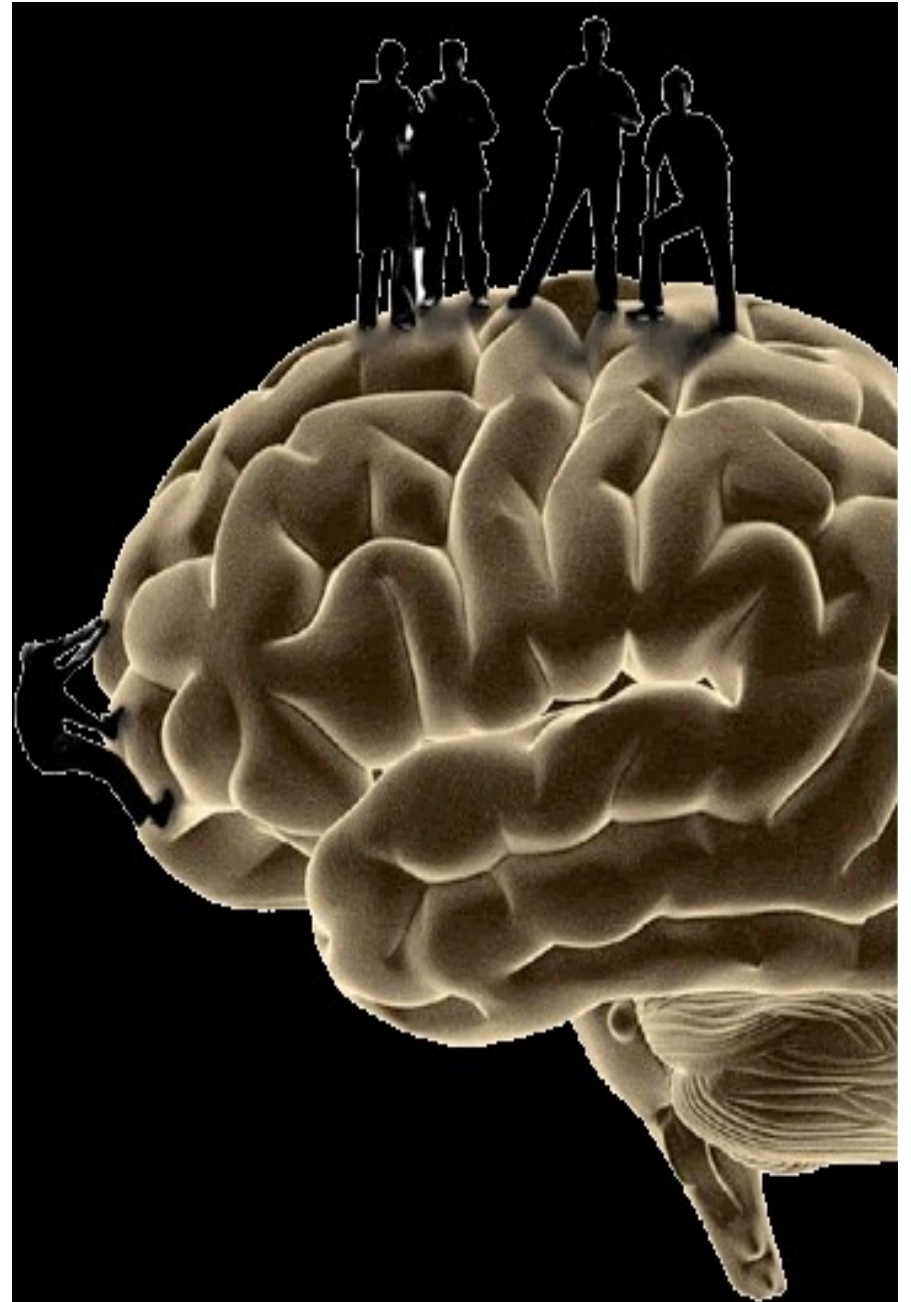


PHYSIOLOGY OF EMOTIONS



EMOTIONS...

THINK OF A TIME IN THE RECENT PAST IN WHICH YOU EXPERIENCED A STRONG EMOTION.

DESCRIBE:

- 1) THE CIRCUMSTANCES**
- 2) YOUR INTERNAL (PHYSIOLOGICAL) STATE**
- 3) BEHAVIORS THAT INDICATED YOUR EMOTIONALITY**
- 4) YOUR CONSCIOUS EXPERIENCE (THE THINKING THAT RELATED TO YOUR STATE)**



What Causes Emotional Experience?

