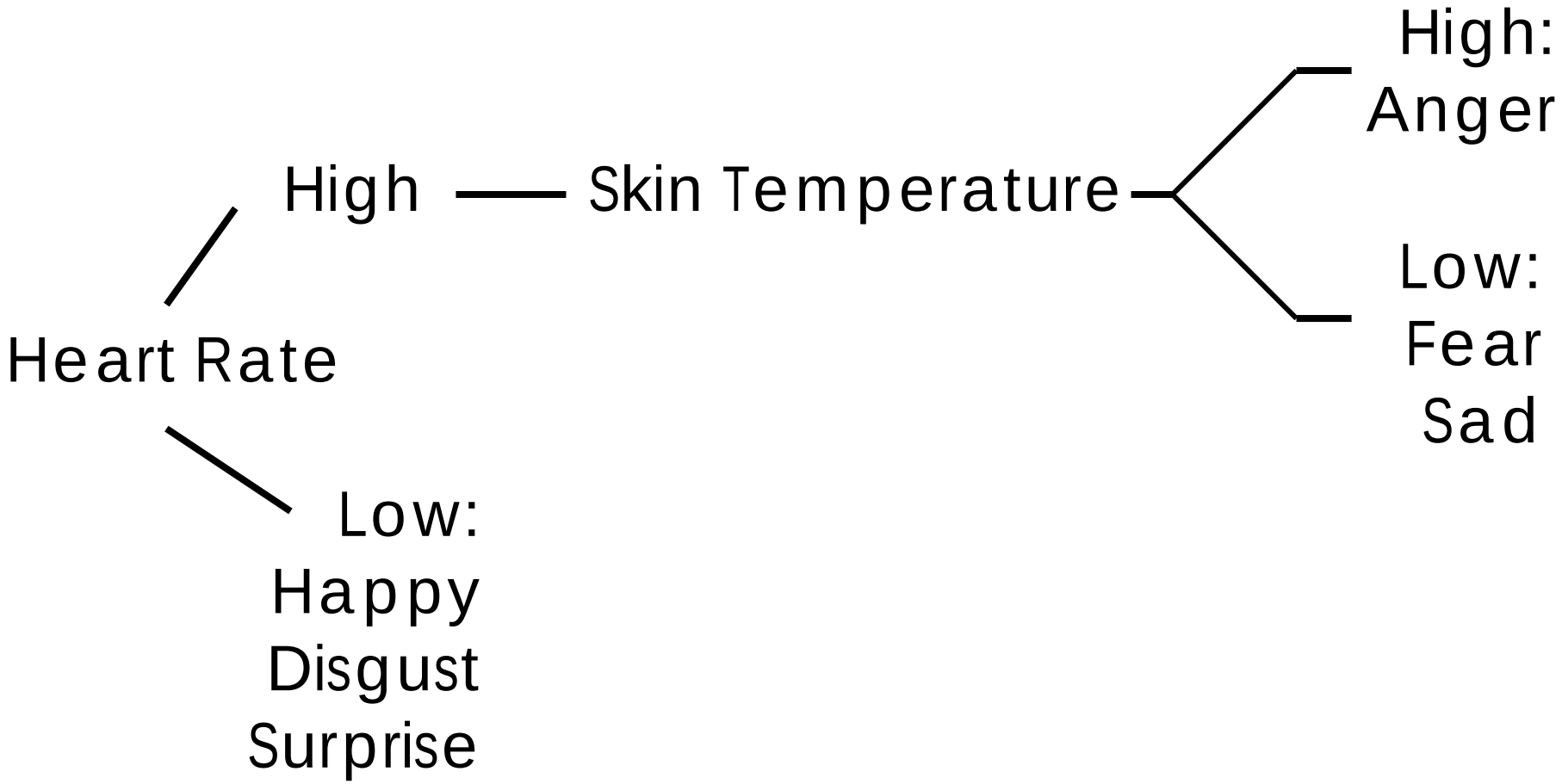
Isolated Preliterate

Photos of tribe members showing various emotions removed due to copyright restrictions.



Do Emotions Have Unique Physiological Signatures?

- **Intuition holds that emotions differ from one another in their bodily manifestations (e.g., pride, disgust, anger, sadness, fear).**
- **Language supports this common sense idea (e.g., "She got hot and bothered," "You make my blood boil," He's just letting off steam").**



Decision tree for discriminating emotions in a facial action task (Ekman et al., 1983) - this approach has failed

Why Do We Have Emotions?

- **Intrapersonal functions**
  - **Feeling: Affect as information**
  - **Behaving: Doing the right thing at the right time**
- **Interpersonal functions**

Social Referencing

An infant on the visual cliff: The infant is placed on the center board laid across a heavy sheet of glass and his mother calls to him. If she is on the "deep" side, he pats the glass but despite this tactual information that all is safe, he refuses to crawl across the apparent cliff.

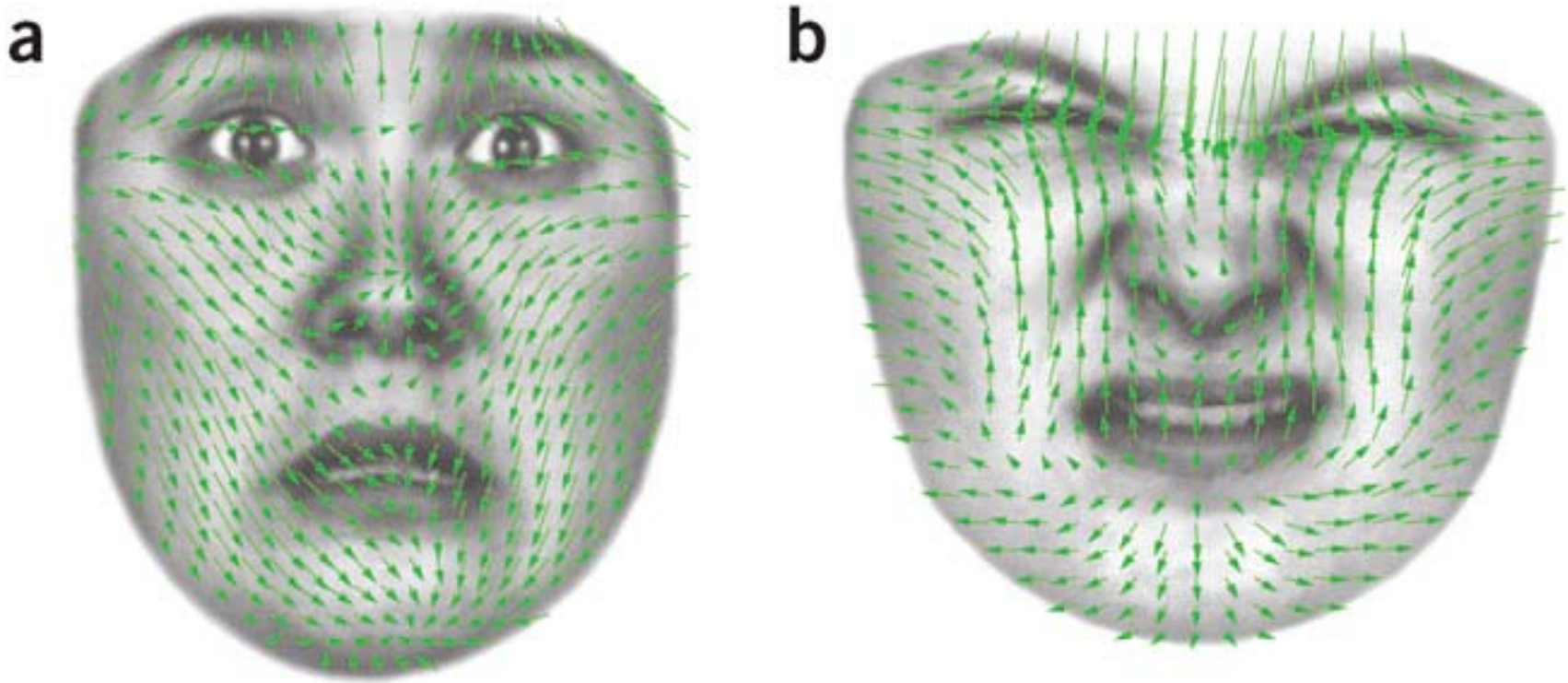
Effect of Mothers' Facial Expressions on Infant Behavior

Variable	Study 1	
	Joy (N = 19)	Fear (N = 17)
Percentage of infants crossing deep side	74%	0
Mean number of retreats per minute to shallow side	.420	1.08
Mean rating of hedonic tone	1.62	2.12
Mean number of references per minute	3.60	2.46

Why Do We Have Emotions?

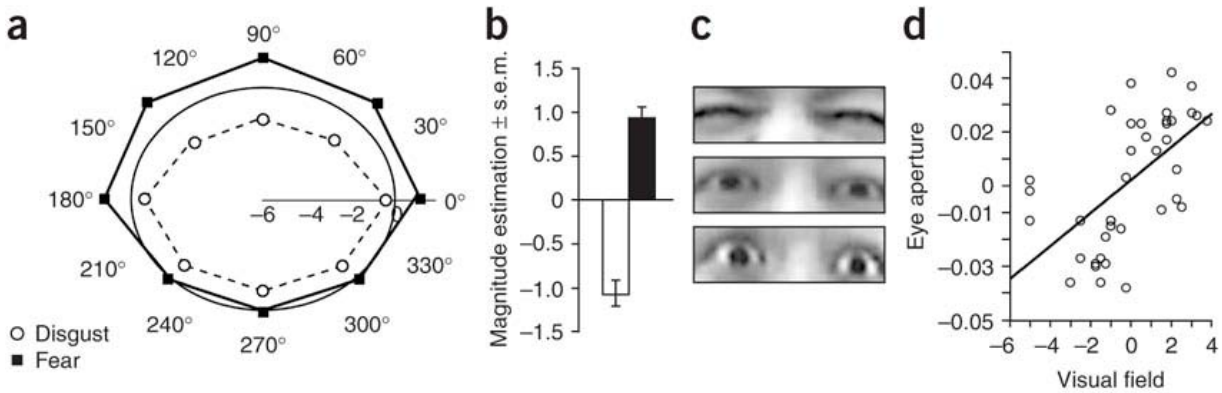
- **Intrapersonal functions**
  - **Feeling: Affect as information**
  - **Behaving: Doing the right thing at the right time**
- **Interpersonal functions**
- **Do expressions have functional purposes? (Adam Anderson)**

Expressing Fear Enhances Sensory Acquisition



*(**a**,**b**) Green arrows depict vector flow fields of skin surface deformations stemming from the antiprototype to the corresponding expression prototype, allowing visualization of the underlying facial-action patterns. Vector flow from antifear to fear (**a**) and antidisgust to disgust (**b**) indicated the opposing expansion versus compression along the longitudinal axis emanating from the bridge of the nose. This resulted in raised versus lowered brows, increased versus decreased eye aperture and vertical elongation versus compression of the nose associated with raised versus lowered lips.*

Fearful Expression enhances subjective visual field size (also faster eye movements)

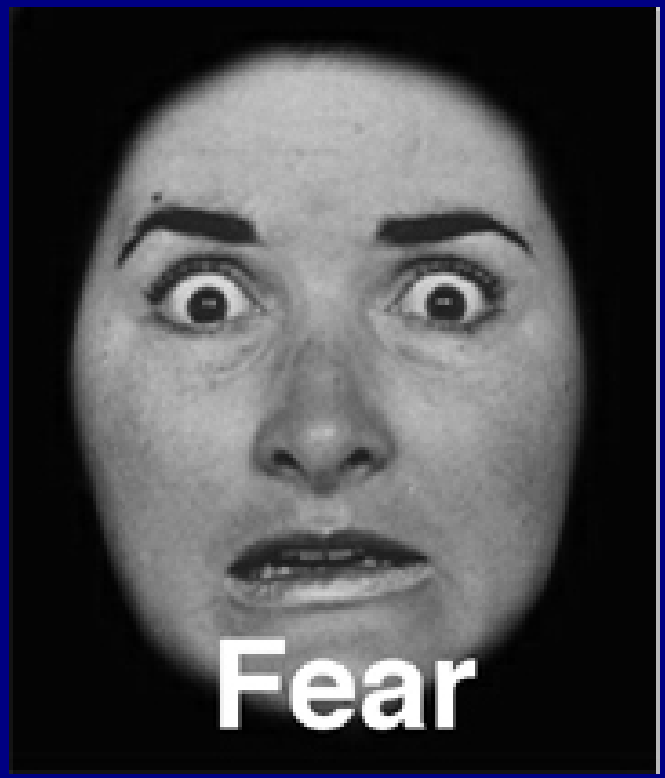


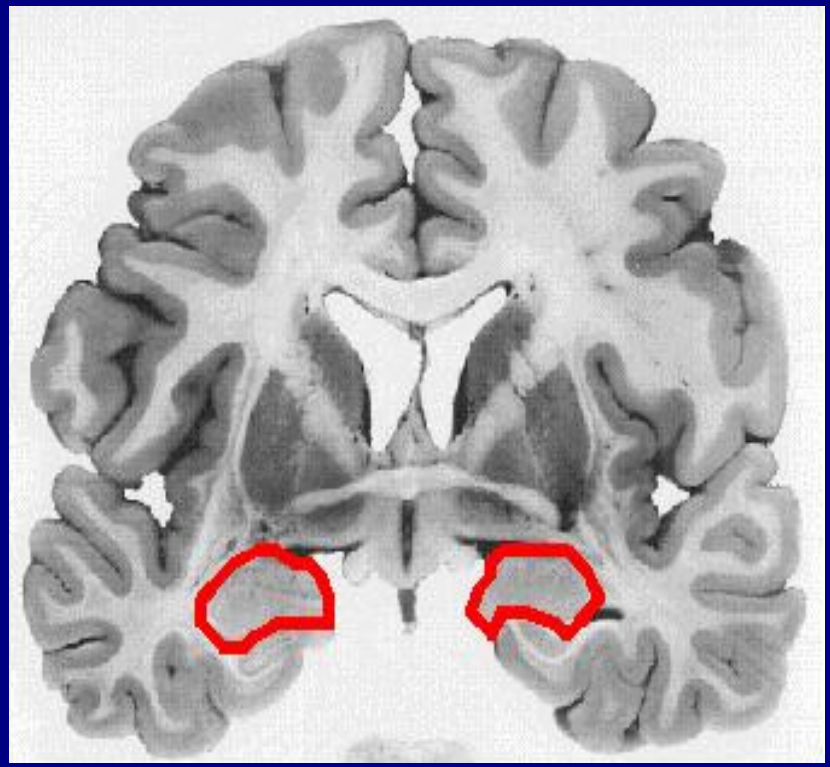
(**a**) Changes in visual field estimation along horizontal, vertical and oblique axes. Central ellipse is neutral baseline. Unit markings are in 9.5° of visual angle. (**b**) Change in estimated visual-field size (in standardized units) for fear and disgust expressions relative to neutral expressions, averaged across visual-field location. (**c**) Average eye opening from participants posing disgust, neutral and fear expressions (from top to bottom row). (**d**) Correlation of vertical eye-size measurements of participants posing disgust and fear expressions with upper visual-field magnitude change from neutral.

