Human Emotion

Psychology 3131
Professor June Gruber

Is our brain emotional?

Human Emotion

Affective Neuroscience

Is our brain emotional?

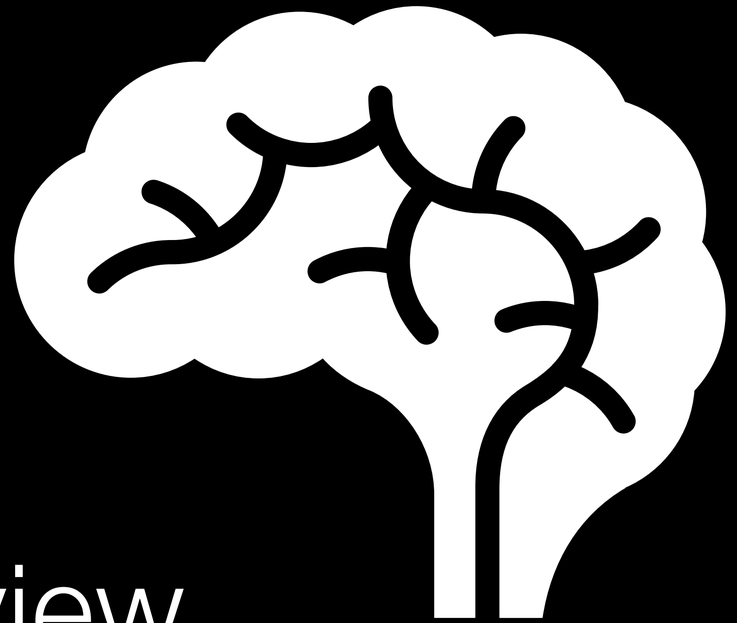
Roadmap

Tools to Study the Emotional Brain

Pleasure and Intensity

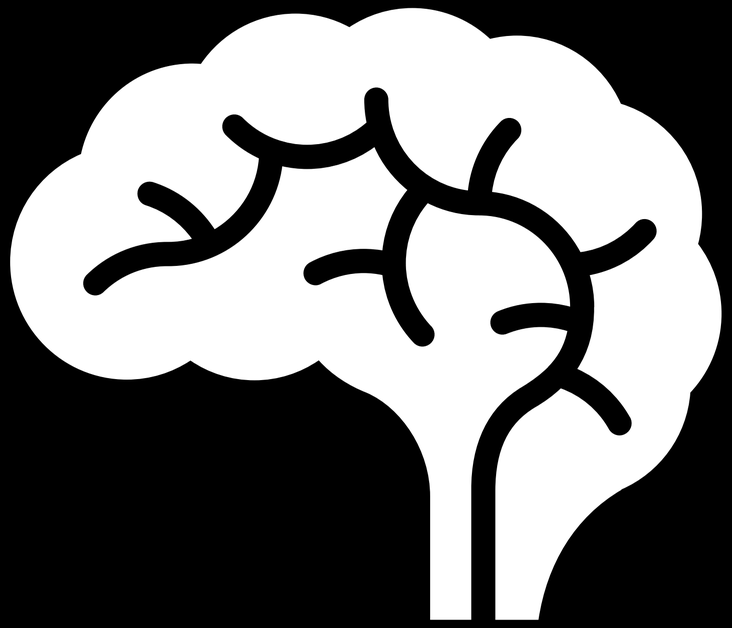
Emotion Regulation

Take-Away Qs & Expert Interview



Brrraaainnns!

Can the Brain Tell us About Emotion?



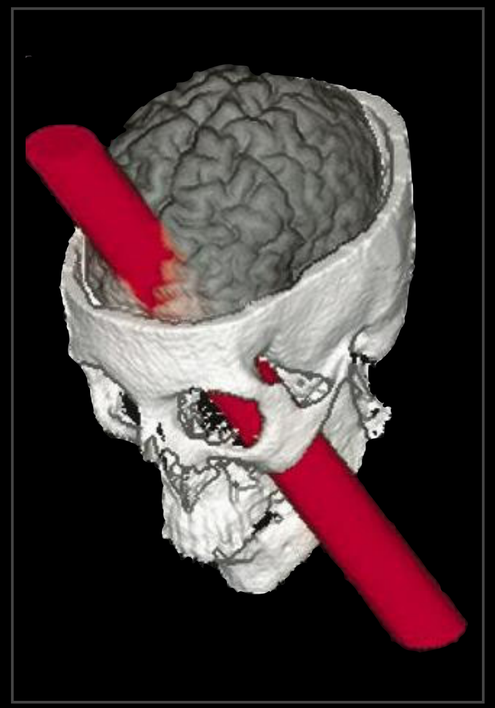
1. Identify potential biomarkers of emotion (e.g., what brain regions are associated with emotion experience).

2. Examine inter-relationships between neural regions to understand how the brain regulates emotion.

3. Inform psychological theories of emotion - causes, mechanisms, consequences.

Tools to Study the (Emotional) Brain

Example 1: Lesions



Naturally occurring lesions

(e.g.,orbitofrontal cortex - Phineas Gage)

Areas of damage

(e.g., left temporal lobe aneurysm)

Areas of disease

(e.g., Frontotemporal Dementia)

Tools to Study the (Emotional) Brain

Example 2: TMS

TRANS-CRANIAL MAGNETIC STIMULATION (TMS)

- Create strong focal magnetic field over scalp of healthy participant.
- Creates temporary disruption in neural activity
- **PROS:** Reversible, repeatable, non-invasive (relatively)
- **CONS:** Not clear where disruption is located precisely, how it is working/what it is doing.

Tools to Study the (Emotional) Brain

Example 3: Neuroimaging

Tools to Study the (Emotional) Brain

Example 3: Neuroimaging

1. Computerized Axial Tomography (CAT/CT)

- Similar to an x-ray, Rarely used now.

2. Positron Emission Topography (PET)

- Inject radioactive isotope, measure where it travels

3. Electro-encephalography (EEG)

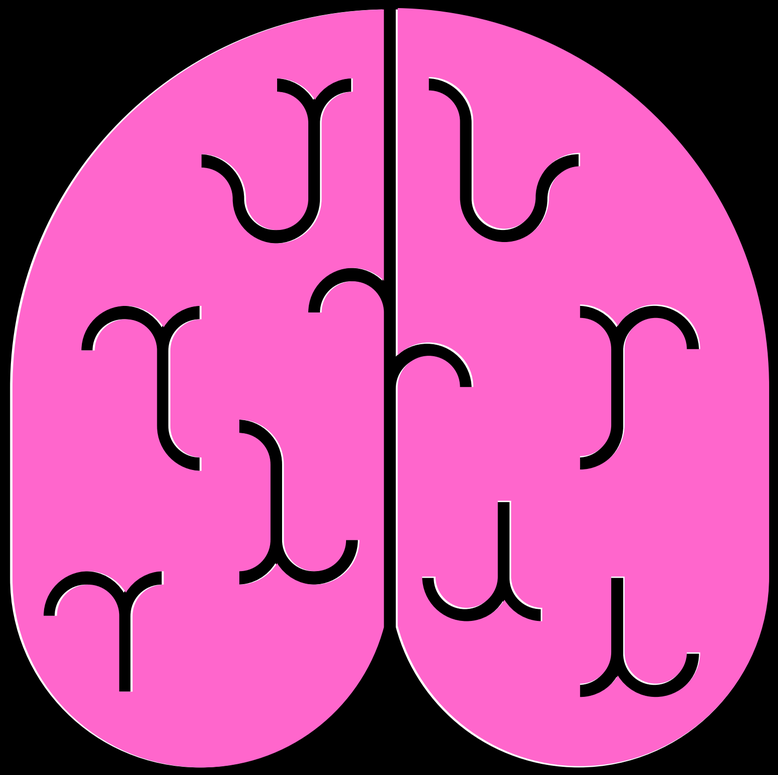
- Measure local electrical activity with scalp electrodes

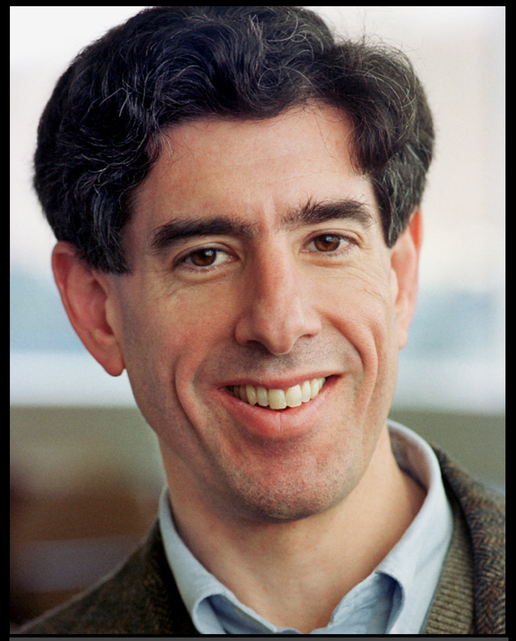
4. Functional Magnetic Resonance Imaging (fMRI)

- Measures amount of oxygenated blood in a brain area (metabolic activity = brain “activity”)

Initial Insights

Emotion and Asymmetry (EEG)





Richard Davidson
U Wisconsin - Madison

Left Brain

= Positive/Approach

Right Brain

= Negative/Avoidance

(With Some Exceptions
Anger = Left Brain Bias)

Mindfulness Meditation

- 8 week randomized controlled study in mindfulness meditation (vs. waitlist)
- Healthy adults
-Meditators show brain changes: increases in left-hemispheric activity

Davidson et al (2003)

How Its Unique Patterns Affect the Way You Think, Feel, and Live—and How You Can Change Them

THE EMOTIONAL LIFE OF YOUR BRAIN

RICHARD J. DAVIDSON, Ph.D.
with SHARON BEGLEY,
bestselling author of *Train Your Mind, Change Your Brain*

16th Annual Wisconsin Symposium on Emotion

Neuroplasticity of Emotion: Psychopathology & Treatment

April 21—22, 2010
Ebling Auditorium, on the campus of
University of Wisconsin—Madison

featuring:
Jennifer Beer, PhD
Richard J. Davidson, PhD
Ron Duman, PhD
John Krystal, MD
Richard Tremblay, PhD
Jon-Kar Zubieta, MD

HealthEmotions
Research Institute
University of Wisconsin

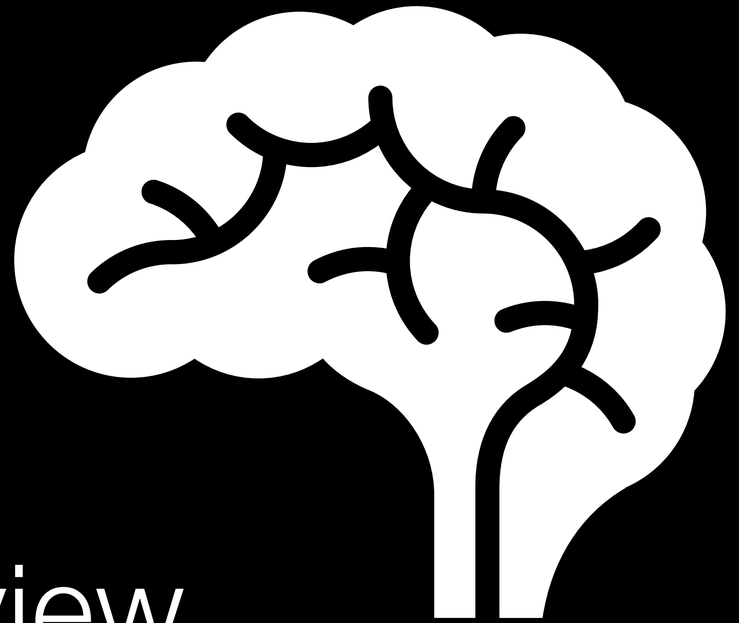
University of Wisconsin
SCHOOL OF MEDICINE
AND PUBLIC HEALTH
Department of Psychiatry