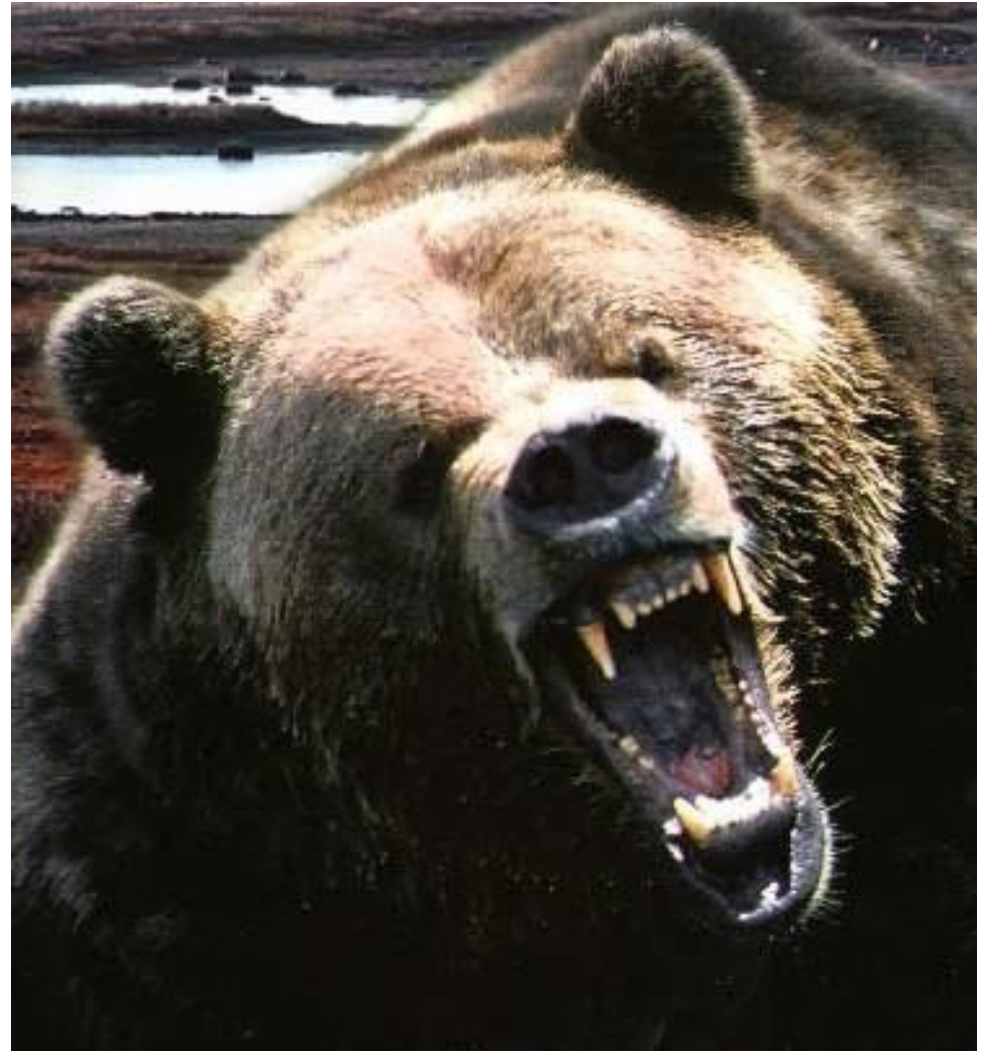
COMMON SENSE VIEW:

event → emotional

feeling → action

(physiology)

For example,
aggressive
behaviour triggers
emotions of anger
and leads to
activation of the
sympathetic nervous
system.



THE PHYSIOLOGY OF EMOTION (HISTORY)



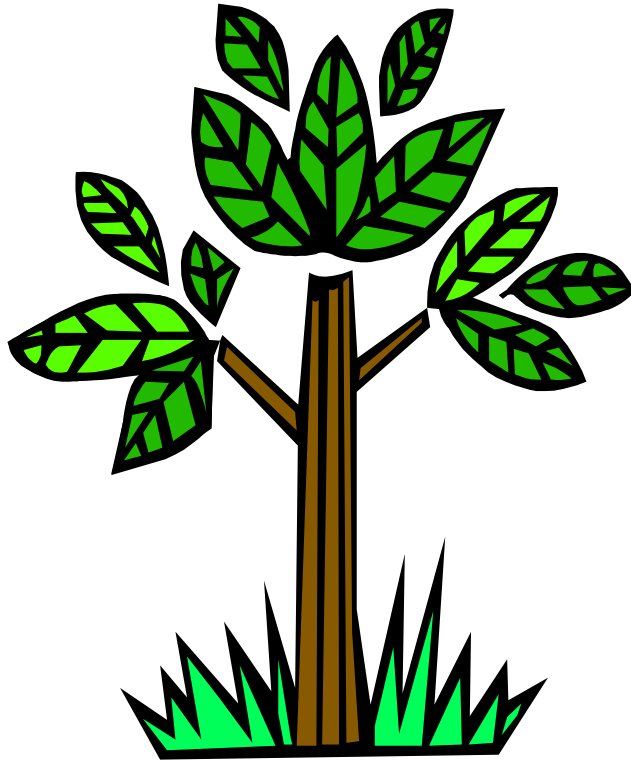
ARISTOTLE: “People were **THINKING ANIMALS**. What makes people special is they can overcome their brutish emotions”.

