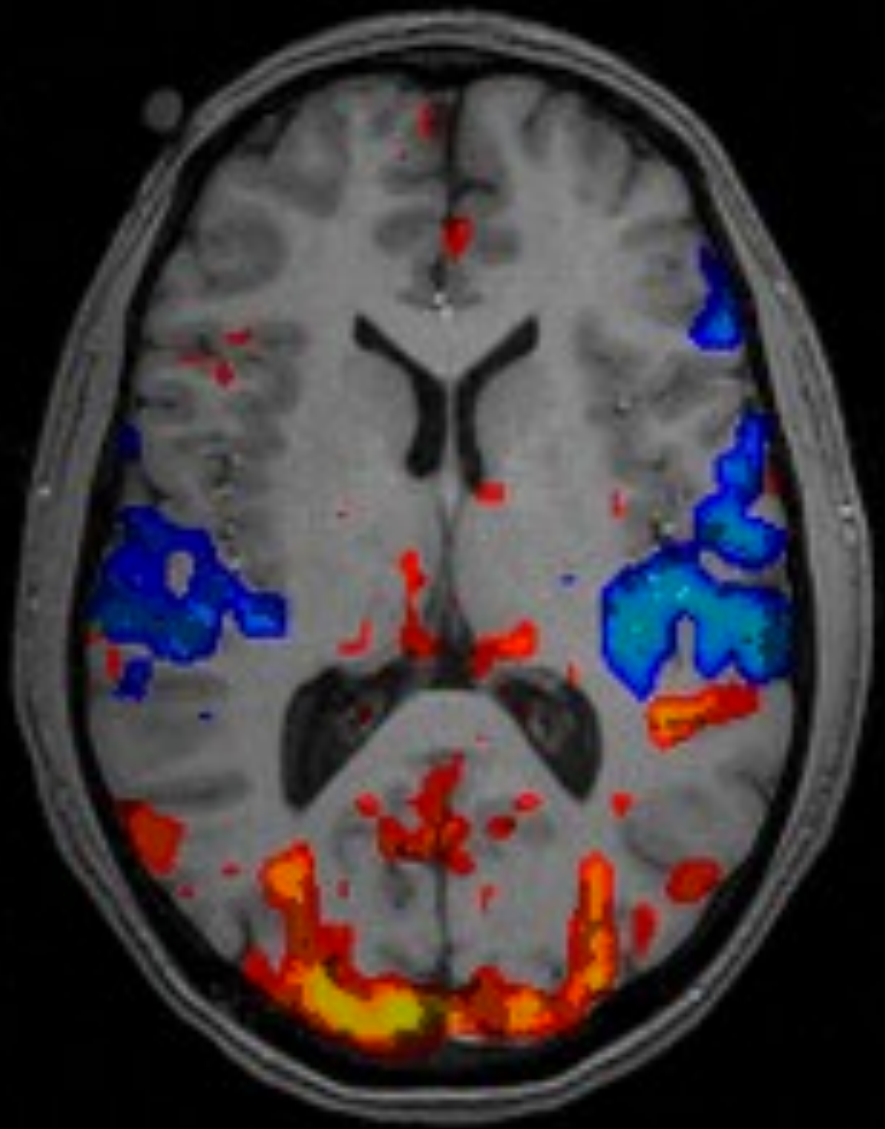
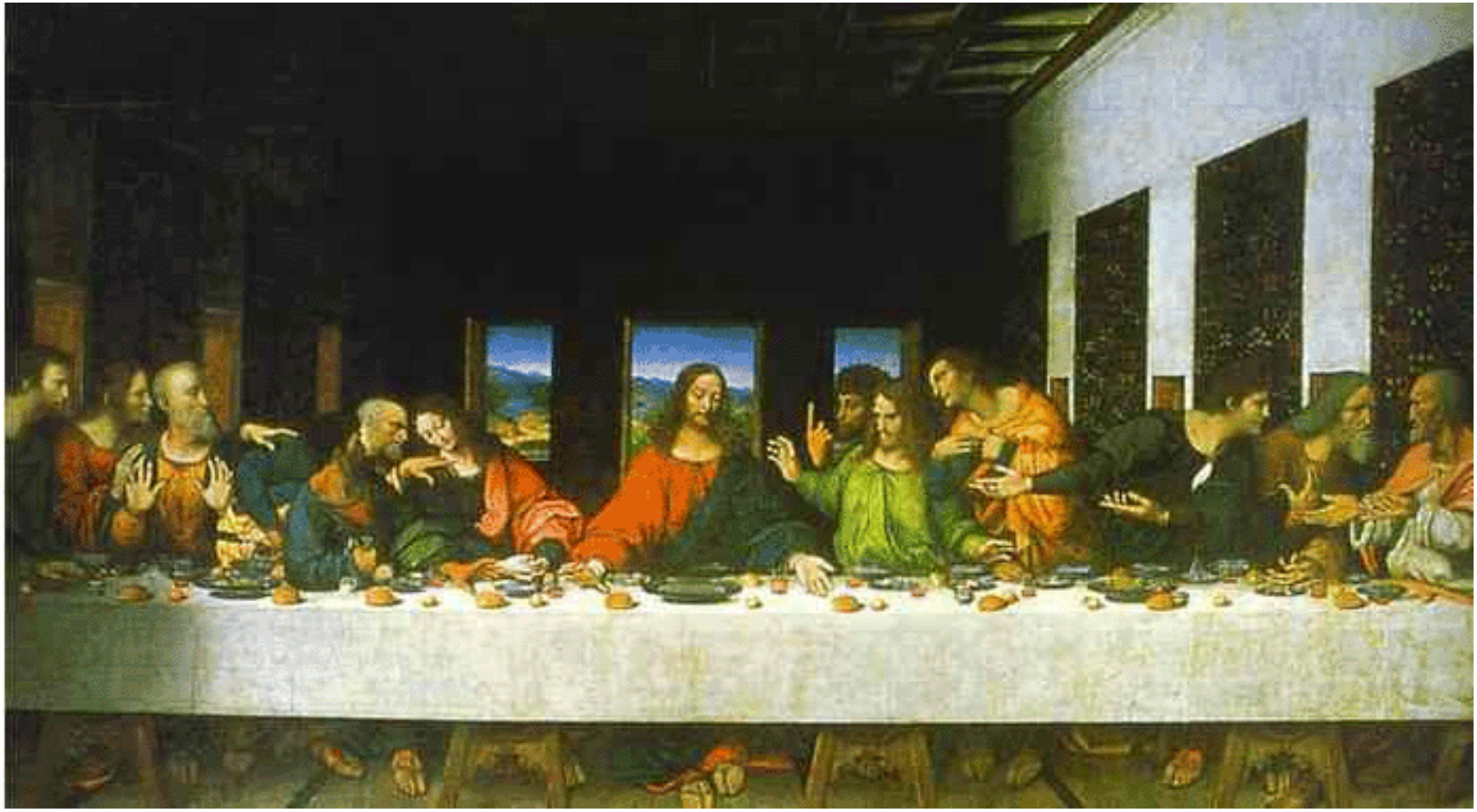
ASHI636: Advanced Neuroscience

Dr. Olav E. Krigolson

Lecture 4: Emotion, Good, and Evil






TO ME, YOU AR
PERFECT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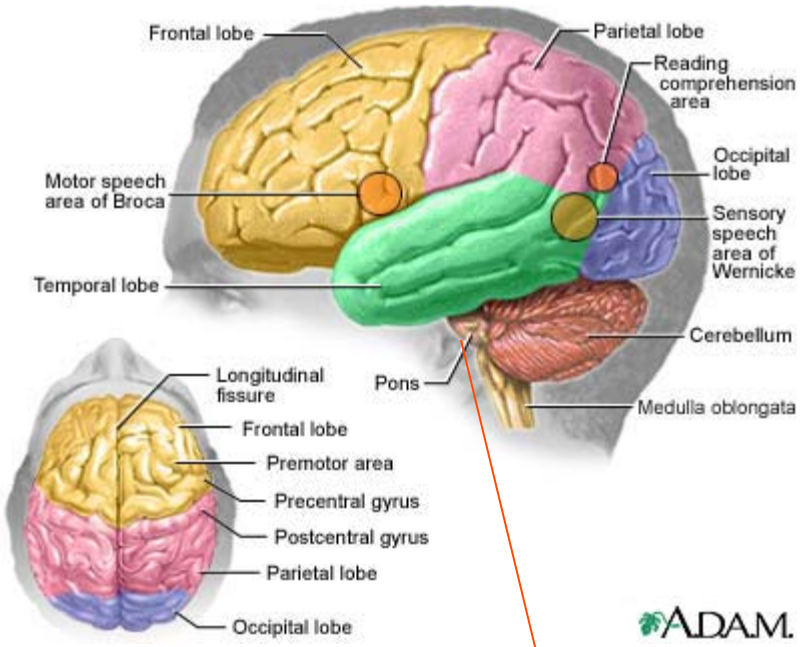
Emotion

Behaviour

1. Fight
2. Flee
3. Feed
4. Sex



To Get at Emotion, Go Deep...

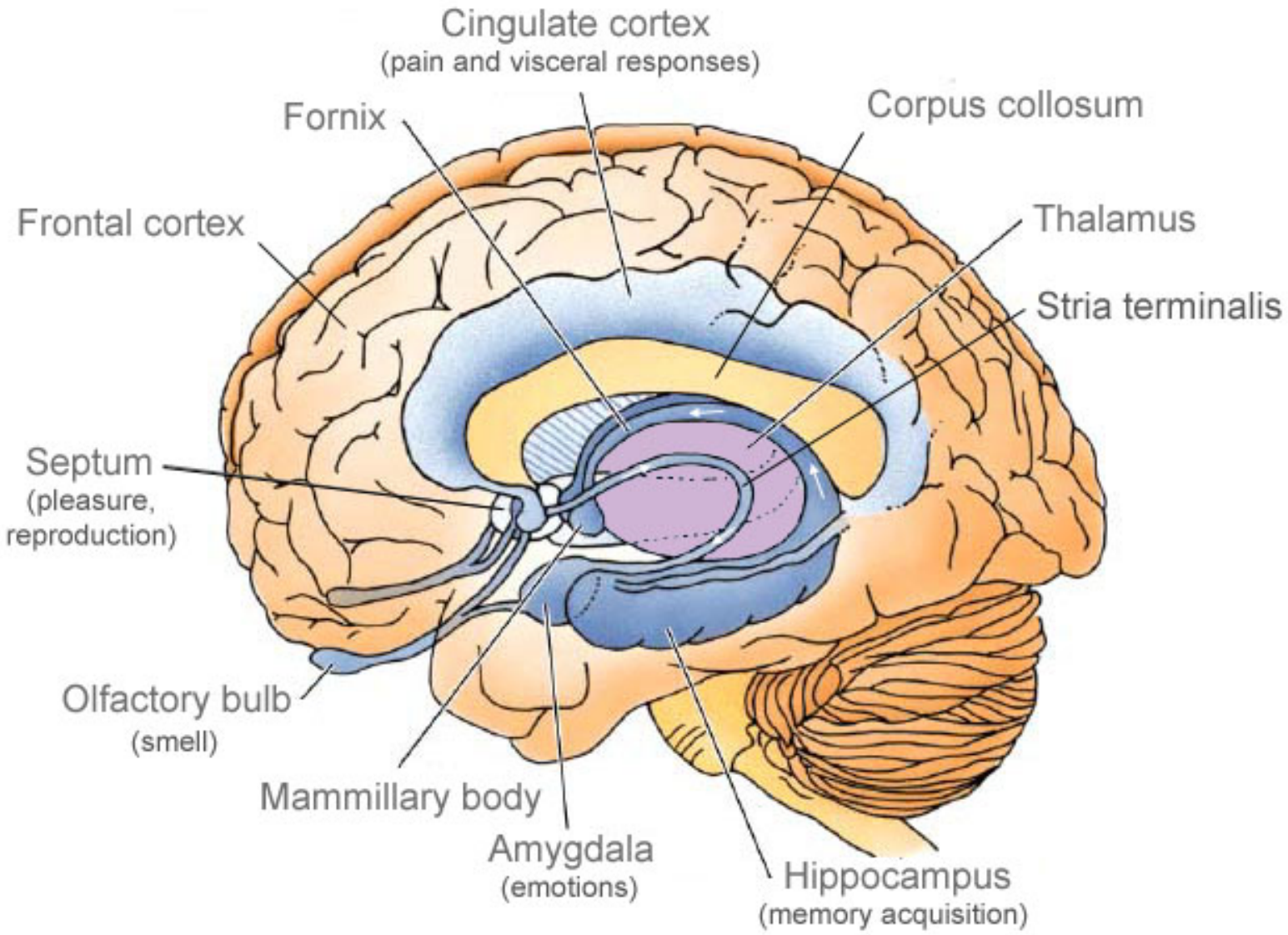
Amygdala is
deep within the most elemental parts
of the brain.