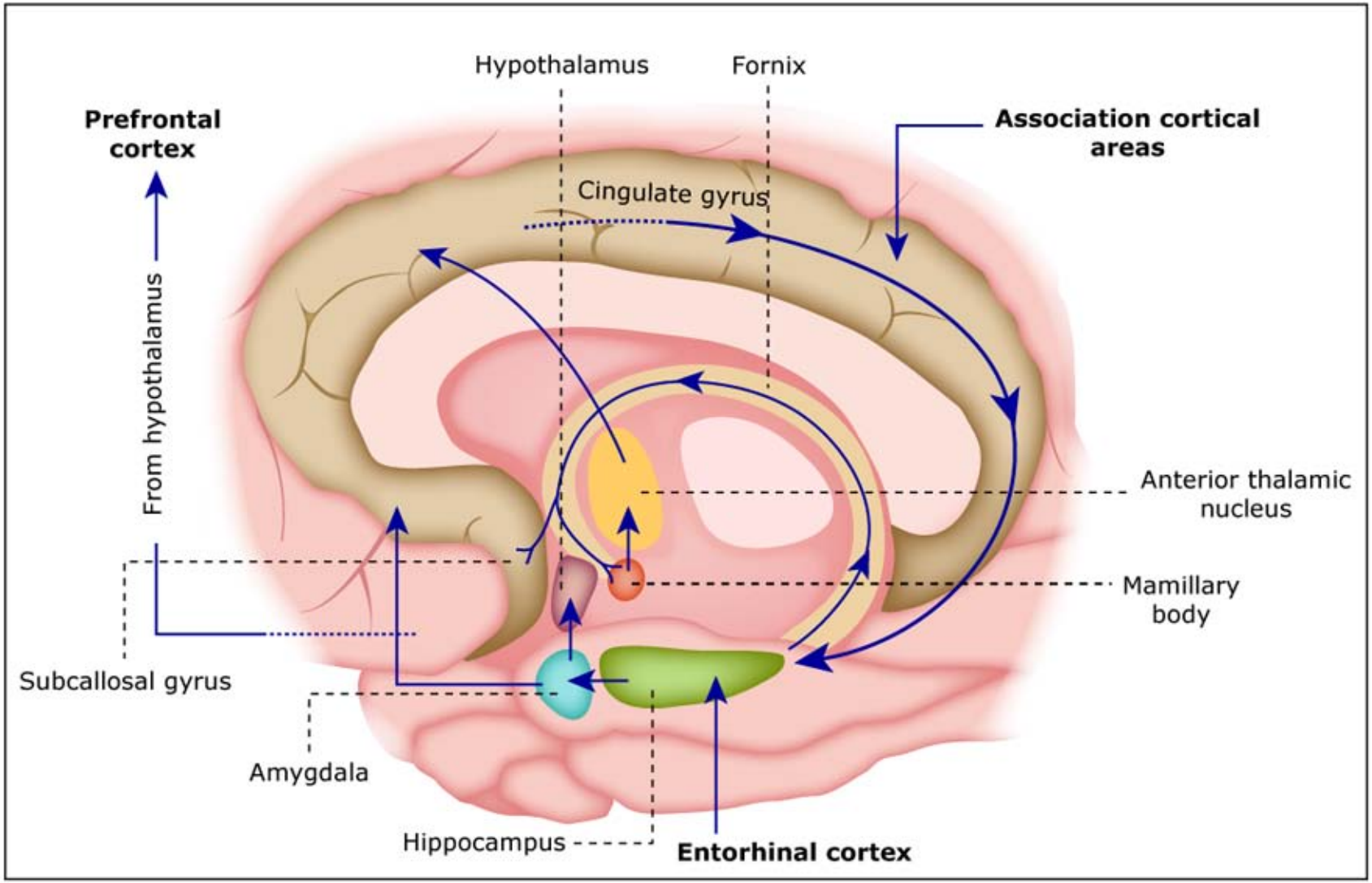
Fearful Expression enhances air velocity and nasal volume during inspiration

*(**a**,**b**) Mean air-flow velocity (in standardized units) for fear and disgust expressions relative to neutral during inhalation over time (2.2-s inhalation; **a**) and mean volume relative to abdominal-thoracic respiratory effort (in standardized units) for disgust and fear expressions relative to neutral (**b**). Velocity was scaled such that the area under the curve for neutral sniffs was equal to 1.*

Fear & The Amygdala







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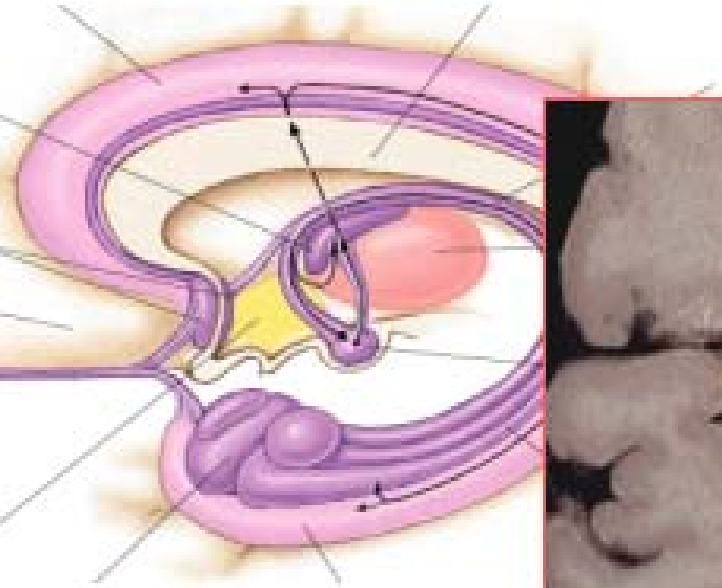
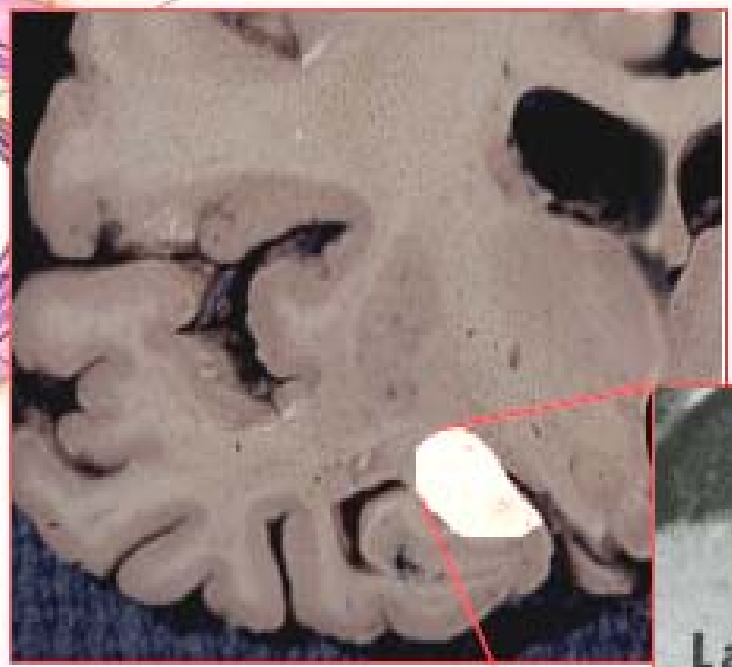
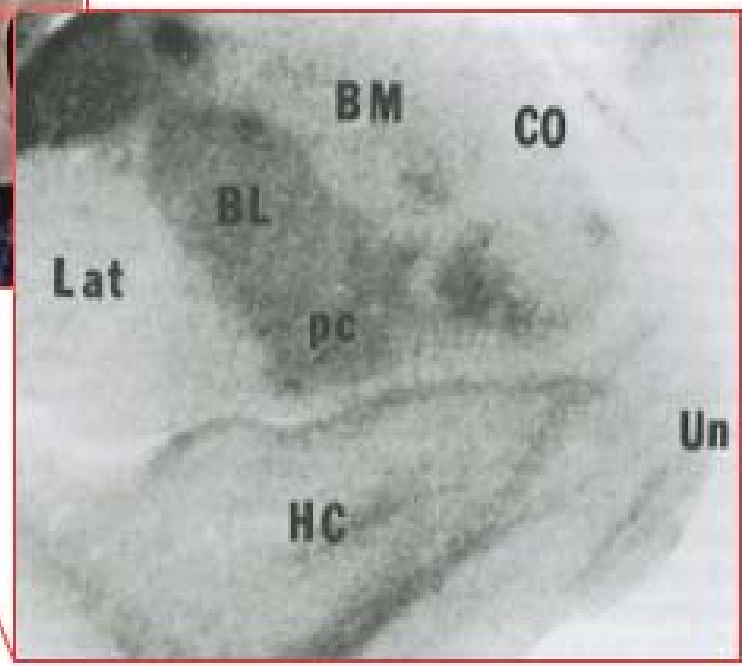
Emotion: The amygdala

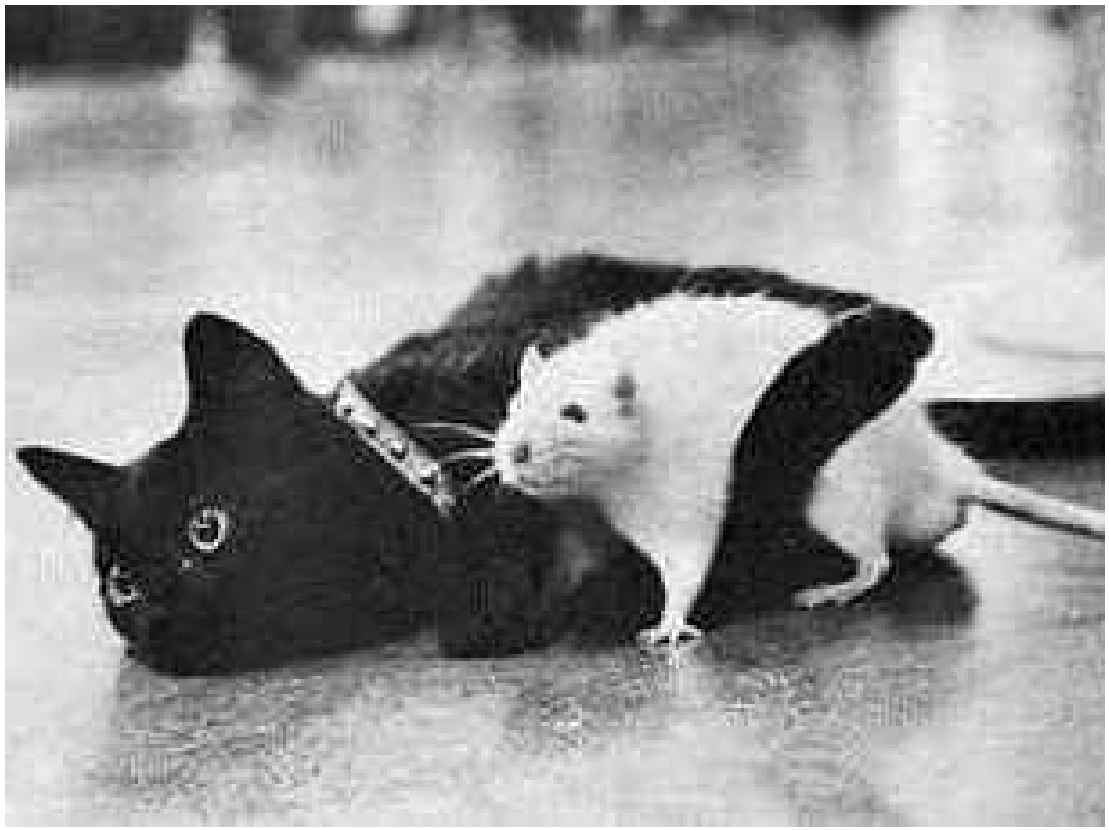






- Anterior temp lobe/ ant. to hippocampus
- Multiple nuclei
- Widespread connections: Cortex to brainstem

Selective Amygdala Lesions



Cute and cuddly or fearsome predator?

Amygdala and Social Fitness

Loss of threat appreciation impairs social fitness

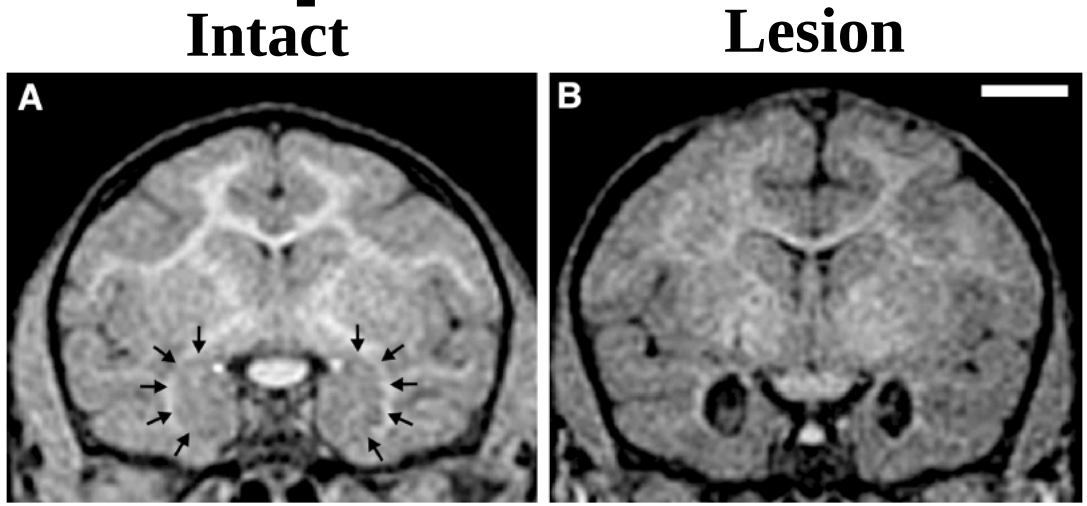
- **Dominance hierarchies**
- **In the lab Rosvold et al. (1954)**
  - **Established hierarchy**
  - **Lesion dominant male**
  - **Fall to subordinate status**
- **In the wild Kling et al. (1970)**
  - **Lesion and returned to wild**
  - **Social rejection**
  - **Early death w/out social support**

Selective amygdala lesions: Nonhuman primates

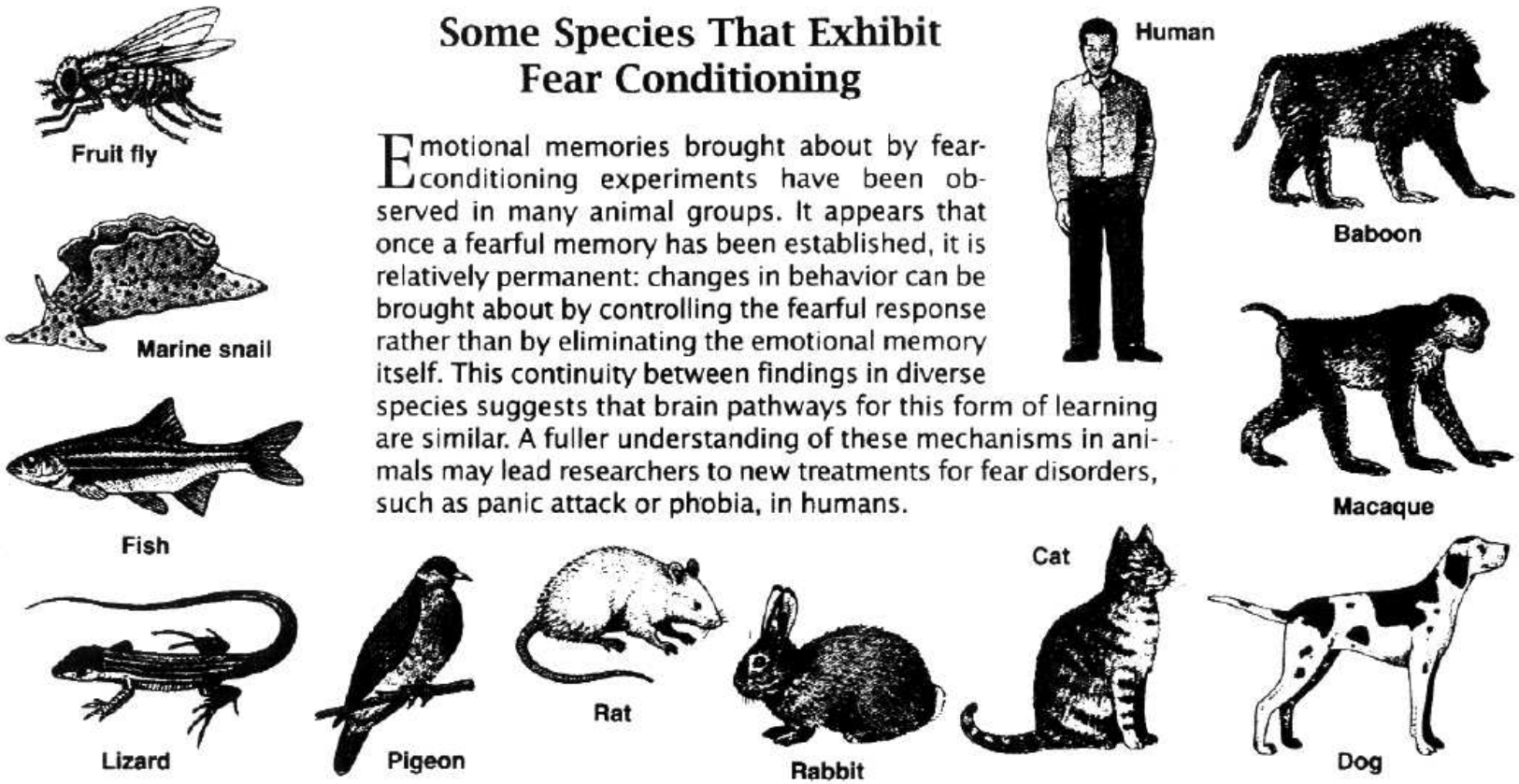
- Rhesus monkeys
- Lesioned @ 2 wks
- Returned to mothers
- Tested @ 6-8 months