ROUSSEAU: “Emotions are what makes people special and gives us a reason for living”.

EMOTION

GARDENER

culture and experience
and expression of
emotion



BRANCHES

thoughts and
explanations

ROOT and TRUNK

biological
capacity for emotion

EMOTIONS

**EMOTIONS ARE
A MIX OF:**

- **PHYSIOLOGICAL
ACTIVATION**
- **EXPRESSIVE
BEHAVIOR**
- **CONSCIOUS
EXPERIENCE**



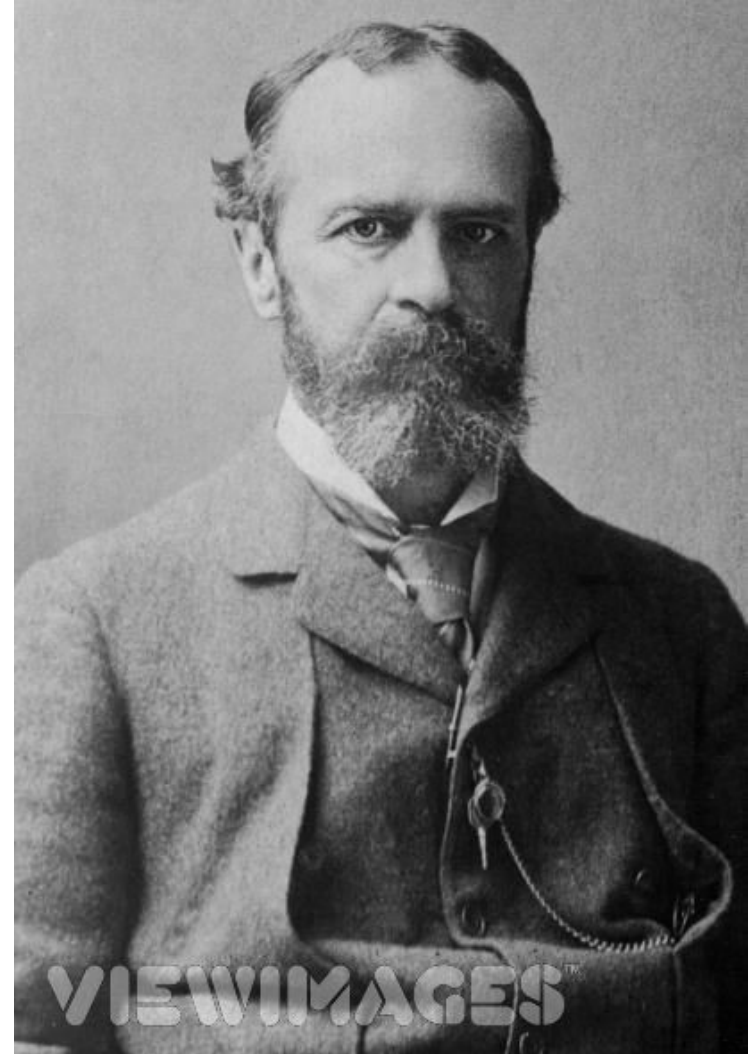
CHARACTERISTICS OF EMOTIONS

- Emotions are accompanied by both physiological and cognitive changes
- Emotions are polar: they are either positive or negative
- Emotions influence behavior



THE JAMES-LANGE THEORY

- **James-Lange (1890) view**
 - Event → action/physiology → emotional feeling
 - We feel fear because we're running!
- **Modern interpretation of James-Lange**
 - Event → cognitive evaluation → physiology/behavior → emotional feeling



THE JAMES-LANGE THEORY

- **OUR EXPERIENCE OF EMOTION IS OUR AWARENESS OF OUR PHYSIOLOGICAL RESPONSES TO AN EMOTION-AROUSING STIMULI**
- **“WE FEEL SORRY BECAUSE WE CRY, ANGRY BECAUSE WE STRIKE, AFRAID BECAUSE WE TREMBLE”**

THE CANNON-BARD THEORY

Problems with James-Lange:

- Feelings sometimes *precede* physiology
- Same physiology → different emotions
- Cannon-Bard (1927)
 - Physiology, behavior, and feelings are independent
 - At best, mixed empirical support

THE CANNON-BARD THEORY

- **AN EMOTION-AROUSING STIMULUS *SIMULTANEOUSLY* TRIGGERS:**
 - 1) PHYSIOLOGICAL RESPONSES**
 - 2) THE SUBJECTIVE EXPERIENCE OF EMOTION**
- **MOST RESEARCHERS AGREE THAT OUR EXPERIENCED EMOTIONS ALSO INVOLVE COGNITIONS**