Visit the
Symposium Website
for details:
http://healthemotions.org/symposium

Roadmap

Tools to Study the Emotional Brain

Pleasure and Intensity



Emotion Regulation

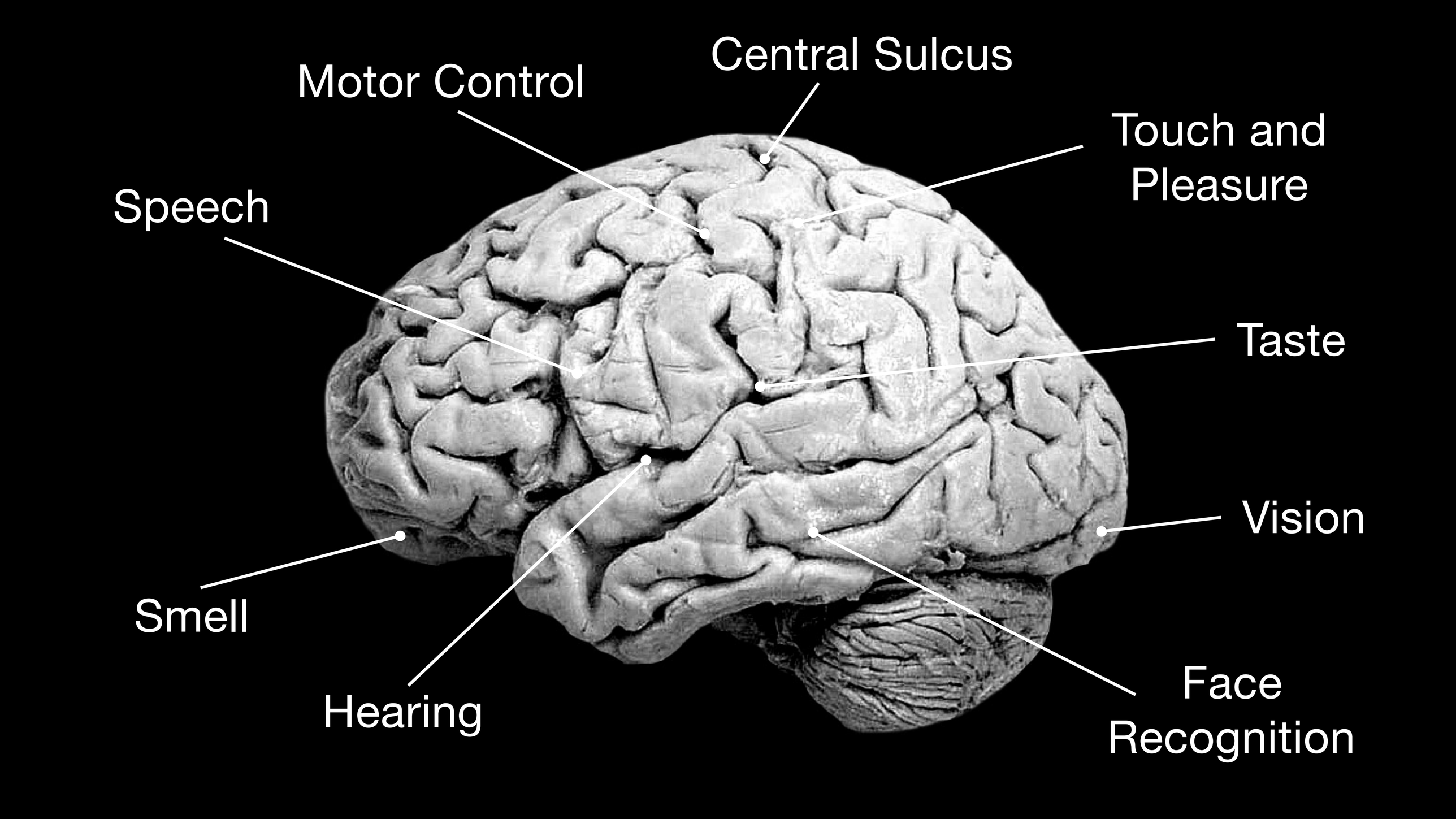
Take-Away Qs & Expert Interview

DESCARTES' ERROR

Emotion, Reason, and the Human Brain

"Antonio Damasio is a profound thinker and an elegant writer... *Descartes' Error* is a fascinating exploration of the biology of reason and its inseparable dependence on emotion."
—Oliver Sacks, author of *An Anthropologist on Mars*

ANTONIO R. DAMASIO


Central Sulcus
Motor Control
Touch and Pleasure
Speech
Taste
Vision
Smell
Hearing
Face Recognition

The Nervous System

Central Nervous System

BRAIN +
SPINAL CORD

Peripheral Nervous System

ALL OTHER
NERVES

Autonomic Nervous System

Monitors internal world; carries out automatic processes.

Somatic Nervous System

Monitors external world; carries out voluntary processes.

Sympathetic Nervous System

Facilitates energy expenditure (flight or flight)

Parasympathetic Nervous System

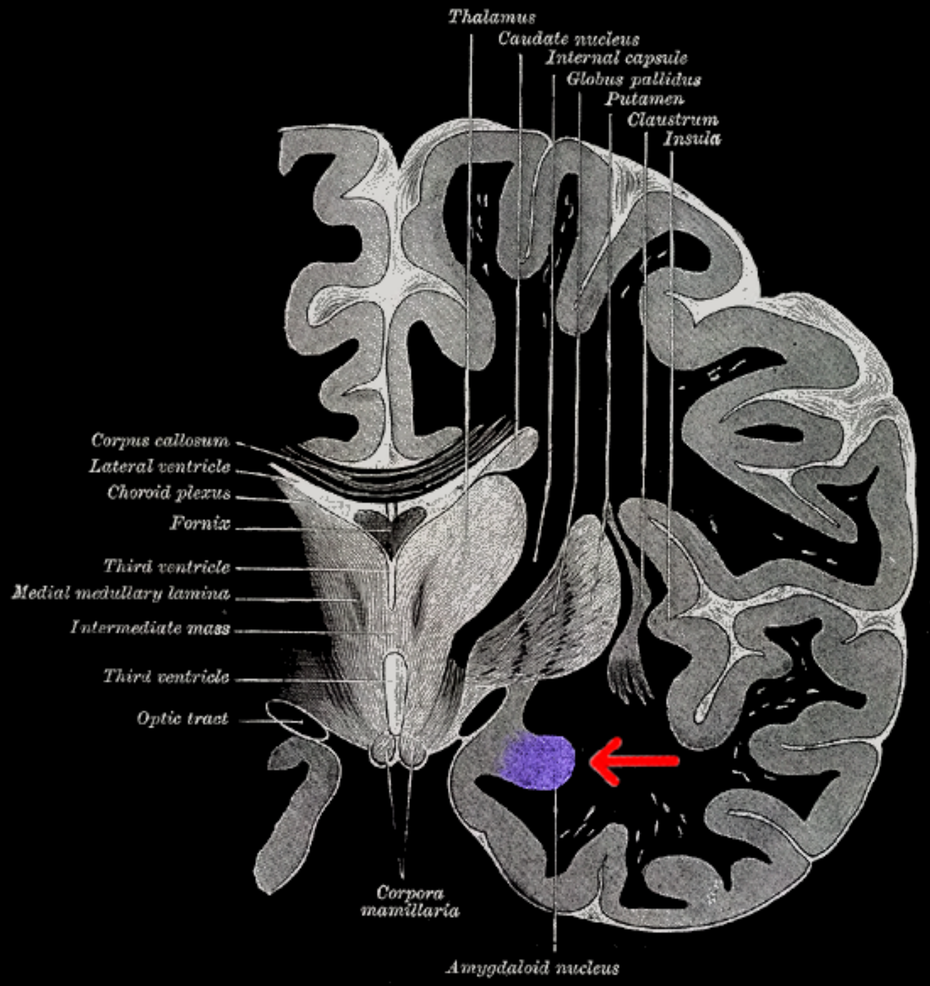
Facilitates energy storage (rest and digest)

I. Limbic system

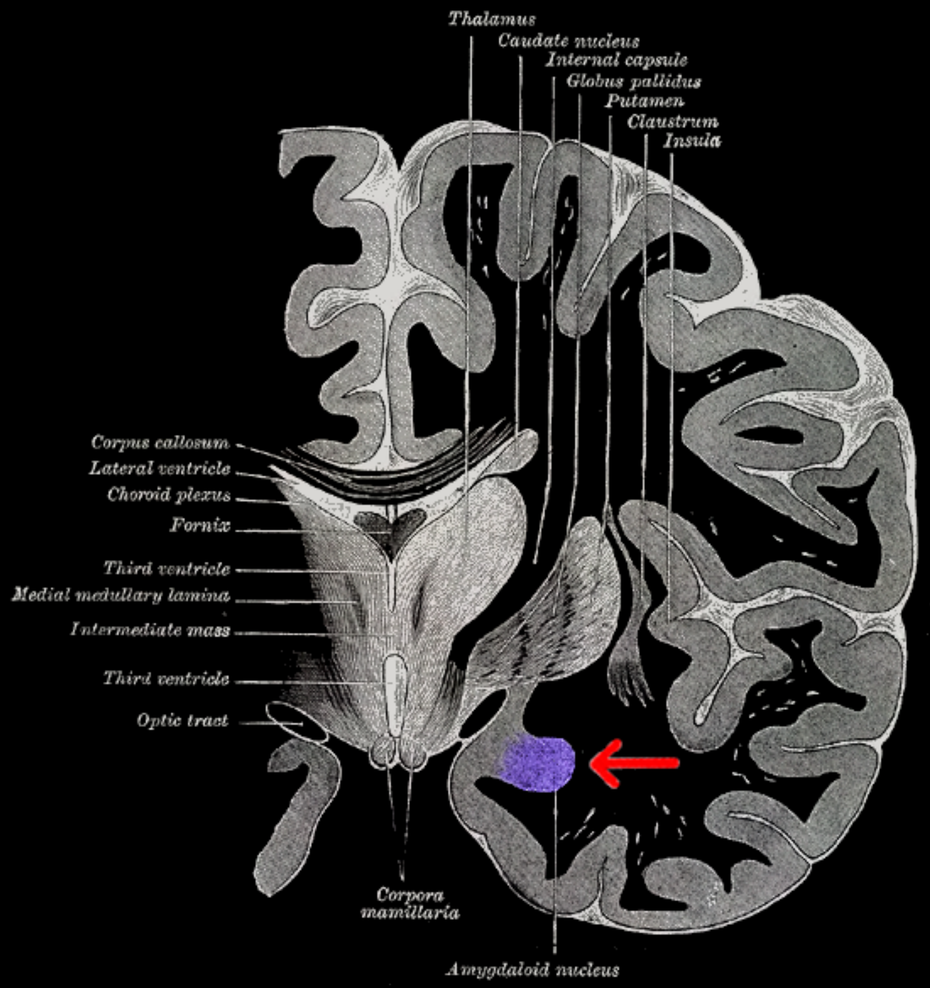
- Includes the hypothalamus, hippocampus, **amygdala**, nucleus accumbens, and several other nearby areas

- Has great importance in emotional life and memories for emotional events

Amygdala


Thalamus
Caudate nucleus
Internal capsule
Globus pallidus
Putamen
Claustrum
Insula
Corpus callosum
Lateral ventricle
Choroid plexus
Fornix
Third ventricle
Medial medullary lamina
Intermediate mass
Third ventricle
Optic tract
Corpora mamillaria
Amygdaloid nucleus

Amygdala



EMOTION INTENSITY - 4 PARTS

1. Emotional Reactivity
2. Emotional Perception
3. Emotional Learning
4. Emotional Salience

I. Amygdala and Emotional Reactivity

Kluver-Bucy Syndrome

Originally in monkeys

(amygdala surgically removed)

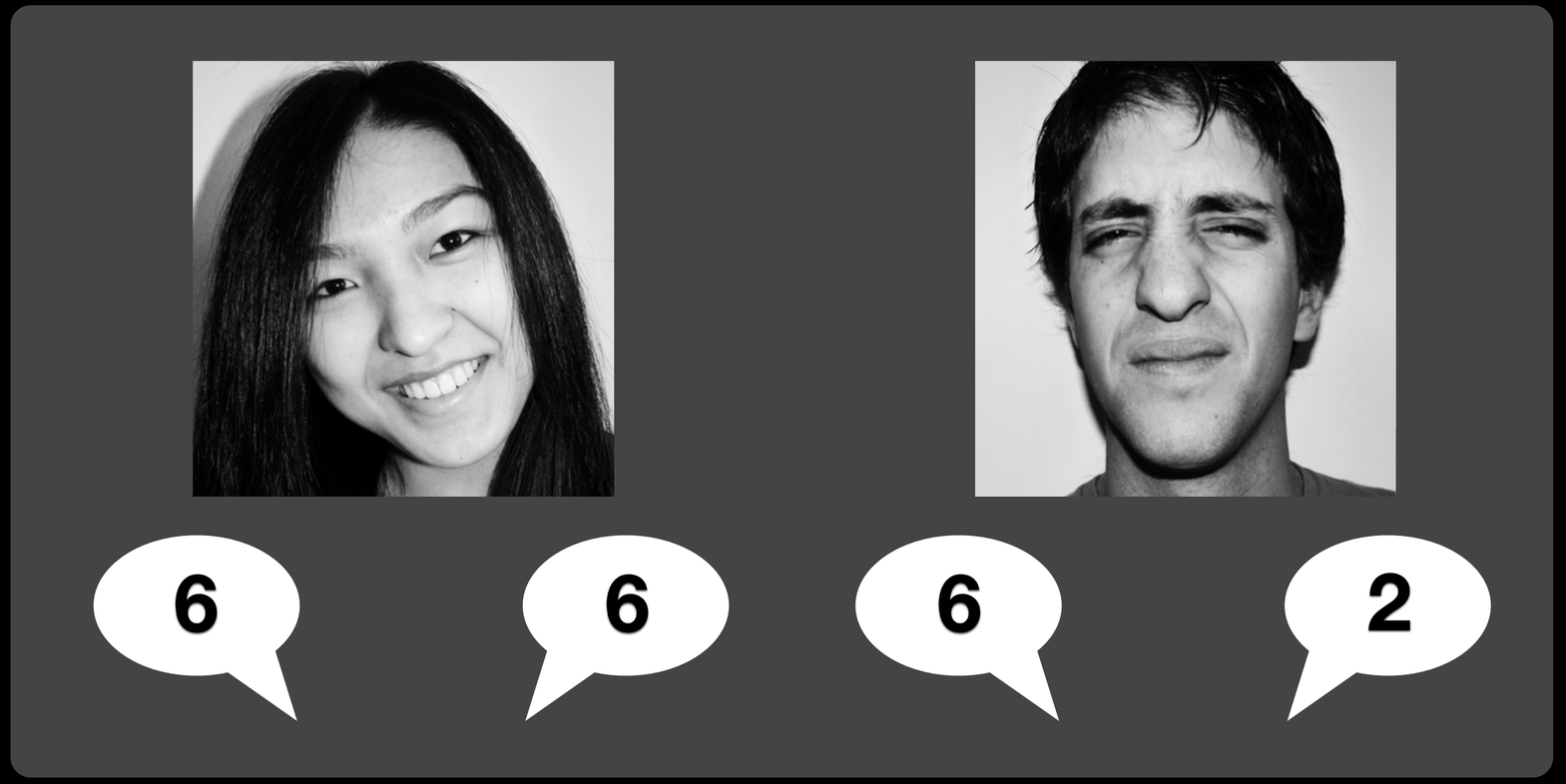
- tameness & lack of fear
- indiscriminate eating patterns
- greatly increased & inappropriate sexual behavior
- tendency to attend & react to all visual stimuli
- Also in humans (e.g., accidents, tumors, stroke, encephalitis)