A) Loss of neophobia

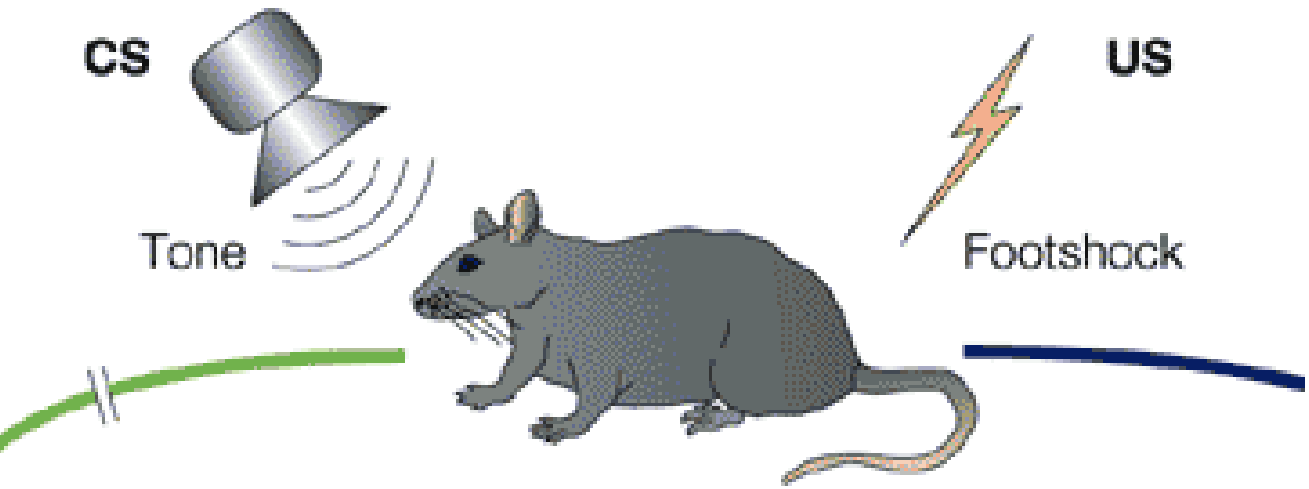
B) Loss of snake fear



Acquired Fear: Fear Conditioning



Fear Conditioning



CS: conditioned stimulus

US: unconditioned stimulus

CR: conditioned response

UR: unconditioned response

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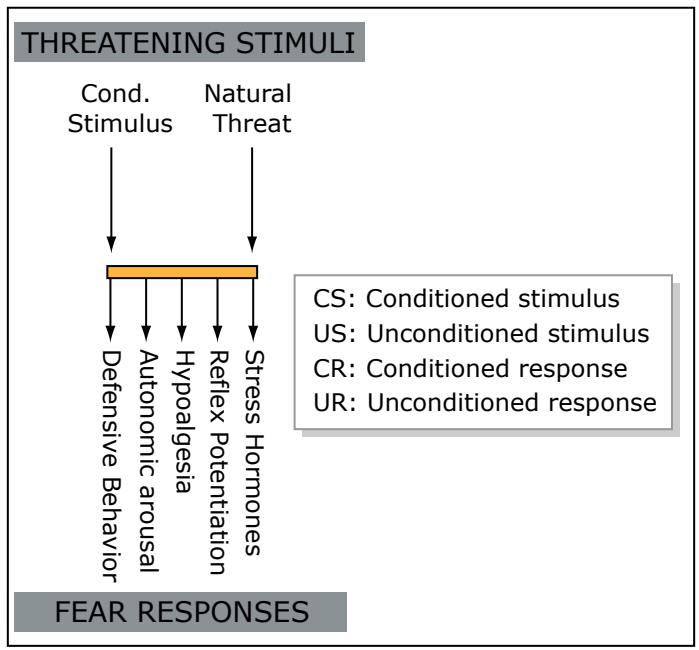
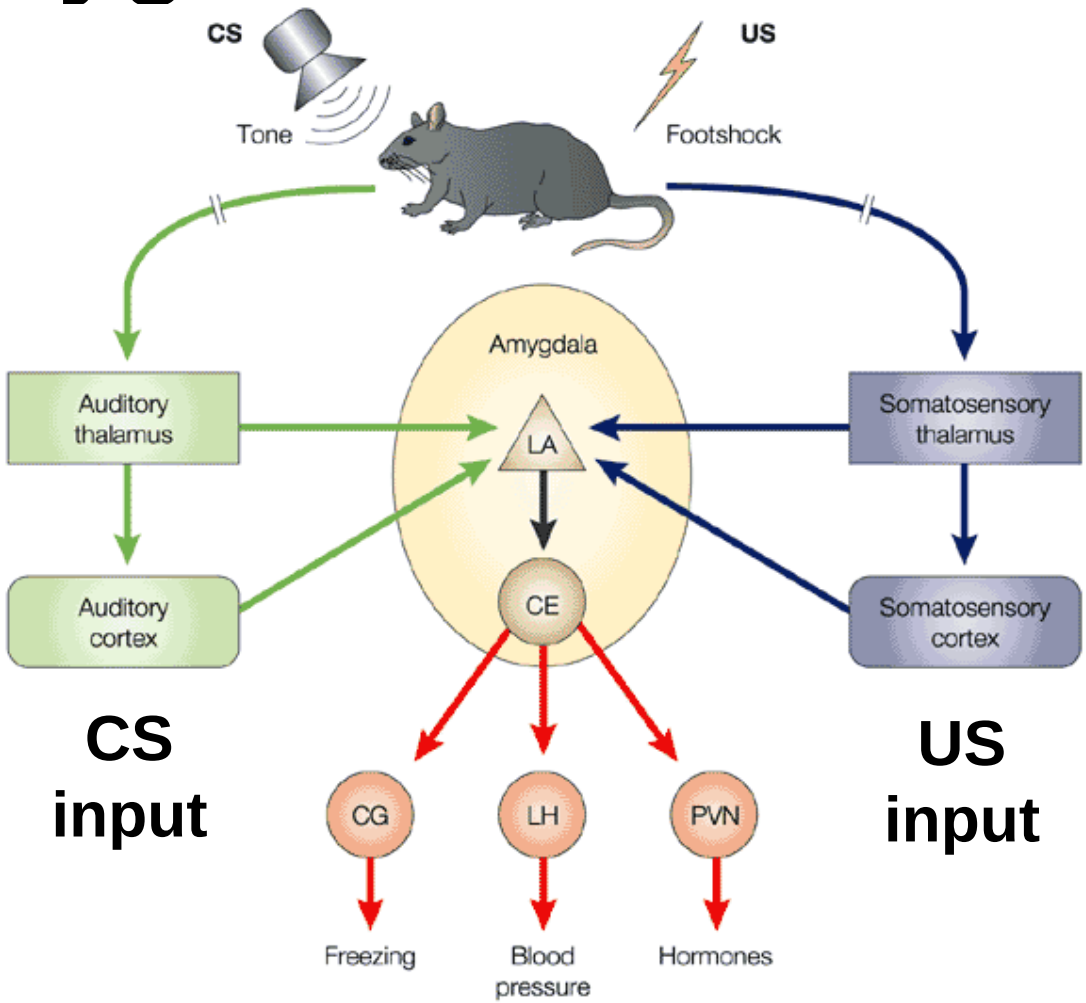


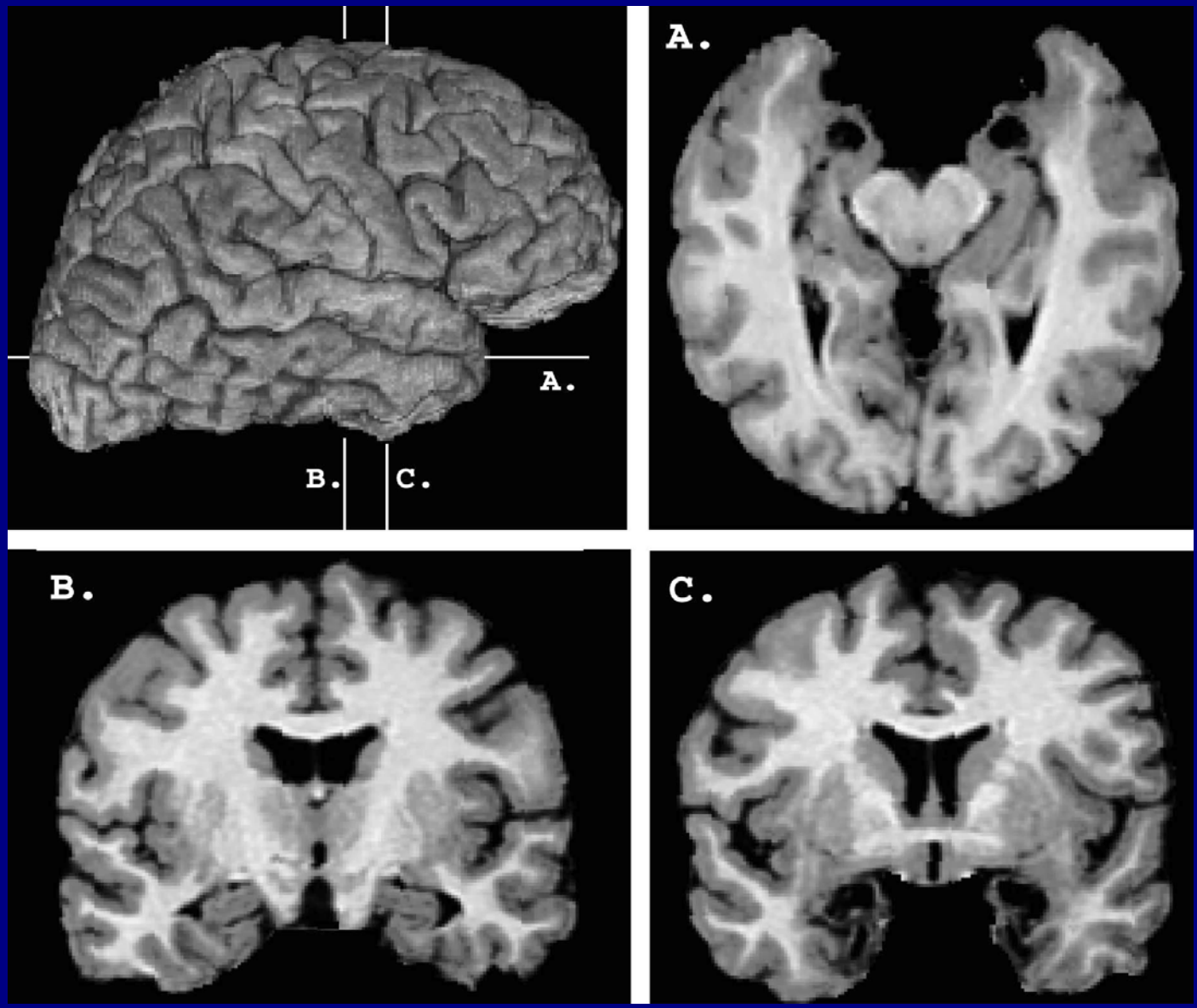
Image by MIT OpenCourseWare.

Fear conditioning depends on amygdala

- **CS & US convergence**
- **Lesion amygdala**
  - **Intact UR**
  - **Impair CR**
- **Lesion cortex**
  - **Intact UR & CR**

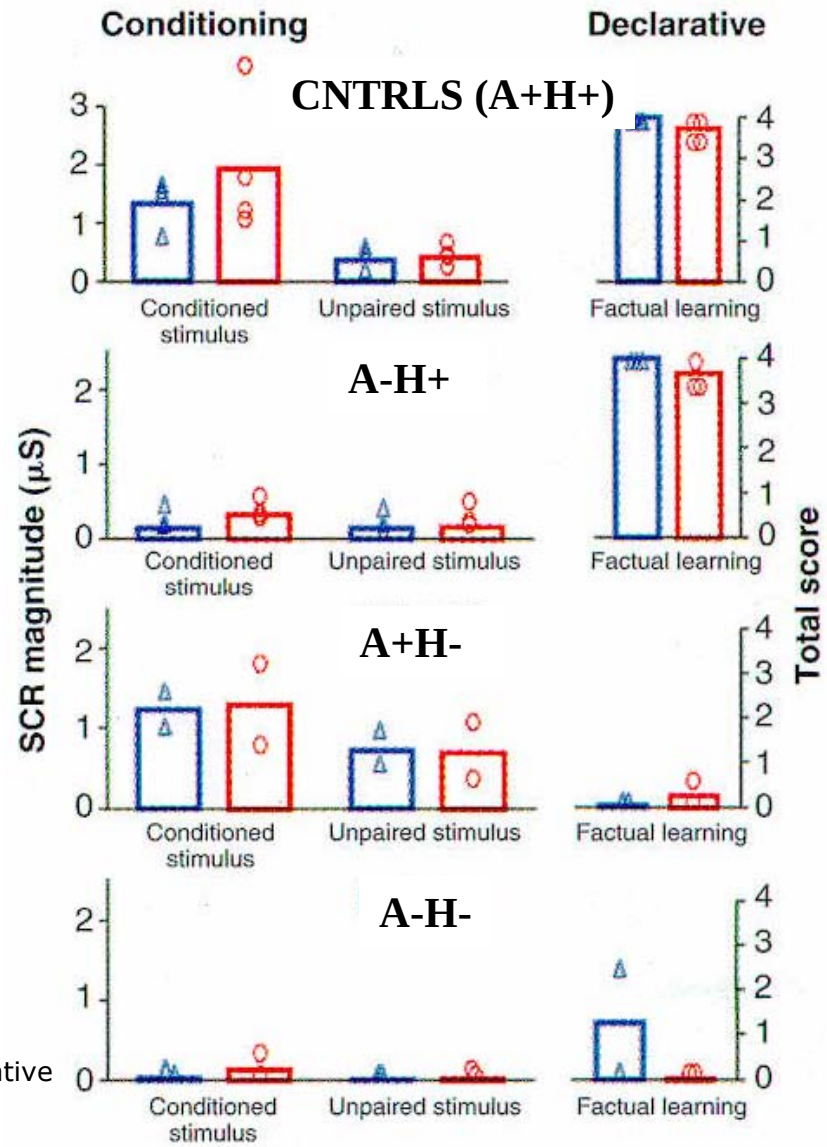


Patient S.M. - Adolphs, Damasio, Tranel et al.