SCHACTER'S TWO-FACTOR THEORY OF EMOTION

- **MOST PSYCHOLOGISTS BELIEVE THAT OUR COGNITIONS (PERCEPTION, MEMORIES, INTERPRETATIONS) ARE AN ESSENTIAL INGREDIENT OF EMOTIONS**
- **SCHACTER – EMOTIONS HAVE *TWO* INGREDIENTS: *PHYSICAL AROUSAL* AND A *COGNITIVE LABEL***
- **AN EMOTIONAL EXPERIENCE REQUIRES A CONSCIOUS INTERPRETATION**

SCHACTER'S THEORY



DANGER

- **“SPILLOVER EFFECT” – A STIRRED UP STATE CAN EXPERIENCED AS ONE EMOTION OR ANOTHER, DEPENDING ON HOW WE *INTERPRET* AND *LABEL* IT**
- **AROUSAL CAN INTENSIFY EMOTIONS**

THEORIES APPLIED TO FEAR

James-Lange

- My heart's pounding.
- So I must be scared.

James-Lange Revised

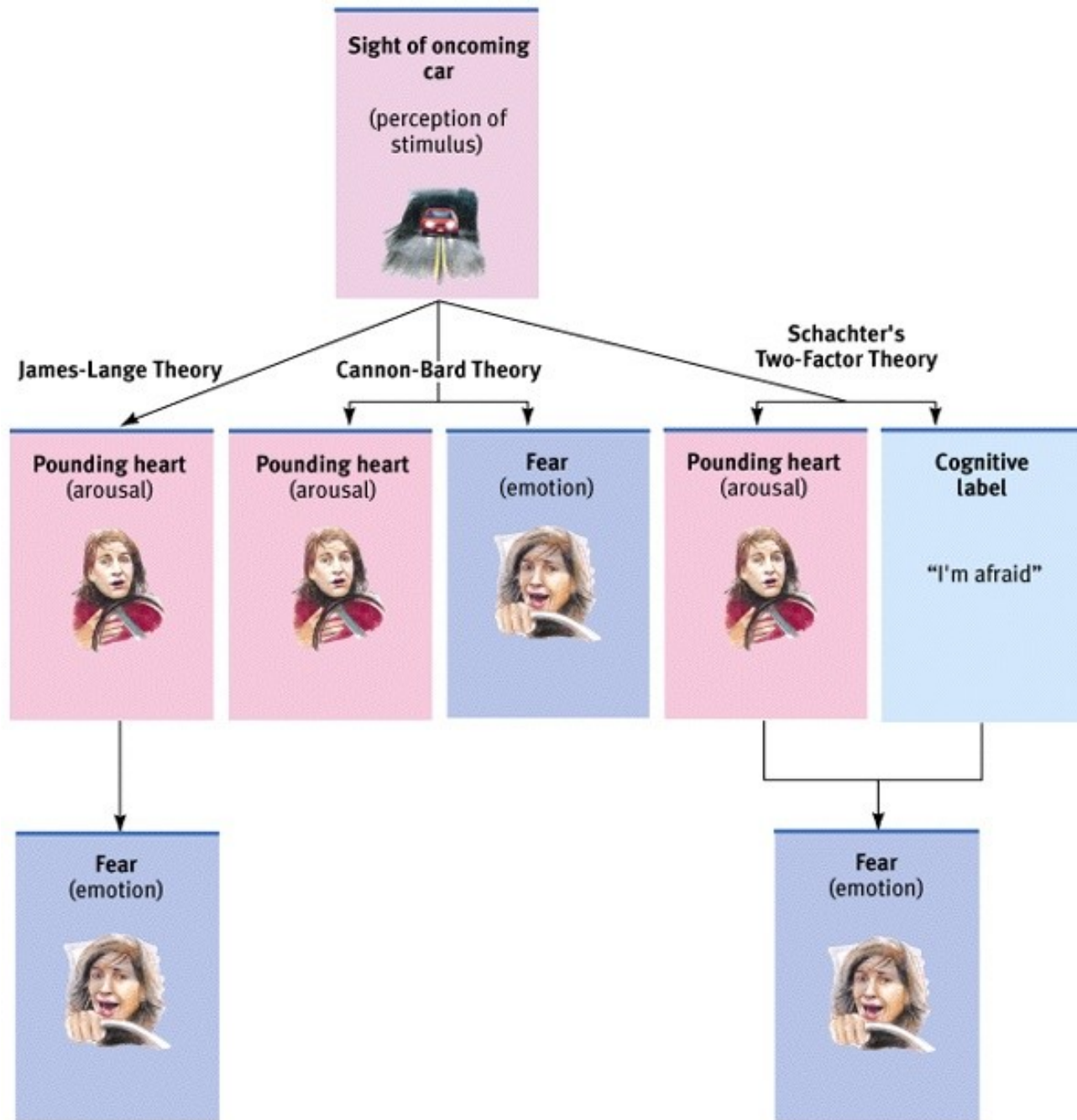
- I'm in danger.
- My heart's pounding.
- So I must be scared.