The main purpose of the innermost
part of the brain is survival

Emotion

The Limbic System

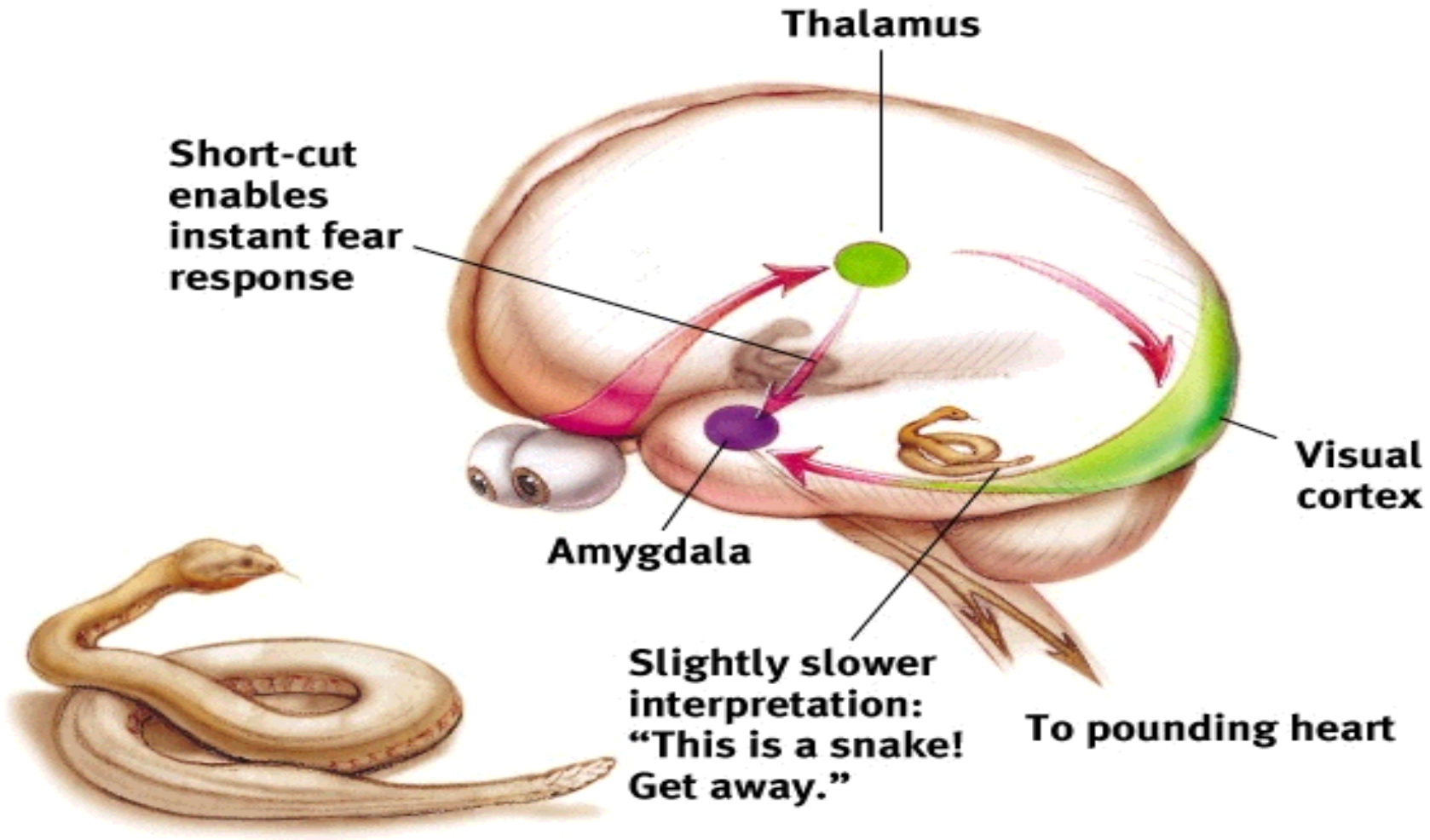
Limbic System



Basal ganglia removed

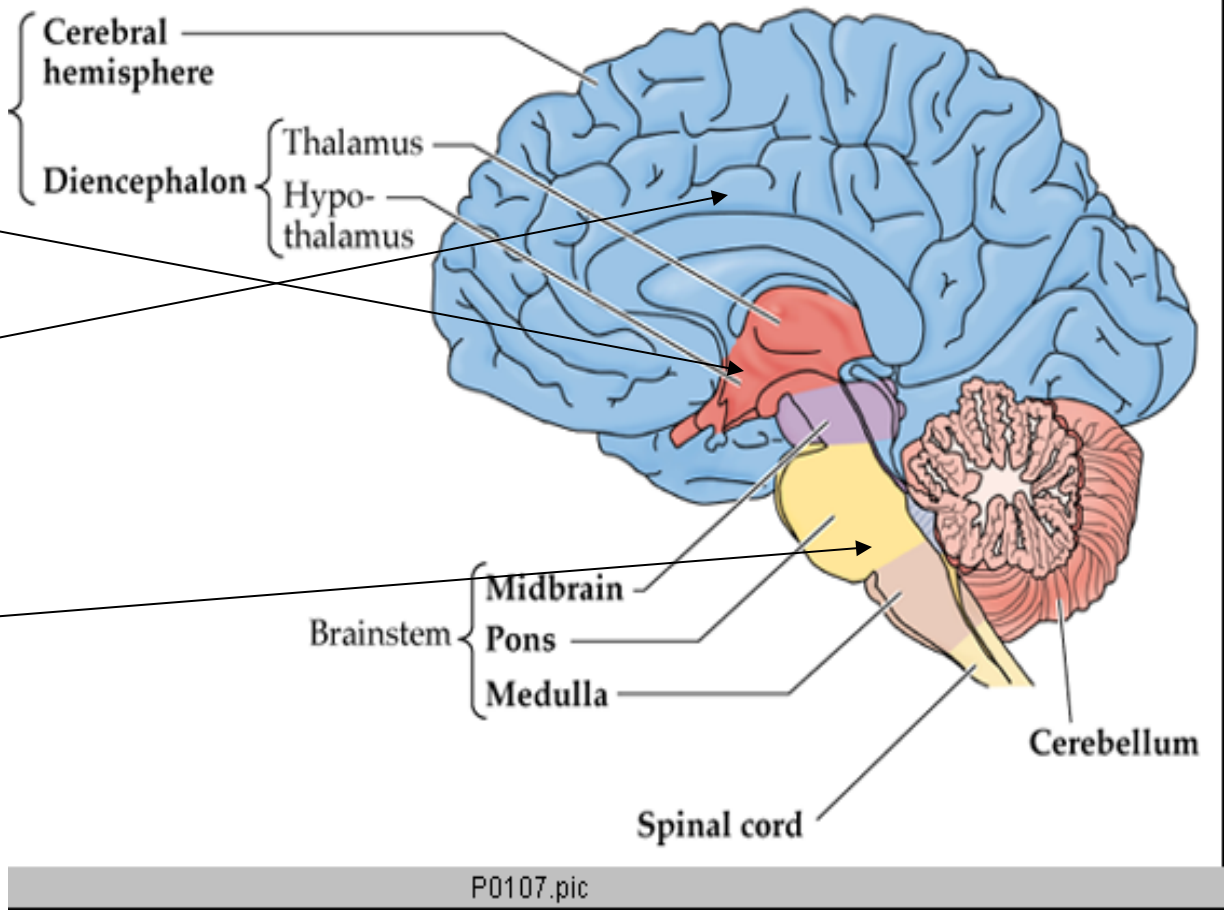
Cognition and Emotion

The brain's shortcut for emotions



Brain Structures That Mediate Emotion

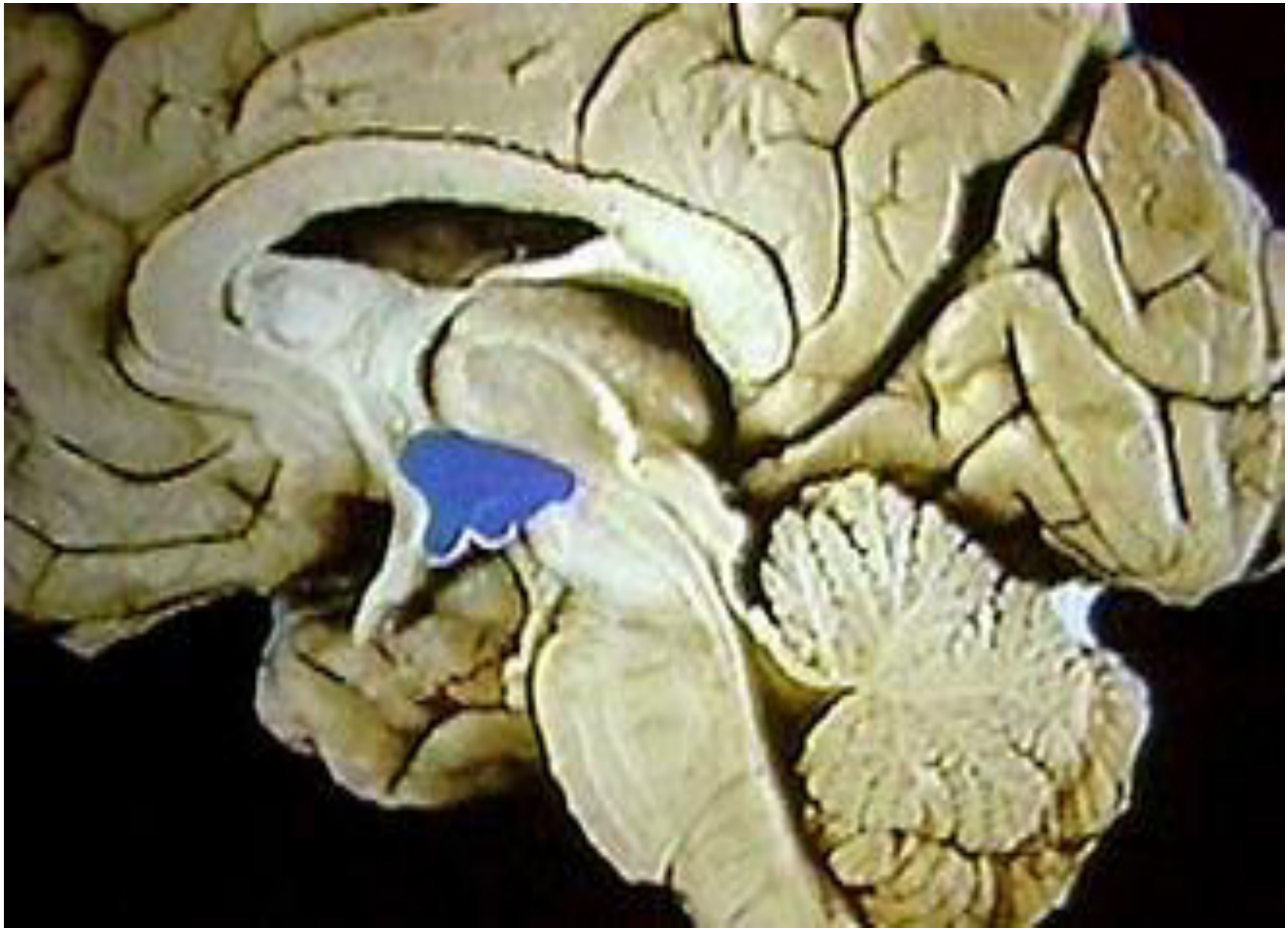
- Hypothalamus
- Limbic System
  - limbic cortex
  - amygdala
- Brainstem

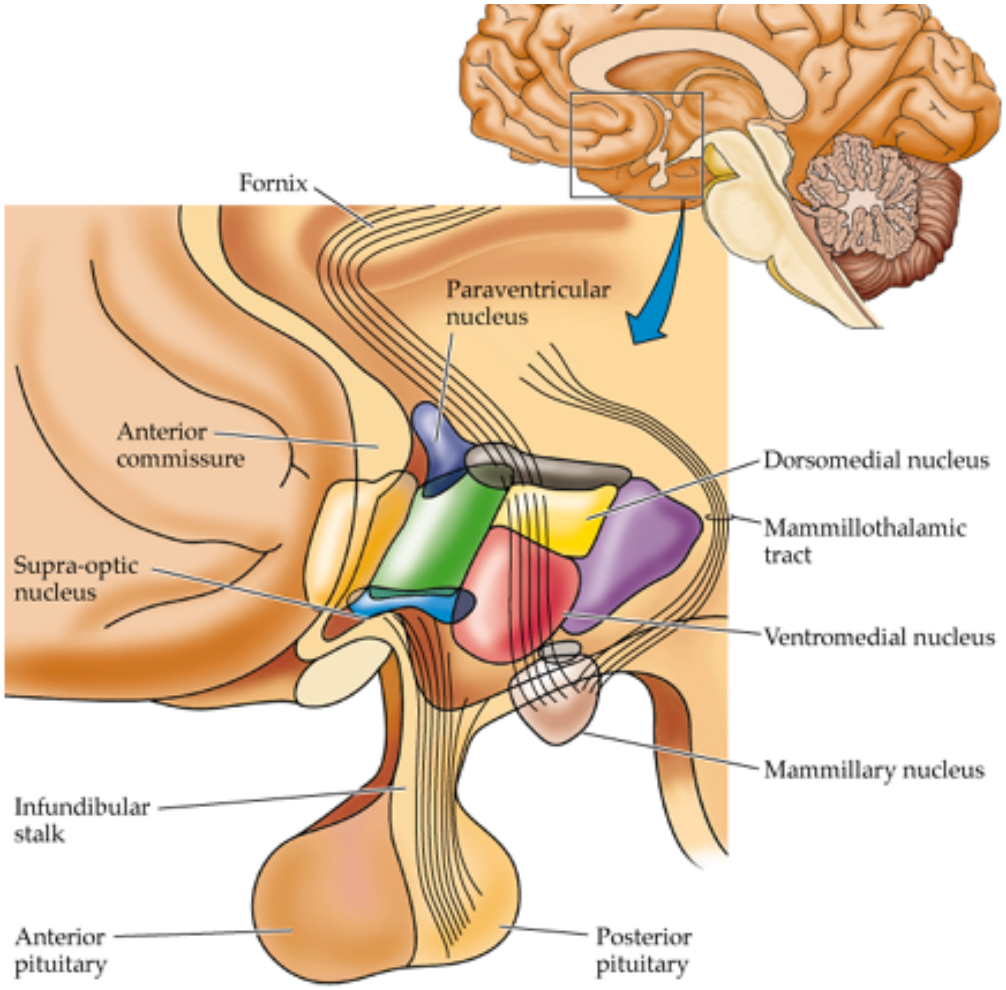


Hypothalamus (Under the thalamus)

- What is it?
  - A deep brain structure made up of a number of nuclei
- Where is it?
  - Base of the fore brain
  - Behind the optic chiasm
  - Forms part of the walls of the 3rd ventricle
  - Contiguous with infundibular stalk to pituitary

The Hypothalamus




Fornix
Paraventricular nucleus
Anterior commissure
Dorsomedial nucleus
Mammillothalamic tract
Supra-optic nucleus
Ventromedial nucleus
Mammillary nucleus
Infundibular stalk
Anterior pituitary
Posterior pituitary

P27ba.pic

Hypothalamic functions

1. Control of the Pituitary gland – anterior and posterior
2. Autonomic control- sympathetic & parasympathetic
3. Temperature regulation
4. Fluid balance – drinking control
5. Eating control – feeding centre & satiety centre
6. Sleep and wake regulation – supra-chiasmatic nucleus
7. Sexual responses
8. Linkage to Limbic system

Hypothalamus

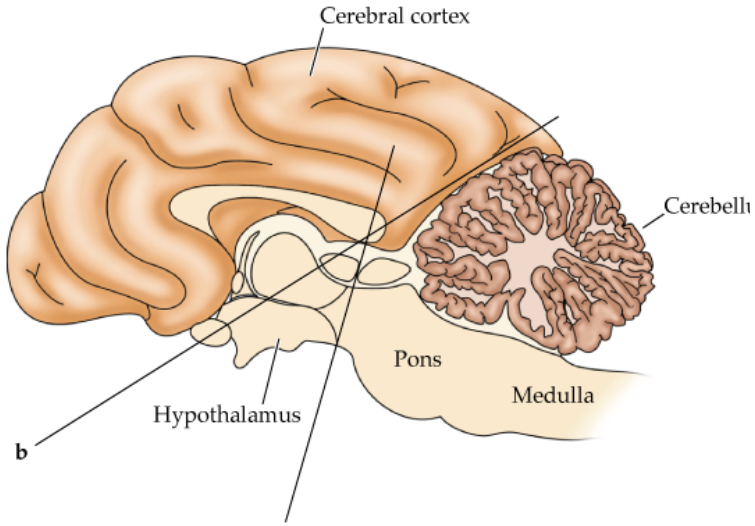
- What does it do?
  - Integration of emotional response
  - Forebrain, brain stem, spinal cord
  - Sexual response
  - Endocrine responses
    - neurosecretory
    - oxytocin, vasopressin

Hypothalamus

- How do we know that it integrates emotions and behaviors?
  - Ablation studies
  - Stimulation studies
  - Primary Emotions: Fear and Anger

Ablation Studies

- Cats
- Remove cerebral hemispheres: rage
- Remove hemispheres and hypothalamus: no rage



Stimulation Studies on Cats

- Lateral hypothalamic stimulation:

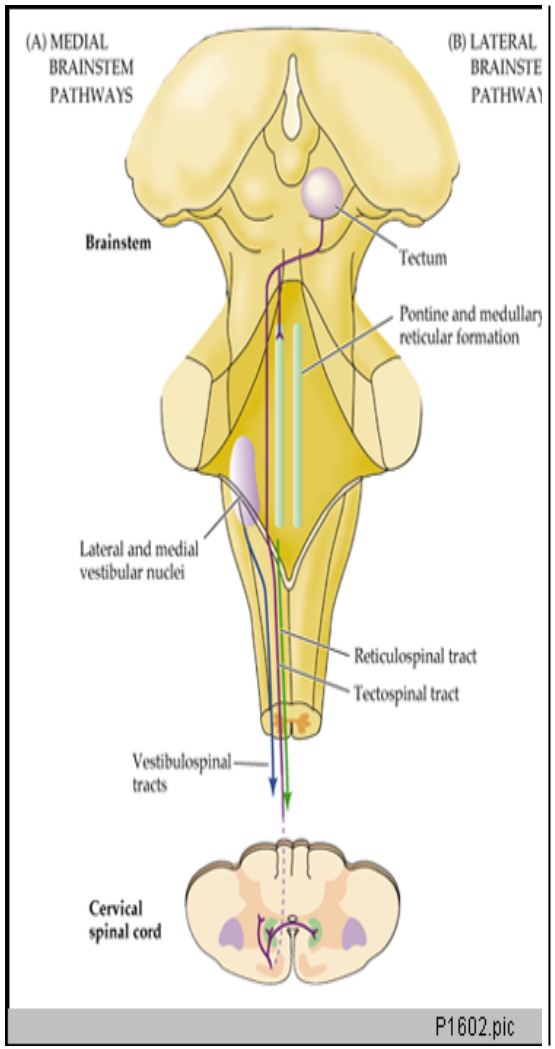
  rage, attack
- Other areas: defensive, fear

Hypothalamus:
Routes of information

- Input from: cortex (relatively unprocessed)
- Output to Reticular Formation

Brainstem: Reticular Formation

- Brainstem web
- 100+ cell groups
- Controls
  - sleep-wake rhythm
  - Arousal
  - Attention



Reticular Formation

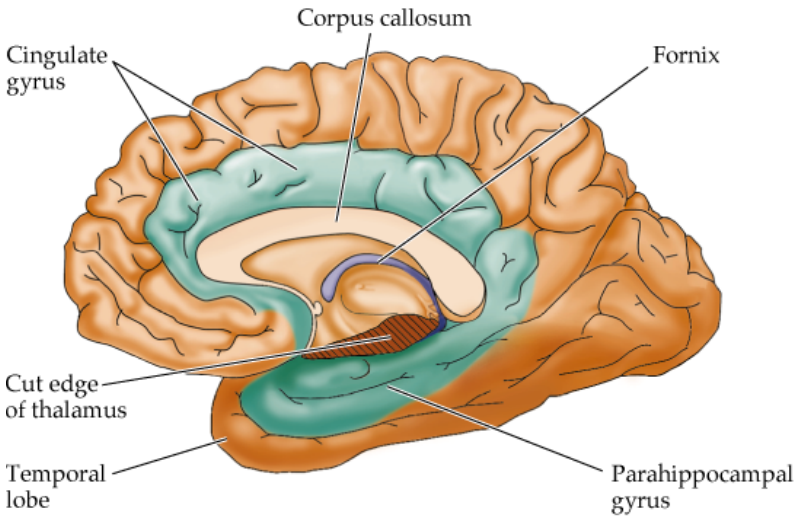
- Receives hypothalamic and cortical output
  - separate descending projections that run parallel to volitional motor system
- Output to somatic and autonomic effector systems
  - cardiac, respiratory, bowels, bladder
  - Coordinates brain-body response

Limbic System

- Higher Cortical Processes (“Secondary Emotions”)
- Why do humans feel embarrassed with flatulence and dogs don’t?

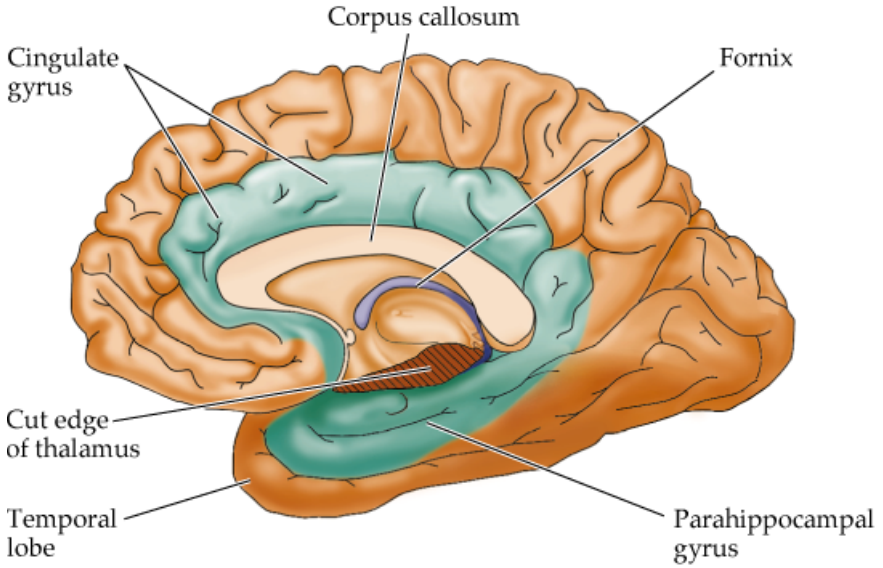
Limbic System

- Link between higher cortical activity and the "lower" systems that control emotional behavior
- Limbic Lobe
- Deep lying structures
  - amygdala
  - hippocampus
  - mamillary bodies



Limbic Lobe

- What is it?
  - Cingulate gyrus
  - Parahippocampal gyrus
- Where is it?
  - Encircles the upper brain stem
  - around corpus callosum

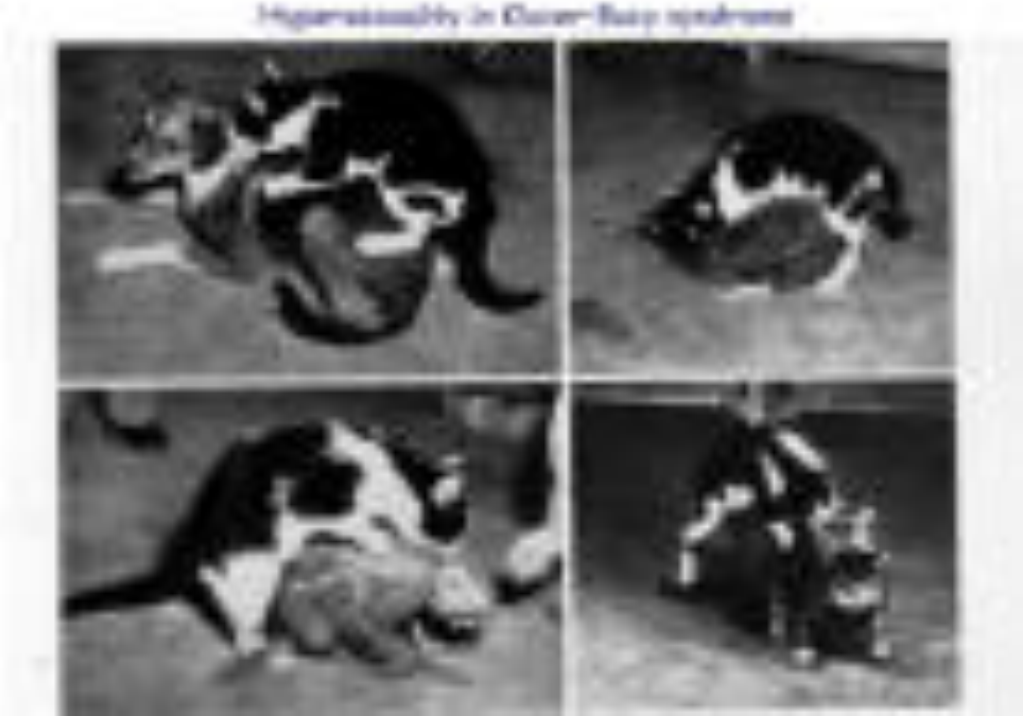


Limbic System

- What does it do?
  - Integrates information from cortical association areas
- How do we know this?
  - Kluver - Bucy Syndrome

Kluver - Bucy Syndrome

- Removal of temporal lobe in animals
- Pre-op
  - aggressive, raging
- Post-op
  - docile, orally fixated, increased sexual and compulsive behaviors