Adolphs et al., 2008

I. Amygdala and Emotional Reactivity

Adolphs et al., 2008

II. Amygdala and Emotion Perception

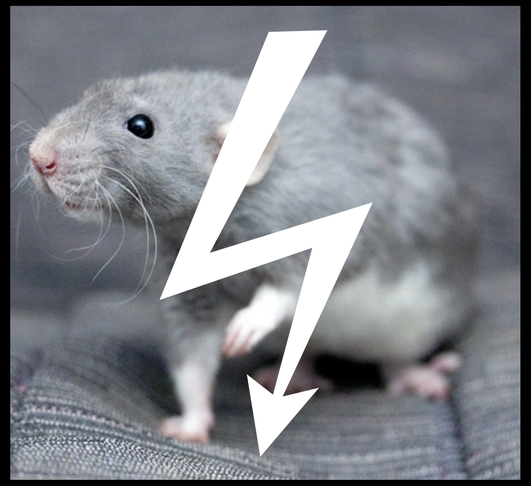


Damage to Amygdala = Impaired Emotion Perception

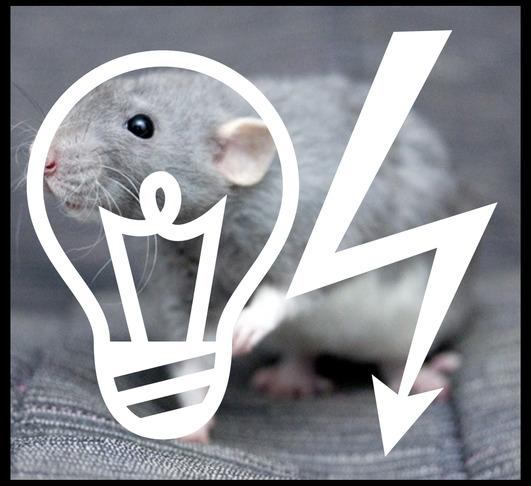
**Especially for Fear

Adolphs et al., 2008

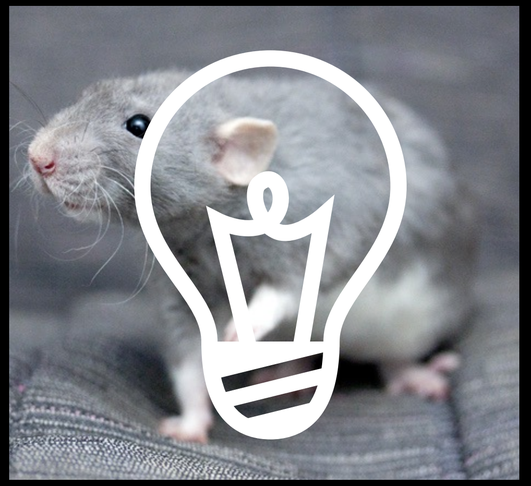
III. Amygdala and Emotional Learning



FEAR RESPONSE



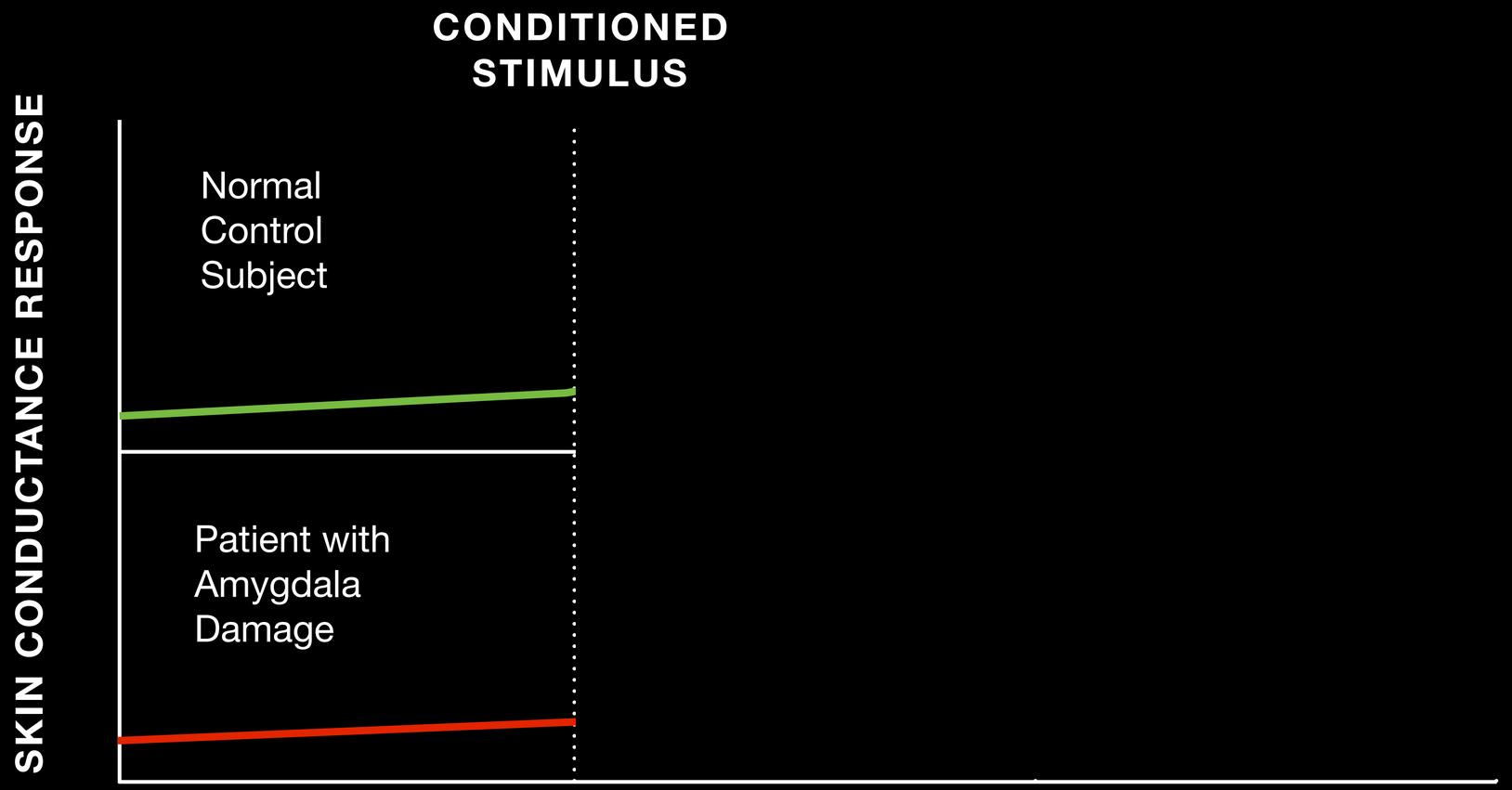
FEAR RESPONSE



FEAR RESPONSE

LeBar et al., 1995; Olsson et al., 2007; Phelphs et al., 2001

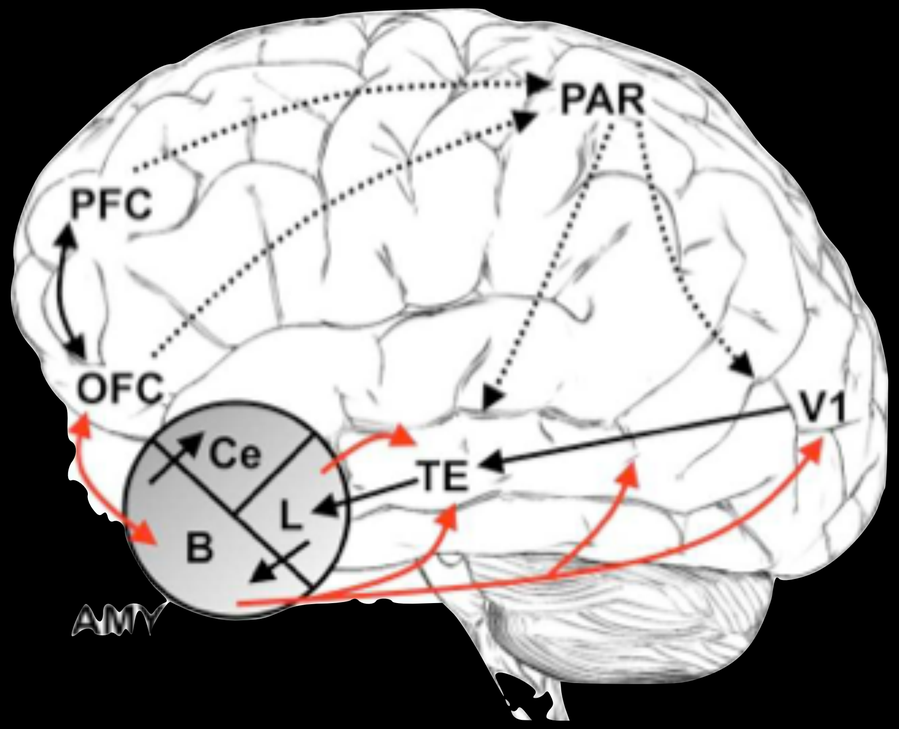
III. Amygdala and Emotional Learning



LeBar et al., 1995; Olsson et al., 2007; Phelphs et al., 2001

IV. Amygdala and Emotion Salience

Is Amygdala Specific to Fear?



- Heavily implicated in fear response
- But also implicated in other emotional responses, some positive.
- Suggest amygdala function is involved in processing stimulus relevance for the goals and motivation of person
- Amygala guides processing of salient stimuli to orchestrate appropriate emotion

Image Courtesy of William Cunningham

(Cunningham & Brosch, 2012)

IV. Amygdala and Emotion Salience

Is Amygdala Specific to Fear?

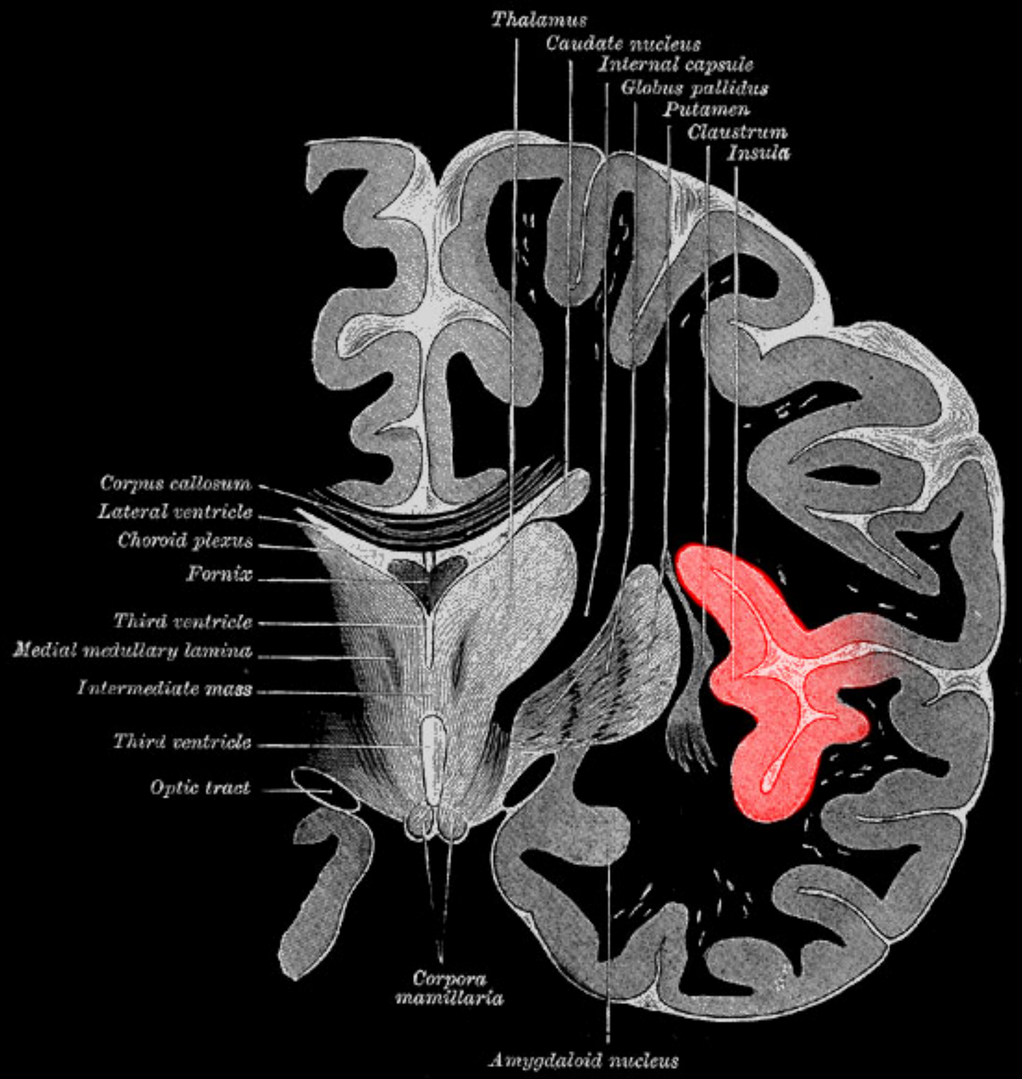
“In anticipation of the 2008 presidential election, we used functional magnetic resonance imaging to watch the brains of a group of swing voters as they responded to the leading presidential candidates... When we showed the subjects the words ‘Democrat,’ ‘Republican’, and ‘Independent,’ they exhibited high levels of activity in the part of the brain called the amygdala, inducing anxiety.”