Fear Conditioning: Distinct roles of amygdala and hippocampus

- **Amygdala lesion**
  - **Impaired autonomic**
  - **Intact factual**
- **Hippocampal**
  - **Intact autonomic**
  - **Impaired factual**



Instructed Fear

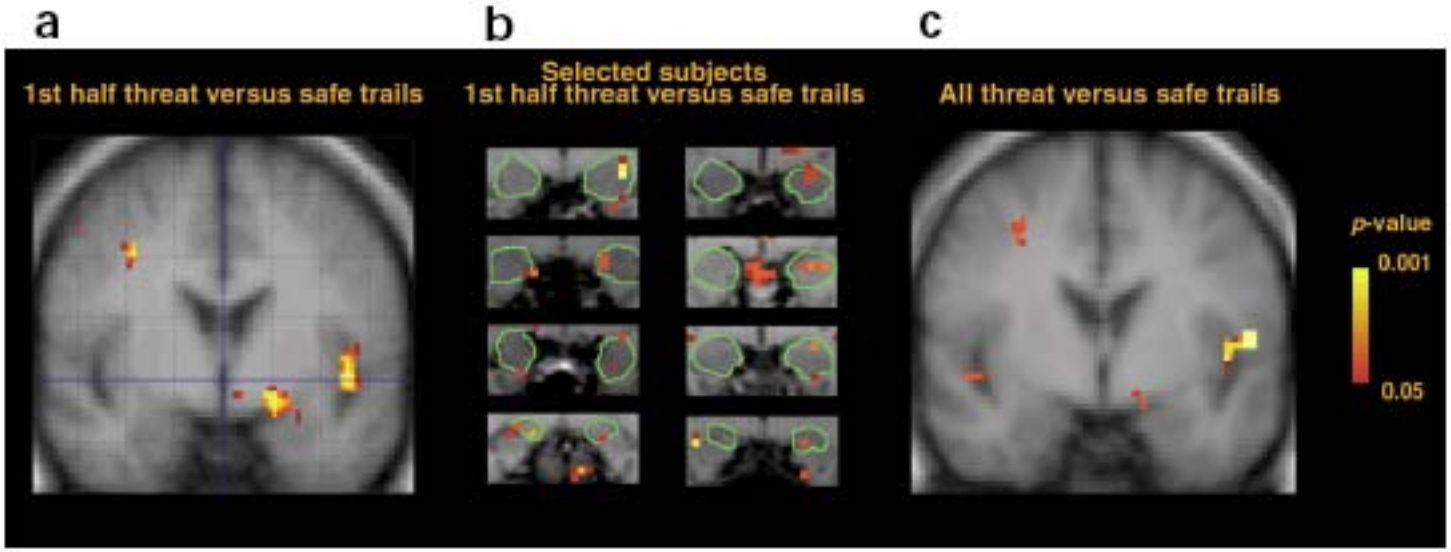


Figure 1. Threat versus safe activation.

Blue Square = SAFE
Yellow Square = THREAT
REST

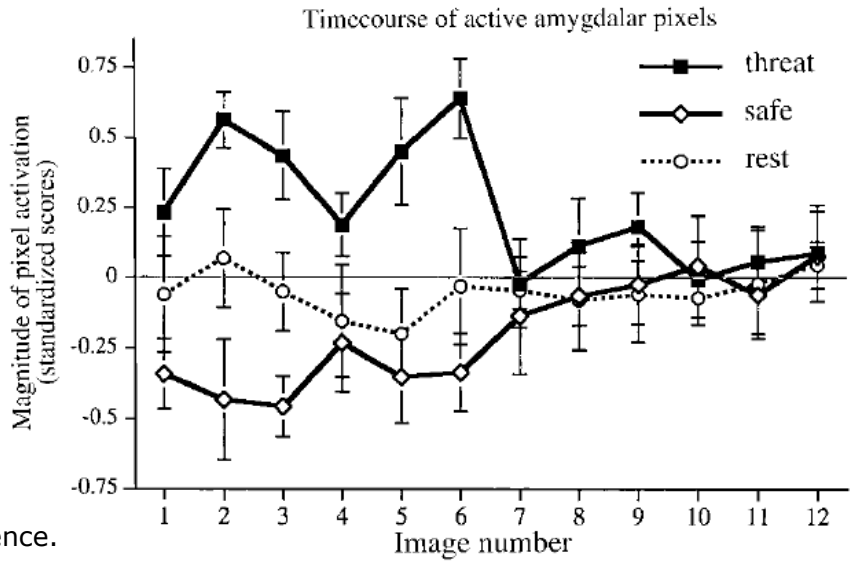
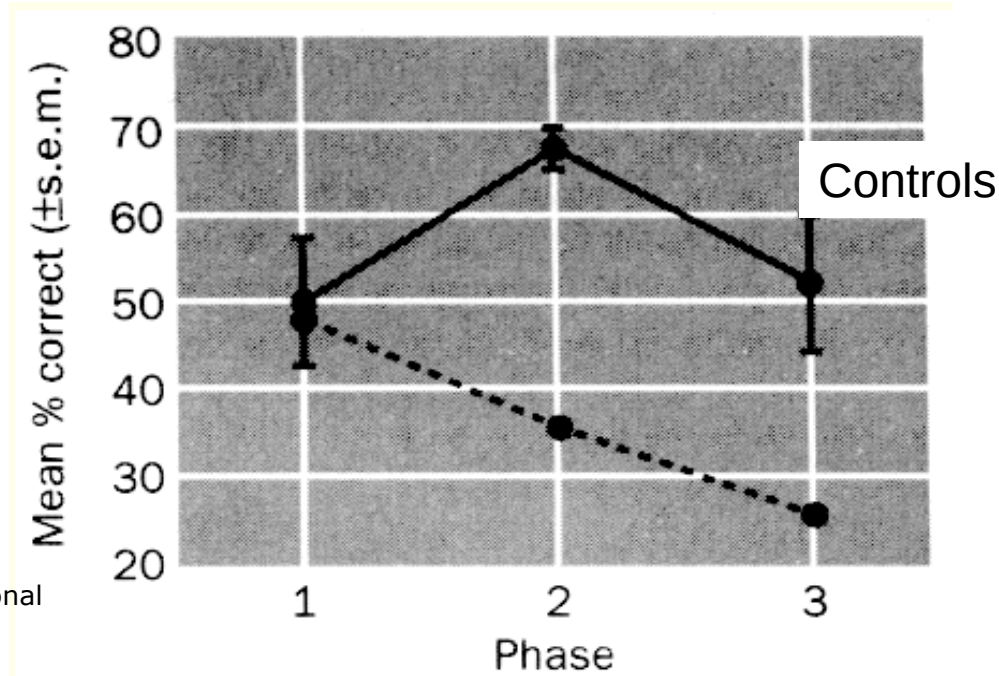


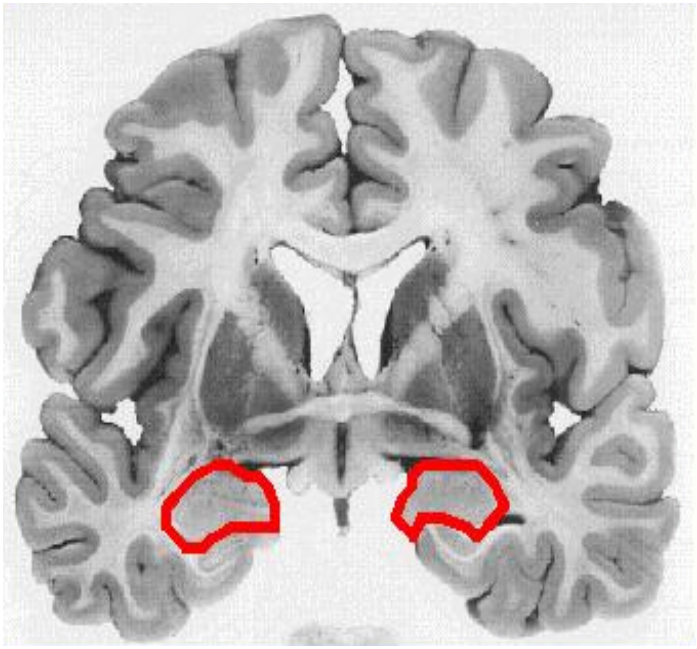
Figure 2. Time course of amygdala activation

Human Amygdala: Emotional Influences on Recollection

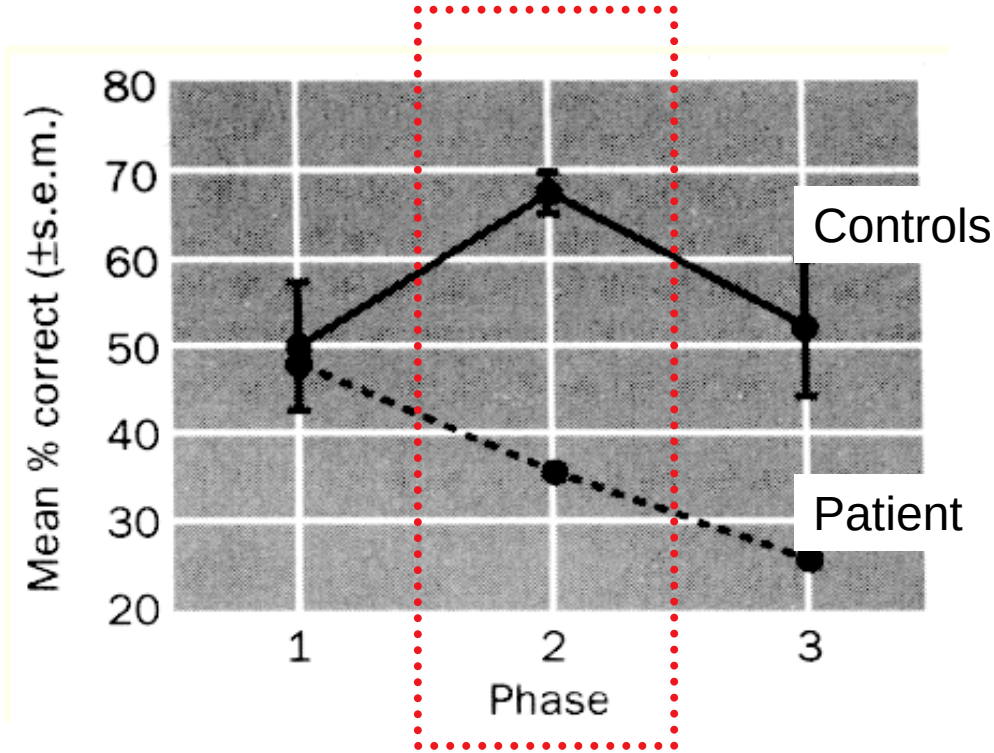


- **View story with emotional middle section**
- **Test recall 1-week later**

Human Amygdala: Emotional Influences on Recollection



(Urbach-Wiethe Disease)



- **View story with emotional middle section**
- **Test recall 1-week later**
- **Intact emotional reactions**
- **No enhanced memory**

Six Basic Emotions

Happy

Sad

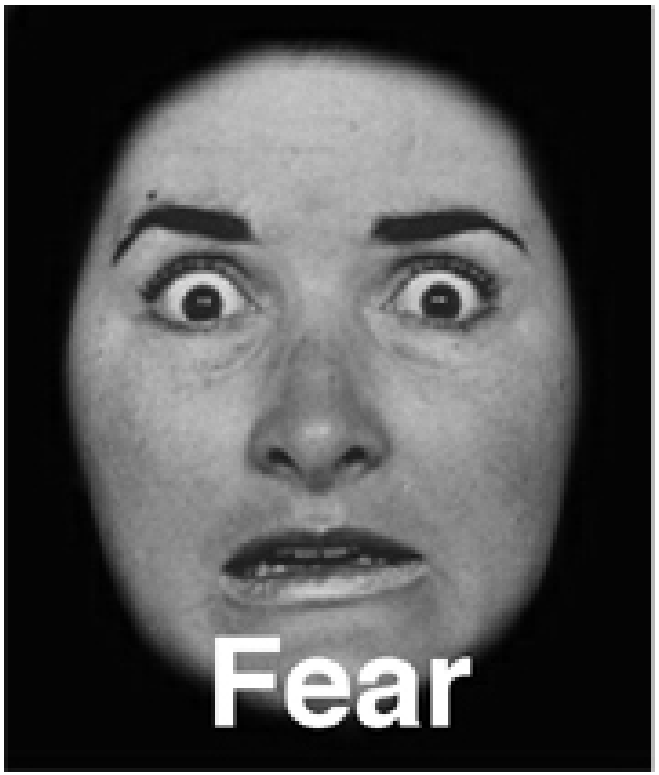
Fear

Anger

Surprise

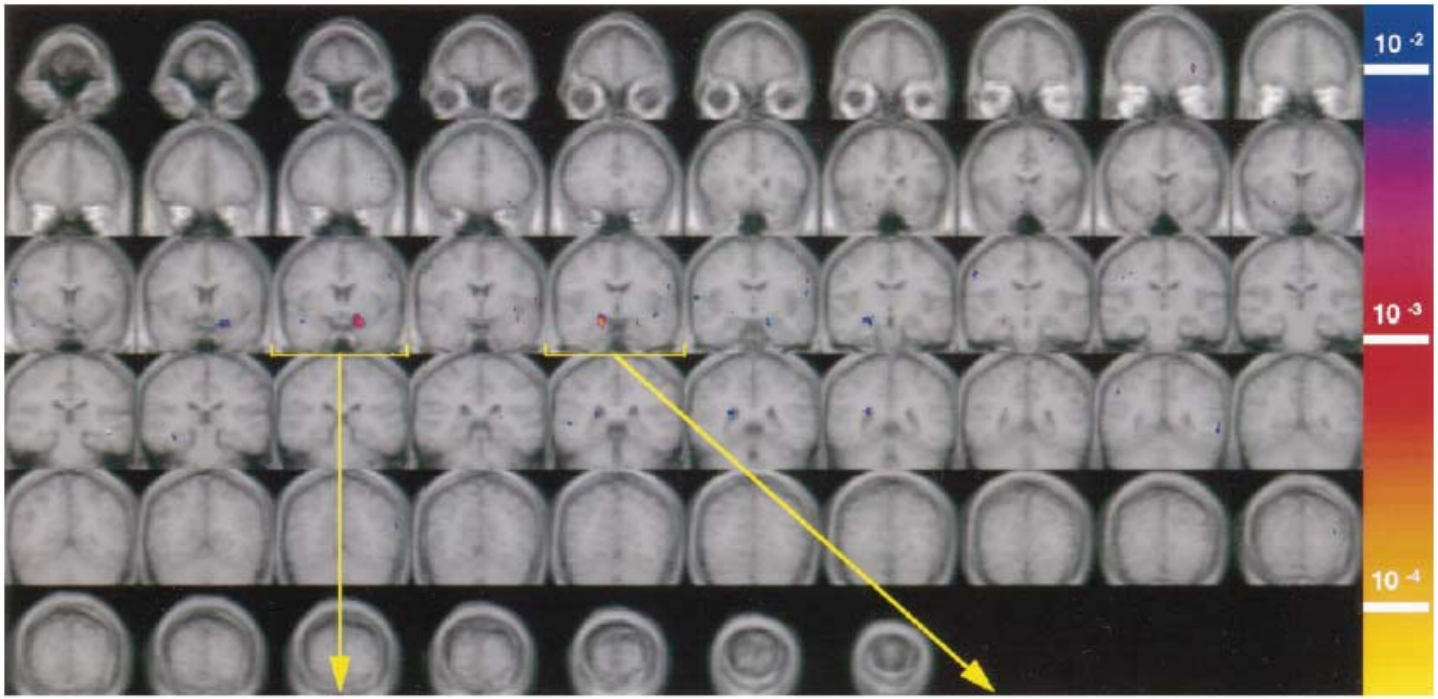
Disgust

Human amygdala: Impaired recognition of fear



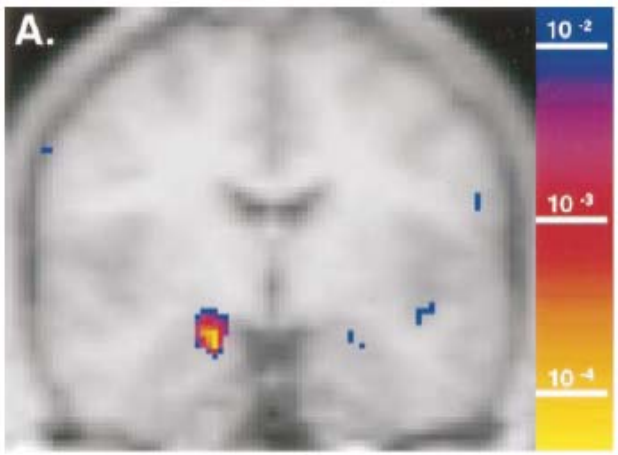
- Intact face recognition
- Impairment selective for fear

Subliminal Fear Faces > Subliminal Happy Faces

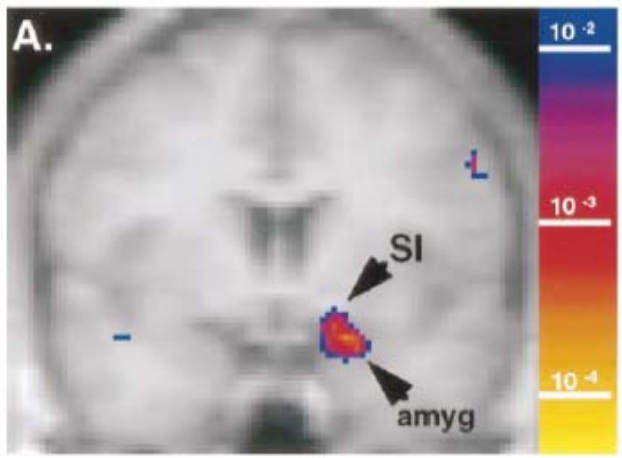


Left Amygdala/SI (y = 0; see Figure 3)