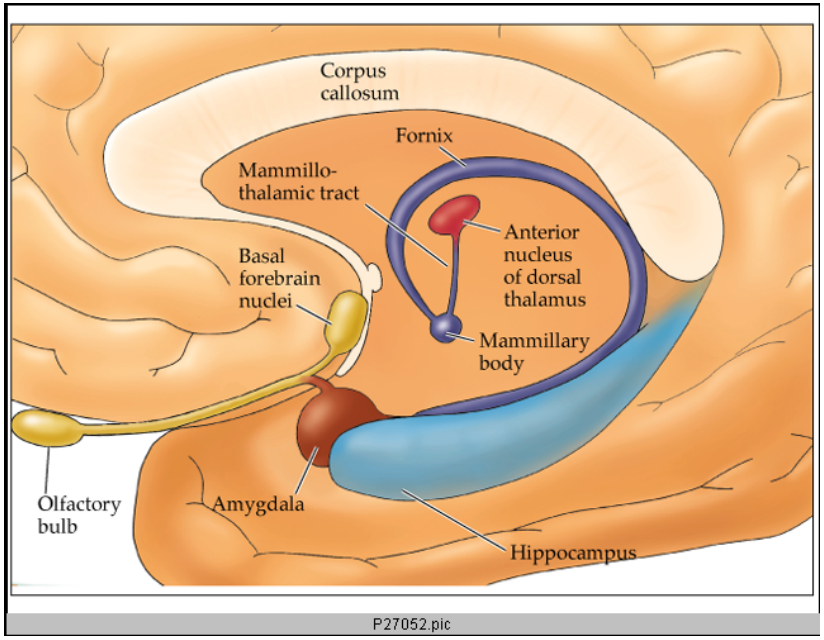


Kluver- Bucy Syndrome in Humans

- Severe temporal lobe damage
  - tumors, surgery, trauma
  - Visual Agnosia
  - Apathy/ placidity
  - Hyperorality
  - Disturbance in sexual function (hypersexuality)
  - Dementia, aphasia, amnesia

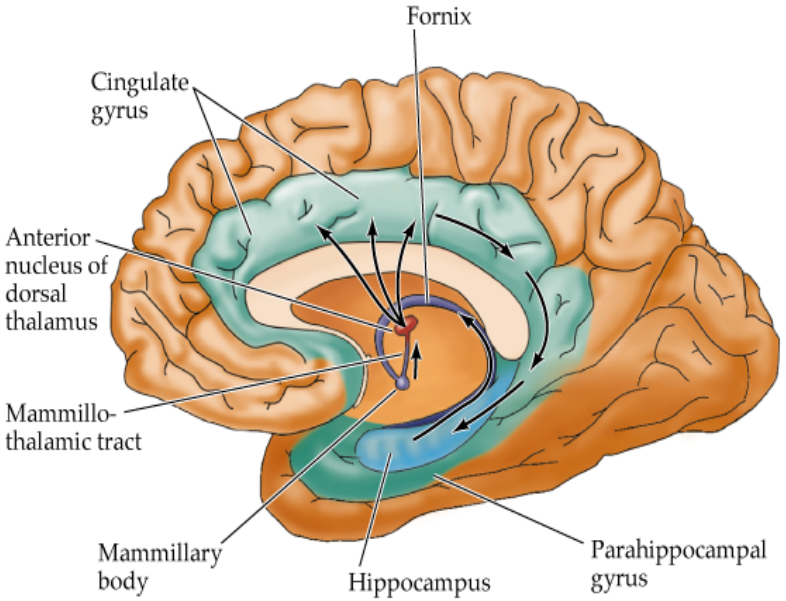
Additional Structures in Limbic System

- Hippocampus
- learning/ retrieval of memory
- Circuit of Papez



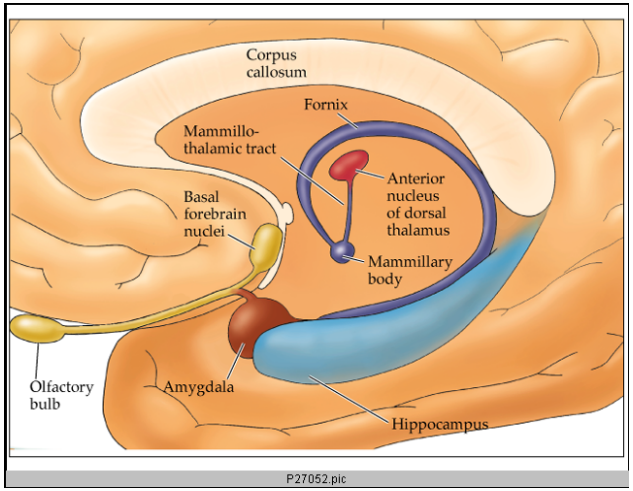
Circuit of Papez

- First localization of Emotion
  - (Overemphasized role of hippocampus)
  - (Left out the amygdala)

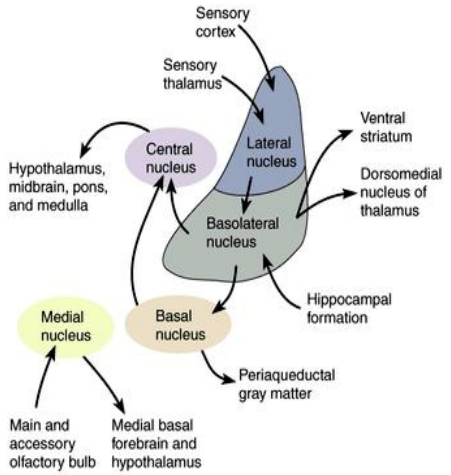


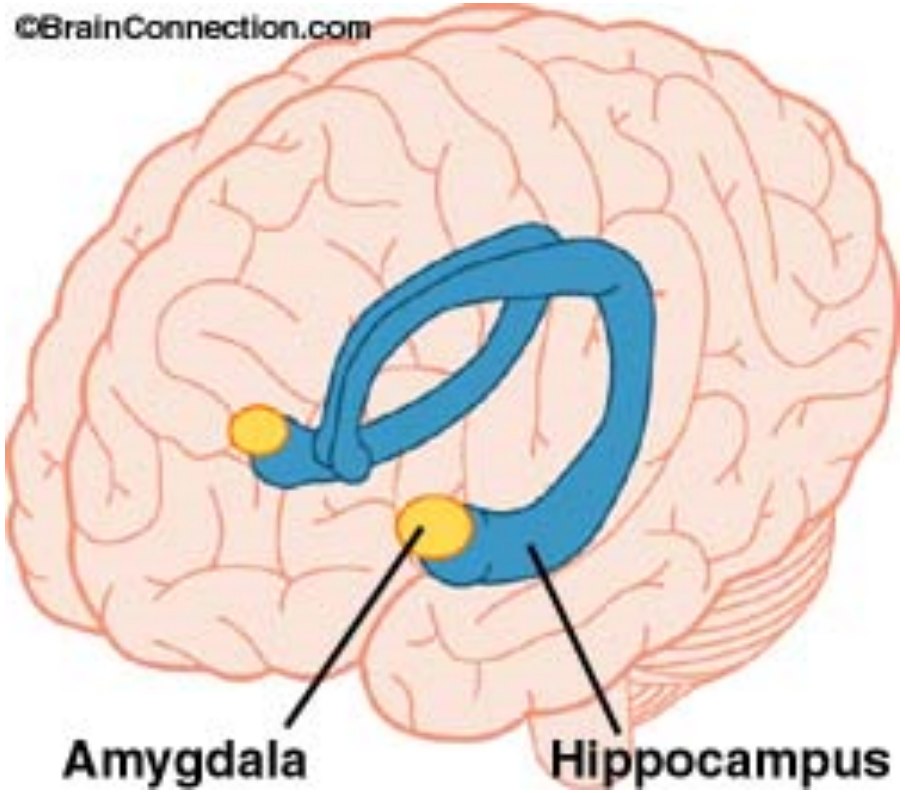
Amygdala

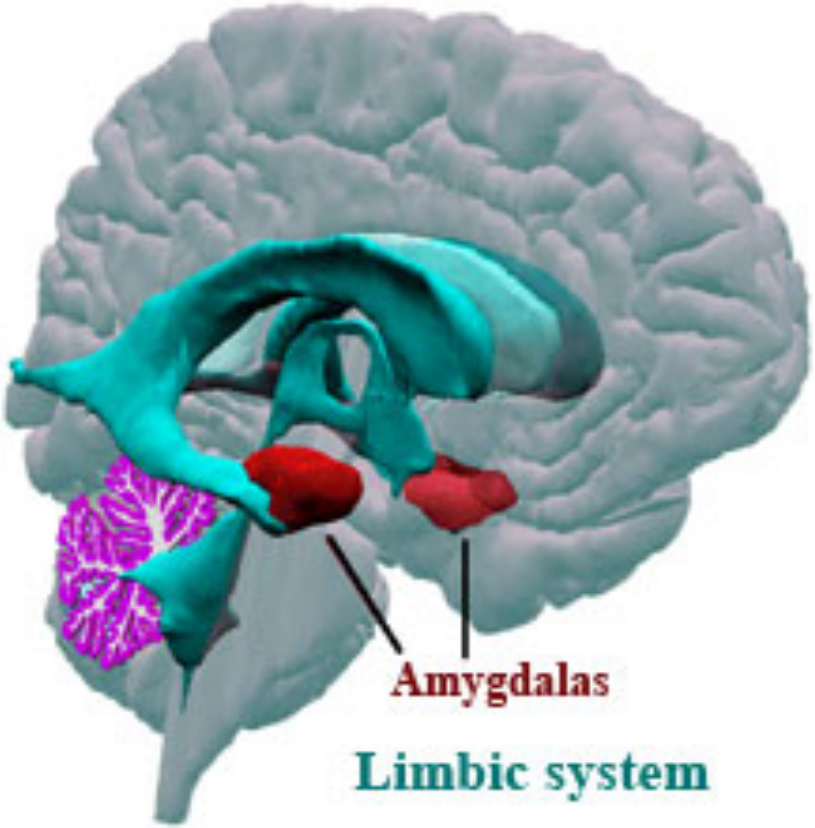
- What is it?
  - Nuclear mass
- Where is it?
  - Buried in the white matter of the temporal lobe, in front of the hippocampus



► **Diagram of the Major Divisions and Connections of the Amygdala**



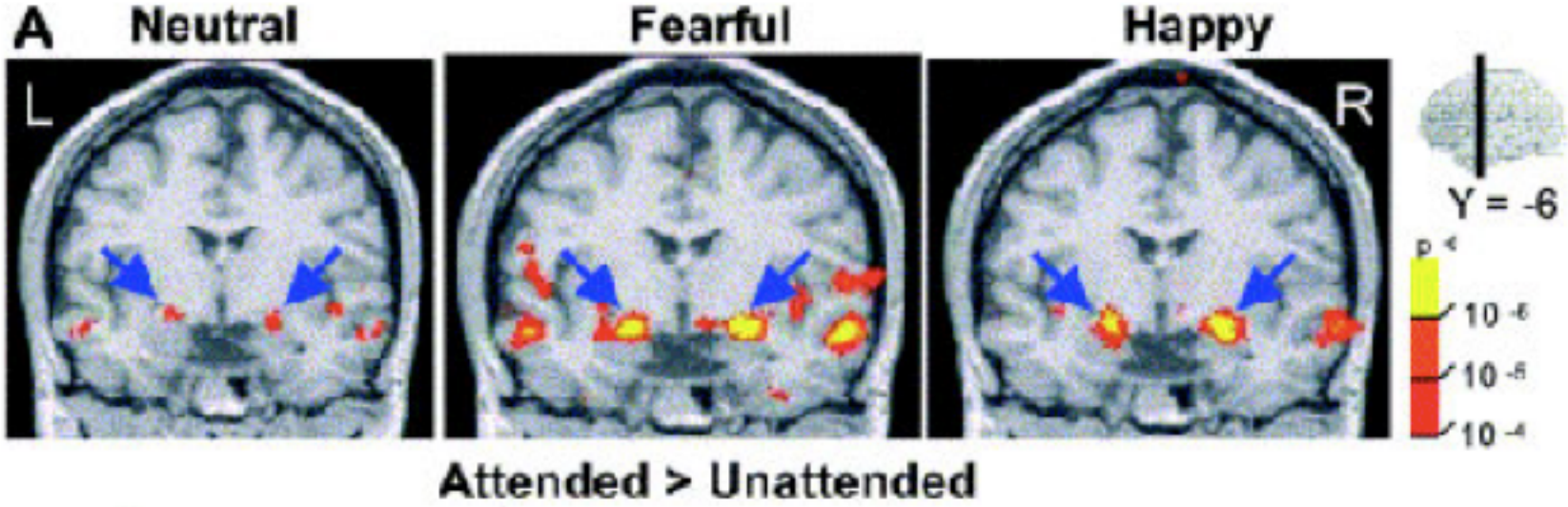

©BrainConnection.com
Amygdala
Hippocampus

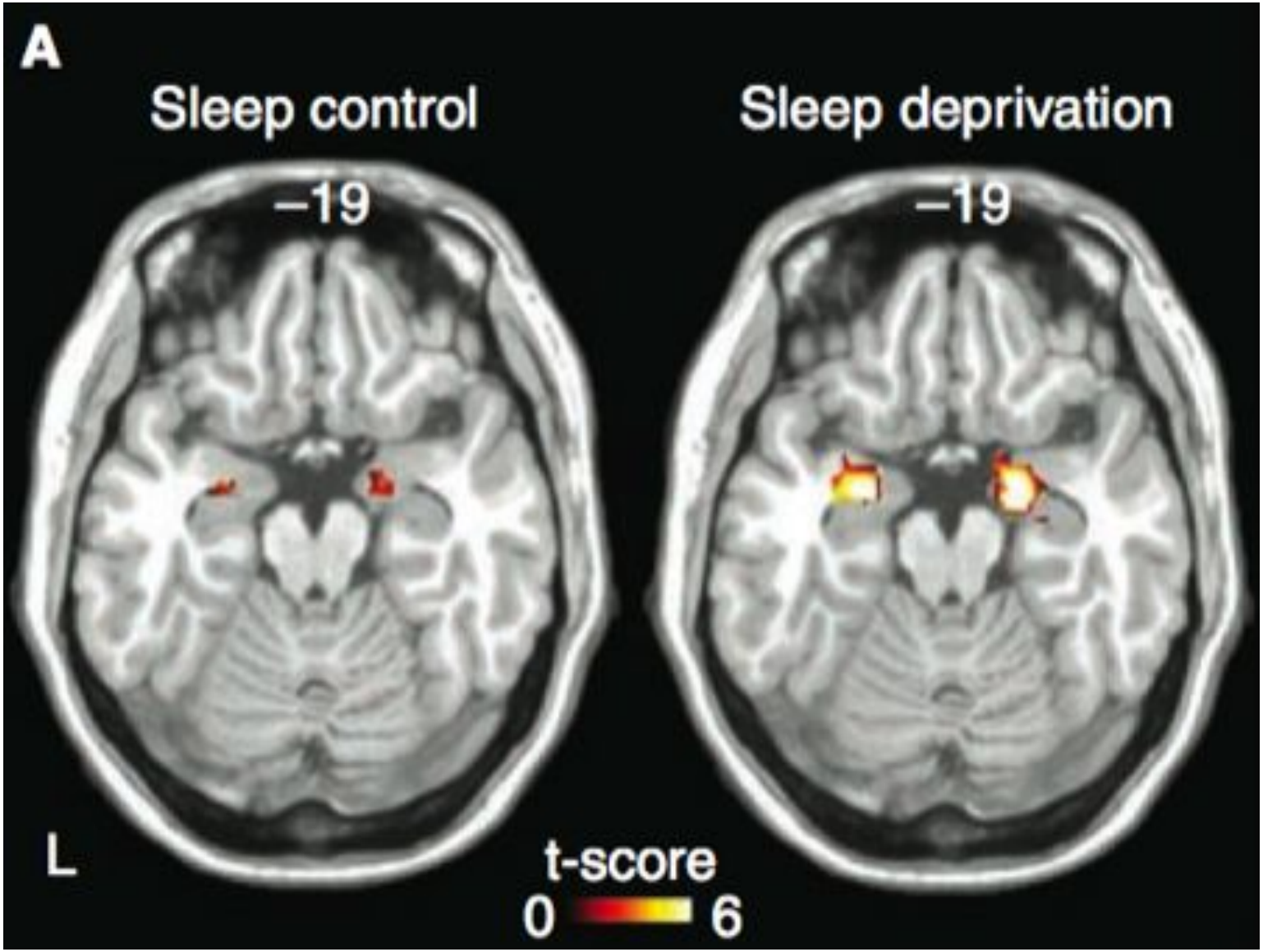

Amygdalas
Limbic system

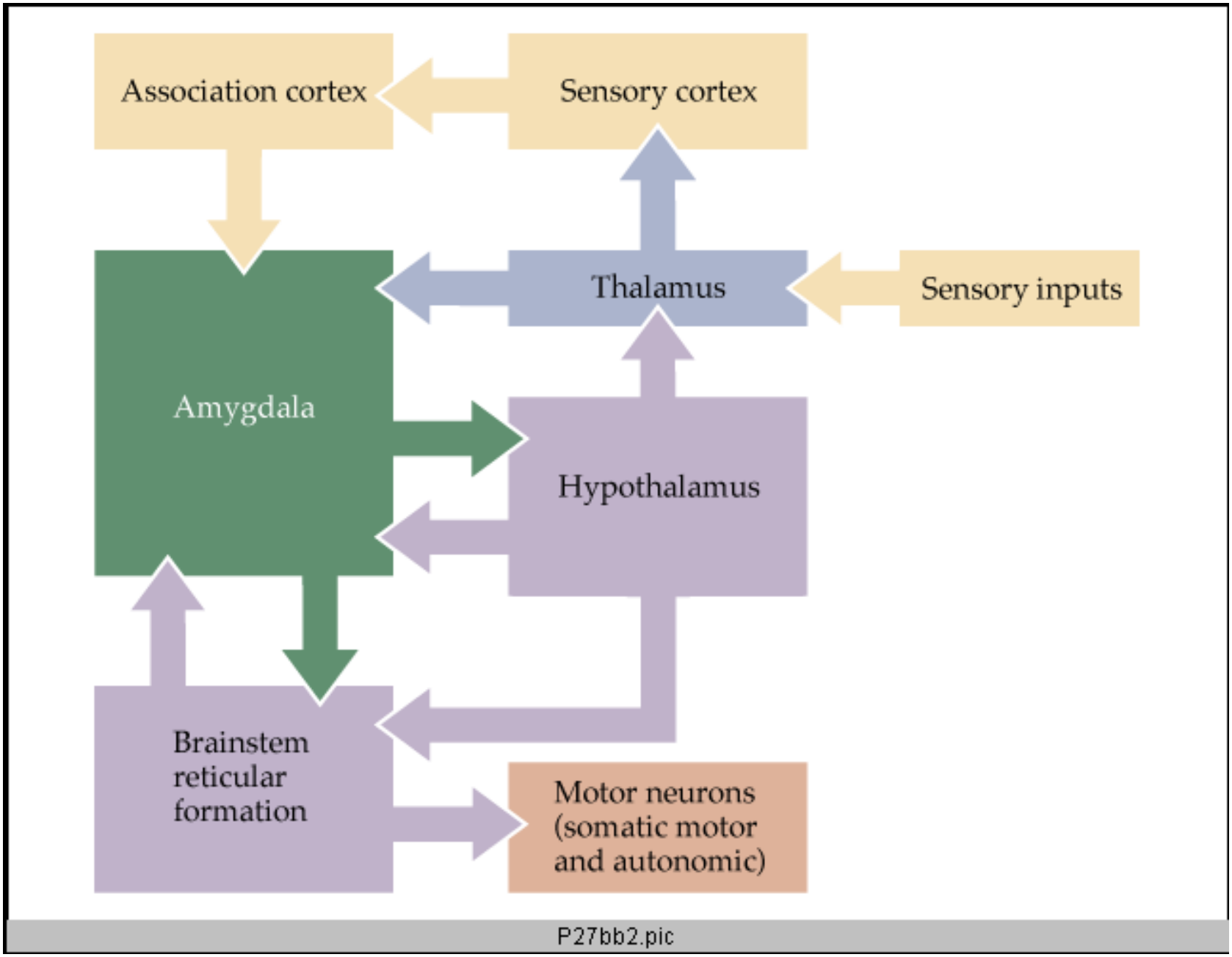
Amygdala: What Does It Do?