NEW YORK TIMES, NOV. 11 2007, This Is Your Brain on Politics

Cunningham & Brosch (2012)

Other Important Limbic Regions

Insula
Implicated in *experience* and *perception* of disgust

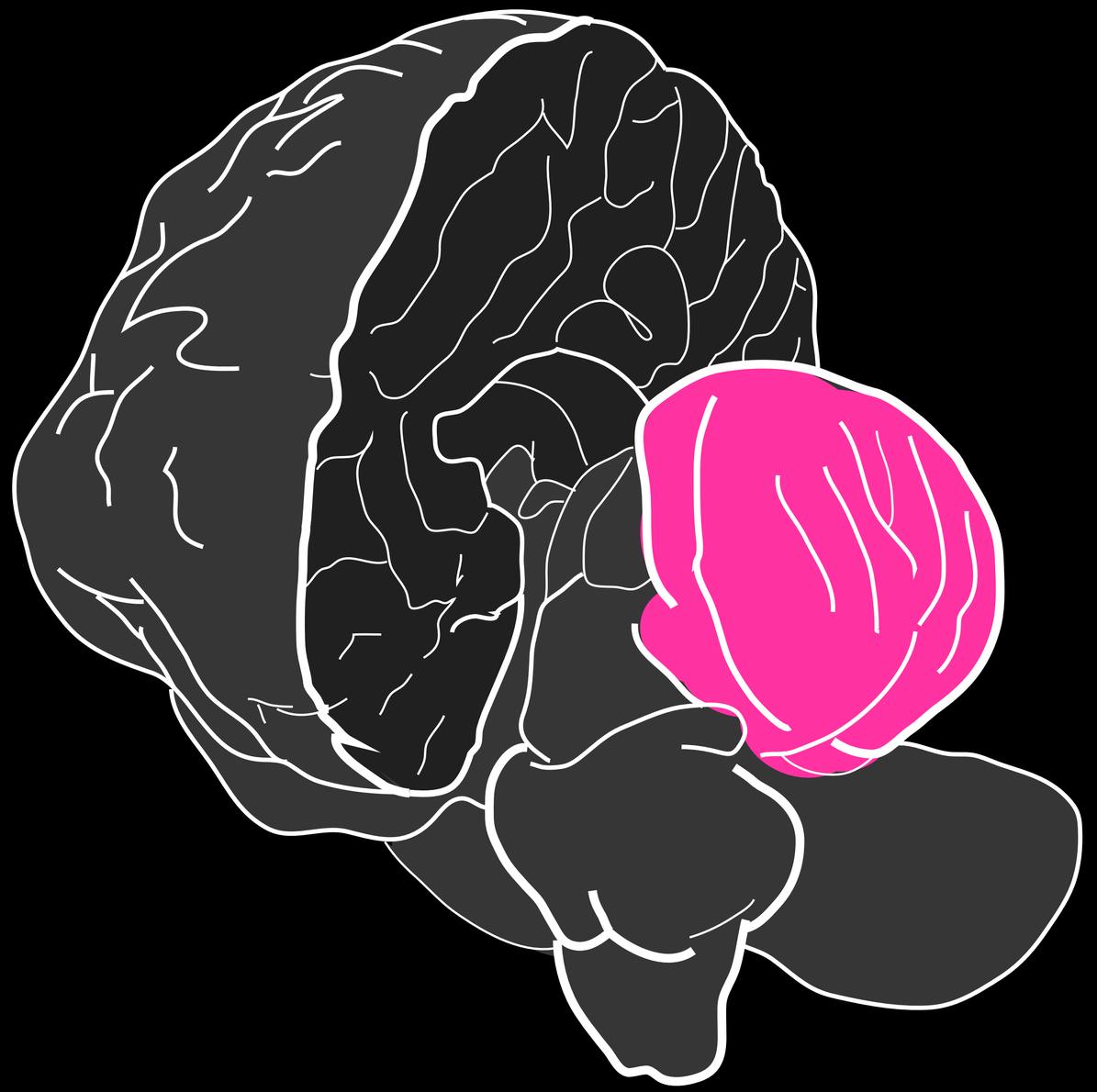


Other Important Limbic Regions

Anterior Cingulate
Implicated in sad and happy memories

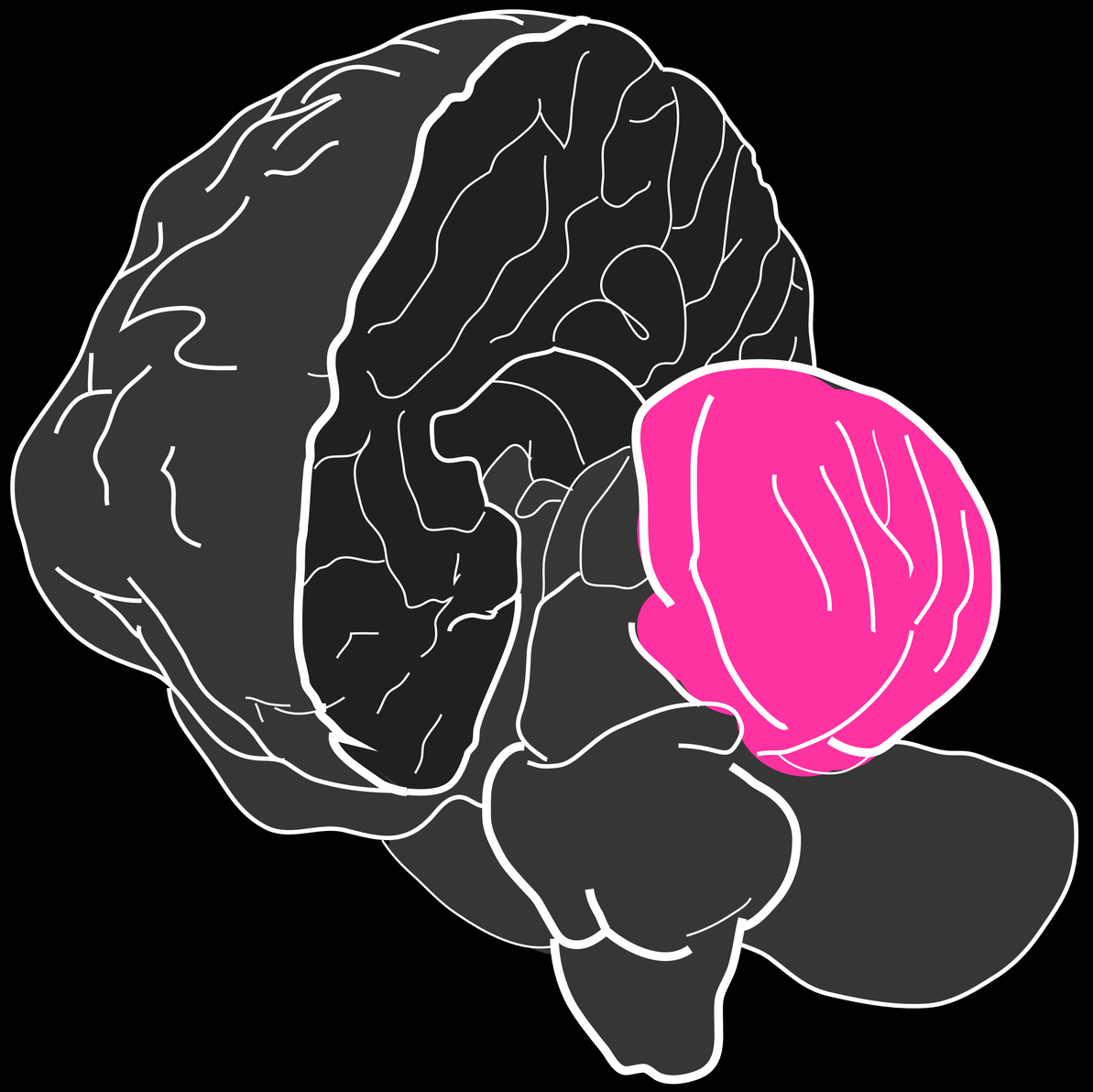
II. Striatal System (Striatum)

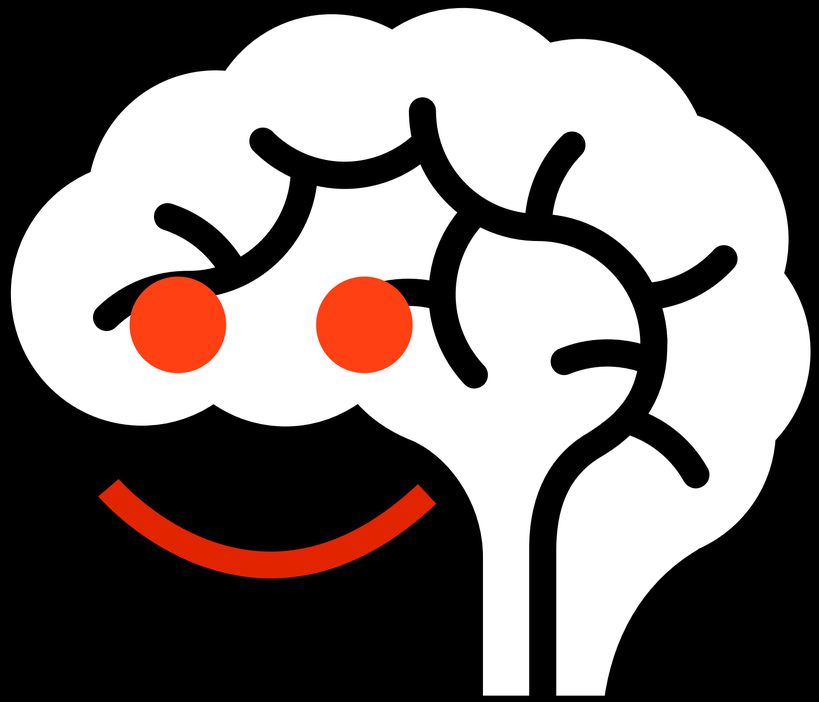
- includes putamen
- includes caudate nucleus
- includes nucleus accumbens
- divided into dorsal and ventral striatum



Striatal System

“Pleasure center”





Tale of Two Pleasures

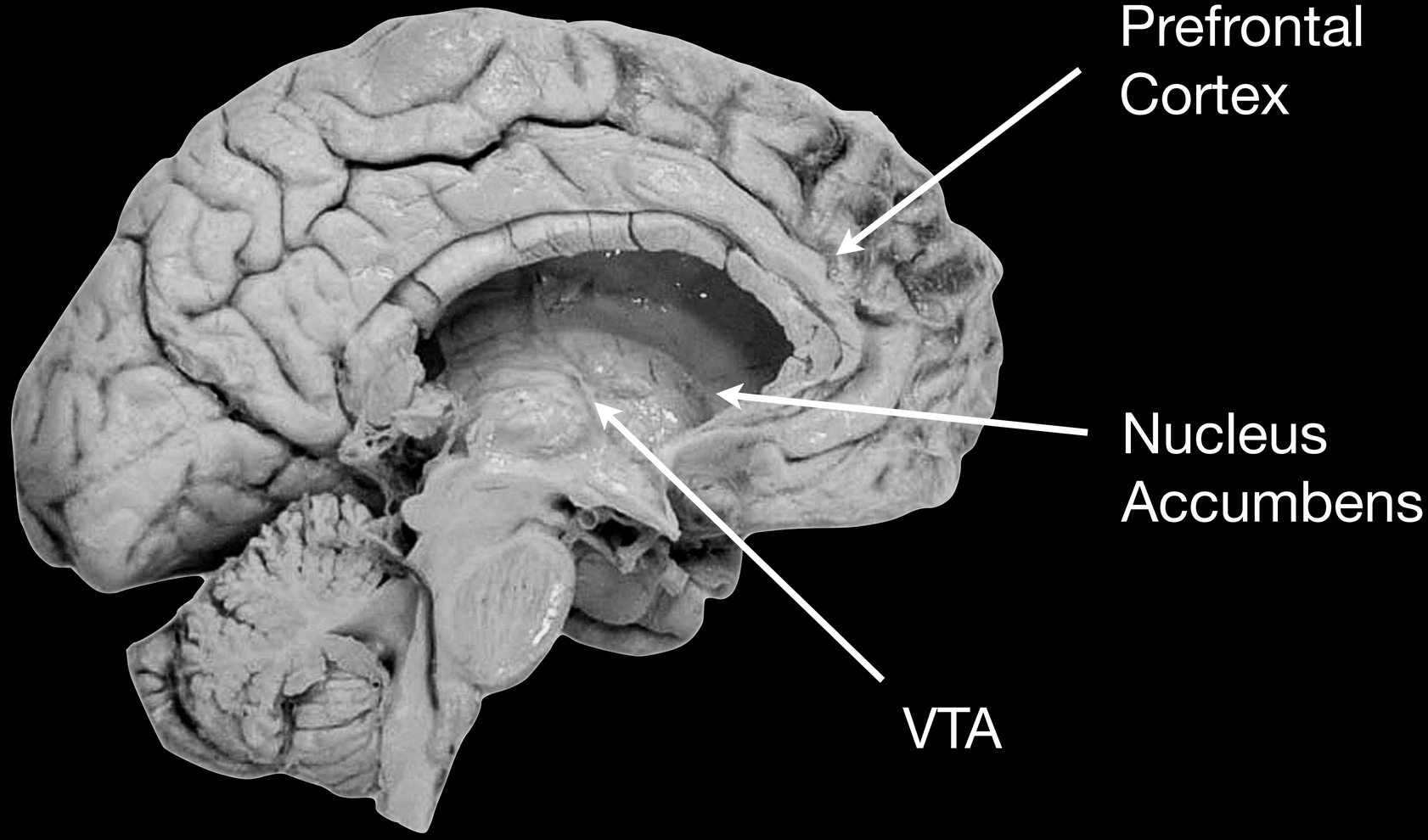
ANTICIPATORY
(Wanting)

CONSUMMATORY
(Liking)

Doggie Smiling Idea Courtesy of Sunny Dutra

ANTICIPATORY
(Wanting)