Cannon-Bard

- I'm scared.
- My heart's pounding too.

Schachter-Singer

- I'm scared.
- My heart's pounding.
- So I must be really scared.



ELEMENTS OF EMOTION

- **Physiological changes in the face, brain, and body**
- **Cognitive processes such as interpretations of events**
- **Cultural influences that shape the experience and expression of emotion**



Face and Emotion (Paul Ekman)

Neurocultural theory

- **1. Universal neurophysiology in the facial muscles**
- **2. Culture-specific variations in the expression of emotion**

Seven universal facial expressions of emotion:

**anger, happiness, fear, surprise,
disgust, sadness, contempt**



(a) Happiness



(b) Anger



(c) Surprised



(d) Sadness



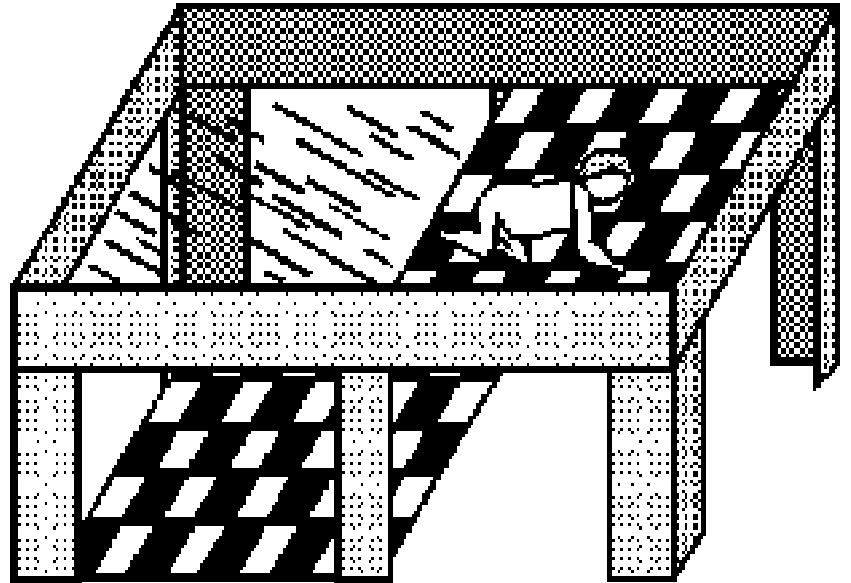
(e) Fear



(f) Disgust

“Visual Cliff Studies”

- 75 % of the babies crossed the obstacle when their mothers put on a happy, reassuring expression.
- Not a single one crossed when their mothers showed an expression of fear.



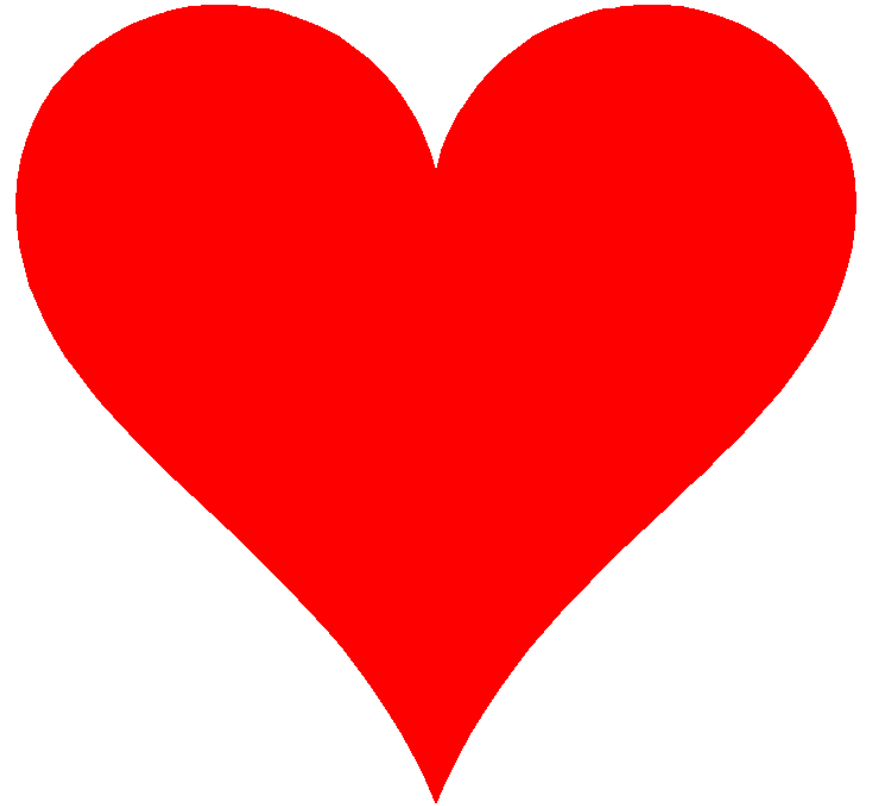
FACIAL FEEDBACK

- Facial expressions affect the sympathetic nervous system.
- A smile sends a message to the brain and positive emotions increase.