- Connects to:
  - olfactory bulb and cortex
  - brainstem and hypothalamus
  - cortical sensory association areas
  - “Emotional Association Area”

(a)

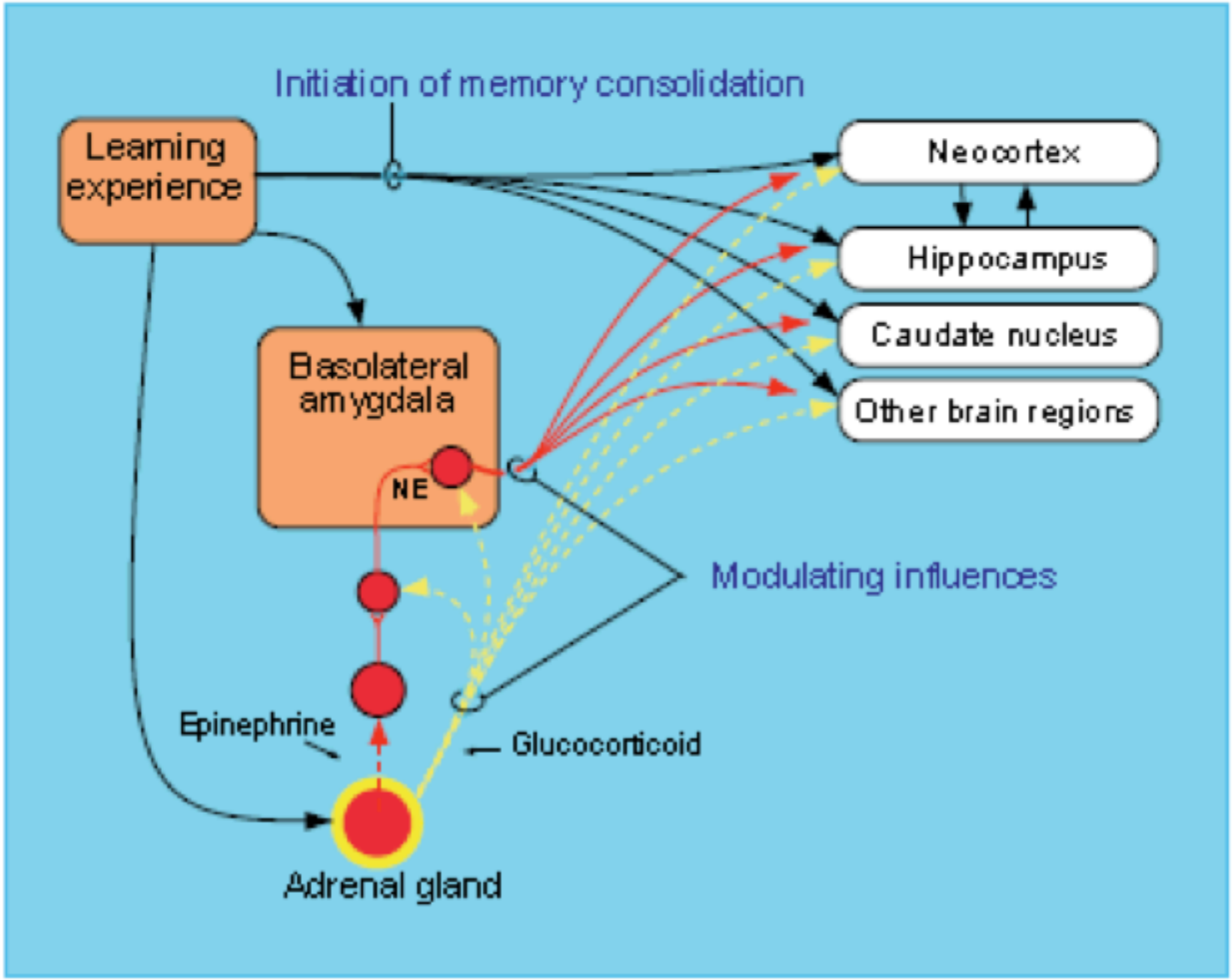

A
Neutral
Fearful
Happy
L
R
Y = -6
p <
10 -6
10 -5
10 -4
Attended > Unattended


A
Sleep control
Sleep deprivation
−19
−19
L
t-score
0
6


Association cortex
Sensory cortex
Thalamus
Sensory inputs
Amygdala
Hypothalamus
Brainstem reticular formation
Motor neurons (somatic motor and autonomic)
P27bb2.pic

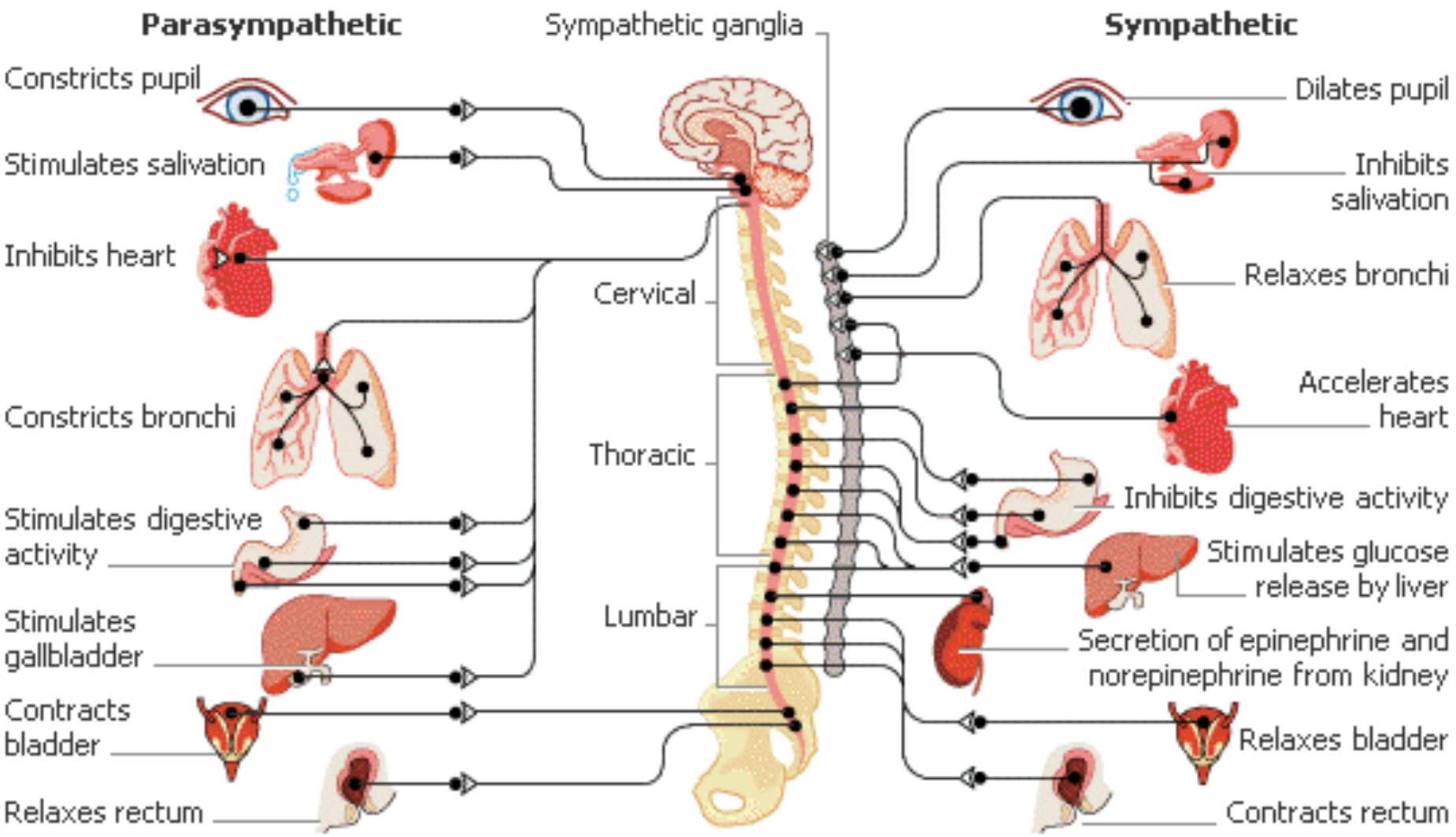
Amygdala and Learned Emotions

- Learned fear: rats and classical conditioning
  - Conditioned emotional response
- Abolish fear response
  - cut central nucleus from amygdala OR
  - infuse NMDA antagonist into amygdala during learning


Initiation of memory consolidation
Learning experience
Neocortex
Hippocampus
Caudate nucleus
Other brain regions
Basolateral amygdala
NE
Modulating influences
Epinephrine
Glucocorticoid
Adrenal gland

Emotion

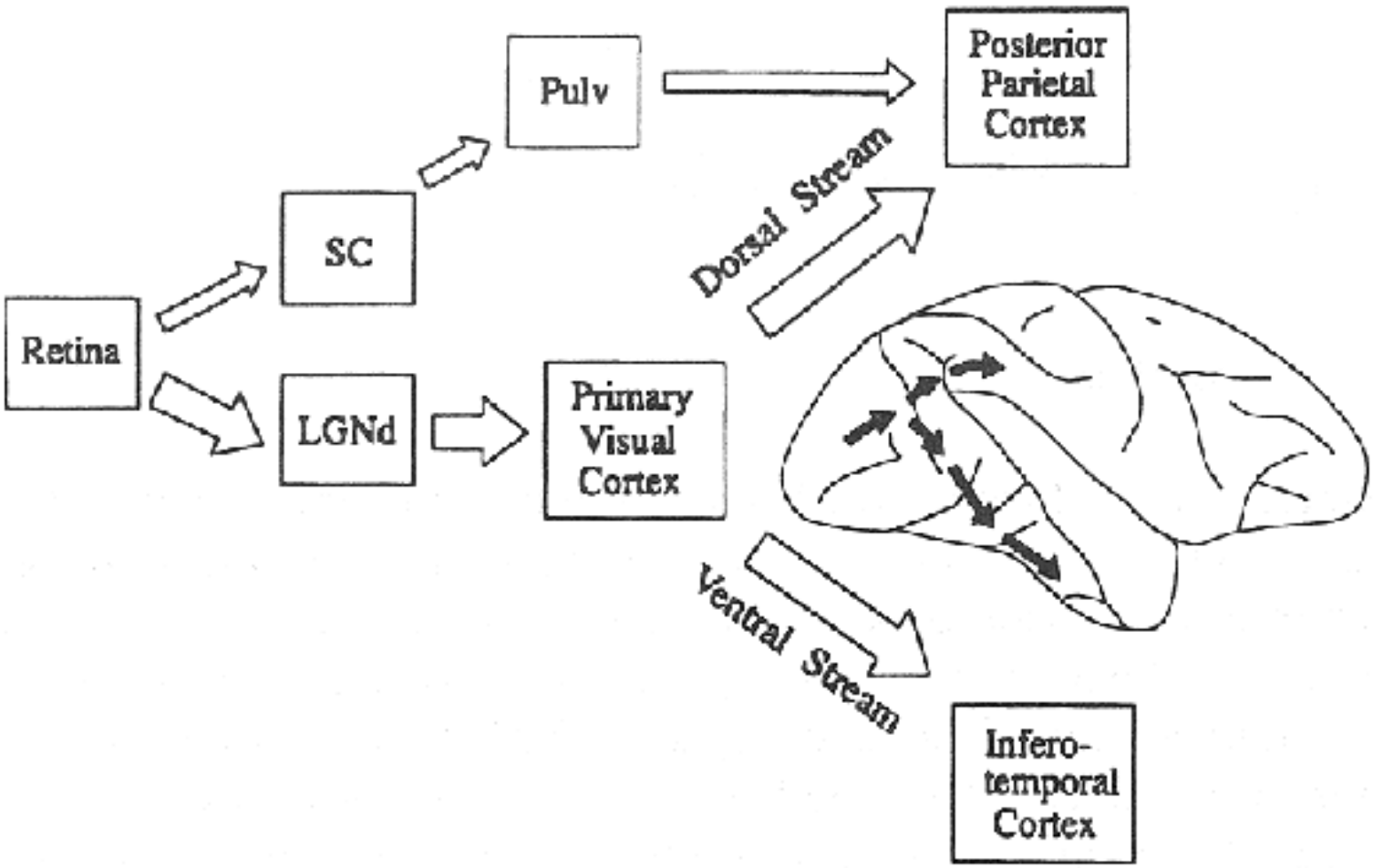
The Autonomic Nervous System

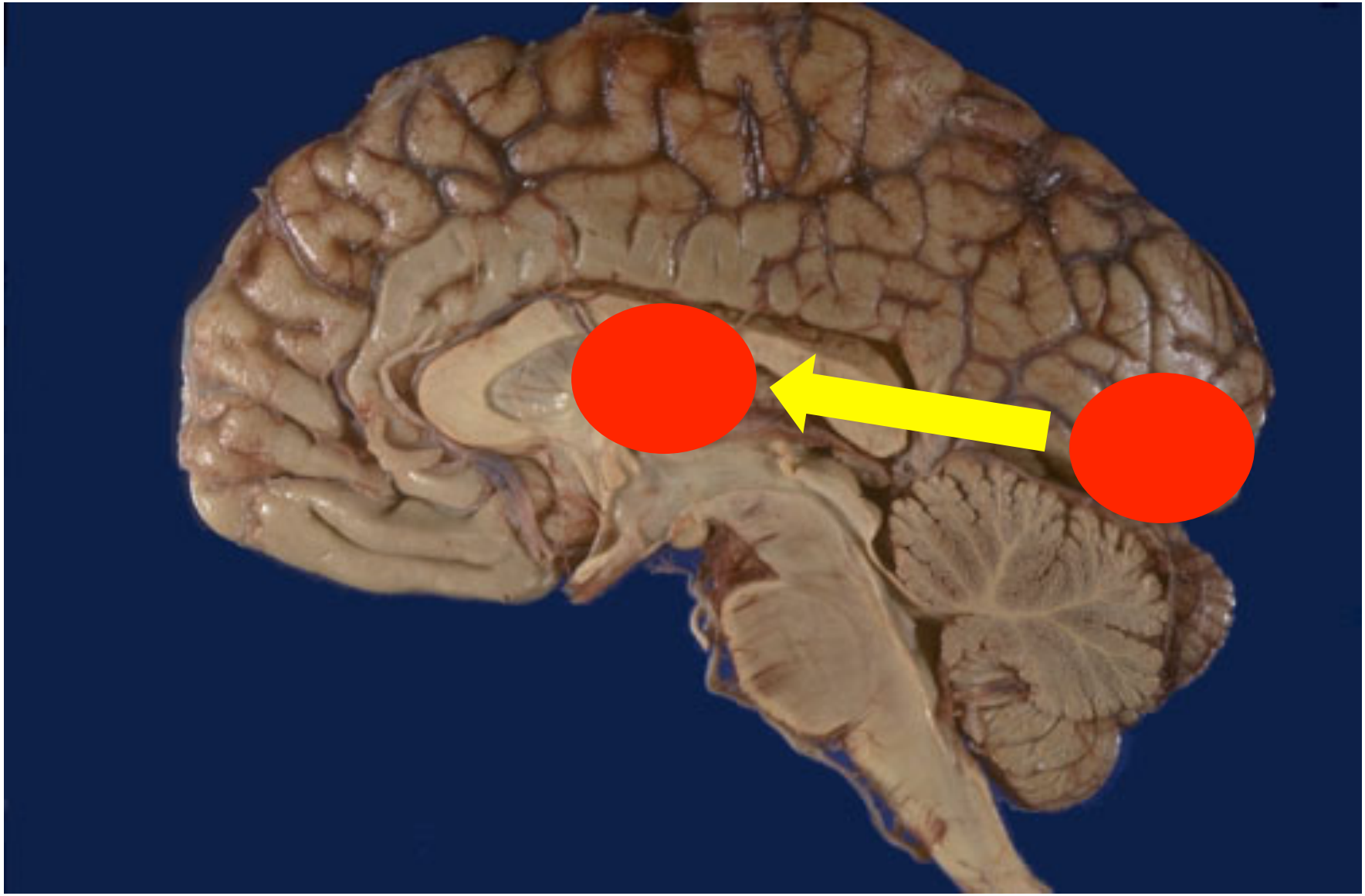

Parasympathetic
Sympathetic ganglia
Sympathetic
Constricts pupil
Stimulates salivation
Inhibits heart
Constricts bronchi
Stimulates digestive activity
Stimulates gallbladder
Contracts bladder
Relaxes rectum
Cervical
Thoracic
Lumbar
Dilates pupil
Inhibits salivation
Relaxes bronchi
Accelerates heart
Inhibits digestive activity
Stimulates glucose release by liver
Secretion of epinephrine and norepinephrine from kidney
Relaxes bladder
Contracts rectum

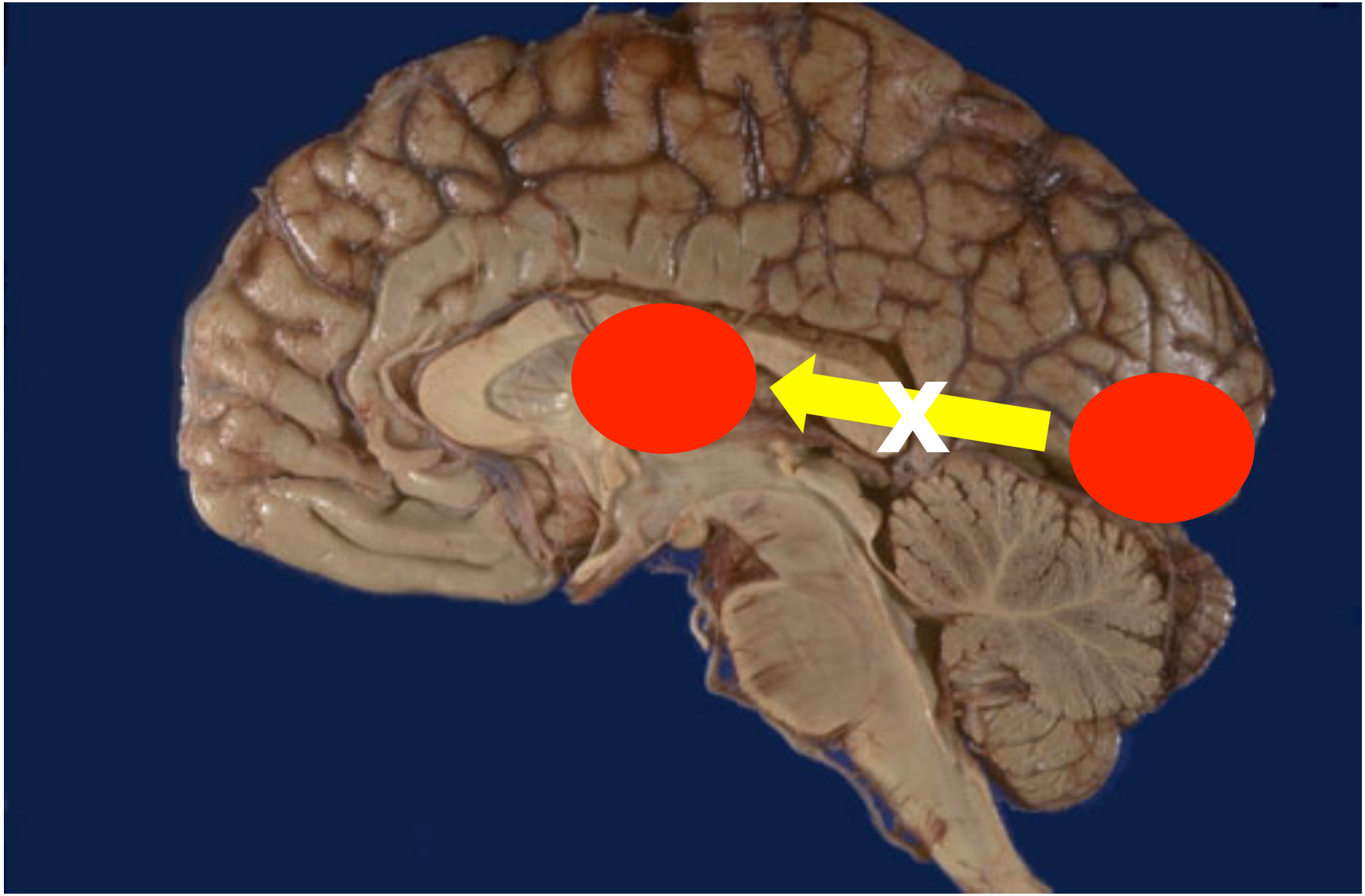
Emotional Salience

Table. Examples of Capgras Syndrome

Physician Descriptions and Patient Comments
Patient believes his wife has been replaced by an imposter.
Patient believes his daughter has been replaced by his dead sister.
Patient believes her husband is a lady or a stranger living in the house.
Patient will look at his wife and ask, "Where is my wife?"
Patient believes there are 6 people, including his wife, all named Shirley.
Patient said, "I am looking for Bob my husband, not him Bob."
Patient believes there are 2 daughters and 2 sons who look alike.
Patient said, "Someone homosexual is masquerading as my wife."