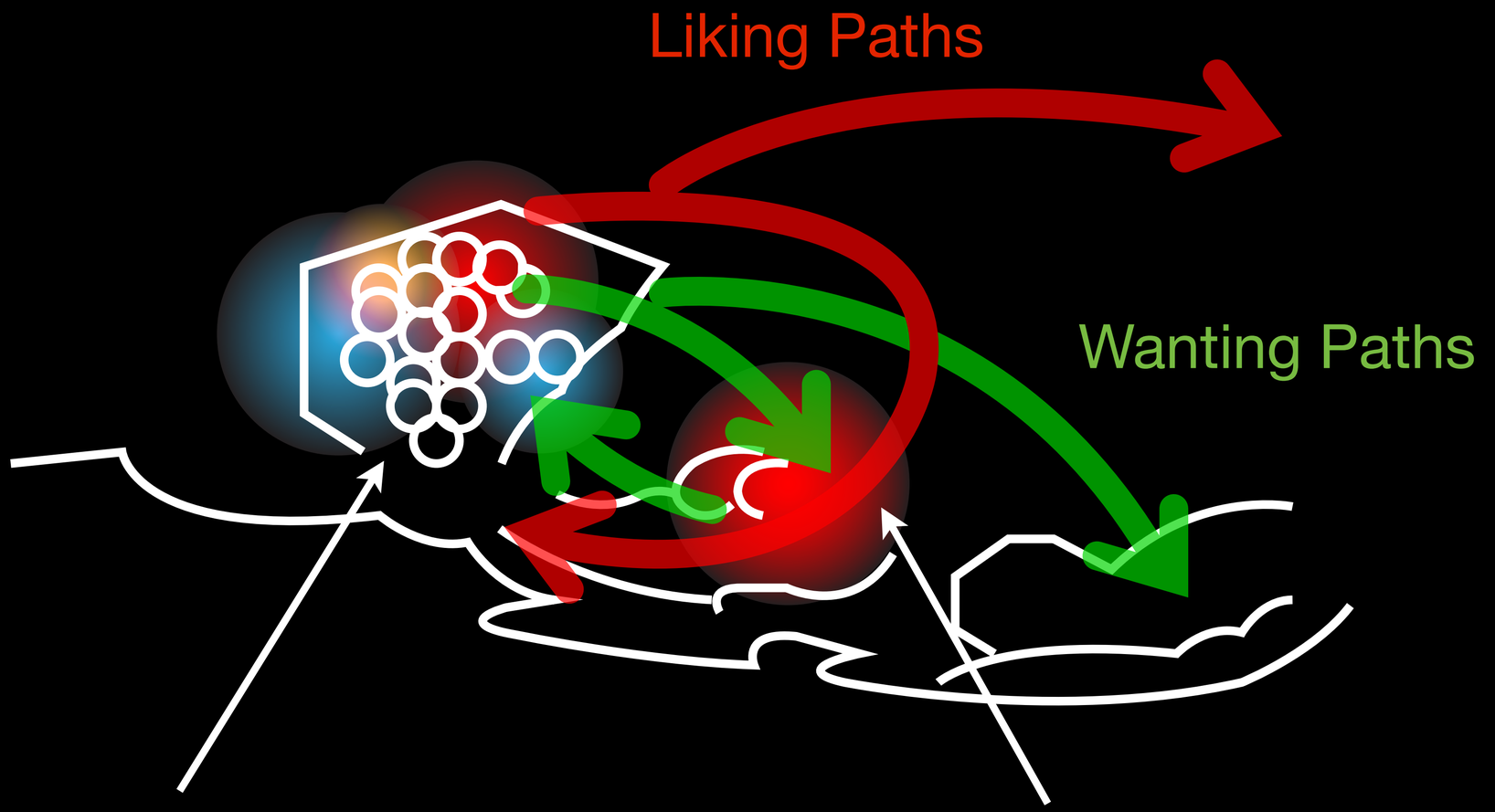
“Wanting” - Anticipatory Pleasure



Berridge & Robinson, 1998; Schultz, 2002; Wise, 2002

CONSUMMATORY
(Liking)

“Liking” - Consummatory Pleasure



Nucleus Accumbens Hotspot **Ventral Pallidium Hotspot**

Berridge & Robinson, 1998; Schultz, 2002; Wise, 2002

Too Much Wanting? Substance Abuse

Berridge & Robinson, 1998; Schultz, 2002; Wise, 2002

Other Varieties of Pleasure?

Happiness?

Well-Being?

ASPEN IDEAS FESTIVAL

GO

WORLD | U.S.A. | ENVIRONMENT | TECHNOLOGY | SCIENCE | HEALTH | EDUCATION | ARTS | ECONOMY | SOCIETY | FESTIVAL

BIOLOGY | MEDICINE | PHYSICS | SPACE

The Neuroscience of Happiness

Is happiness a skill? Modern neuroscientific research and the wisdom of ancient contemplative traditions converge in suggesting that happiness is the product of skills that can be enhanced through training and such training exemplifies how transforming the mind can change the brain.

Speakers: Kent Berridge, Richie Davidson, Daniel Gilbert

Festival: 2011

MORE ON THIS SESSION

Read transcript now

Download Transcript

http://www.aspenideas.org/session/new-neuroscience-happiness

III. Neocortex

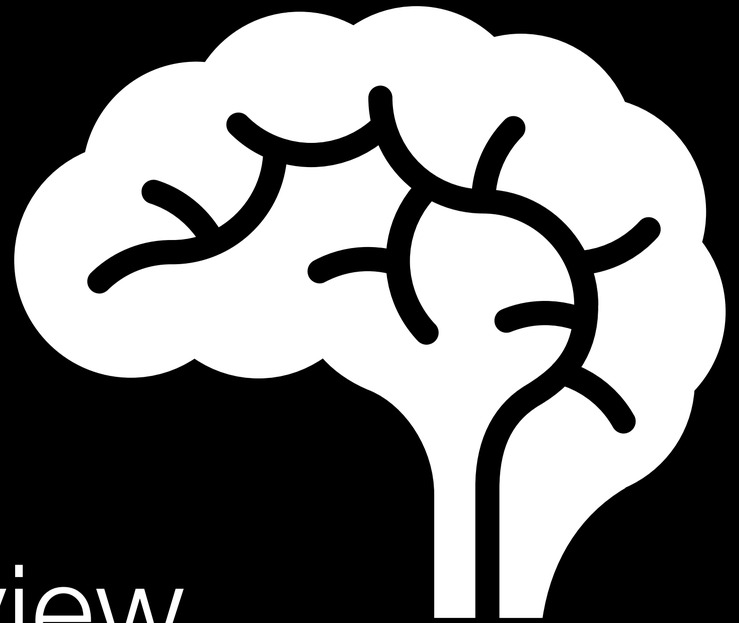
- Outer layer of the brain, deeply folded, the prefrontal cortex is in the front part of the brain
- Involved in regulation of emotion

Roadmap

Tools to Study the Emotional Brain

Pleasure and Intensity

Emotion Regulation

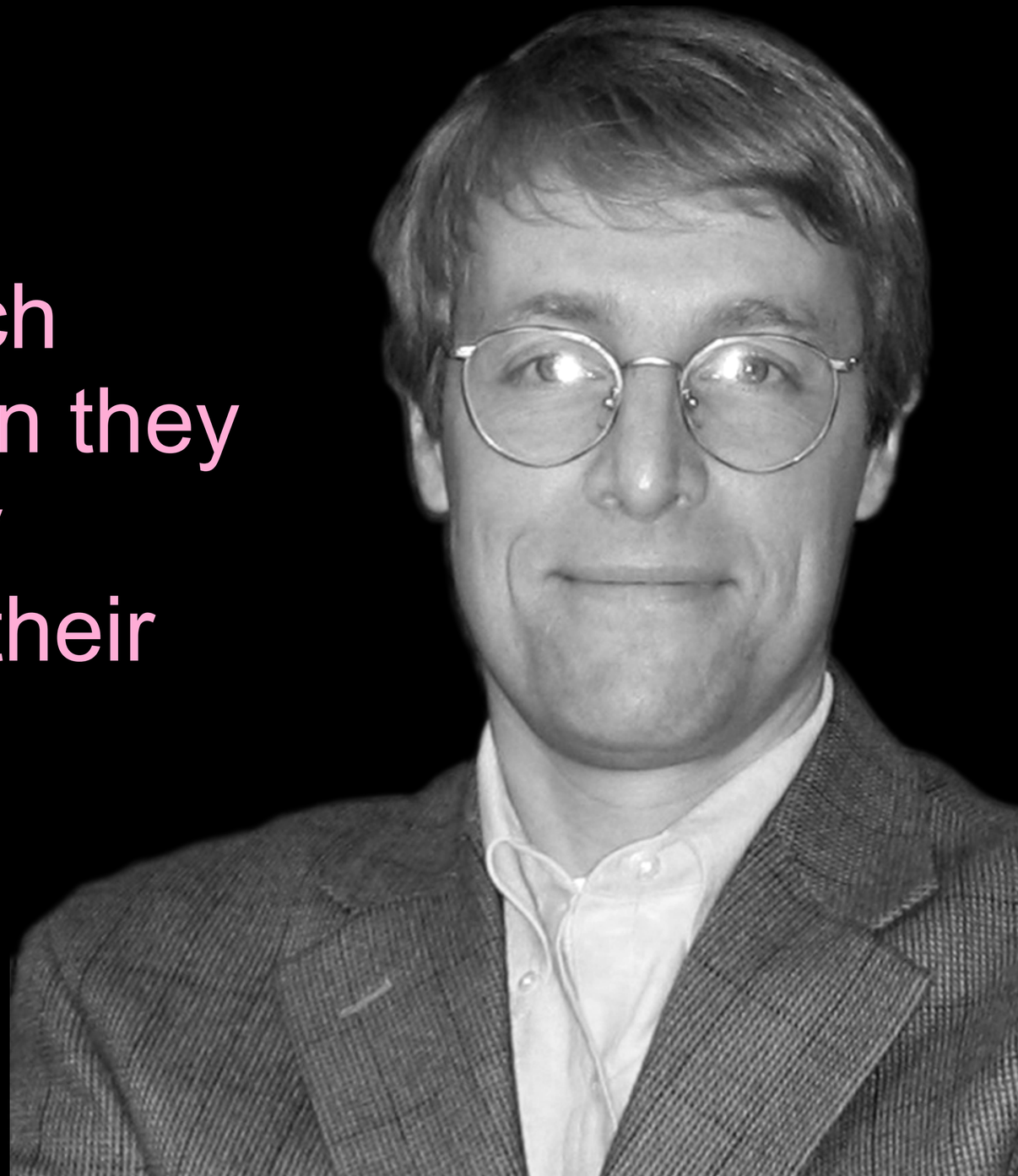


Take-Away Qs & Expert Interview

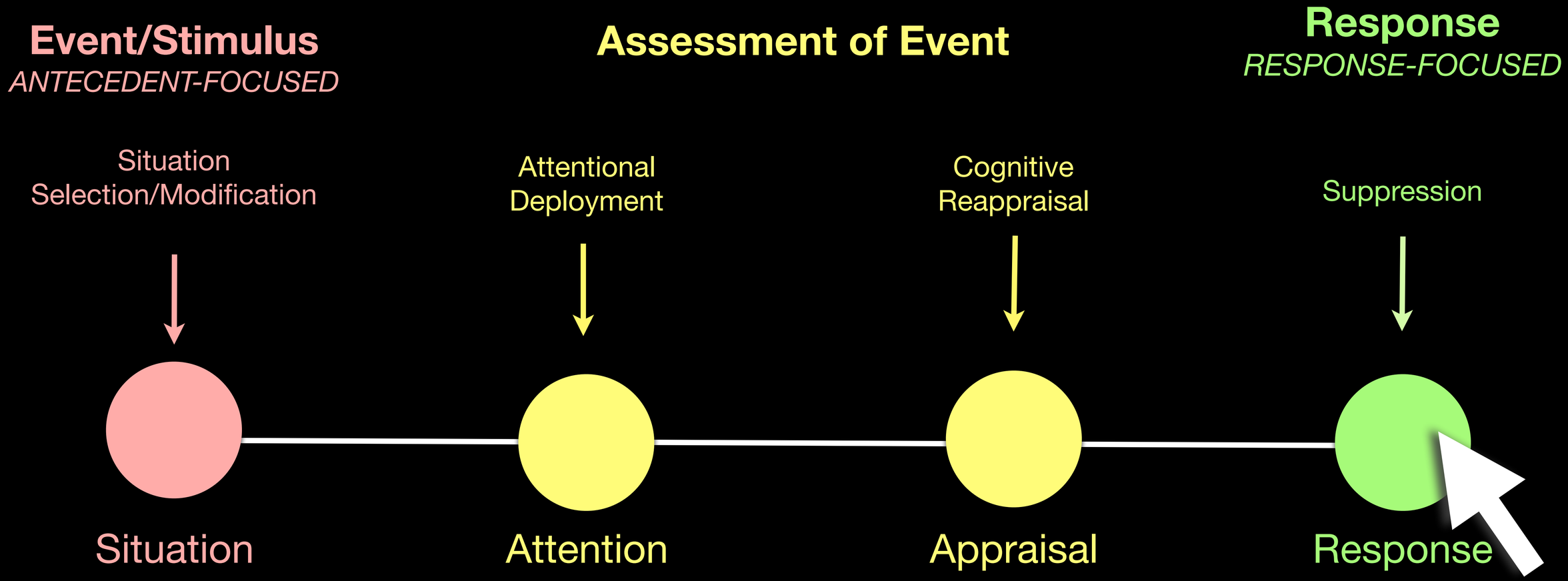
Prefrontal Cortex

“The processes by which individuals influence which emotions they have, when they have them, and how they experience and express their emotions”

(Gross, 1998).