Right Amygdala (y = -6; see Figure 2)



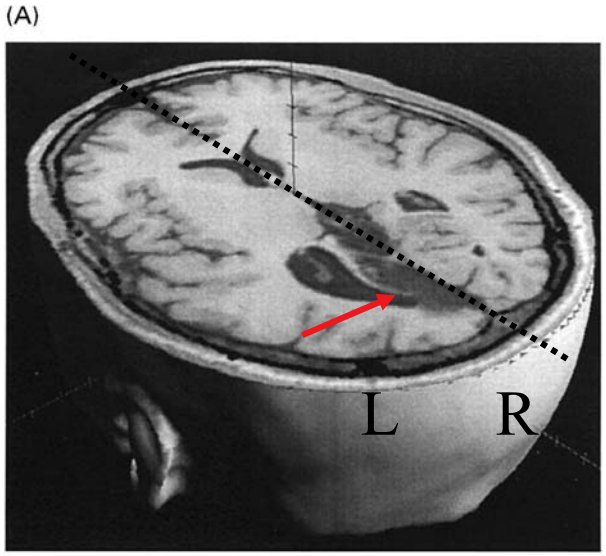
y = -6



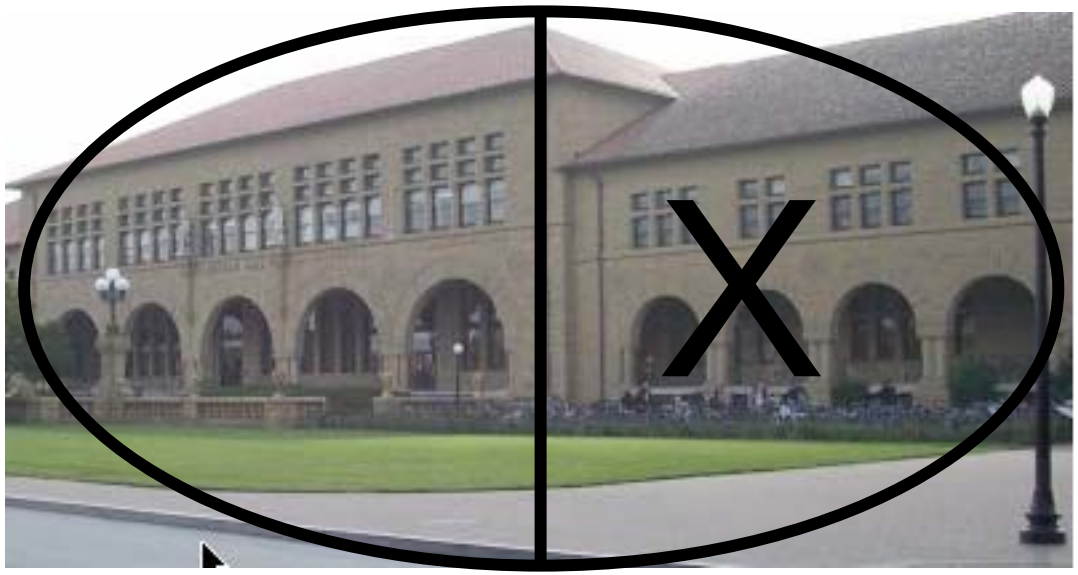
y = 0

Whalen, 1998

Cortical blindness: Fear blindsight



- **Does amygdala response depend on cortex?**
- **Examine patient w/ cortical blindness**
- **Examine amygdala response in the absence of cortex/awareness**



Morris et al., 2001

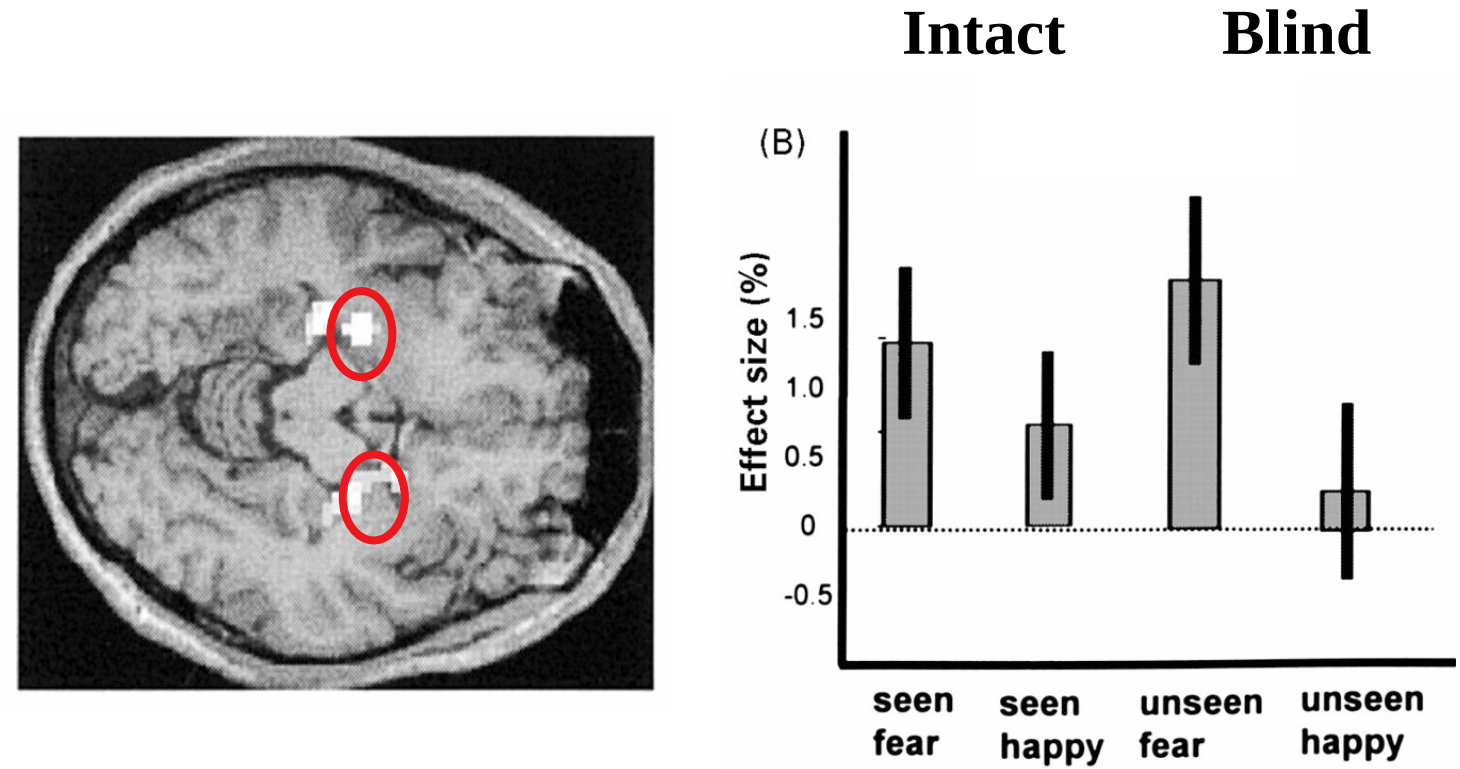
Cortical blindness: Fear blindsight

Intact/Seen

Lesion/Blind

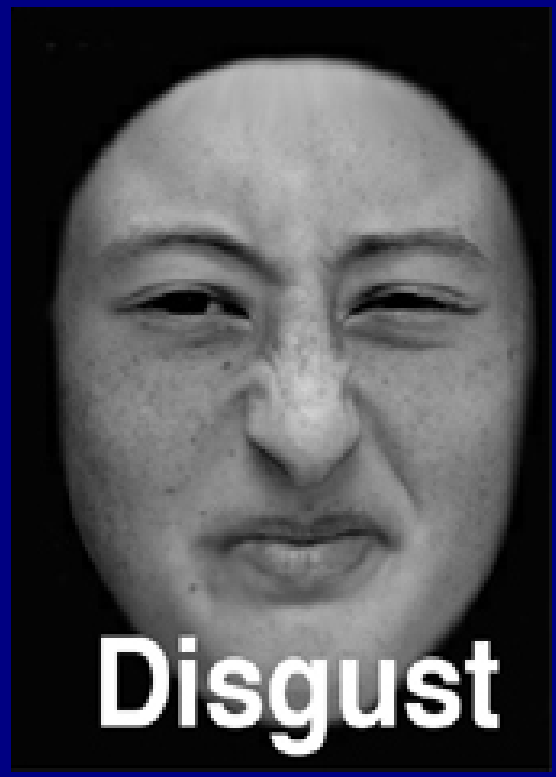
- Stimuli presented to intact and blind hemifield

Cortical blindness: Fear blindsight



 Source: Morris, J. "Differential Extrageniculostriate and Amygdala Responses to Presentation of Emotional Faces in a Cortically Blind Field." *Brain* 124, no. 6 (2001): 1241-52.

- **Amygdala discrimination of fear in blind field**
- **Depends on subcortical thalamo-amygdala pathway**

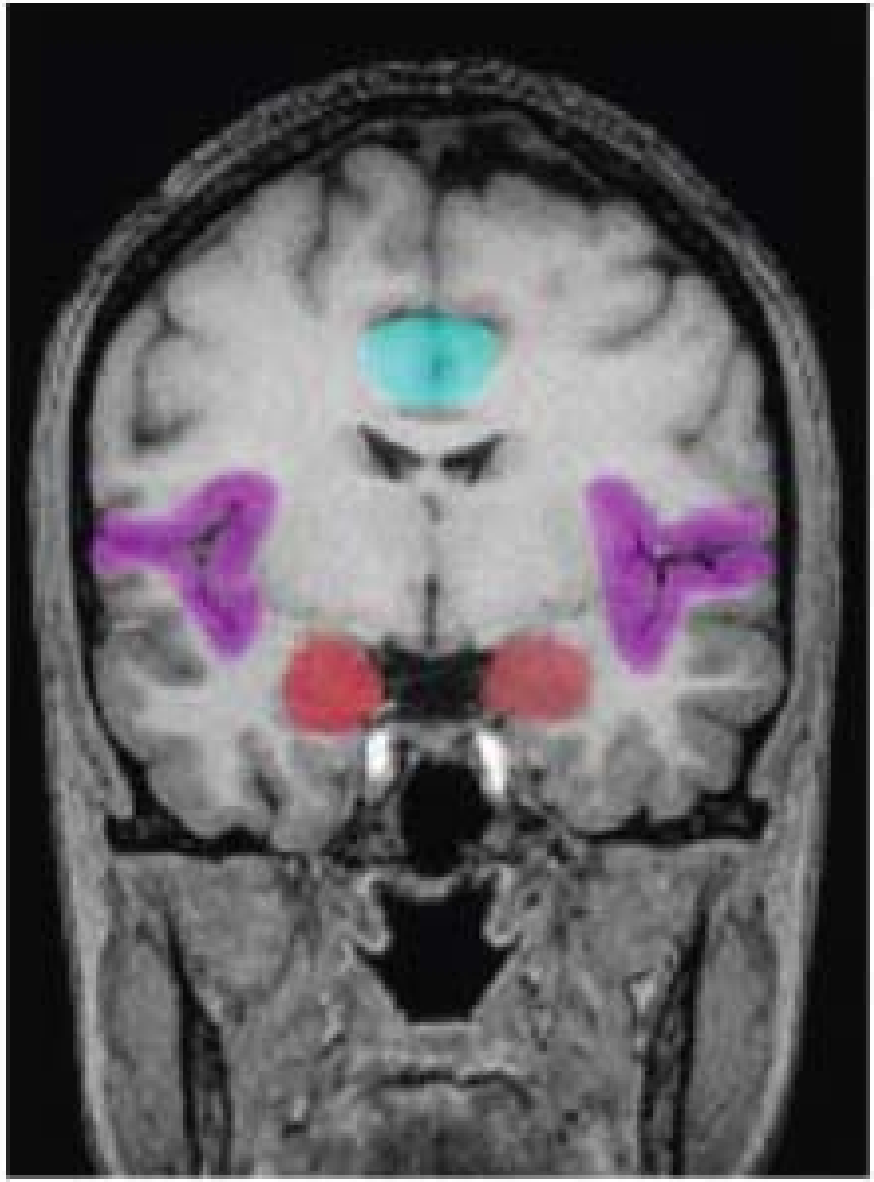


Threat ?

AMYGDALA

Contamination ?

INSULA



Insula and Disgust

- **Lesions impair recognition of disgust facial expressions** **(Calder et al., 2000)**

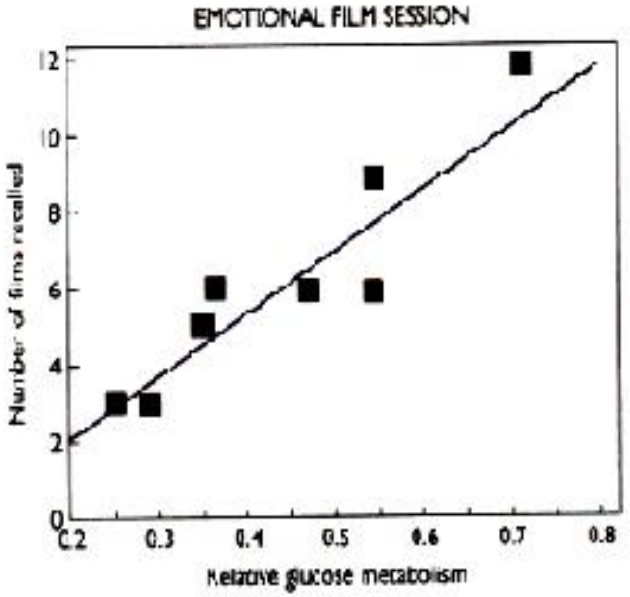
- **Increased fMRI/PET activation for disgust facial expressions** **(Phillips et al., 1997)**

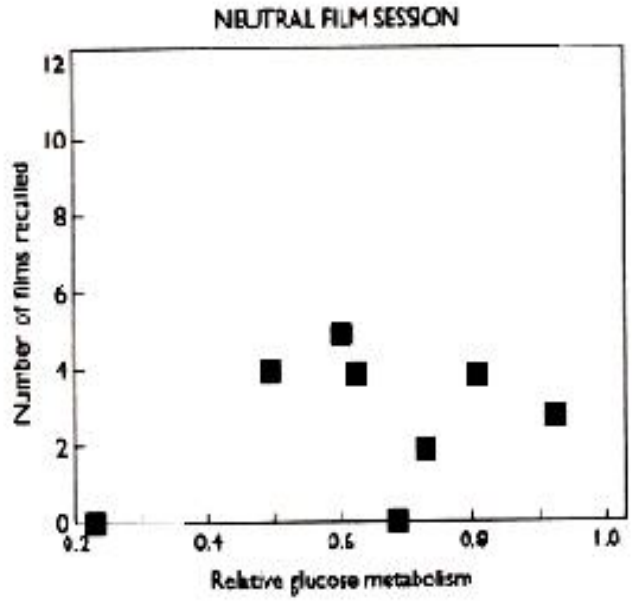
Photo courtesy of Lil' Mike on Flickr used under a cc-by license.

“ The horror of that moment,” the King went on, “I shall never, never, forget.”

“You will though,” the Queen said, “if you don’t make a memorandum of it.”