Retina
SC
LGNd
Pulv
Primary Visual Cortex
Posterior Parietal Cortex
Dorsal Stream
Ventral Stream
Infero-temporal Cortex

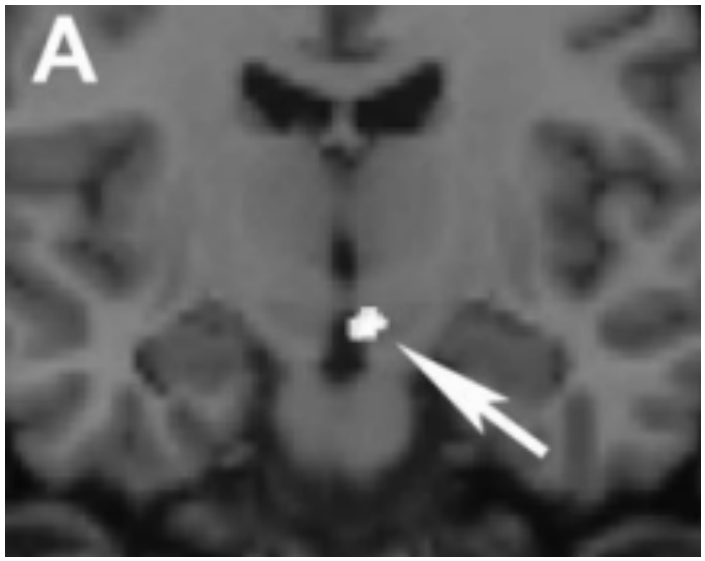




Larger Scale Emotions

Romantic Love: An fMRI Study of a Neural Mechanism for Mate Choice

HELEN FISHER,[1]* ARTHUR ARON,[2] AND LUCY L. BROWN[3]
[1]Department of Anthropology, Rutgers University, New Brunswick, New Jersey 08901
[2]Department of Psychology, State University of New York at Stony Brook, Stony Brook, New York 11794
[3]Departments of Neurology and Neuroscience, Albert Einstein College of Medicine, Bronx, New York 10461



A small region of cortex that is more active when viewing potential mates…

The neural basis of romantic love

Andreas Bartels and Semir Zeki

Wellcome Department of Cognitive Neurology, University College London, London WC1E 6BT, UK

Received 5 September 2000; accepted 26 September 2000

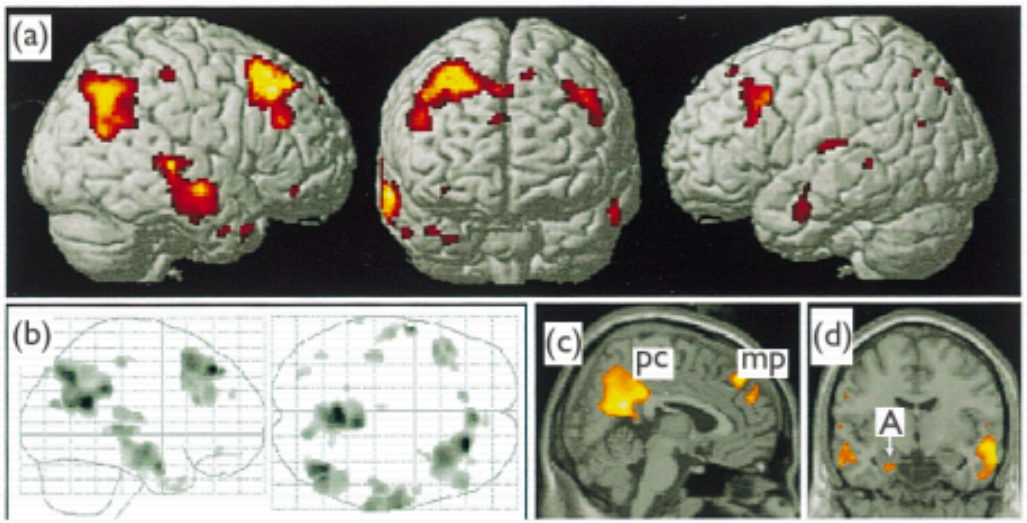


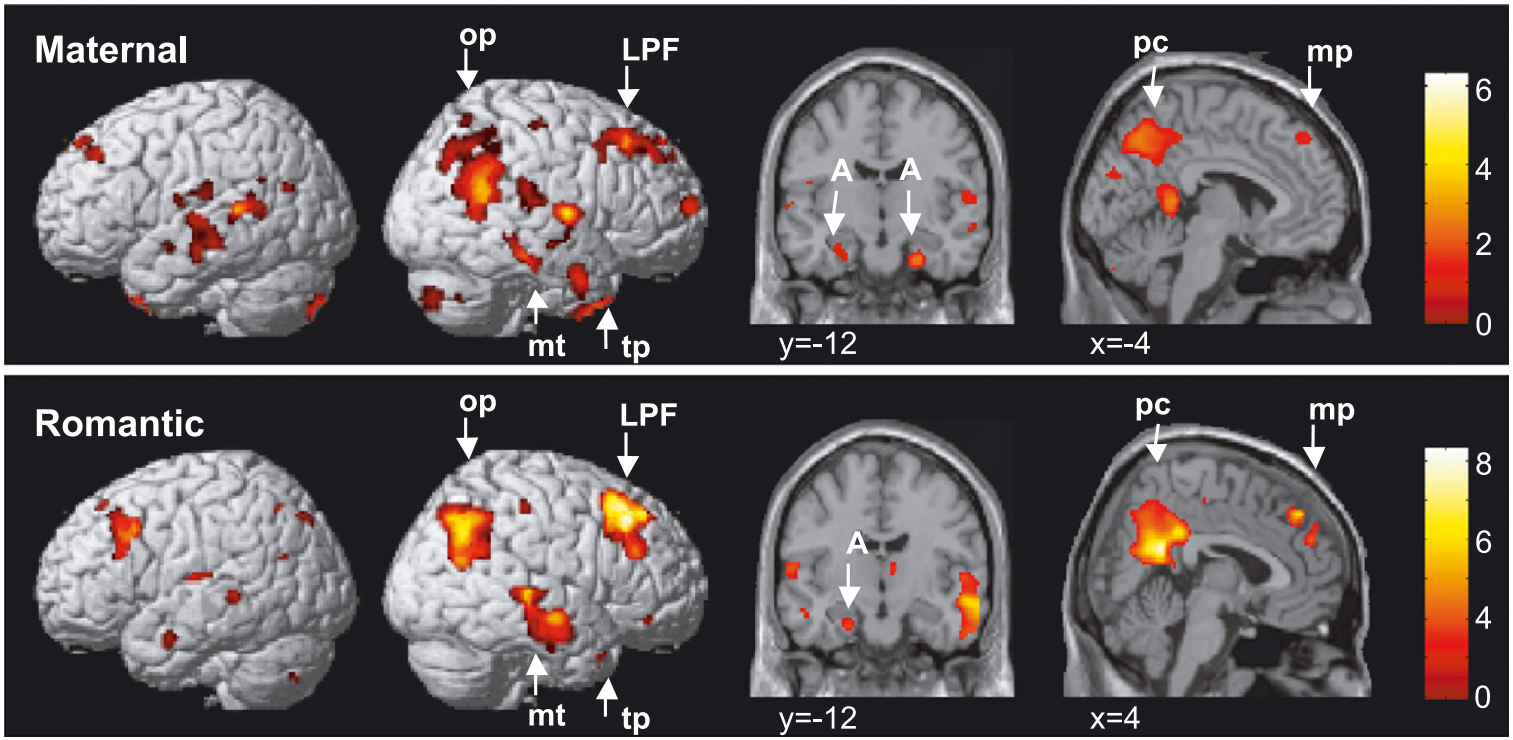
Fig. 4. Deactivations revealed by a comparison of brain activity elicited when subjects viewed pictures of their friends with that produced when they viewed pictures of their loved partner. Cortically, deactivations were right-lateralized within the prefrontal cortex, the middle temporal gyrus and the parietal cortex, as is apparent (**a**) in the projections onto the cortical surfaces in side and front views of a template brain and (**b**) in glassbrain projections. (**c**) The sagittal section ($x = 4$ mm) shows deactivations in the posterior cingulate gyrus (pc) and in the medial prefrontal cortex (mp). (**d**) The coronal section ($y = -8$ mm) shows deactivation in the left amygdaloid region (A). Thresholding: as in Fig. 3, with (a) thresholded as (b).

The neural correlates of maternal and romantic love

Andreas Bartels* and Semir Zeki

Wellcome Department of Imaging Neuroscience, University College London, London, UK

Received 9 September 2003; revised 5 November 2003; accepted 13 November 2003



The Neural Basis of Altruistic Punishment

Dominique J.-F. de Quervain,[1*†] Urs Fischbacher,[2*] Valerie Treyer,[3] Melanie Schellhammer,[2] Ulrich Schnyder,[4] Alfred Buck,[3] Ernst Fehr[2,5†]

seem to feel bad if they observe that norm violations are not punished, and they seem to feel relief and satisfaction if justice is established. Many languages even have proverbs indicating such feelings, for example, "Revenge is sweet."

A design to study the punishment of defectors. We examined the hypothesis that people derive satisfaction from the punishment of norm violations by combining an economic

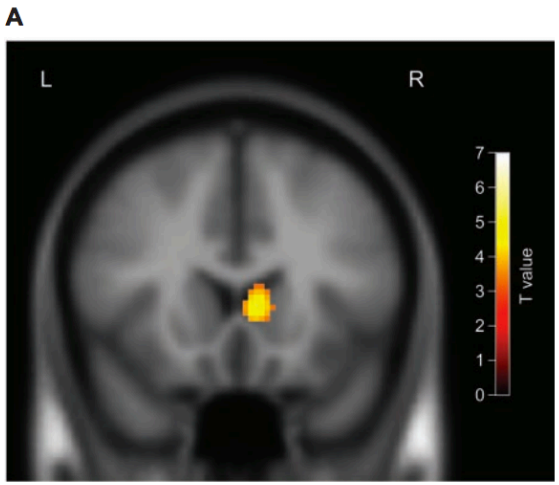


Fig. 2. (**A**) Activation in the caudate nucleus in conditions in which subjects indicated a strong desire to punish and could effectively do so (IC and IF) relative to conditions in which there is no effective punishment or the desire to punish is absent (IS and NC). (**B**) Effect sizes at the peak of blood-flow increase in the caudate nucleus. Bars indicate caudate activity in each condition relative to the mean brain activation ± SD.

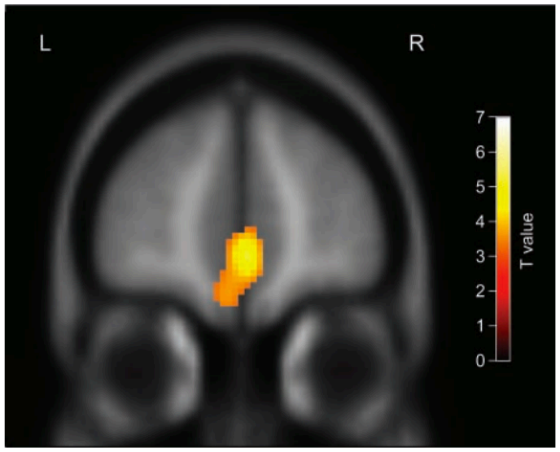


Fig. 4. The role of the prefrontal cortex in integrating the benefits and costs of punishing. Activation of the ventromedial prefrontal cortex and the medial orbitofrontal cortex in the condition where subjects have a strong desire to sanction but where sanctioning is costly for the punisher (IC) relative to the condition where there is also a strong desire to sanction but sanctioning is costless for the punisher (IF).

Patterns of neural activity associated with honest and dishonest moral decisions

Joshua D. Greene[1] and Joseph M. Paxton

Department of Psychology, Harvard University, 33 Kirkland Street, Cambridge, MA 02138

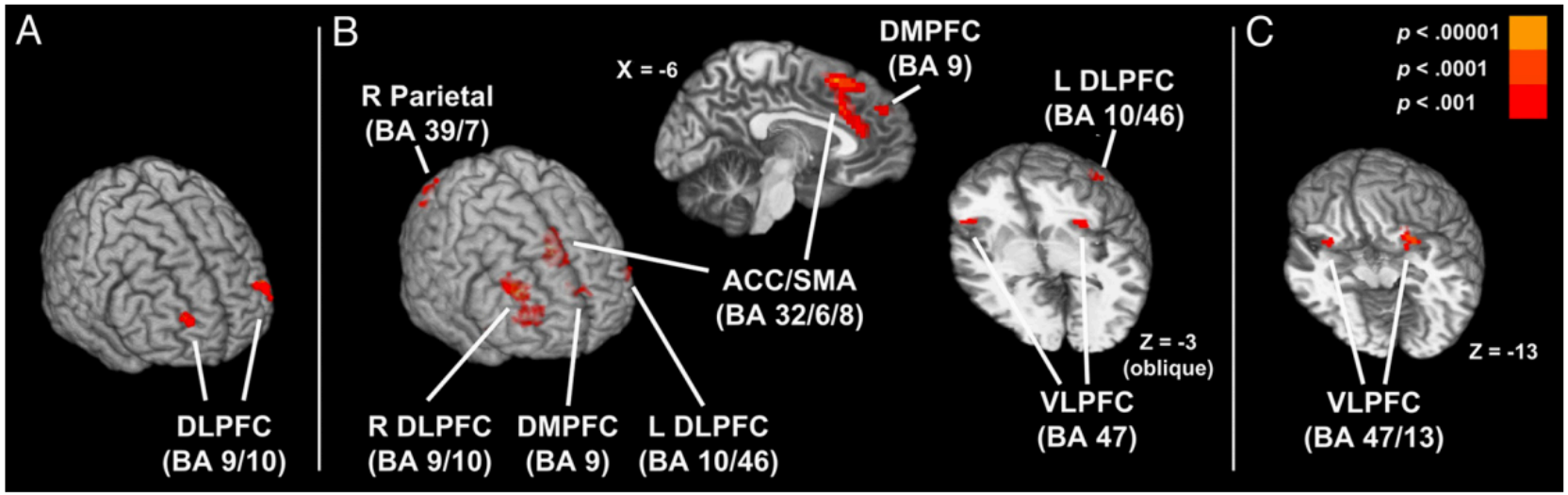


Fig. 3. Brain regions exhibiting increased activity in the Opportunity condition, as compared with the No Opportunity condition, broken down by group (honest vs. dishonest) and outcome type (win vs. loss). BA, Brodmann area. fMRI data are projected onto a reference anatomical image. (*A*) Increased activity in bilateral DLPFC is associated with decisions to lie (Opportunity Wins > No-Opportunity Wins) in dishonest subjects. (*B*) Increased activity in bilateral ACC/SMA, DLFPC, VLPFC, DMPFC, and right parietal lobe is associated with decisions to refrain from lying (Opportunity Losses > No-Opportunity Losses) in dishonest subjects. (*C*) Increased activity in bilateral VLPFC is associated with decisions to accept honest wins (Opportunity Wins > No-Opportunity Wins) in honest subjects. No significant effects were observed in association with decisions to refrain from lying (Opportunity Losses > No-Opportunity Losses) in honest subjects.

The Black Darker Side…


WANTED
MICHAEL MYERS
DEAD OR ALIVE
REWARD
IL DEPT OF CORR
CD1065

Evil

The exercise of power to:

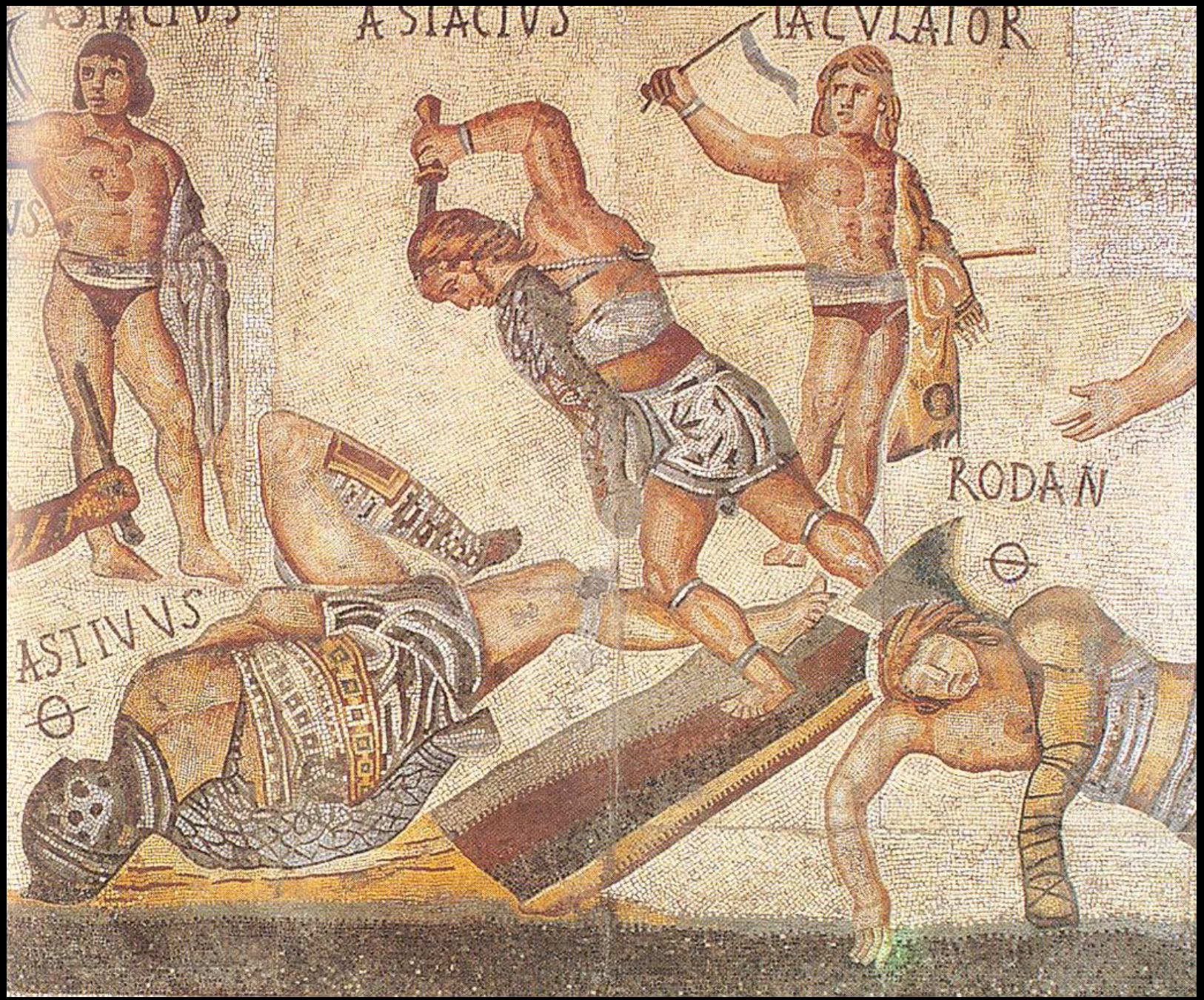
Intentionally

Harm (Psychologically),

Hurt (Physically), and/or

Destroy (Morally) and/or

Commit Crimes Against Humanity


ASIACVS
ASIACVS
IACVLATOR
RODAN
ASTIVVS

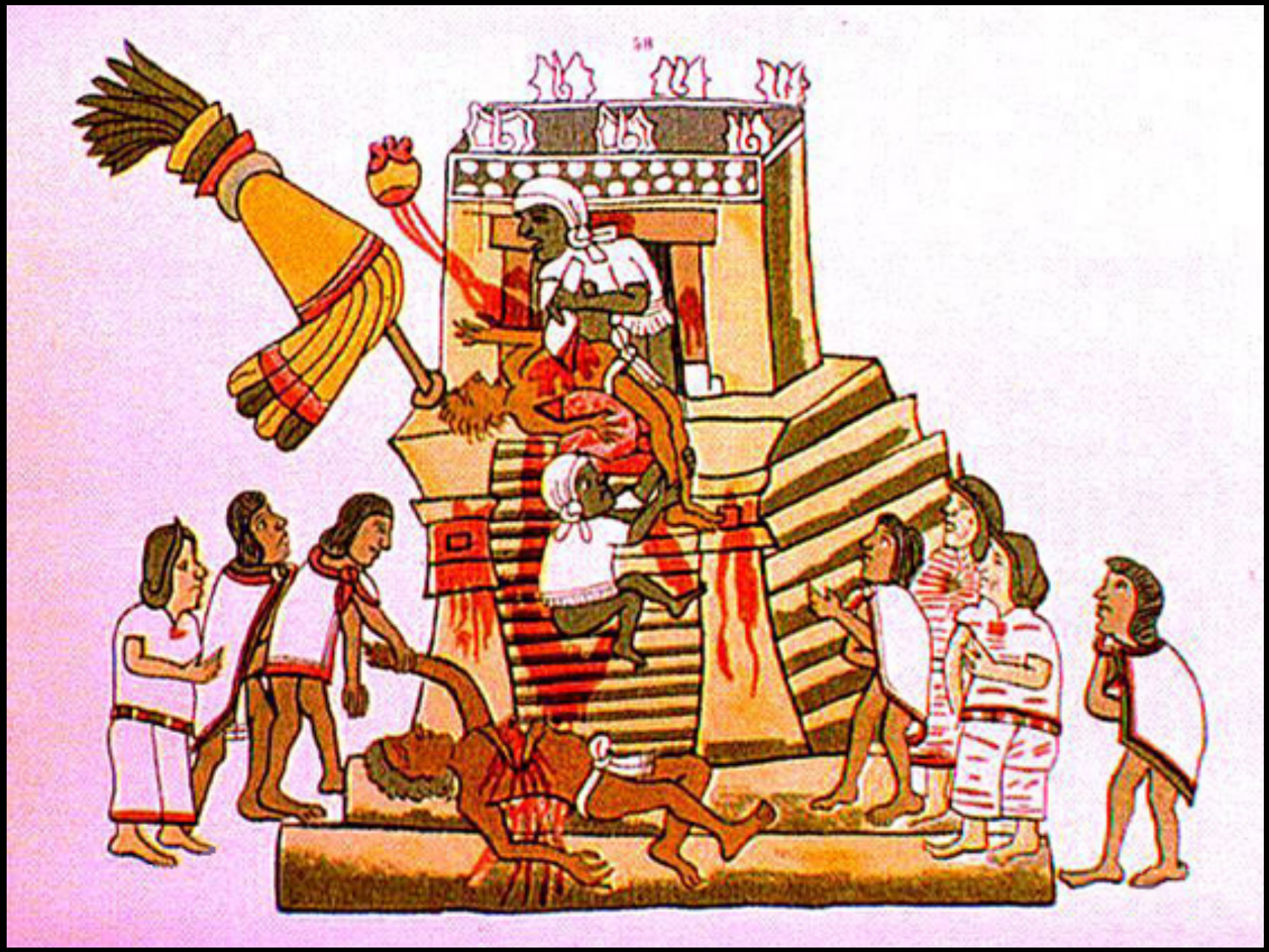


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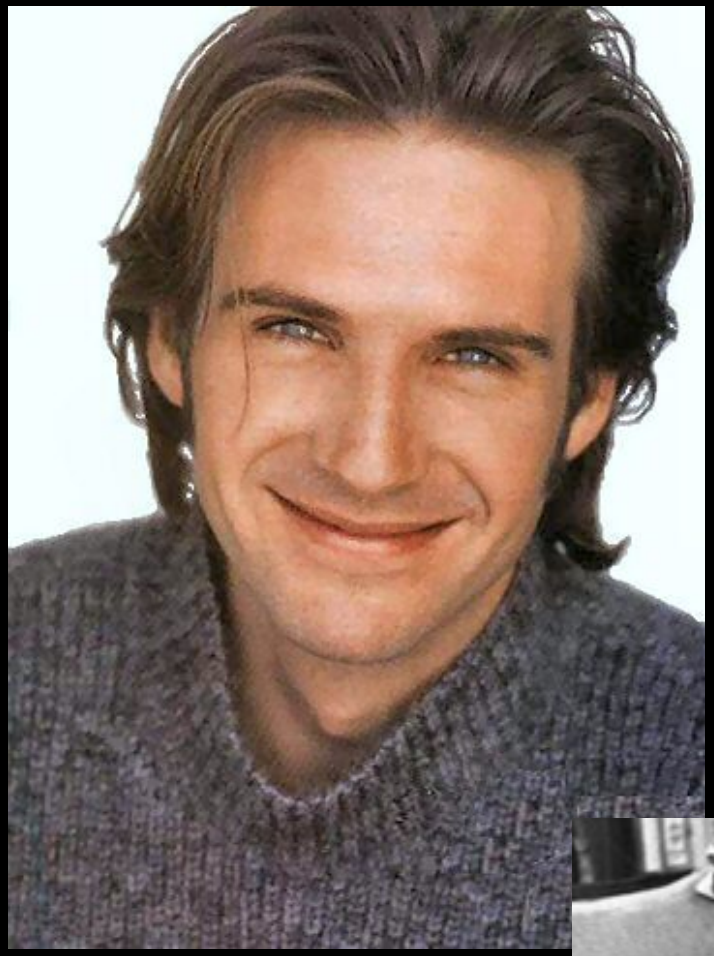
Foto: Wittig | 6. November 1959

Who is Evil?

Us (Good) vs Them (Evil Doers)

We consider evil to be a quality that some people simply have



Or is it the case people become evil?

In the last 100 years 50 million people have been systematically killed by government decrees.

Our century of genocides could not have been perpetrated by psychopaths, sadists, and sociopaths alone.

The “Banality of Evil”
Evil occurs when ordinary individuals are put into corrupt situations that encourage their conformity.

Before he was sentenced to death, Adolf Eichamann was found to be “perfectly normal” and “mentally healthy”.

“I did my duty. I obeyed orders.”

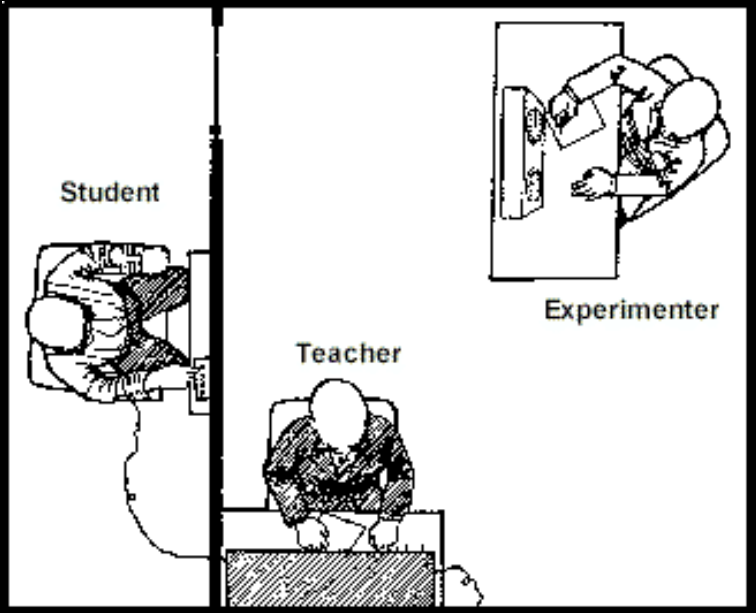
From Good to Evil

Dispositional (inside of individual)

Situational (external)

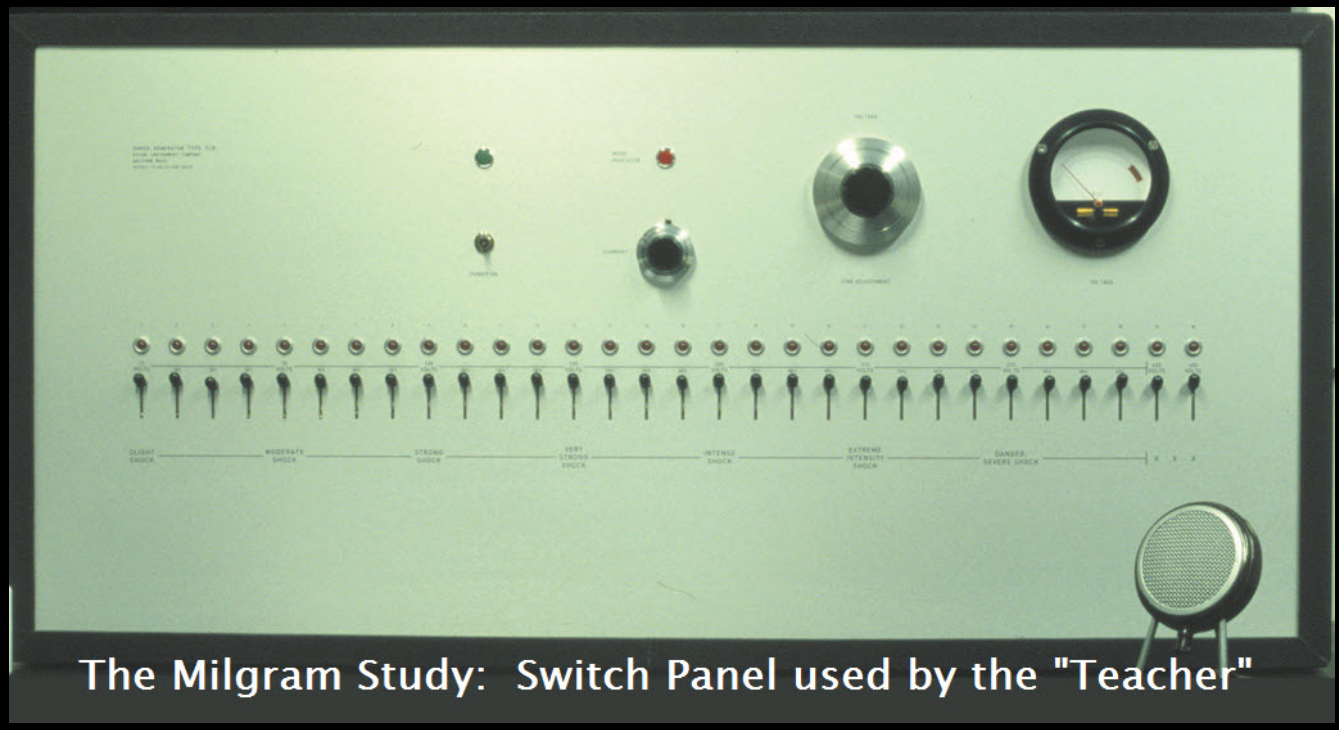
Systematic (broad influences – political, economic, legal, cultural)

Milgram (1963)



Milgram recruits people to participate in an experiment about memory. The participant is introduced to a tall, sharp and stern looking experimenter (Milgram) wearing a white lab coat. The participant is also introduced to a friendly co-participant, who is actually a confederate. Milgram explains that the experiment investigates punishment in learning, and that one will be the "teacher", and one will be the "learner." Rigged lots are drawn to determine roles, and it is decided that the true participant will be the "teacher."

Milgram (1963)



The Milgram Study: Switch Panel used by the "Teacher"

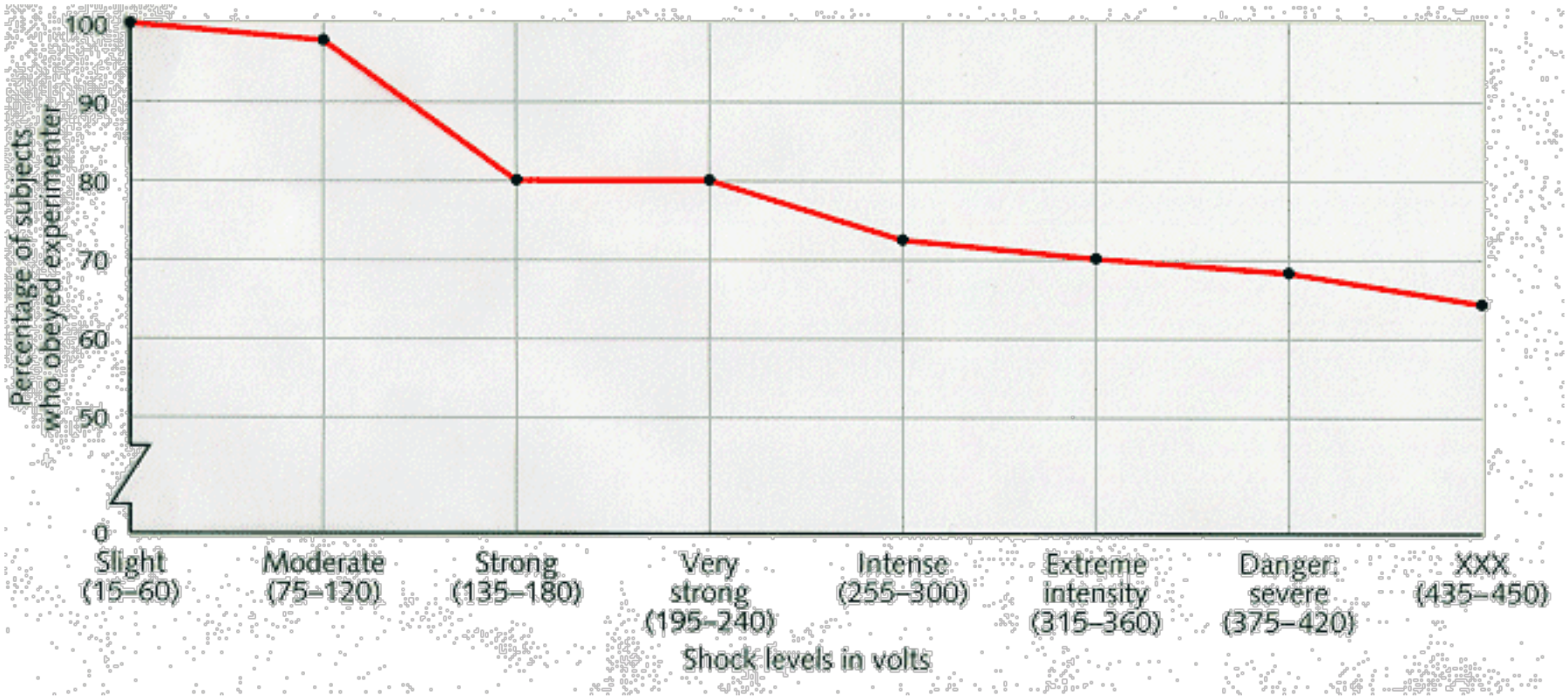
The confederate is strapped to a chair, and his arm is dotted with electrodes. Milgram instructs the teacher to read out word pairs from a list, such as "clear" goes with "air", or "dictionary" goes with "red". Afterwards, when the teacher says a word, the learner must regurgitate the other word that goes with the teacher's word. If the learner recalls the correct word, we move to the next word pair. Otherwise, he is given a voltage shock. These shocks increase in amplitude as more mistakes are made. However, Milgram says that "no permanent tissue damage will occur". Shocks start at 15 volts, and grow in 15 volt increments.

Milgram (1963)

voltage	confederate response
75	grunts
120	shouts in pain
150	says that he refuses to continue with this experiment
200	blood-curdling screams
300	refuses to answer, mumbles something about a heart condition
+330	silence

objection	milgram's response
first	"He's fine. go on."
second	"The experiment requires you to go on."
third	"It is absolutely essential to go on."
fourth	"You have no choice. You must go on."

Milgram (1963)



Milgram's Other Studies

Teacher does not deliver shock but just helps out	93%
Standard Experiment (no gender effect)	65%
Victim in same room	40%
Teacher puts hand on shock plate	30%
Experimenter in remote location	19%
Teacher told to select level of shock	3%

Replicating Milgram

Would People Still Obey Today?

Jerry M. Burger
Santa Clara University

Table 1
Education and Ethnicity of Participants

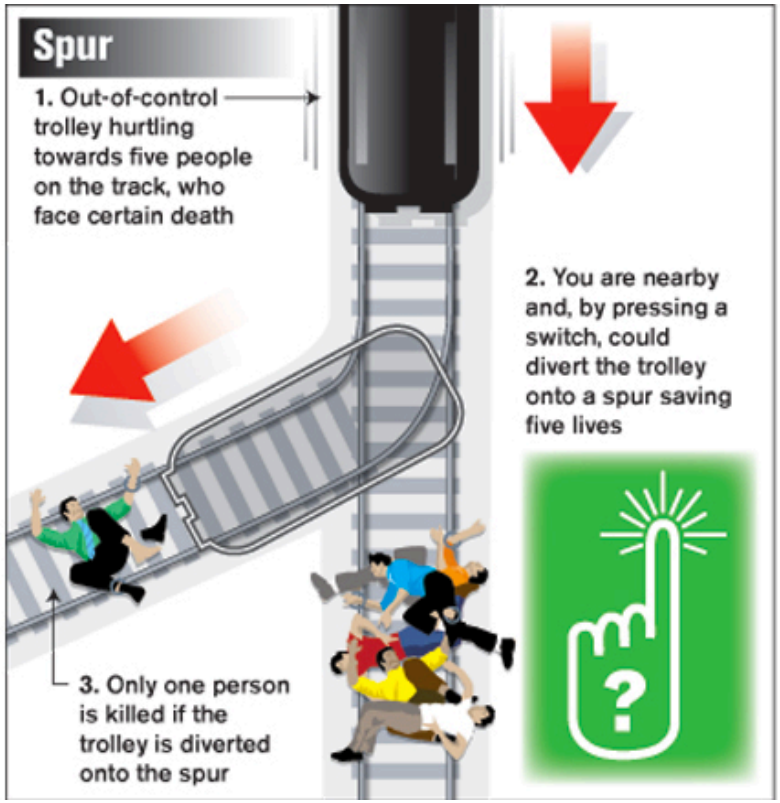
Education and ethnicity	*n*	%
Education		
High school or less	12	17.1
Some college	16	22.9
Bachelor's degree	28	40.0
Master's degree	14	20.0
Ethnicity		
White Caucasian	38	54.3
Asian	13	18.6
Latin/Hispanic	9	12.9
Indian (Asian)	6	8.6
African American	3	4.3
Did not state	1	1.4

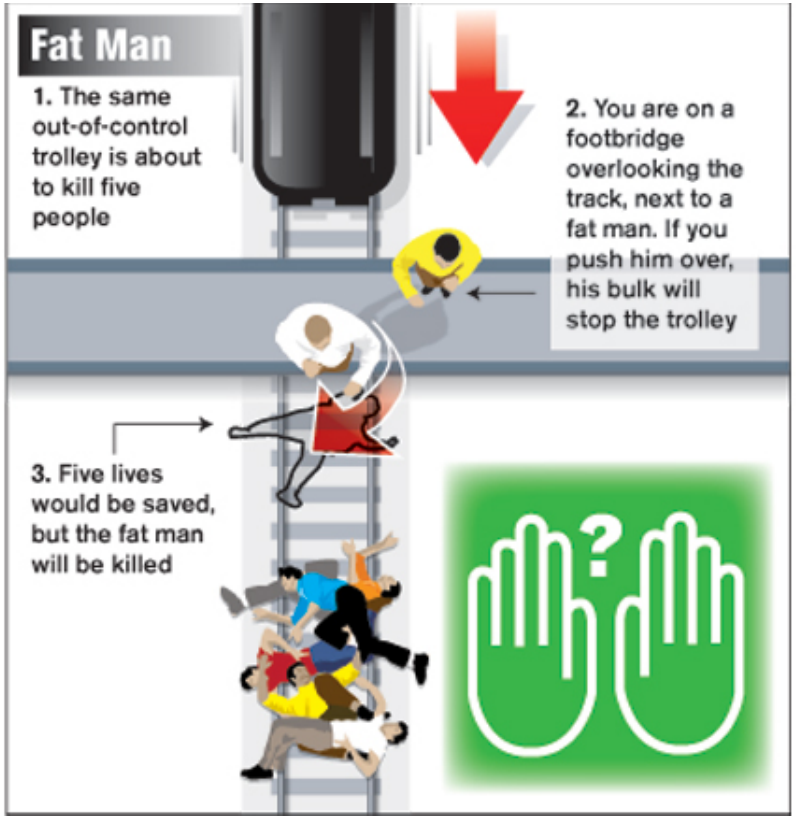
Table 2
Numbers (and Percentages) of Participants Who Stopped and Who Continued

Behavior	Base condition	Modeled refusal condition	Milgram's Experiment 5
Stopped at 150 volts or earlier	12 (30.0)	11 (36.7)	7 (17.5)
Continued after 150 volts	28 (70.0)	19 (63.3)	33 (82.5)

THE OPENING IN THE ROOF OF THE GAS CHAMBER THROUGH WHICH "CYCLONE" CRYSTALS WERE POURED.