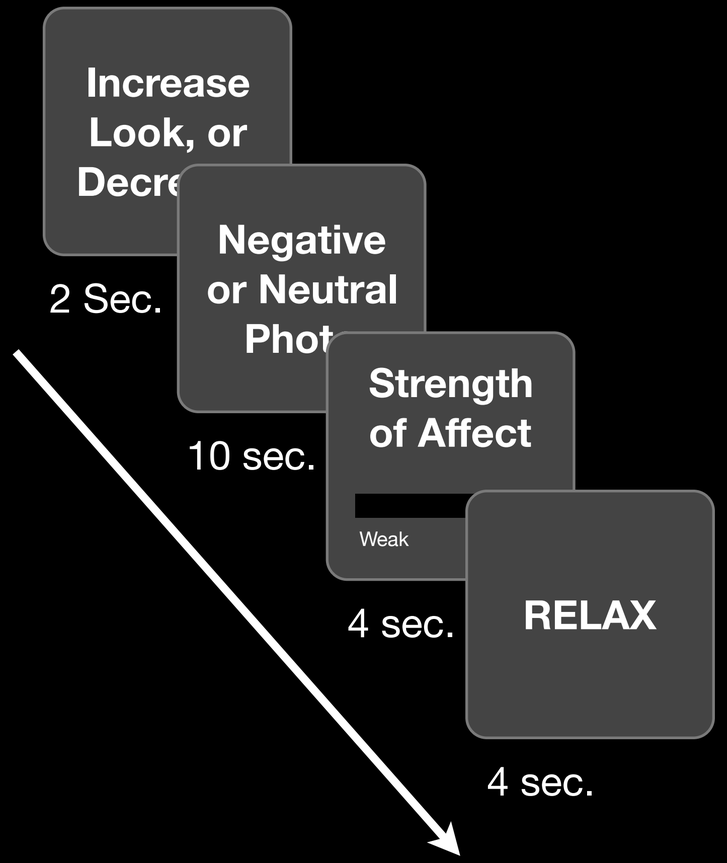


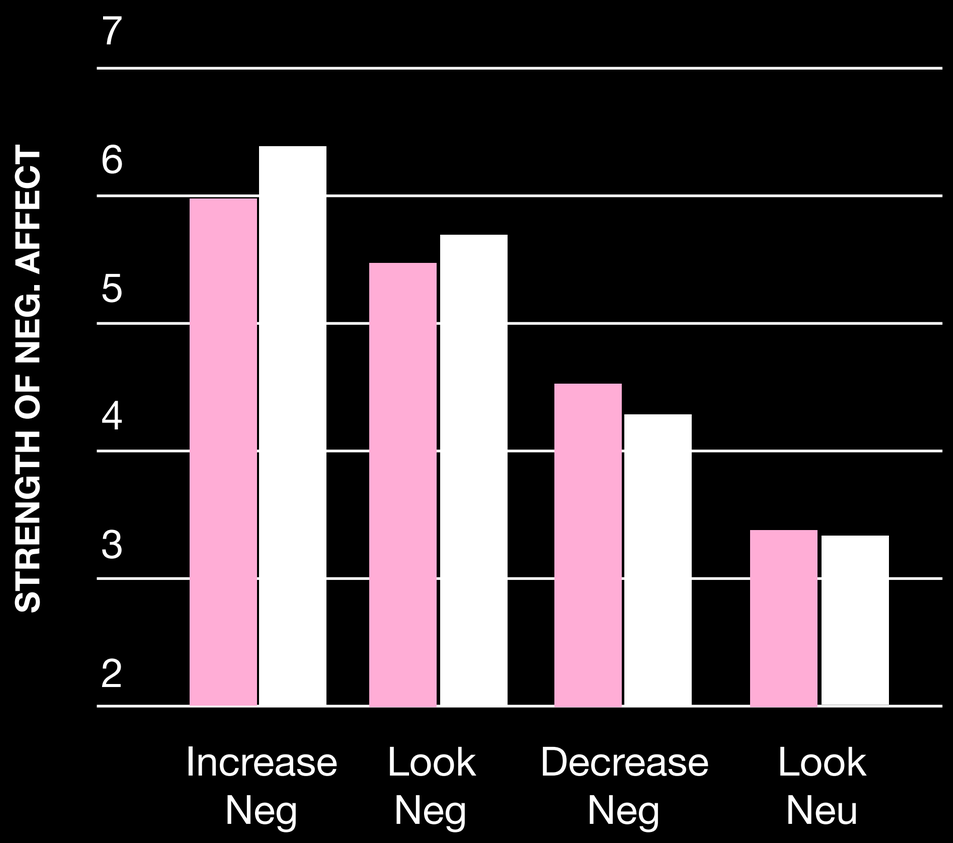
Process Model of Emotion Regulation



Gross, 1998; Gross & Munoz, 1995

fMRI Studies of Emotion Regulation





INCREASE NEG
Think about image in a way that makes you feel more negative

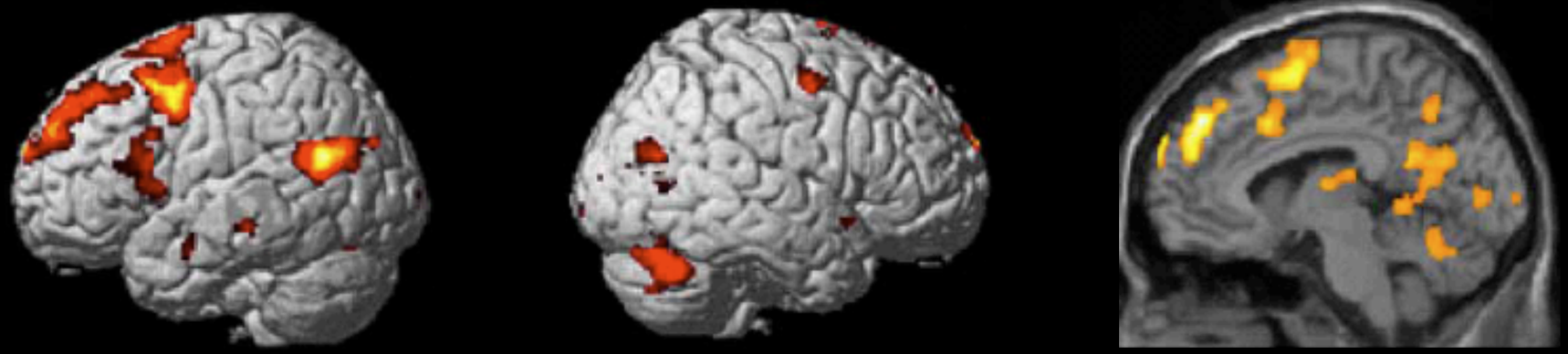
DECREASE NEG
Think about image that makes you feel less negative

LOOK NEG (NEU)
Observe image naturally

Ochsner et al., (2004)