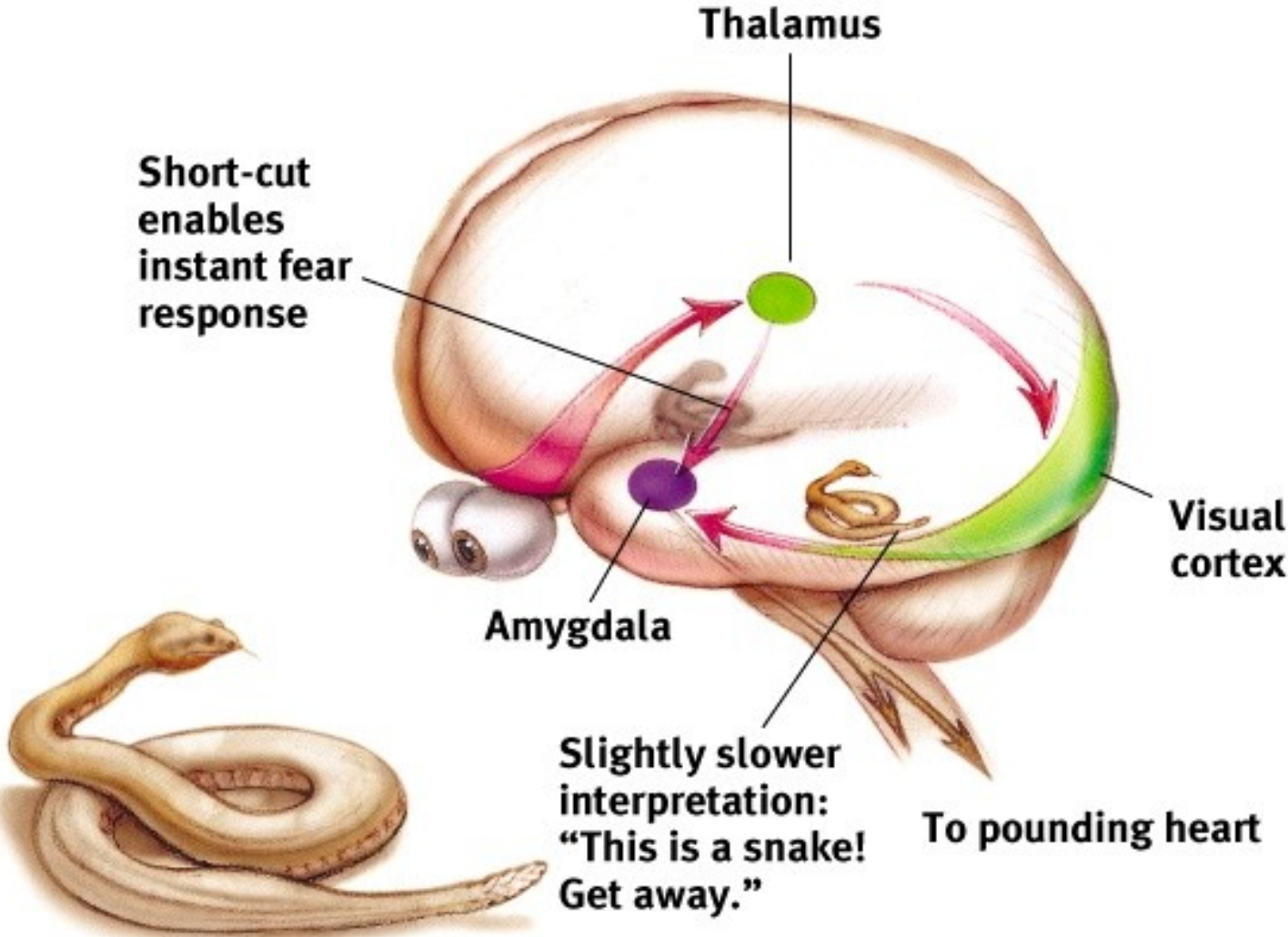


EMOTION PRECEDE COGNITION (ZAJONC)

- **RESEARCH SHOWS WE CAN EXPERIENCE EMOTION BEFORE COGNITION**
- **NEURAL PATHWAYS BYPASS CORTICAL AREAS INVOLVED IN THINKING AND AMYGDALA IS ACTIVATED**
- **“THE HEART IS NOT ALWAYS SUBJECT TO THE MIND”**