Lewis Carroll, *Through the Looking Glass*, 1887

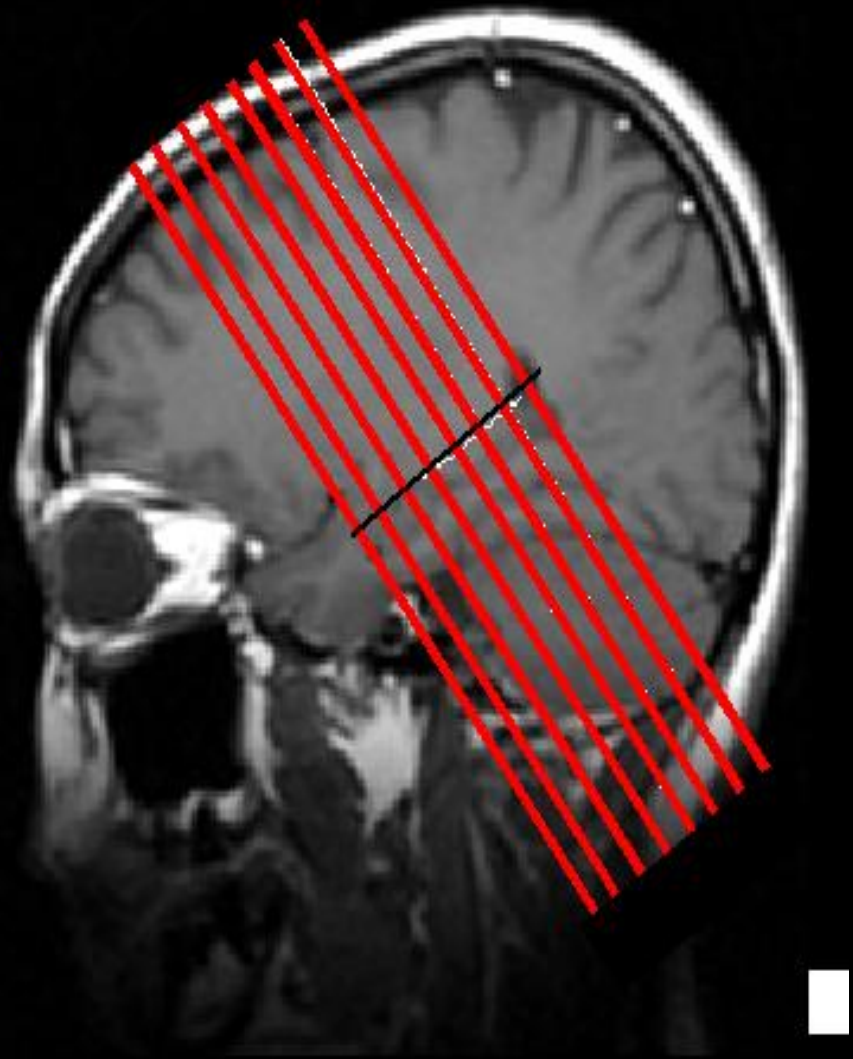




Series of images from the International Affective Picture System removed due to copyright restrictions.

Functional Imaging Parameters

- 10 female subjects
- 1.5 T Scanner
- Standard motion correction
  - (Air 3.0)
- 8 slices, 7 mm thick
  - (perpendicular to hippocampal axia plane)
- Gradient echo spiral pulse sequence
  - TE=40 ms
  - TR=360 ms
  - Flip Angle= 50°
- Bite-bar to minimize motion



Event-Related fMRI Study Design

Encoding in scanner

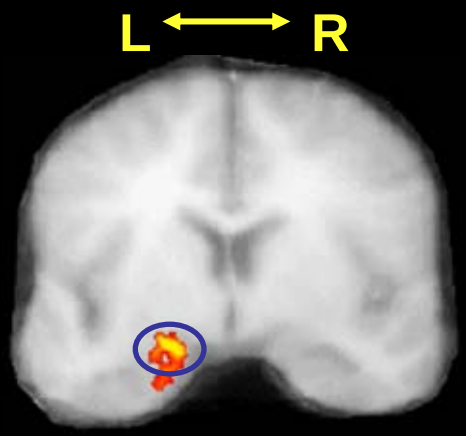
Rating (0-3) of emotional arousal of 96 color scenes (Neutral to Negative)

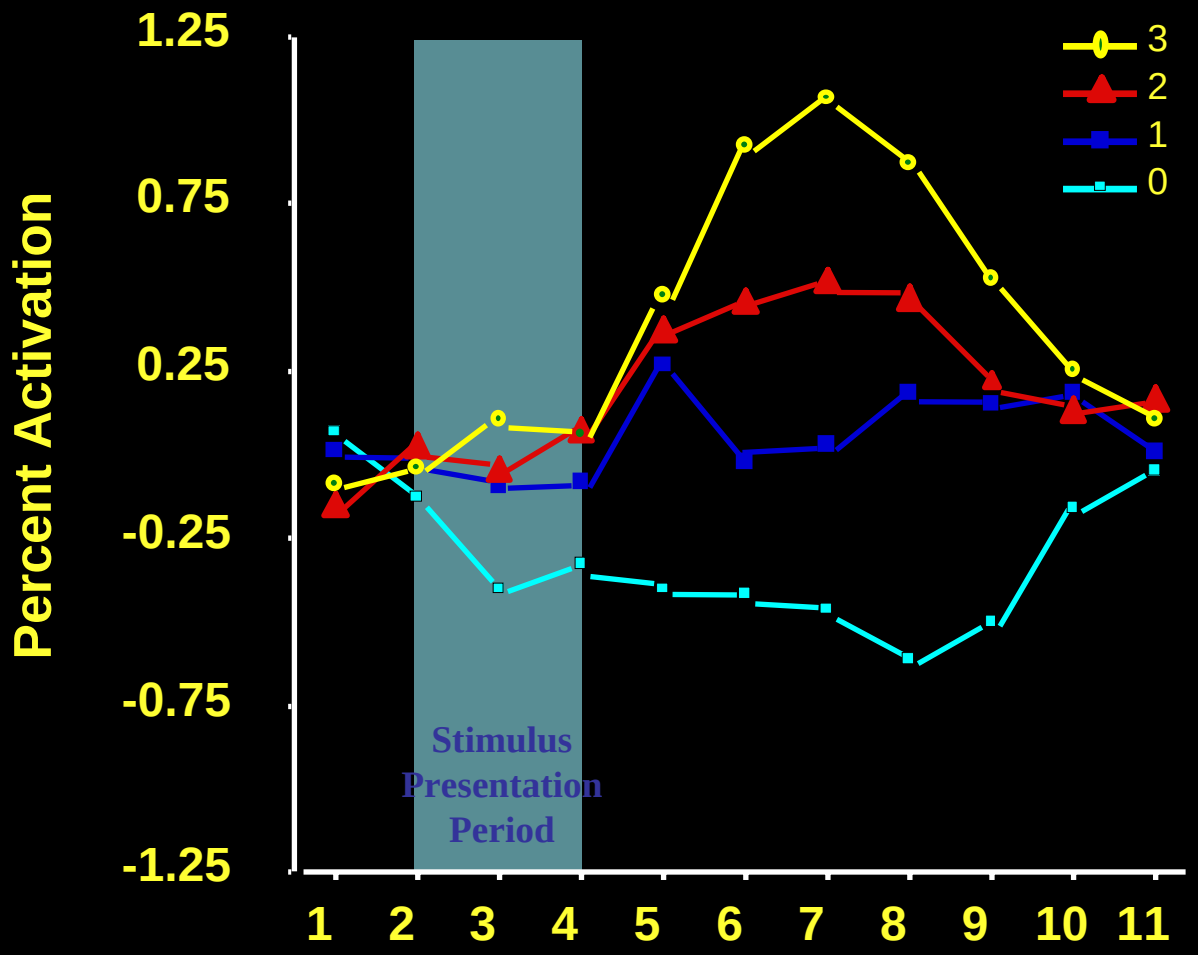
3 week delay

retrieval out of scanner

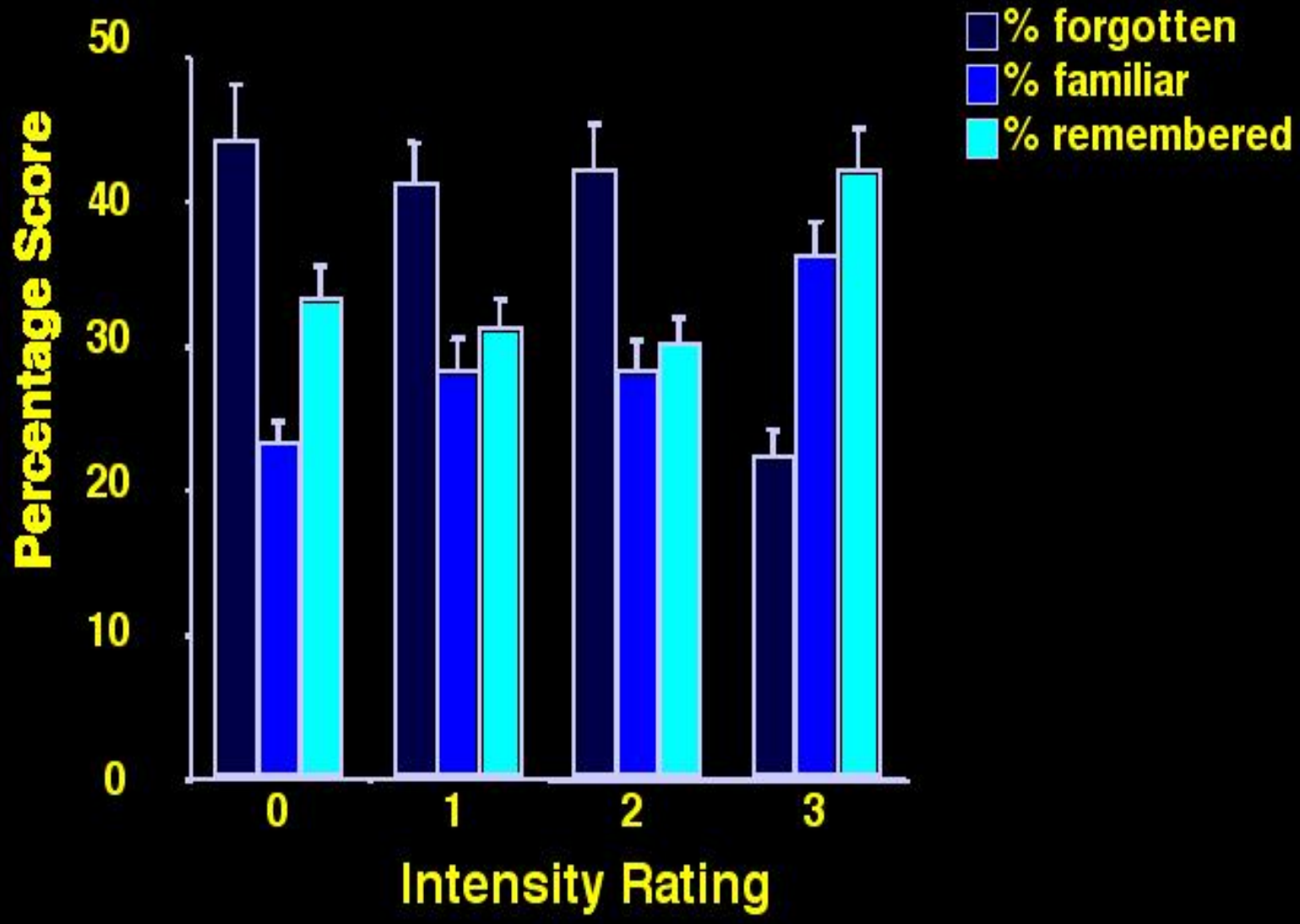
Old/New recognition judgements of 96 old & 48 new scenes
Remembered
Known (familiar)
Forgotten