Reanalyzing the Trolley Dilemma





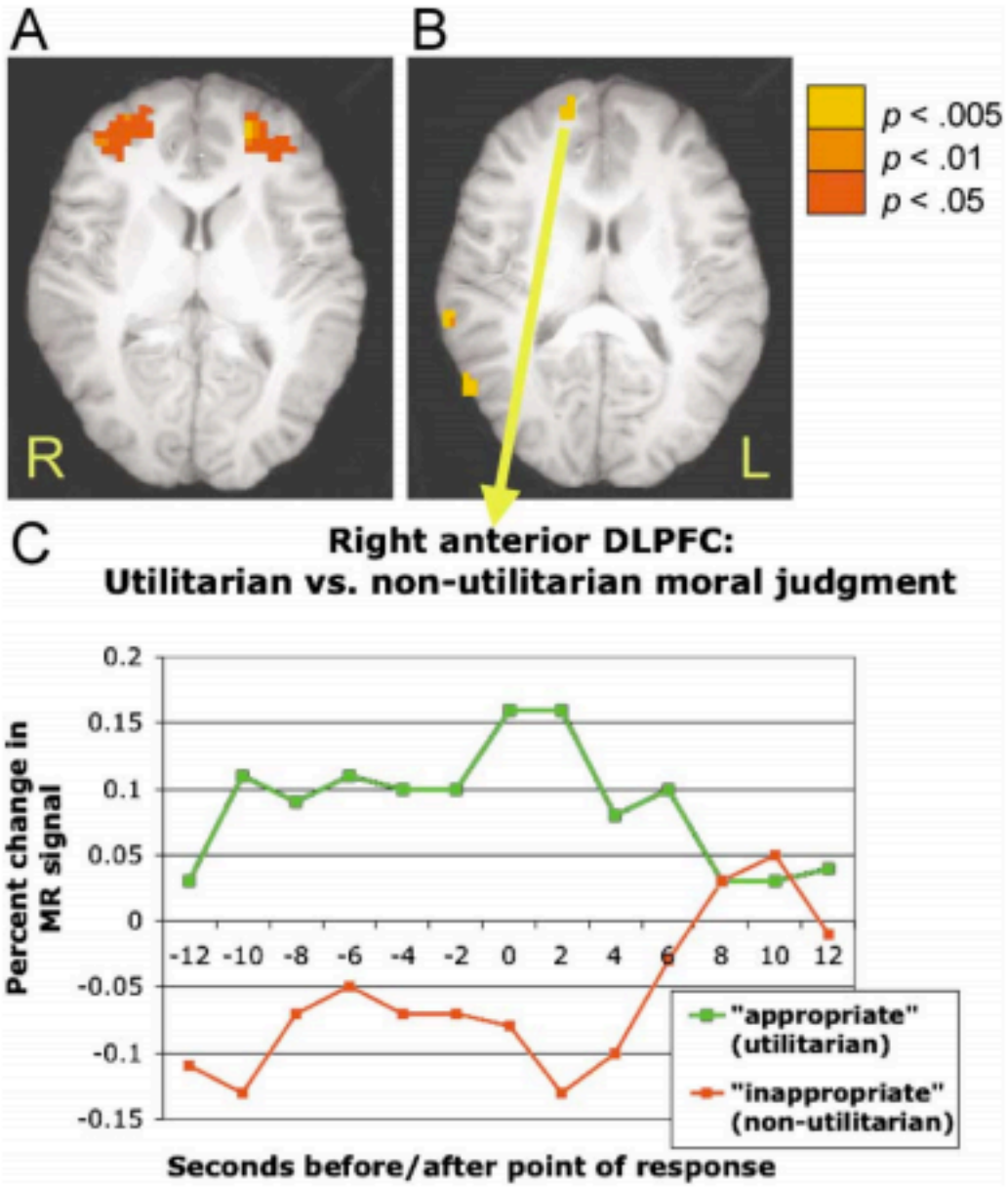


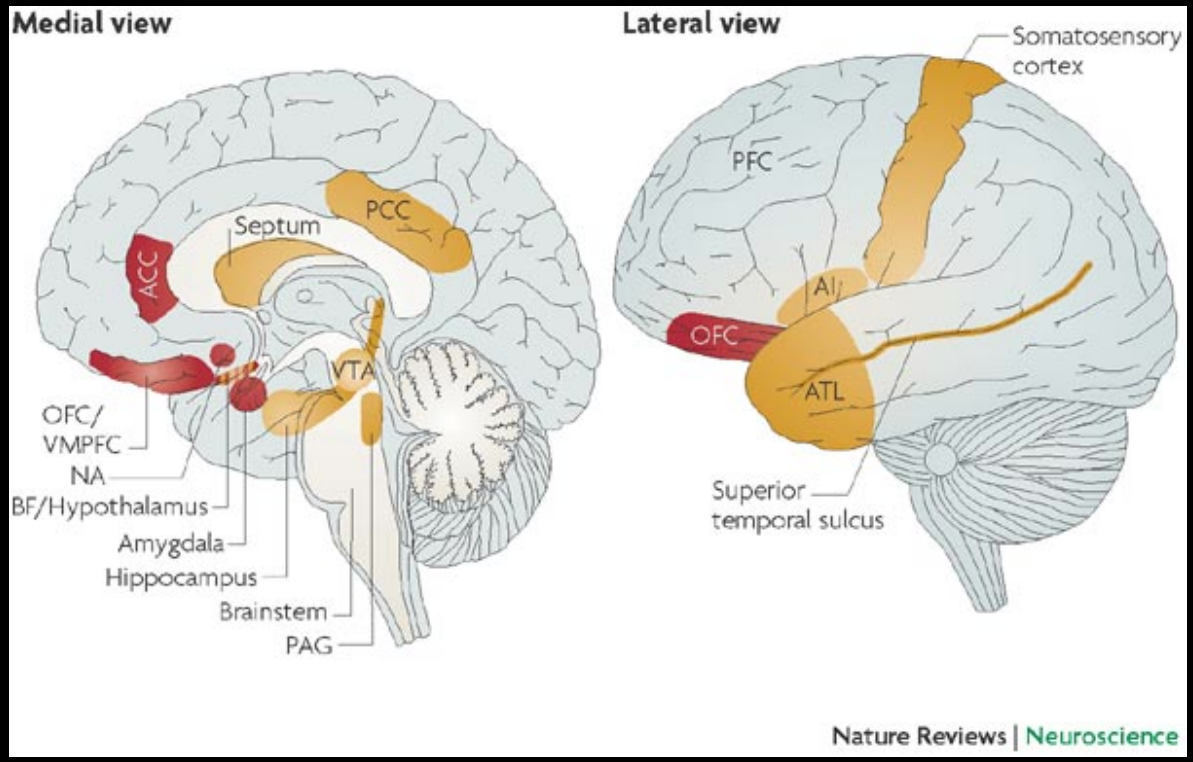
Figure 3. Utilitarian versus Nonutilitarian Difficult Personal Moral Judgment

Selected brain regions (see Tables 3–4) exhibiting significantly increased activity for utilitarian, as compared to nonutilitarian, difficult personal moral judgment. Images are reversed right to left according to radiologic convention. (A) A spatially restricted analysis ($p < 0.05$, cluster size ≥ 8) of activity in the anterior dorsolateral prefrontal cortex (BA 10/46) revealed bilateral clusters of voxels exhibiting increased activity during trials in which participants made utilitarian judgments. Axial slice plane is $z = +8$ (Talairach and Tournoux, 1988). (B) A whole-brain analysis ($p < 0.005$, cluster size ≥ 8) revealed a contiguous and slightly anterior region on the right side exhibiting the same effect ($z = +13$) . (C) Time course of activity in this region by participant response: utilitarian/"appropriate" (green) versus nonutilitarian/"inappropriate" (red). Data are not adjusted for hemodynamic lag.

Moral Judgment

Cognitive Areas:
Lateral PFC
ACC

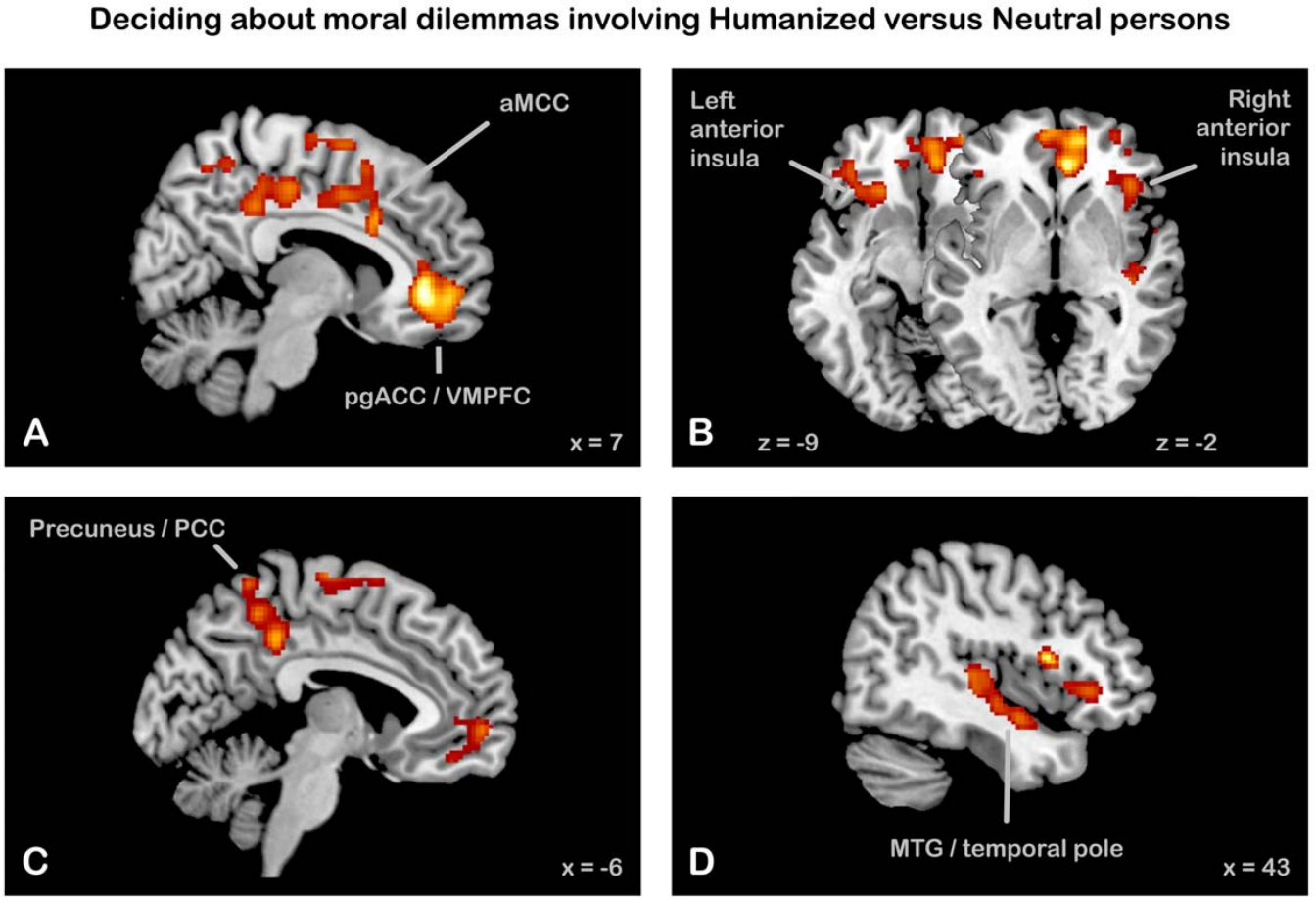
Emotional Areas:
Medial PFC
PCC
Amygdala



The Human Factor: Behavioral and Neural Correlates of Humanized Perception in Moral Decision Making

Jasminka Majdandžić[1,2]*, Herbert Bauer[1], Christian Windischberger[2], Ewald Moser[2], Elisabeth Engl[1], Claus Lamm[1]*

1 Social, Cognitive and Affective Neuroscience Unit, Faculty of Psychology, University of Vienna, Vienna, Austria, **2** Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria



Stanford Prison Study 1971

Stanford Prison Study 1971

24 Stanford students were randomly selected, 12 as prison guards, 12 as prisoners. After 6 days the experiment had to be called off due to the level of abuse to the prisoners. Even the Principle Investigator, Dr. Zimbardo, fell victim to the experiment and let the abuse continue in the name of science. Prisoners even got to the appoint where they willingly abused each other.

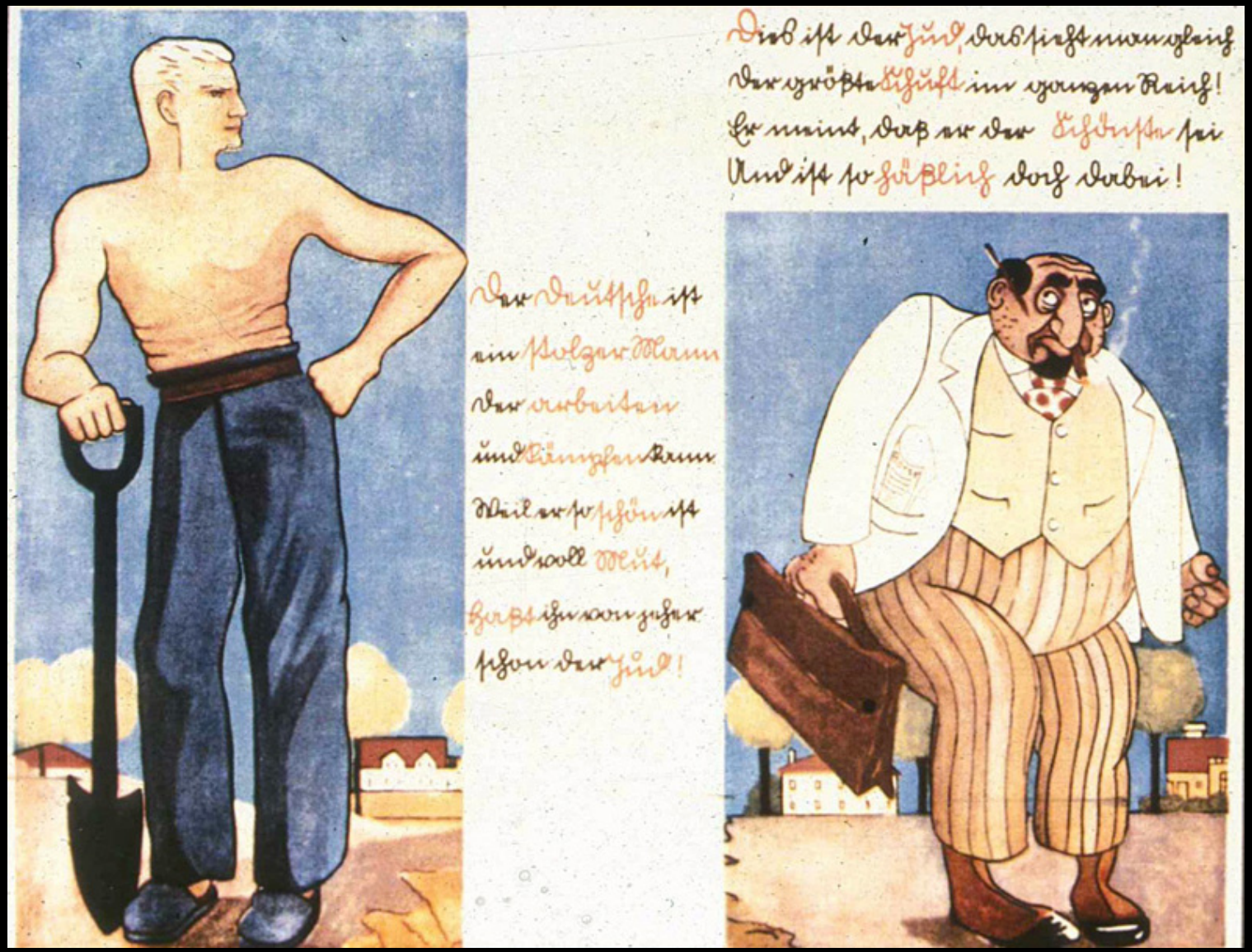
Stanford Prison Study 1971

“The experiment became exciting on day two when the prisoners staged a revolt. Once the guards had crushed the rebellion, "they steadily increased their coercive aggression tactics, humiliation and dehumanization of the prisoners," Zimbardo recalls. "The staff had to frequently remind the guards to refrain from such tactics," he said, and the worst instances of abuse occurred in the middle of the night when the guards thought the staff was not watching. The guards' treatment of the prisoners - such things as forcing them to clean out toilet bowls with their bare hands and act out degrading scenarios, or urging them to become snitches.”