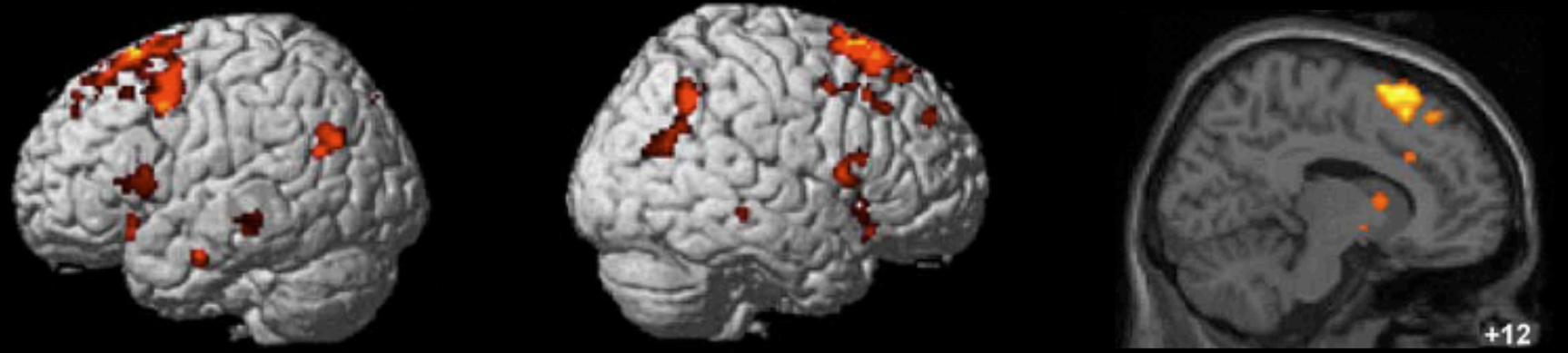
fMRI Studies of Emotion Regulation

Increase Neg > Look Neg



Lateral PFC
Anterior Cingulate

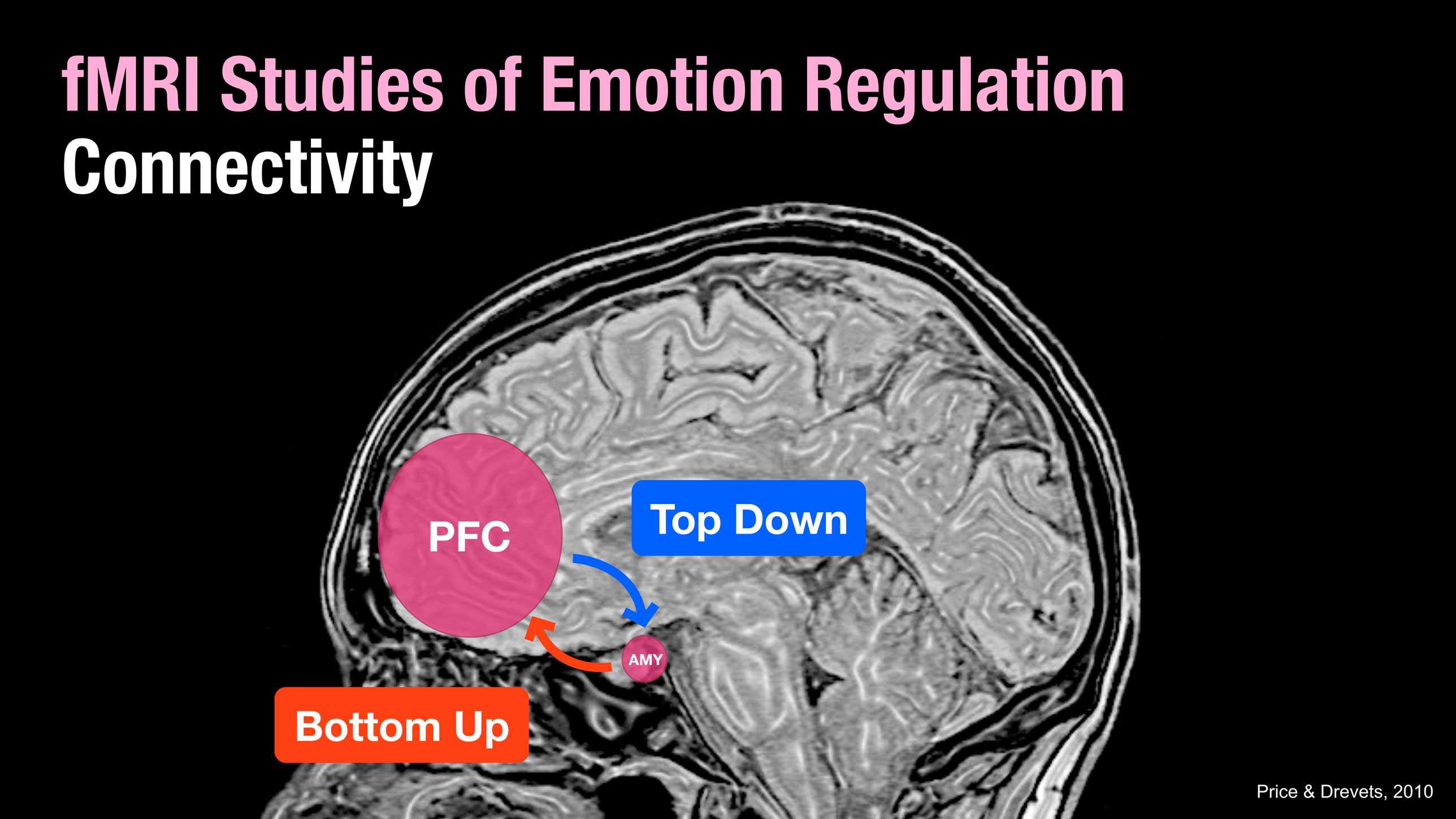
Decrease Neg > Look Neg



Images Courtesy of Kevin Ochsner

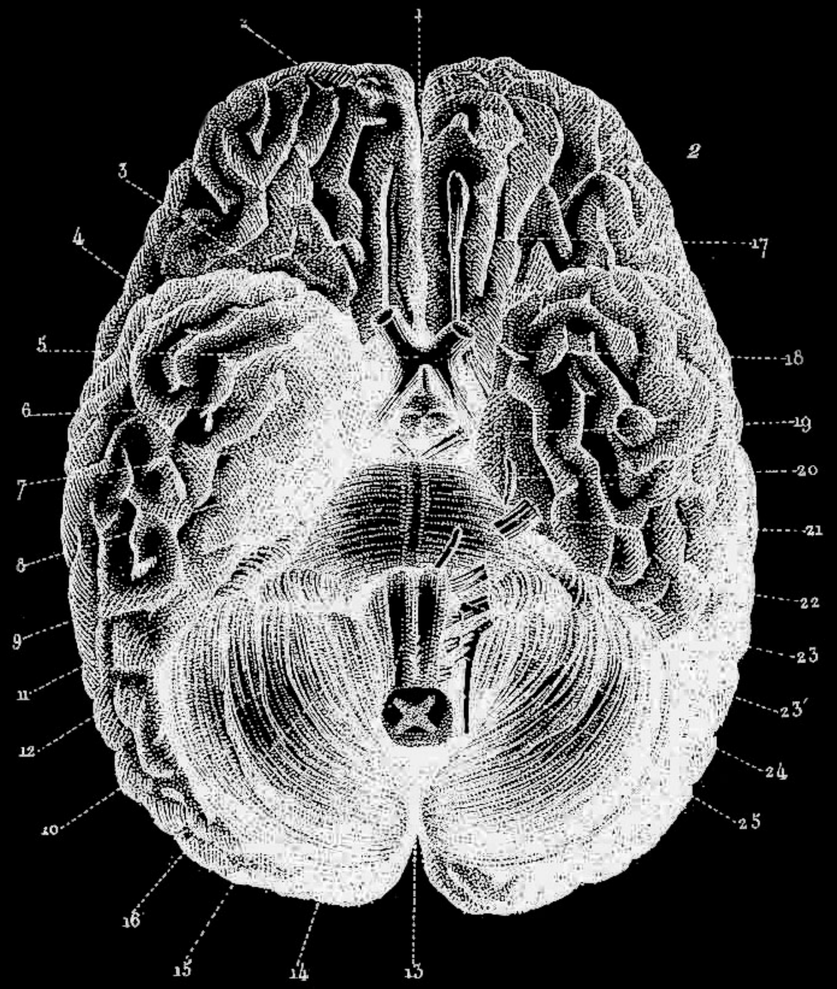
fMRI Studies of Emotion Regulation

Connectivity



Price & Drevets, 2010

Lesion Studies of Emotion Regulation



Involved in emotion regulation

Patients with OFC damage/lesions exhibit trouble regulating emotions

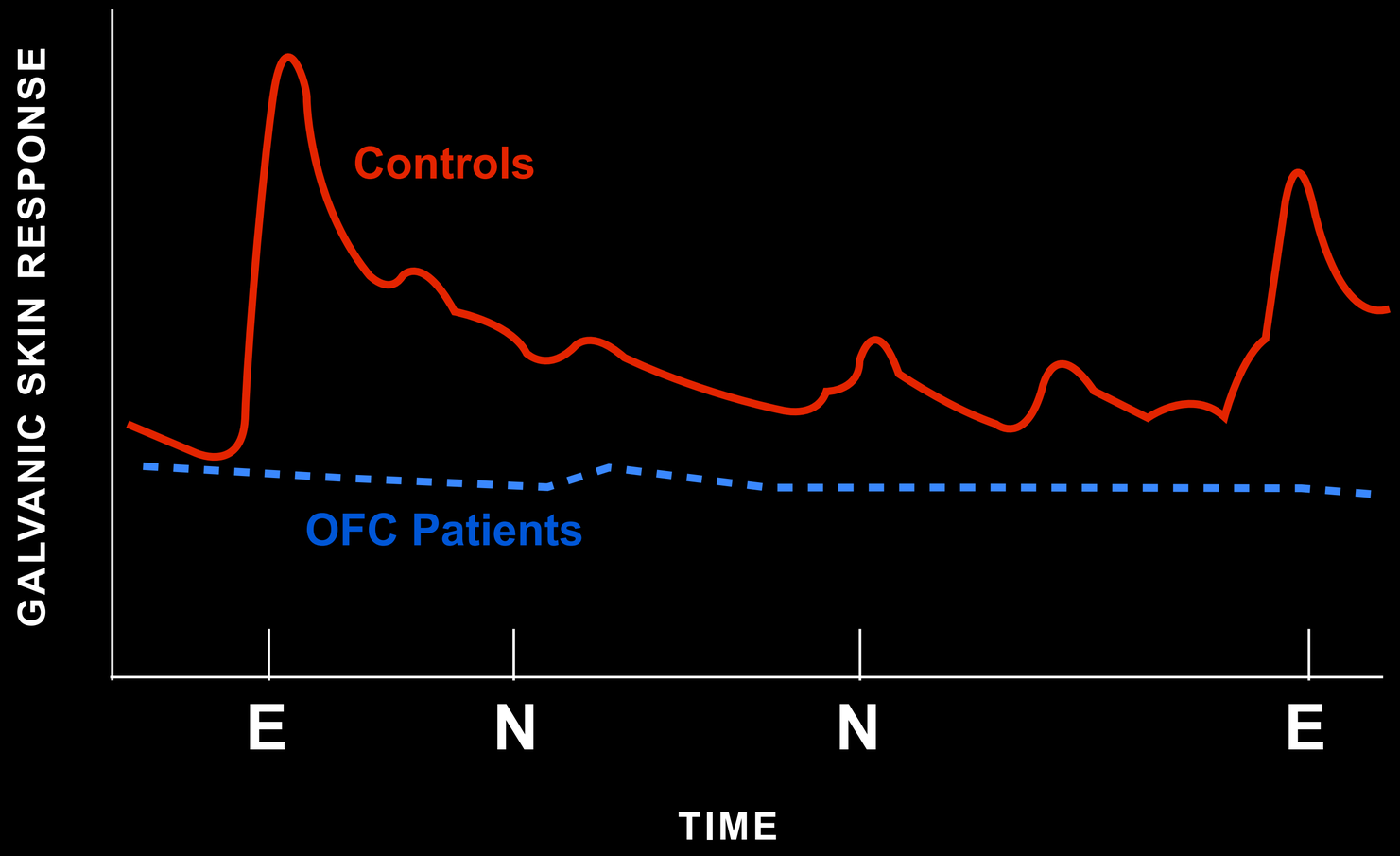
- greet strangers by kissing
- engage in inappropriate joking
- disclose to strangers

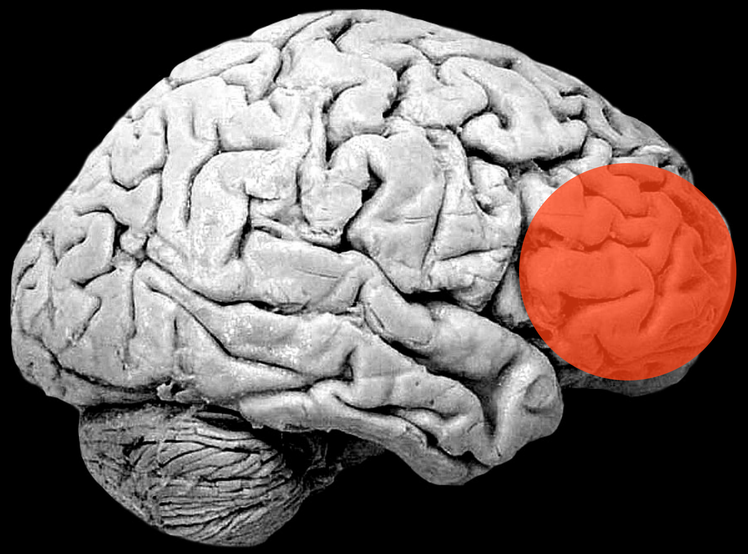
Teasing Study (Jennifer Beer)

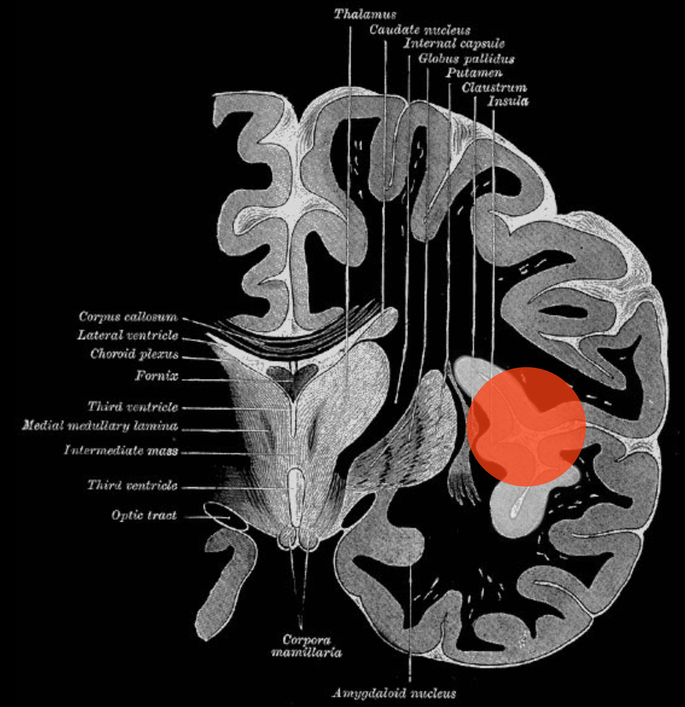
- OFC patient: Asked to generate nickname for stranger & tease them with this nickname.
- Teased in overly forward/sexual manner
- Showed low embarrassment levels

Beer et al. (2006)

Lesion Studies of Emotion Regulation






Thalamus
Caudate nucleus
Internal capsule
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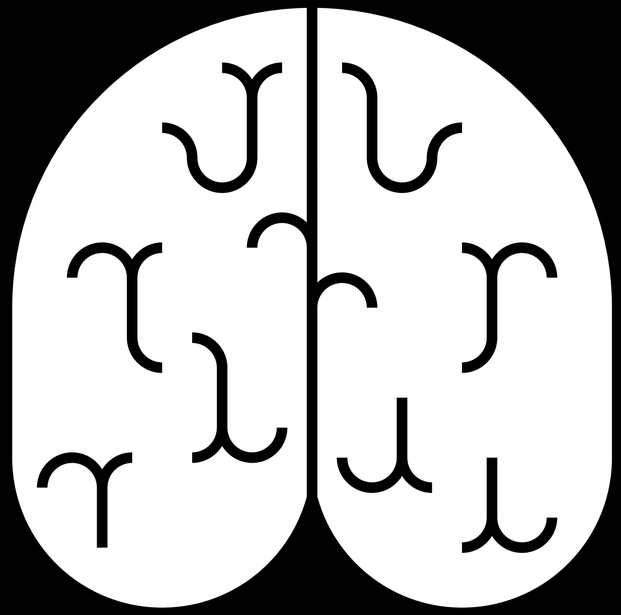


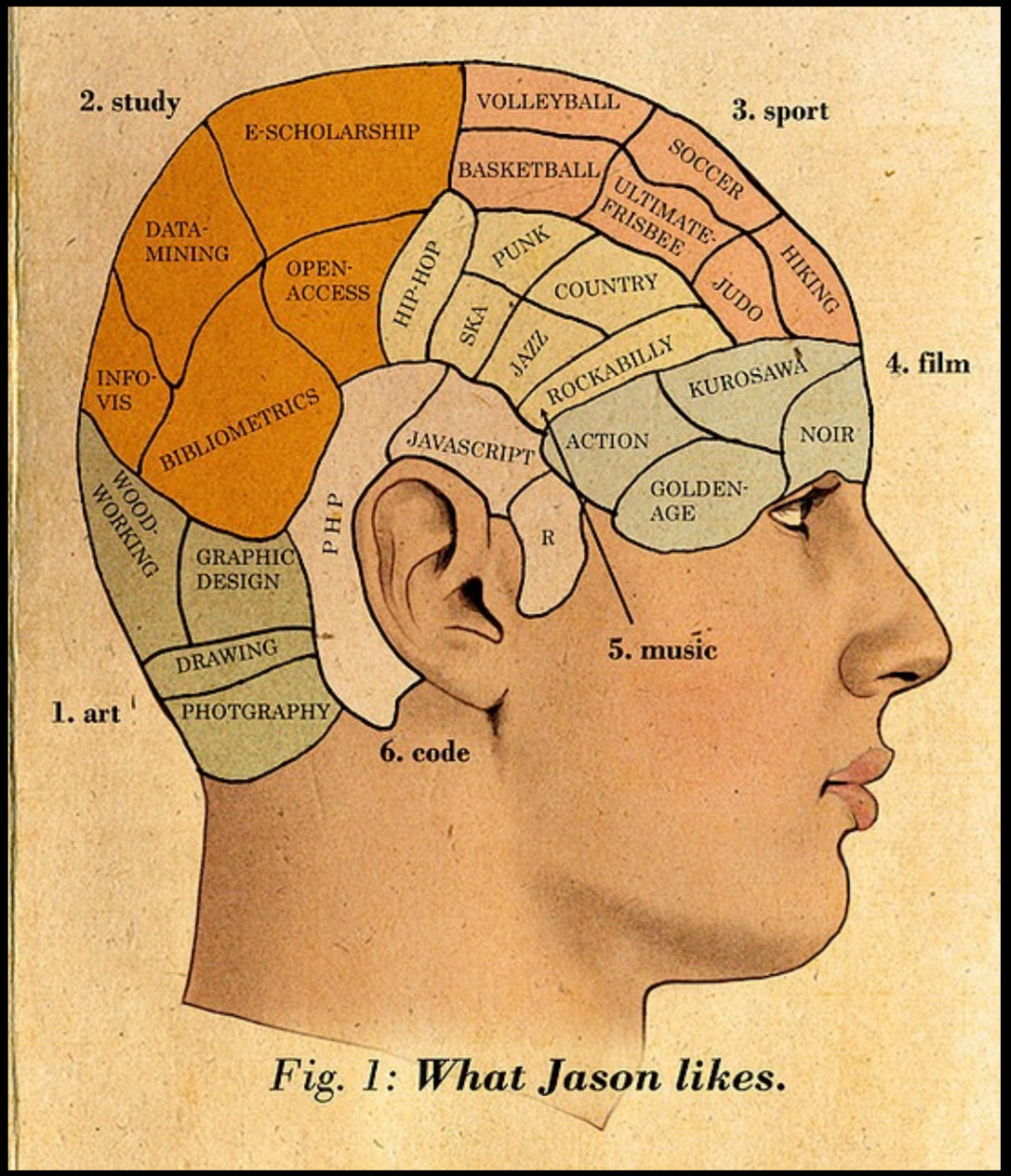
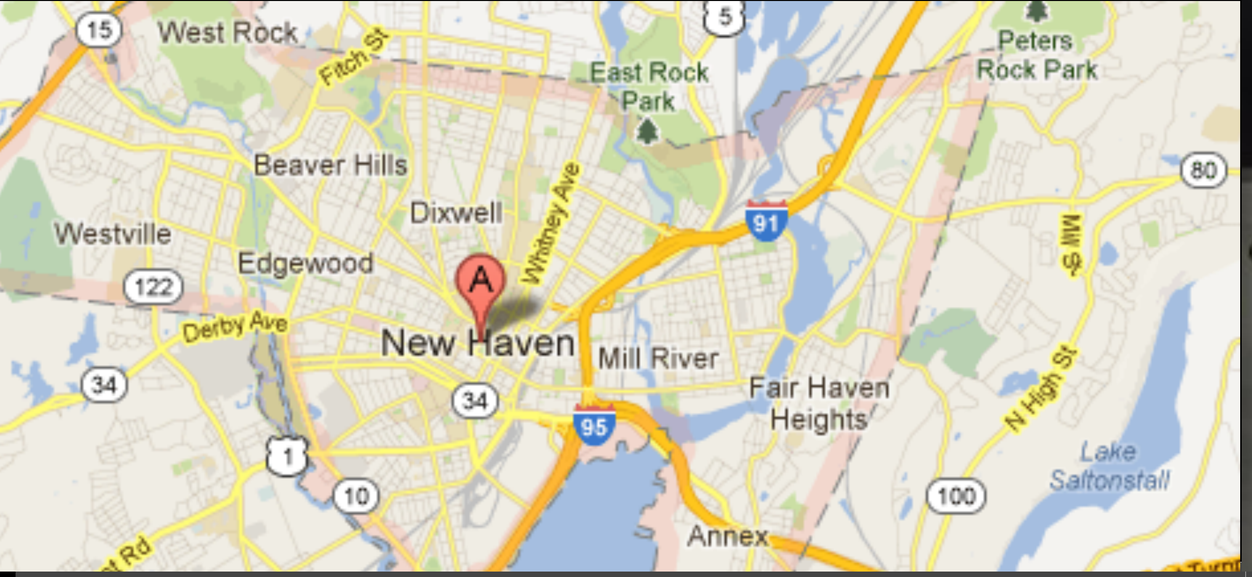


Fig. 1: ***What Jason likes.***

Emotion Specificity?