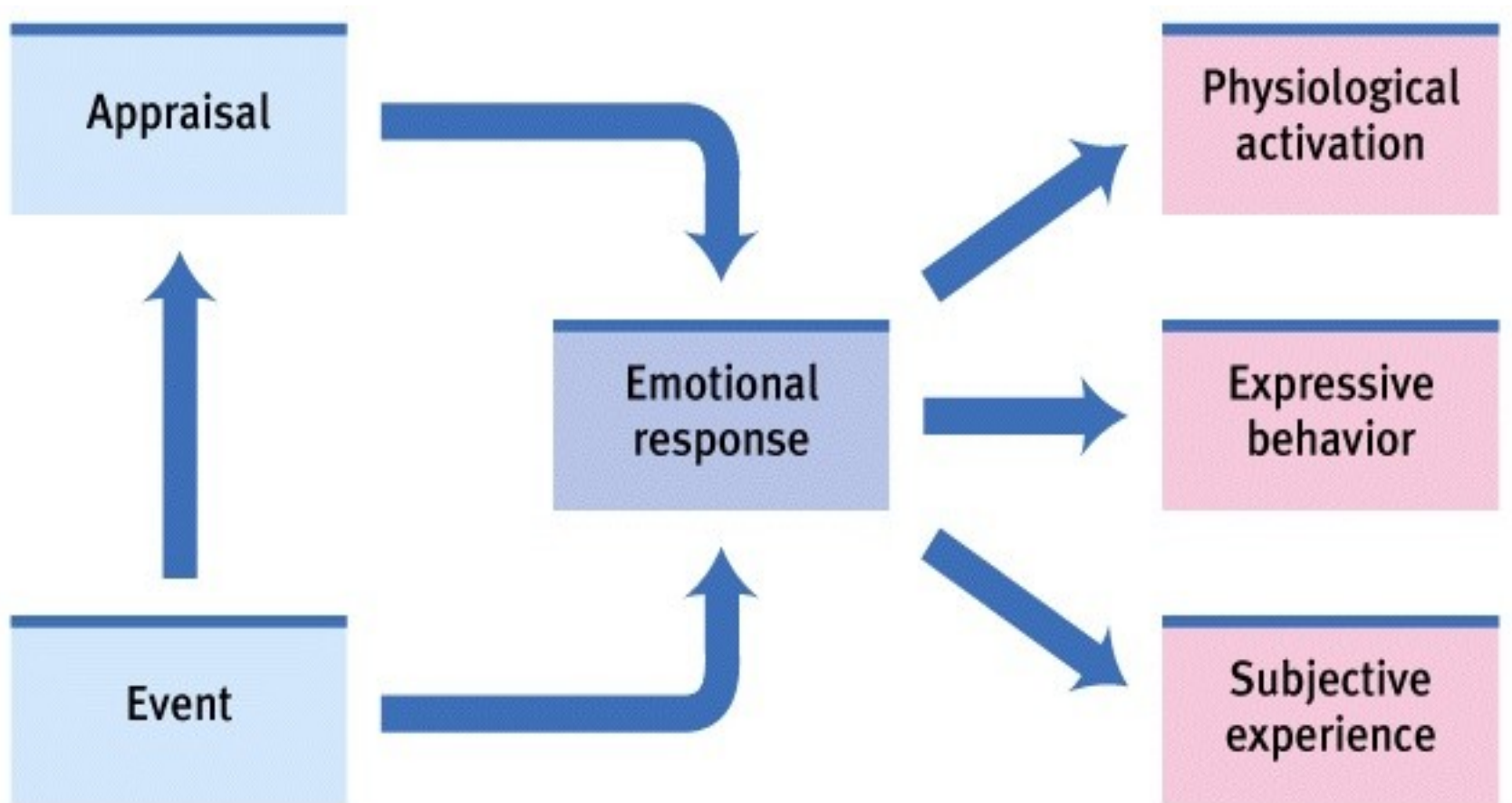
EMOTION PRECEDE COGNITION



COGNITION MUST PRECEDE EMOTION (LAZARUS)

- **SOME COGNITIONS INVOLVE EFFORTLESS EVALUATION**
- **LIKES, DISLIKES, FEARS PROBABLY INVOLVE NO CONSCIOUS THINKING**
- **OTHER EMOTIONS (DEPRESSIVE MOODS, HATE, LOVE) ARE GREATLY AFFECTED BY OUR INTERPRETATIONS, MEMORIES AND EXPECTATIONS**

COGNITION MUST PRECEDE EMOTION (LAZARUS)