Abu Ghraib 2004

Abu Ghraib 2004

Setting the Stage… Dehumanization



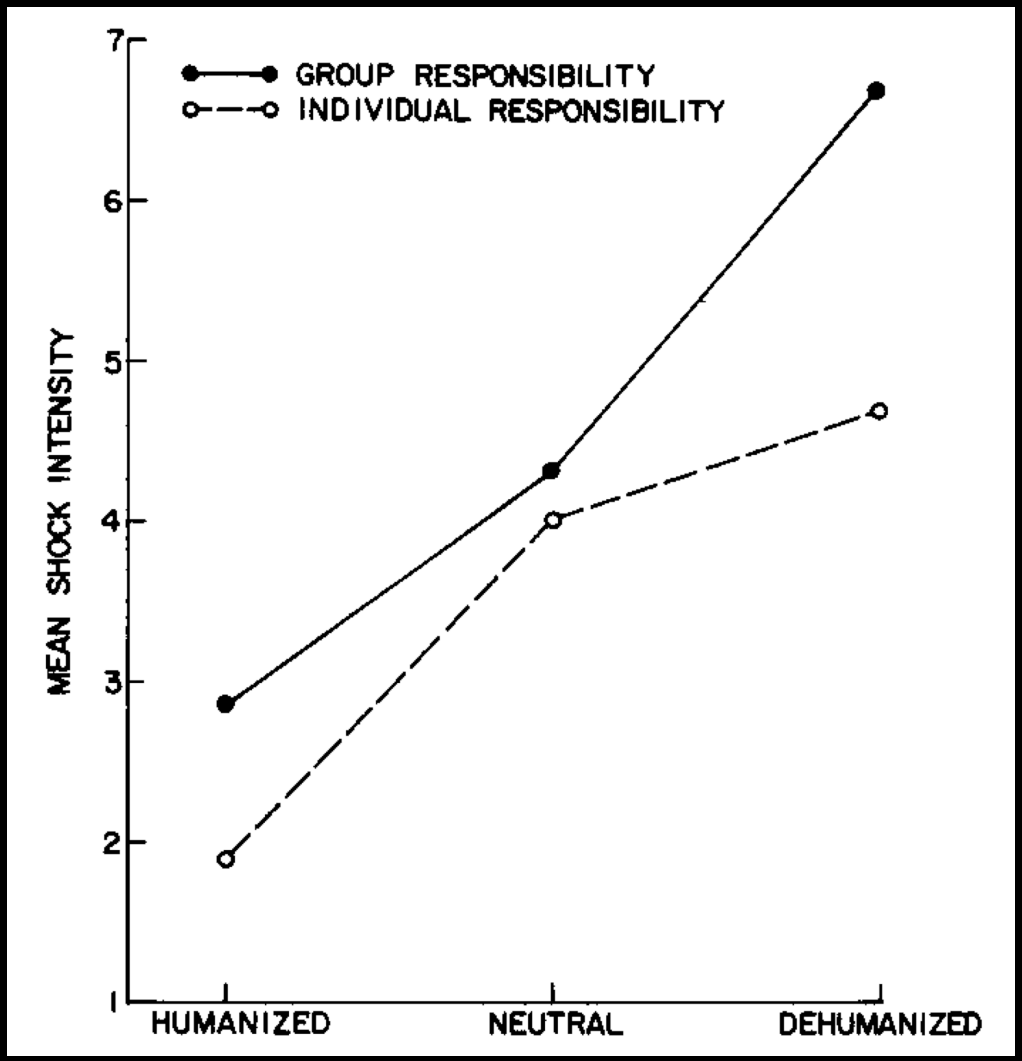
Bandura 1975

Participants completed an experiment similar to Milgrams. They were going to help “teach” other participants via an electrical shock device. However, Bandura manipulated responsibility and humanization.

Responsibility: Individual vs Diffuse

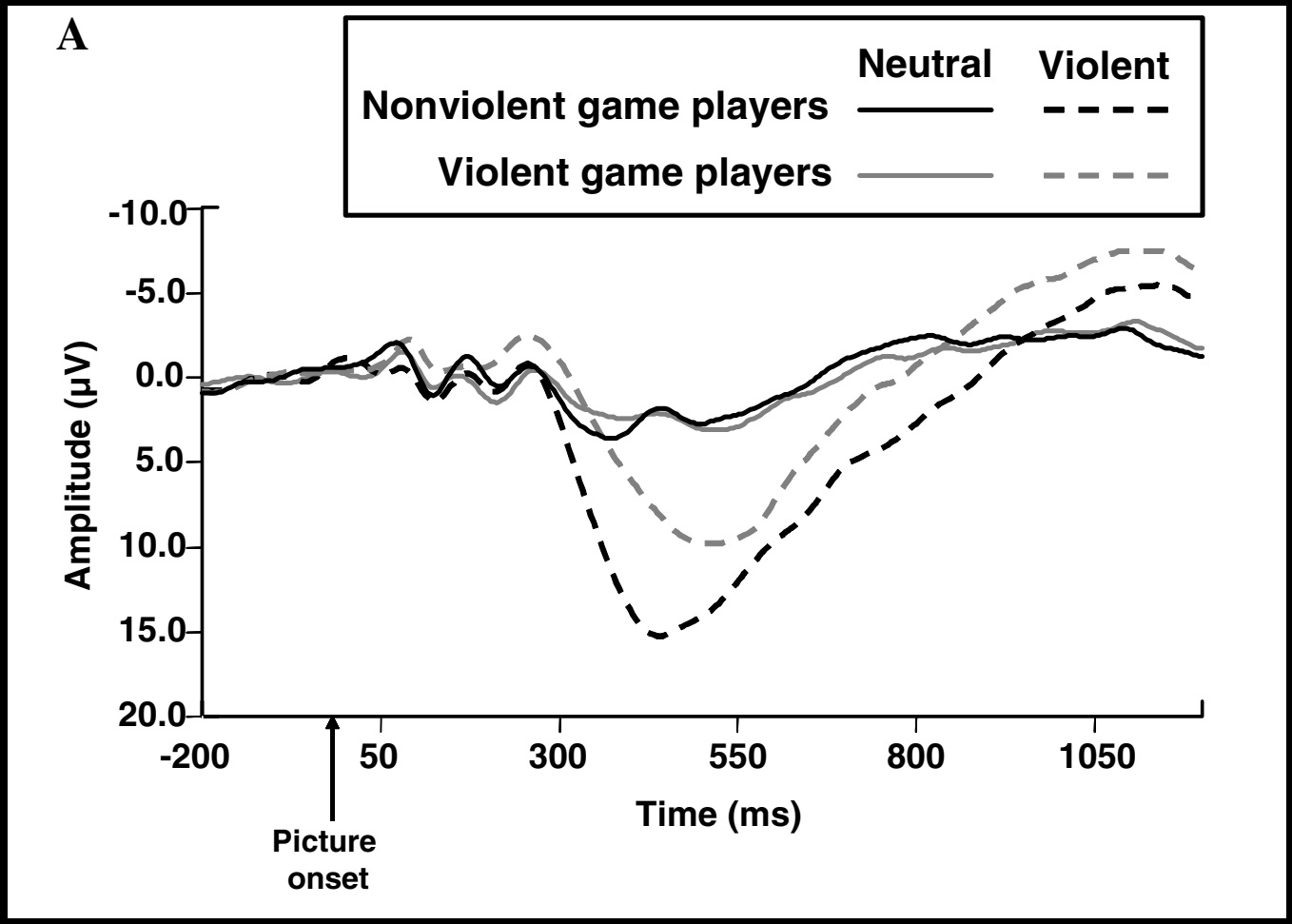
Humanization: Good vs Bad People

Bandura 1975



Setting the Stage… Desensitization

Bartholow 2006



Setting the Stage… Learning

Bandura and the Bobo Doll, 1961

Table 12.3 Mean aggression scores for experimental and control subjects

Response category	*Experimental groups*				*Control group*
	Aggressive		*Non-aggressive*		
	Female model	*Male model*	*Female model*	*Male model*	
Imitative physical aggression					
Female subjects	5.5	7.2	2.5	0.0	1.2
Male subjects	12.4	25.8	0.2	1.5	2.0
Imitative verbal aggression					
Female subjects	13.7	2.0	0.3	0.0	0.7
Male subjects	4.3	12.7	1.1	0.0	1.7
Mallet aggression					
Female subjects	17.2	18.7	0.5	0.5	13.1
Male subjects	15.5	28.8	18.7	6.7	13.5
Punches Bobo					
Female subjects	6.3	16.5	5.8	4.3	11.7
Male subjects	18.9	11.9	15.6	14.8	15.7
Non-imitative aggression					
Female subjects	21.3	8.4	7.2	1.4	6.1
Male subjects	16.2	36.7	26.1	22.3	24.6
Aggressive gun play					
Female subjects	1.8	4.5	2.6	2.5	3.7
Male subjects	7.3	15.9	8.9	16.7	14.3

Source: Bandura, Ross & Ross (1961).

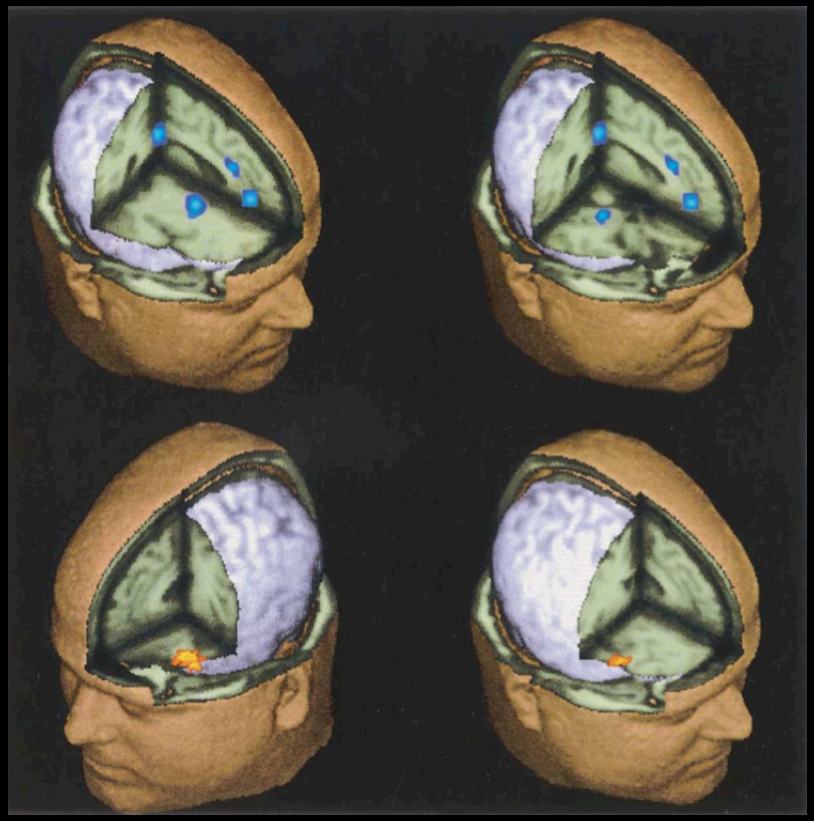
Child is put in a room with an adult. They both play with their own toys. After a few minutes the adult begins beating up the Bobo Doll aggressively.

Child is put in a new room with exciting toys. Child gets to play for a few minutes. Child is then told they cannot play in the room anymore, the toys will be saved for other children… FRUSTRATION

Child is put back in the original room by themselves. 88% of the chidlren in the first study acted aggressively towards the Bobo Doll. 40% of the children retained this aggressiveness months later.

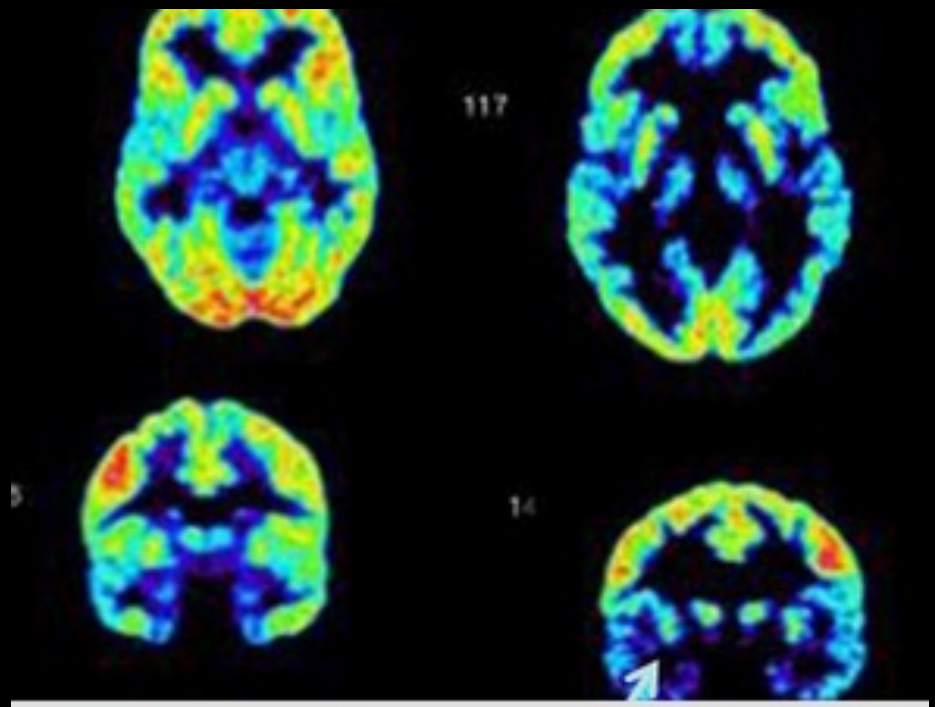
The Individual

It's not all learned…
Kent Kiehl and colleagues



Participants in the psychopathy group exhibited significantly less activation in the ventromedial prefrontal cortex, lateral orbitofrontal cortex, and periaqueductal gray relative to controls

Maybe it is learning after all… Fallon 2011



Fallon's brain (on the right) has dark patches in the orbital cortex, the area just behind the eyes. This is the area that Fallon and other scientists say is involved with ethical behavior, moral decision-making and impulse control. The normal scan on the left is his son's.

ORIGINAL ARTICLE

Reduced Prefrontal Gray Matter Volume and Reduced Autonomic Activity in Antisocial Personality Disorder

Adrian Raine, DPhil; Todd Lencz, PhD; Susan Bihrle, PhD; Lori LaCasse, BA; Patrick Colletti, MD

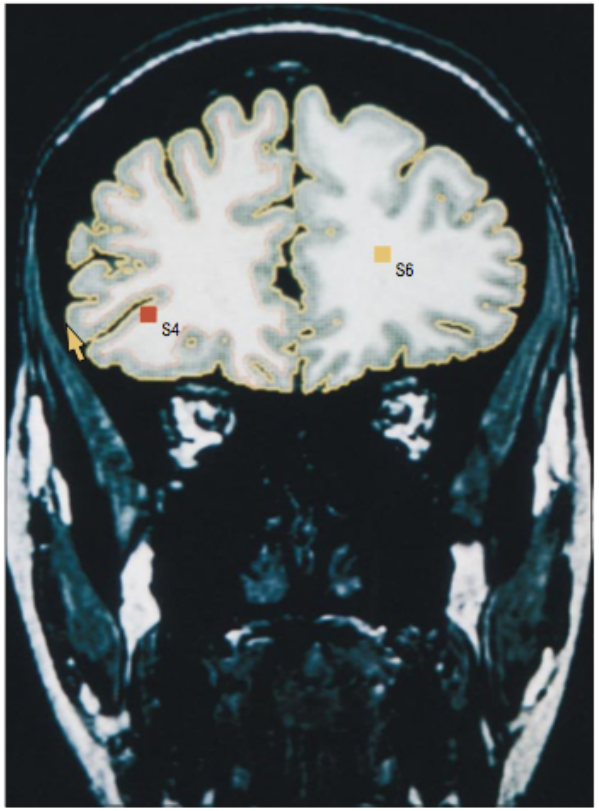
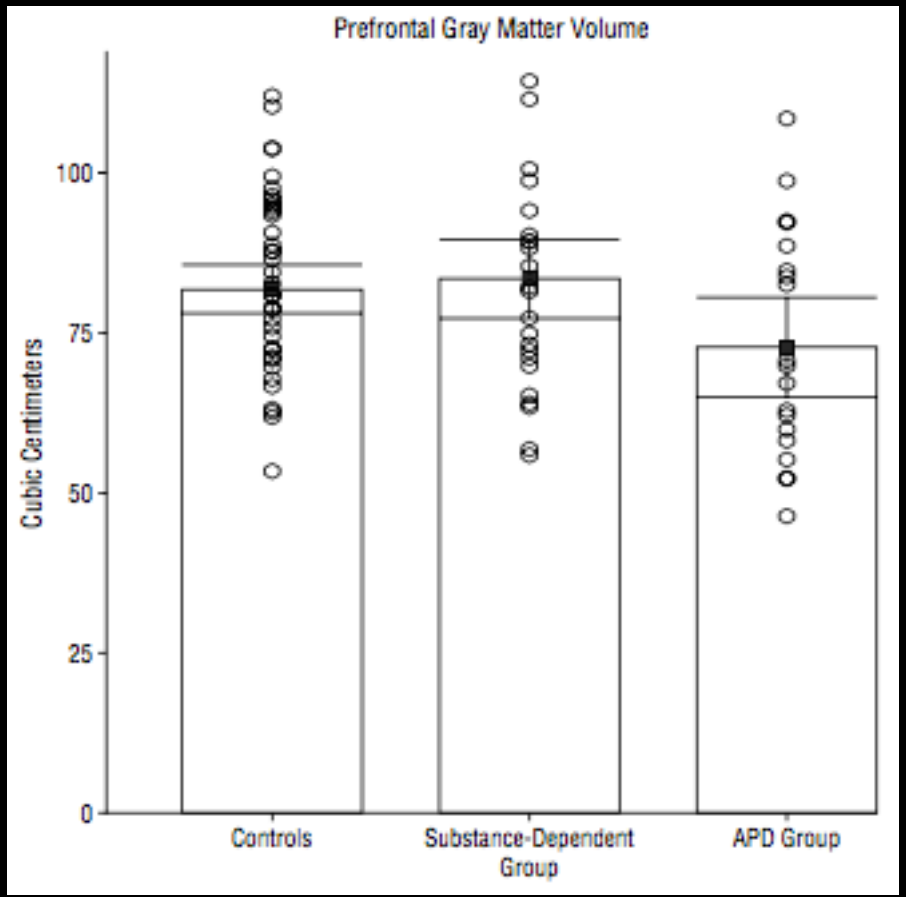


Figure 1. *Coronal slice of the prefrontal cortex illustrating the seeding program for calculation of gray and white volumes.*



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Journal of Affective Disorders 50 (1998) 235–243

JOURNAL OF AFFECTIVE DISORDERS

Preliminary communication

A brain MRI study in subjects with borderline personality disorder

In Kyoon Lyoo[a,c,*], Moon Hee Han[b,c], Doo Young Cho[a,c]

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[b]*Department of Radiology, Seoul National University Hospital, Seoul, South Korea*
[c]*Seoul National University College of Medicine, Seoul, South Korea*

Table 2
Volume measurements of the frontal lobes, the temporal lobes, the lateral ventricles, and the cerebral hemispheres in subjects with borderline personality disorder (BPD) and healthy comparisons

	Subjects with BPD ($n = 25$)		Healthy comparisons ($n = 25$)	
	Mean volume (ml)	S.D.	Mean volume (ml)	(S.D.)
Frontal lobes[a]	234.2	24.6	249.8	25.1
Temporal lobes	103.4	13.9	105.1	12.4
Lateral ventricles	16.5	9.8	14.7	7.5
Cerebral hemispheres	926.3	91.7	918.6	79.2

[a]Significant difference in volumes of the frontal lobe between groups controlling for age and sex (multivariate regression analysis, $t = 2.225$, $df = 46$, $P = 0.031$).

No significant differences between groups controlling for age and sex, in volumes of the temporal lobes (multivariate regression analysis, $t = 0.457$, $df = 46$, $P = 0.650$), the lateral ventricles (multivariate regression analysis, $t = 0.730$, $df = 46$, $P = 0.469$), the cerebral hemispheres (multivariate regression analysis, $t = 0.318$, $df = 46$, $P = 0.752$).

A lot of what you have seen today can be framed in terms of VALUE… thus, it impacts and drives decision making.

And the systems that drive it? Think of the trolley dilemma.

Of course, events must happen that allow values to become skewed.