LOCATIONIST

-Distinct emotion categories (including happiness, sadness, fear, anger, and disgust) are biologically basic.

-Emotions can be localized to specific brain regions (or defined networks)

-Every basic emotion has specific physiological response

PSYCHOLOGICAL CONSTRUCTIONIST

-Emotions are constructed mental states that occur when many different systems in the brain work together.

-Networks of brain regions interact to produce valence & arousal.

-Emotions emerge when neural systems associated with valence or arousal interact to produce distributed pattterns of activation across brain

-Each emotion is heterogeneous (different kinds of fear) and have different neural patterns.

Meta-Analysis of Affective Neuroscience

Phan et al. (2002)

55 fMRI/PET studies on emotion (fear, sad, disgust, anger, happiness) between 1990-2000

Tabulated # of studies reporting brain activation in specific regions for tasks eliciting these emotions

Used chi-squared analysis to examine proportion of studies reporting activation in a specific region for a given emotion

2 regions:

Amygdala (66% fear, 20% happiness, 15% sadness)

Subcallosal cingulate (46% sadness, 20% happiness, 20% anger)

1. Core Limbic

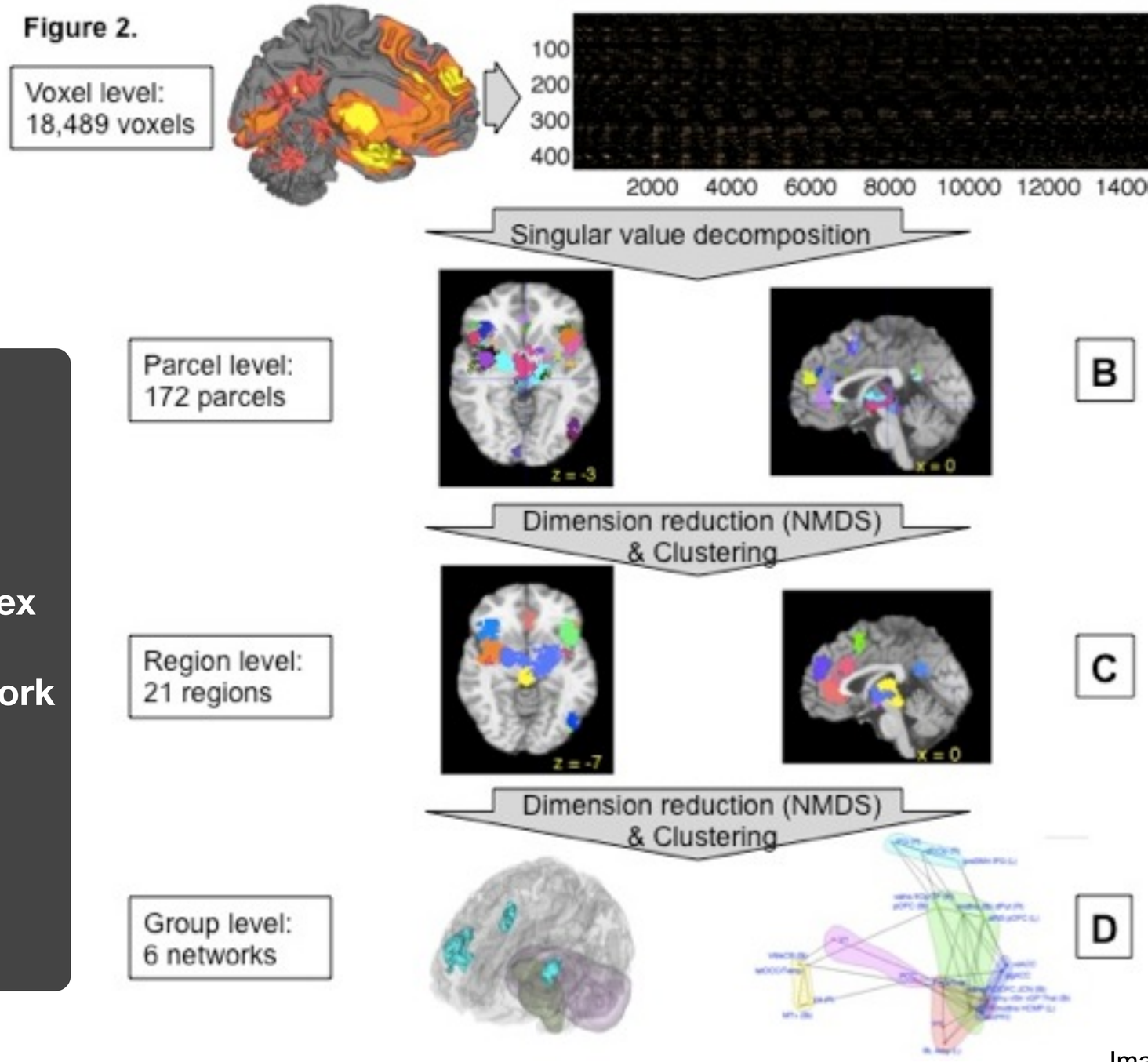
2. Lateral Paralimbic

3. Medial prefrontal cortex

4. Cognitive/motor network

5. Occipital/visual association

6. Medial posterior



Kober et al. (2008)

Image Courtesy of Hedy Kober

Meta-Analysis of Affective Neuroscience

Lindquist et al. (2012)

91 fMRI studies on emotion perception or experience (fear, sad, disgust, anger, happiness) between 1990-2007

Use Multilevel Peak Kernel Density Analysis to examine set of brain regions specifically active across all study contrasts. Then use density analysis to identify regions with consistent activations for specific emotions.

Used chi-squared analysis to create maps to indicate if certain active regions were more active in studies of each emotion category vs. average of all other emotions.

Found functionally consistent AND selective regions

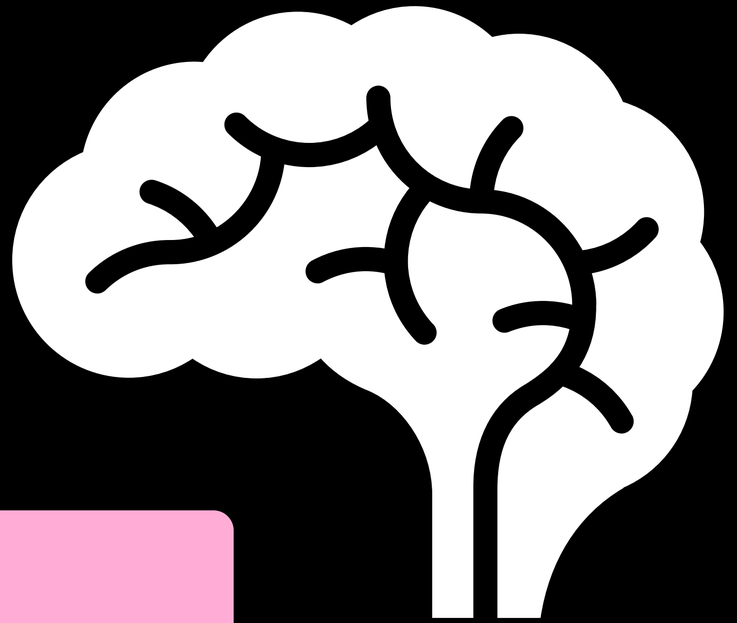
Support for both approaches.

Roadmap

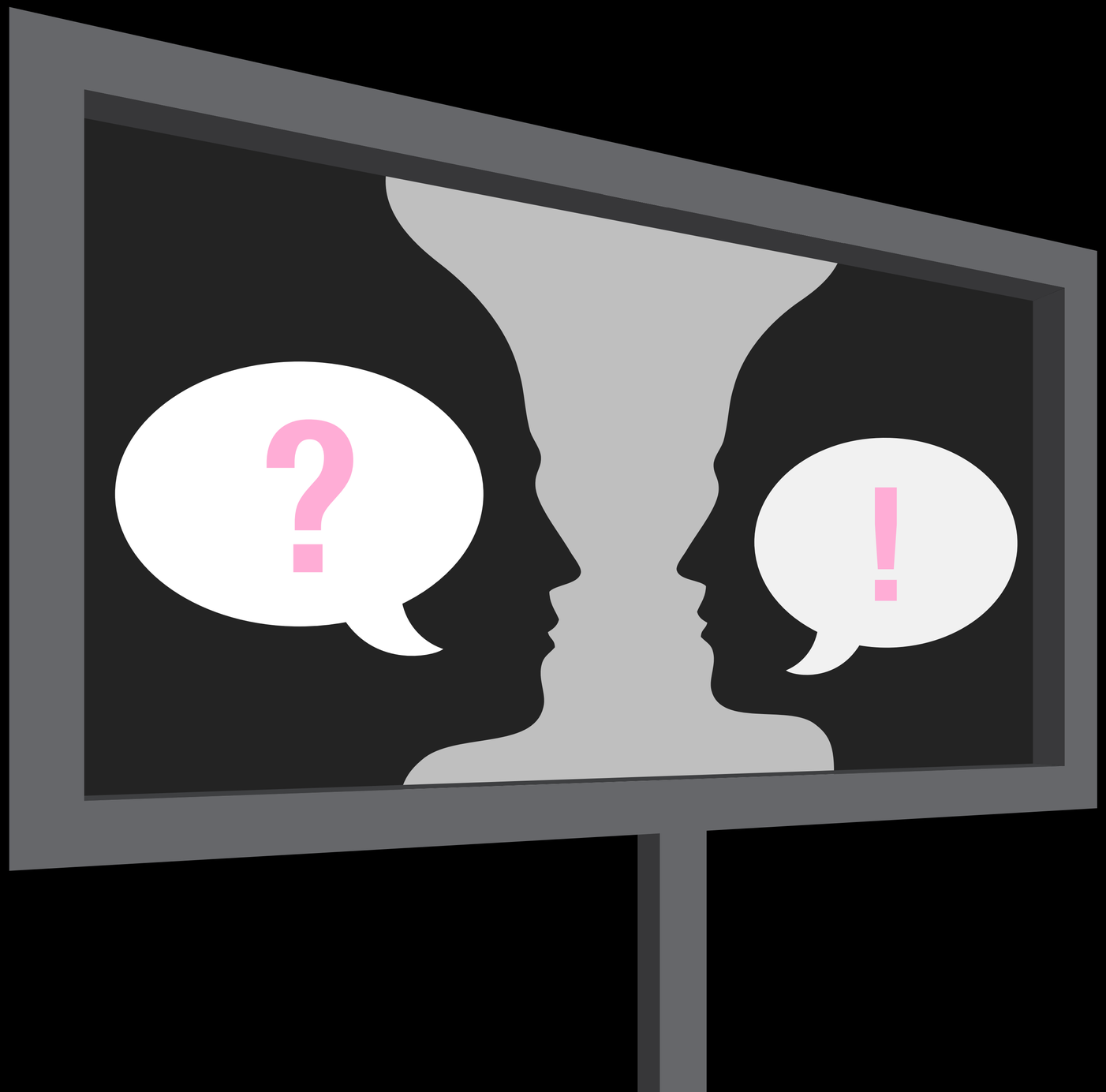
Tools to Study the Emotional Brain

Pleasure and Intensity

Emotion Regulation



El Fin!



Experts In Emotion

June Gruber
Yale University

Experts In Emotion Interview

Dr. Richard Davidson

William James and Vilas Professor of Psychology and Psychiatry
Director, Waisman Brain Imaging Lab
Director, Lab for Affective Neuroscience
Founder and Chair, Center for Investigating Healthy Minds

Affective neuroscience

Experts In Emotion Interview

Dr. Kent Berridge

James Olds Collegiate Professor of Psychology and Neuroscience
University of Michigan

Pleasure and reward in the brain

Experts In Emotion Interview

Dr. Tor Wager

Professor of Psychology and Neuroscience
University of Colorado at Boulder

Emotion and the Brain

Thank You!