Emotional Experience

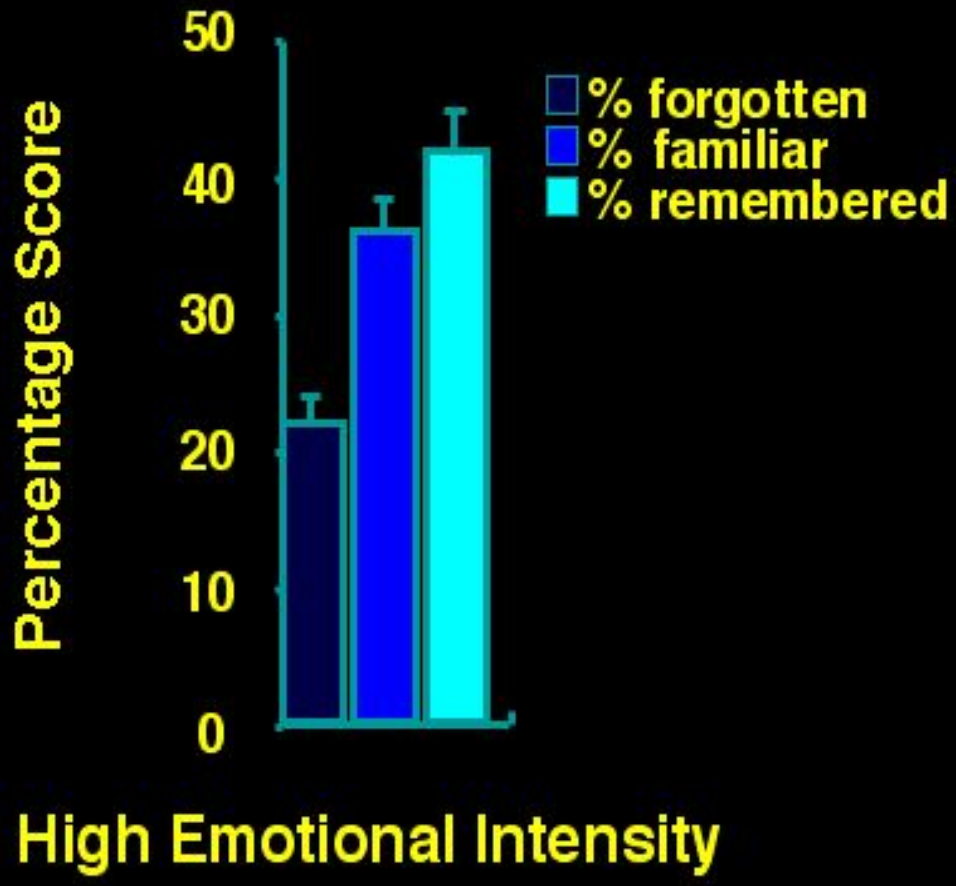


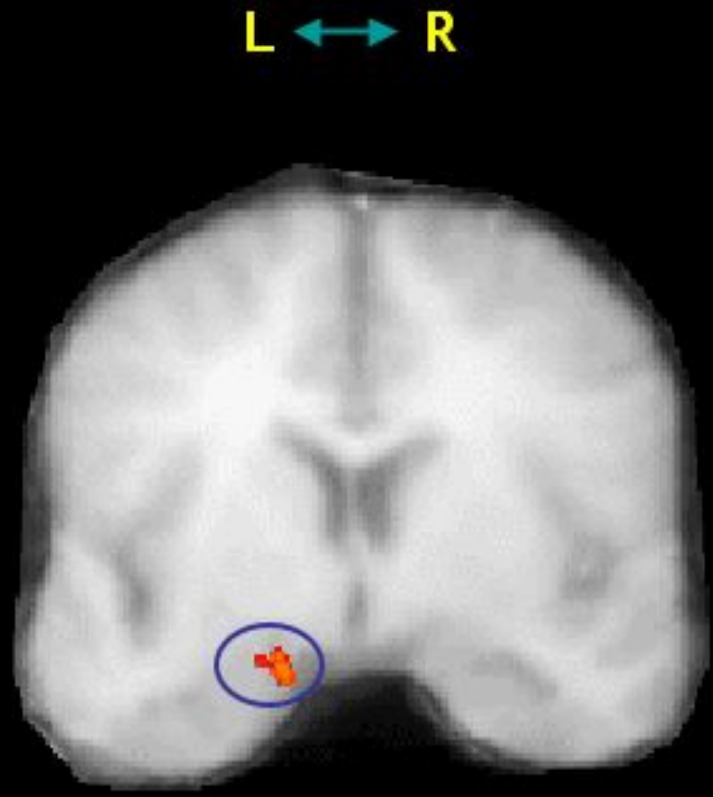


Highly Emotional Items Produced Enhanced Memory

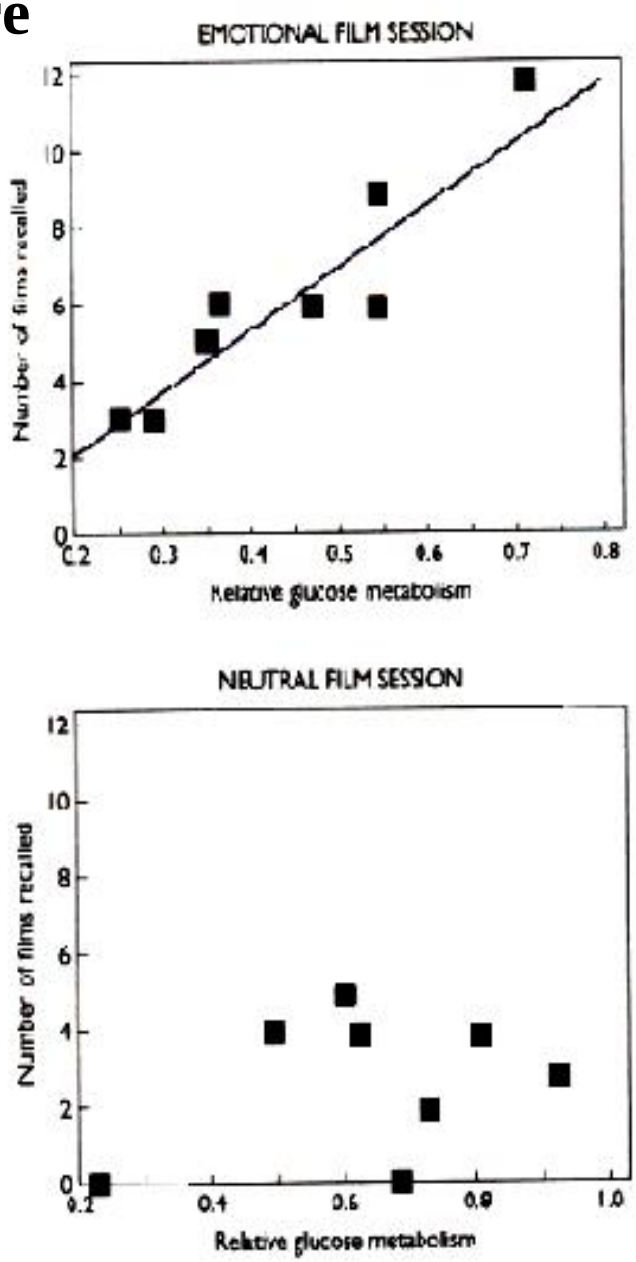


Enhanced Memory Associated with Left Amygdala Activation

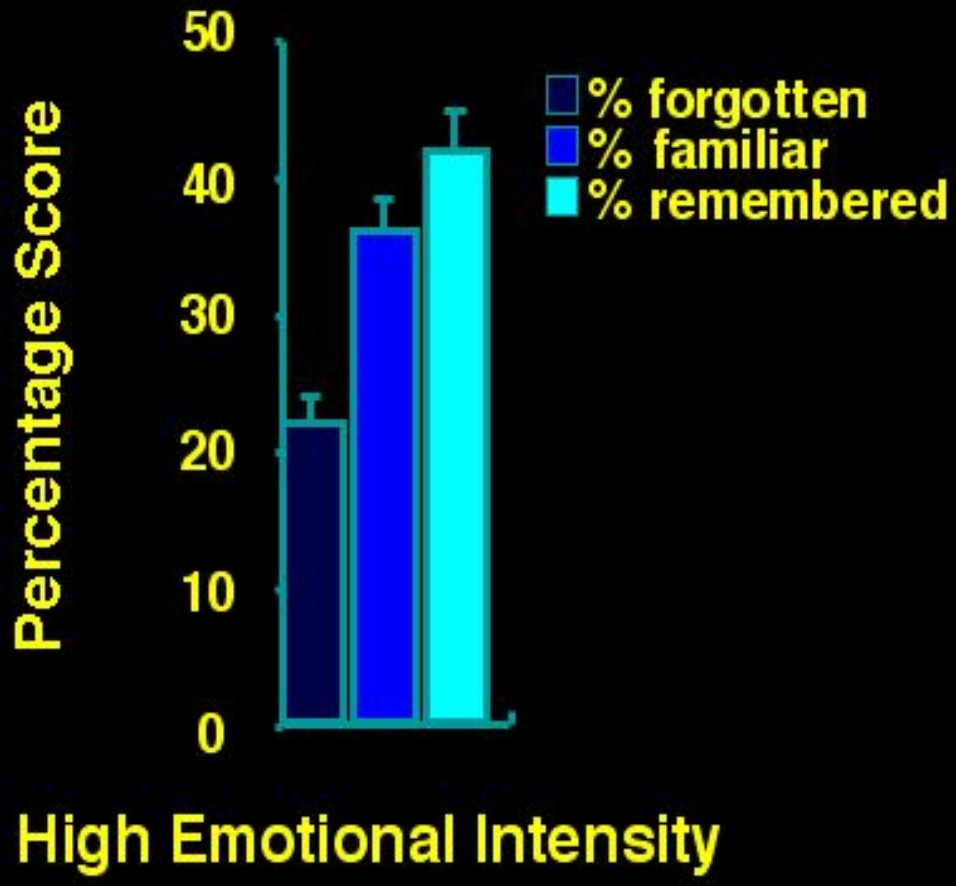


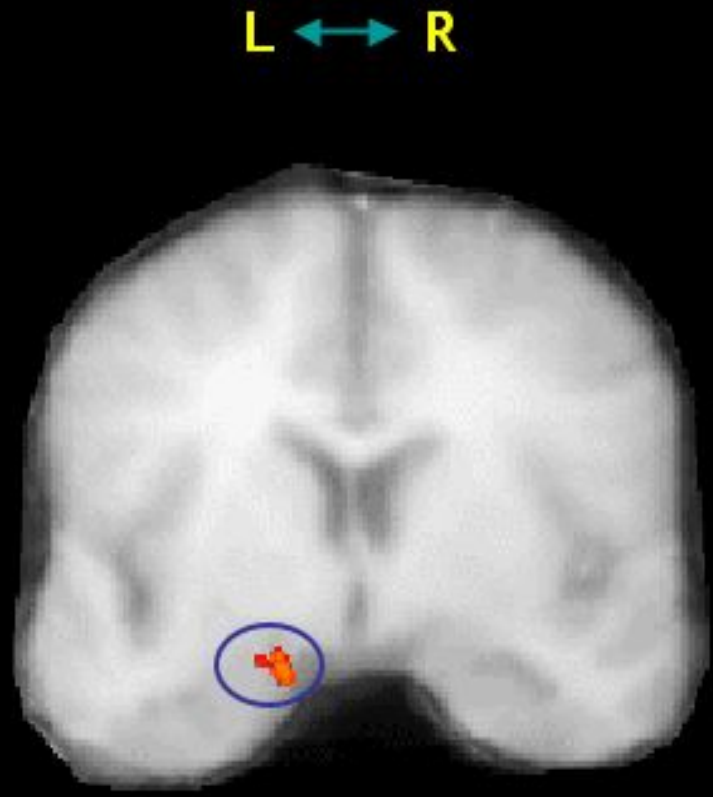


Right Hemisphere



Enhanced Memory Associated with Left Amygdala Activation





4 Studies

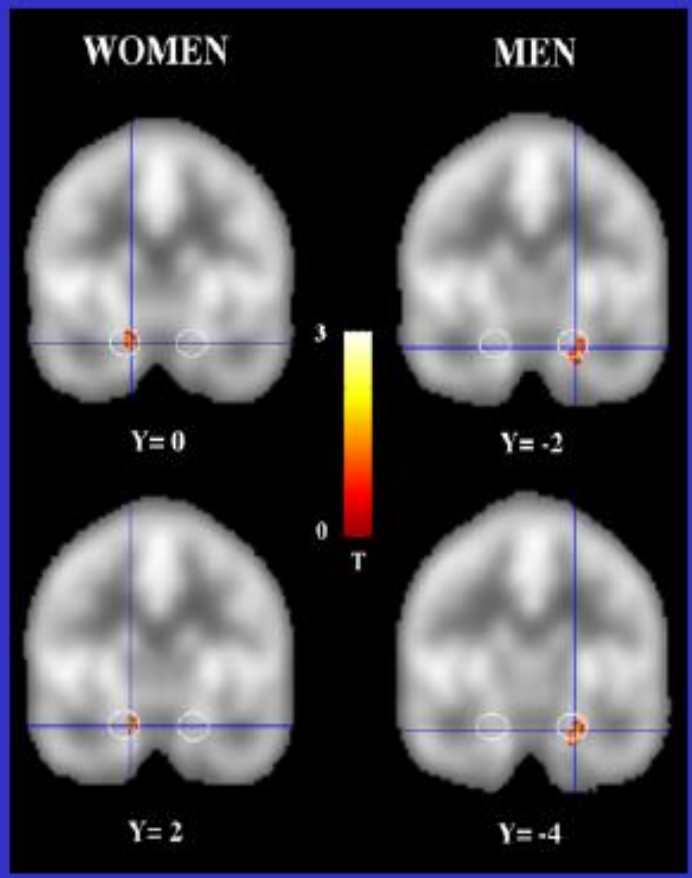
	Left Amygdala Memory Correlation		Right Amygdala Memory Correlation	
Authors	Canli et al. 1999	Canli et al. 2000	Cahill et al. 1996	Hamann et al. 1999
Imaging	fMRI (block)	fMRI (event)	PET	PET
Subjects	10 F	10 F	8 M	10 M
Stimuli	Pictures	Pictures	Films	Pictures
Paradigm	Recog	Recog	Recall	Recall/Recog
Delay	Months	Weeks	Weeks	Minutes/Weeks

Is Gender the Critical Variable?

Women have better memory than men

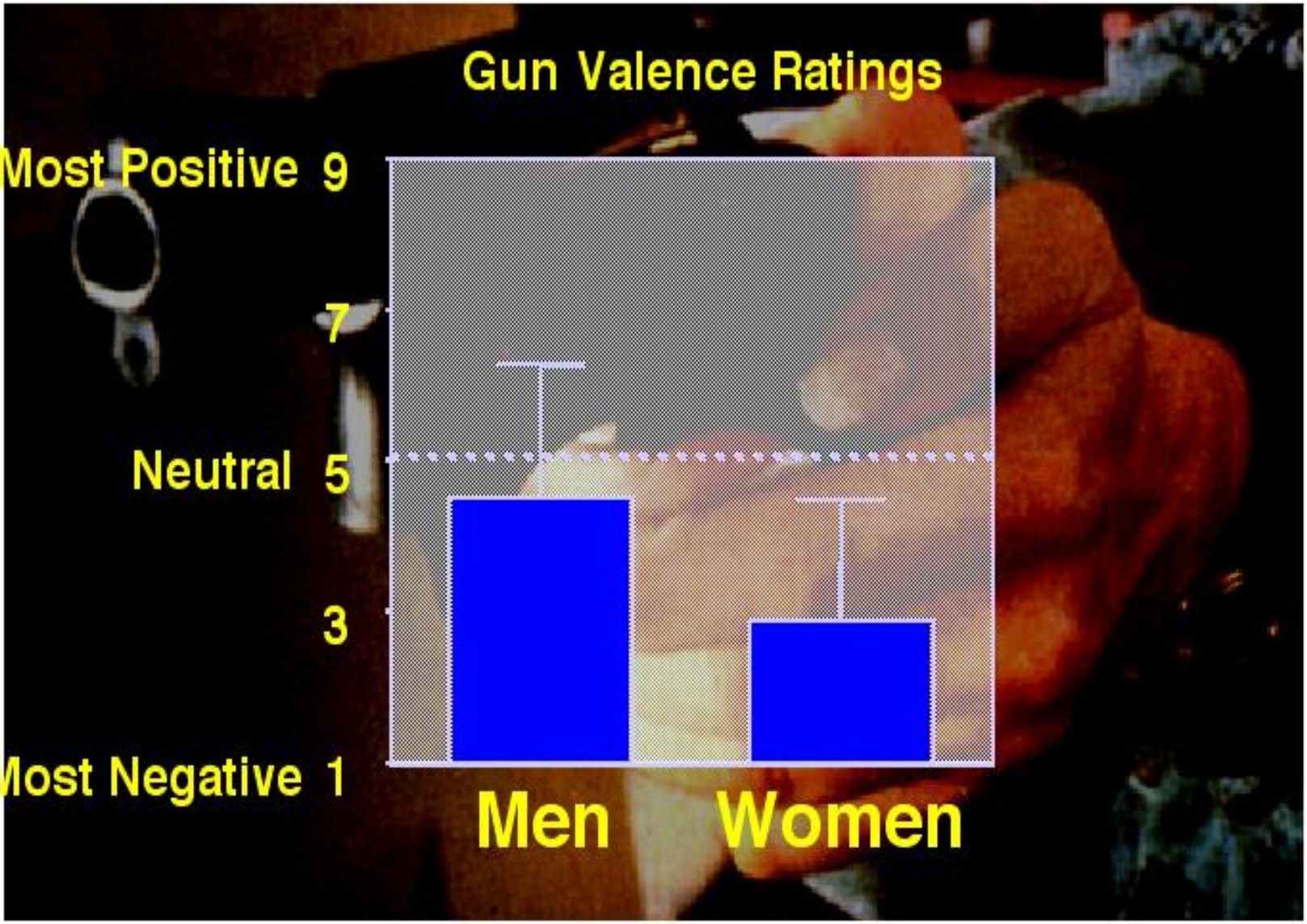
- better recall of emotional life events
- faster production of autobiographical memories to cues
- more accurate in dating memories
- wives score higher than husbands on vividness of memories for first date, last vacation, recent argument

Amygdala activation predicts subsequent memory for emotional experiences

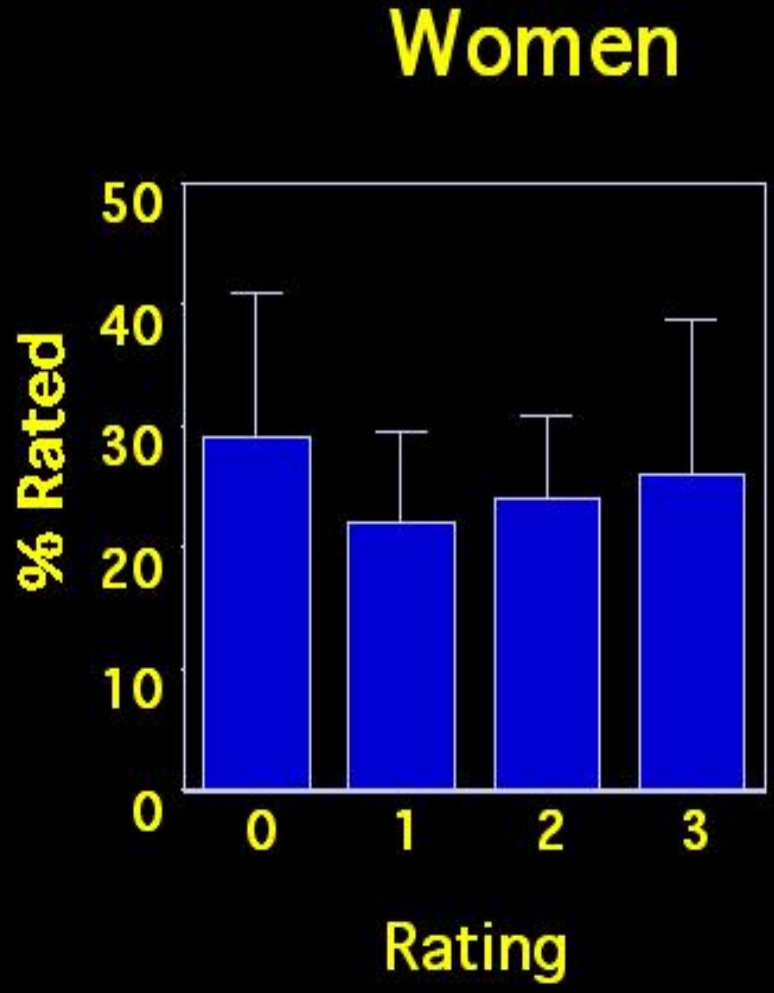


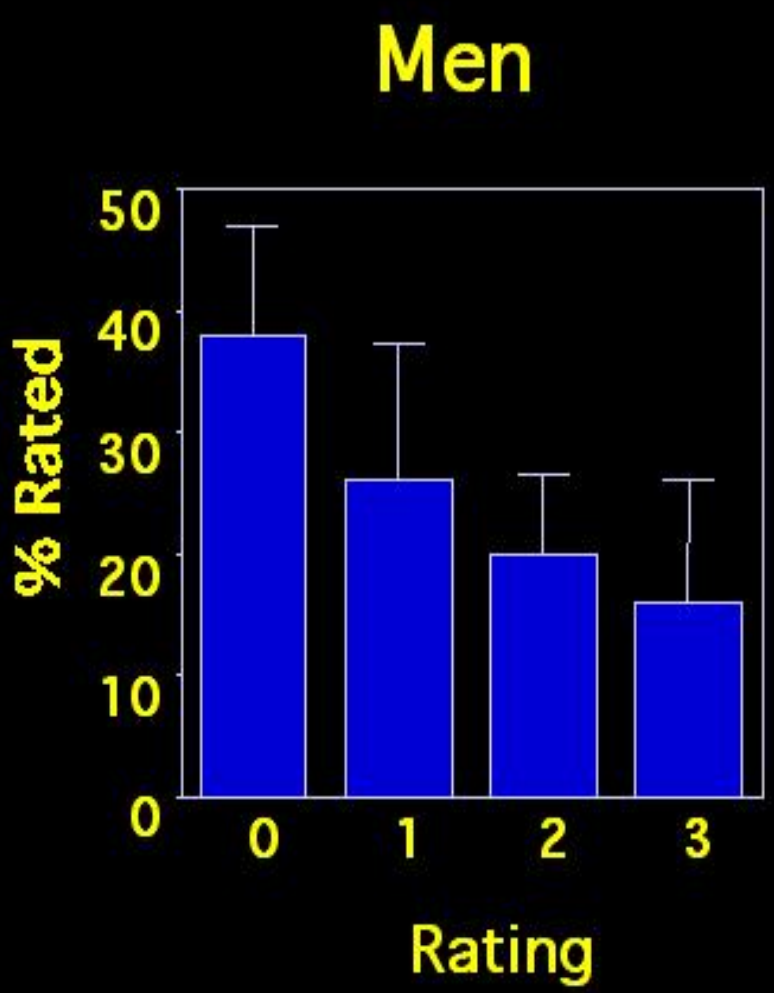
Courtesy of Elsevier, Inc., http://www.sciencedirect.com. Used with permission. Source: Cahill, L., et al. "Sex-Related Difference in Amygdala Activity During Emotionally Influenced Memory Storage." *Neurobiology of Learning and Memory* 75, no. 1 (2001): 1-9.

Is Gender the Critical Variable?

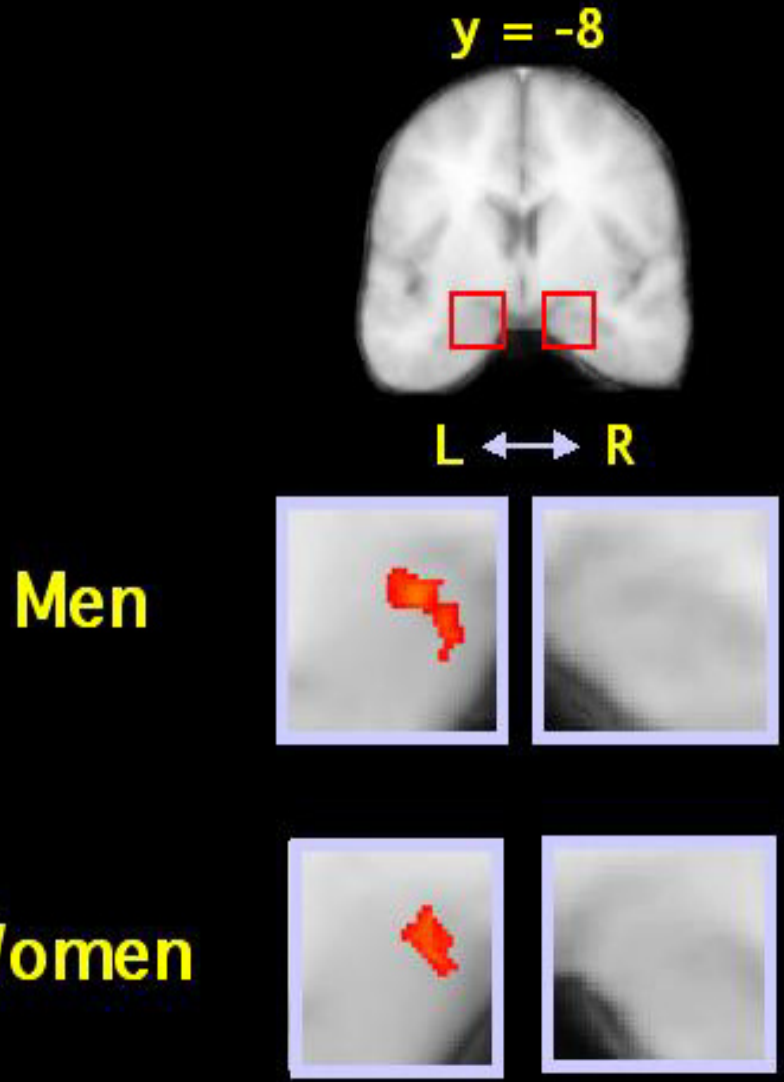


Emotional Rating Profiles

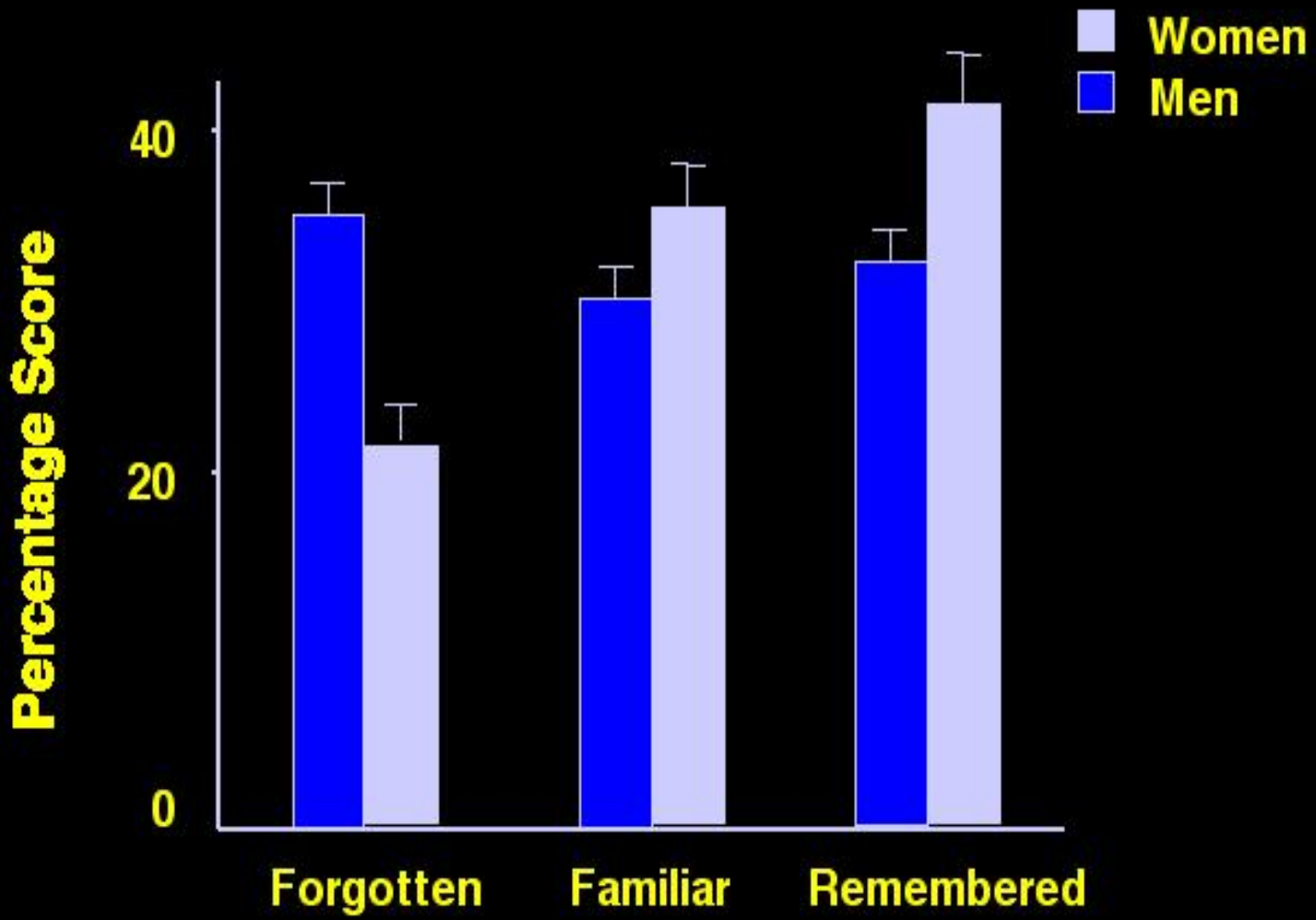




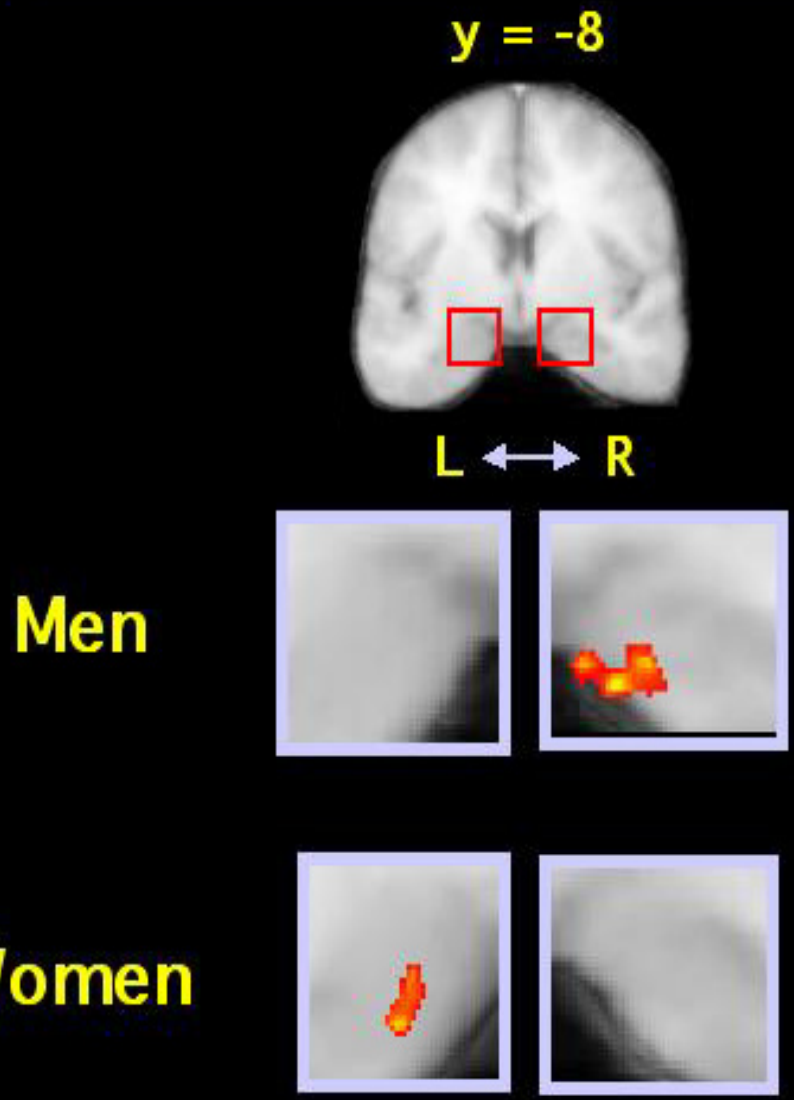
Correlation with Emotional Ratings

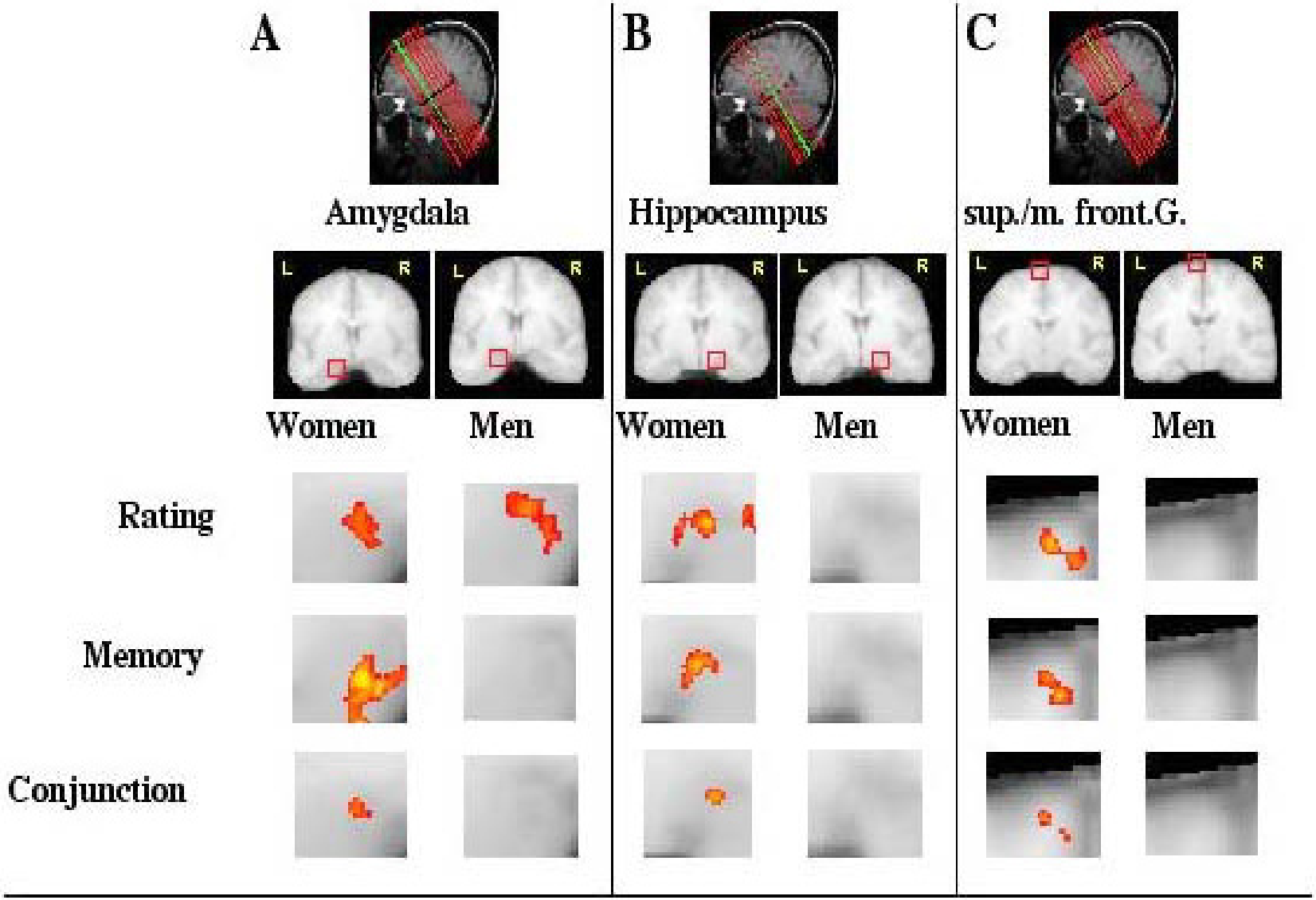


Memory For Most Intense Items



Memory Correlation For Most Intense Items





Sex Differences in Amygdala Activation and Memory for Emotional Material

- **superior memory for most intense pictures in women**
- **both men and women had greater *left* amygdala activation for pictures rated more intense**
- **in women, greater *left* amygadala activation predicted stronger long-term emotional memories**
- **in men, greater *right* amygadala activation predicted stronger long-term emotional memories**
- **interpretation - both men and women activate brain in response to emotional pictures, but there is, on average, a greater overlap in brain regions involved in analyzing felt emotions and in making memories in women - better memories (and greater risk for depression?)**

9.00SC Introduction to Psychology
Fall 2011