THE AUTONOMIC CONTROL OF EMOTION

- THE AUTONOMIC NERVOUS SYSTEM IS ENGAGED
- THE LEVEL OF AROUSAL FOR OPTIMAL PERFORMANCE VARIES FOR DIFFERENT TASKS



AUTONOMIC NERVOUS SYSTEM

In threatening situations sympathetic nervous system releases nor-epinephrine (adrenaline) which produces marked physiological changes:

- **Palms sweating**
- **Increased heart rate**
- **Focused attention**
- **Greater skin conductance**
-

(particular response may depend on what particular emotions one is experiencing)

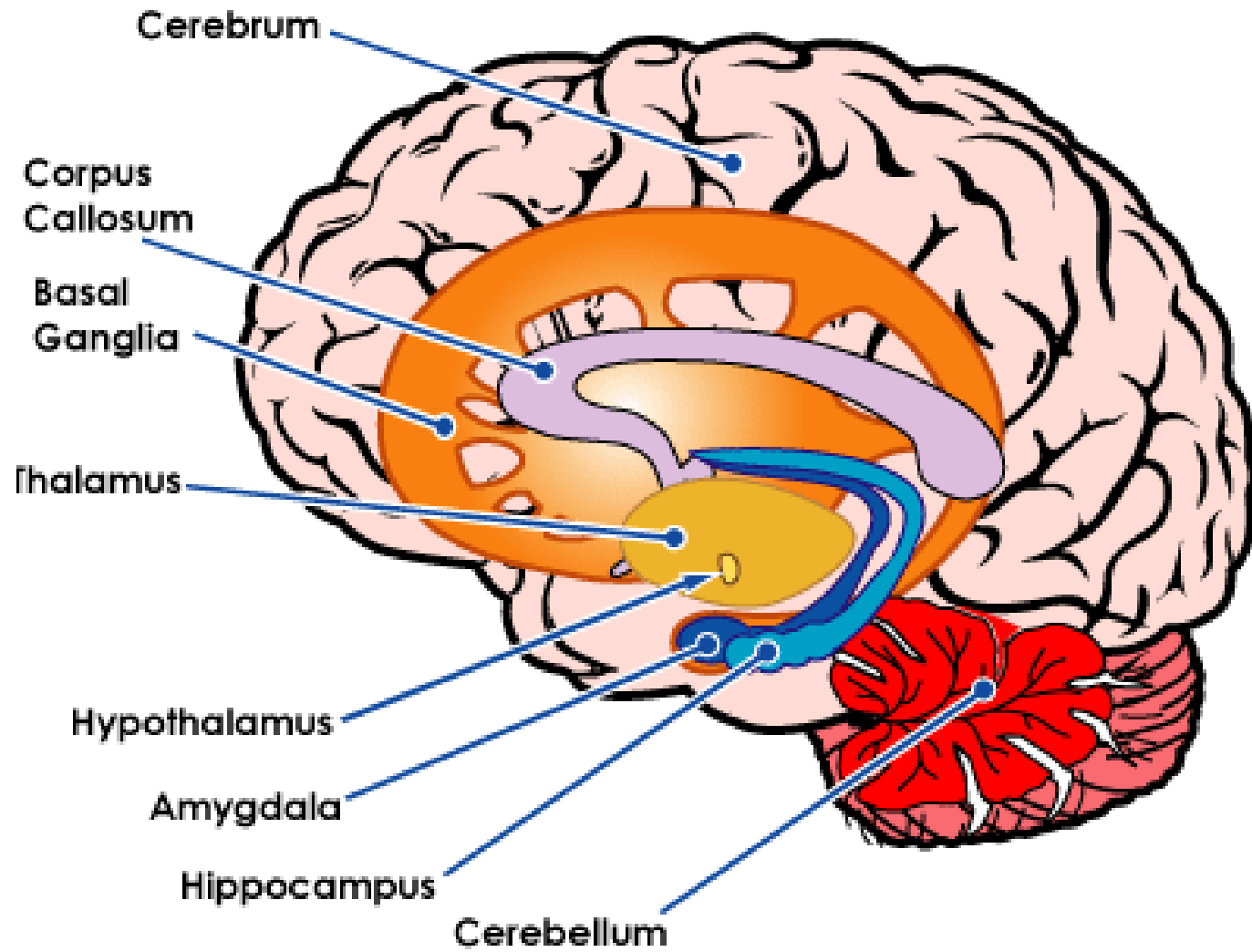
Autonomic nervous system controls physiological arousal

Sympathetic
division (arousing)

Parasympathetic
division (calming)

Pupils dilate	EYES	Pupils contract
Decreases	SALIVATION	Increases
Perspires	SKIN	Dries
Increases	RESPIRATION	Decreases
Accelerates	HEART	Slows
Inhibits	DIGESTION	Activates
Secrete stress hormones	ADRENAL GLANDS	Decrease secretion of stress hormones

LIMBIC SYSTEM



EVIDENCE THAT LIMBIC SYSTEM REGULATES BEHAVIOR

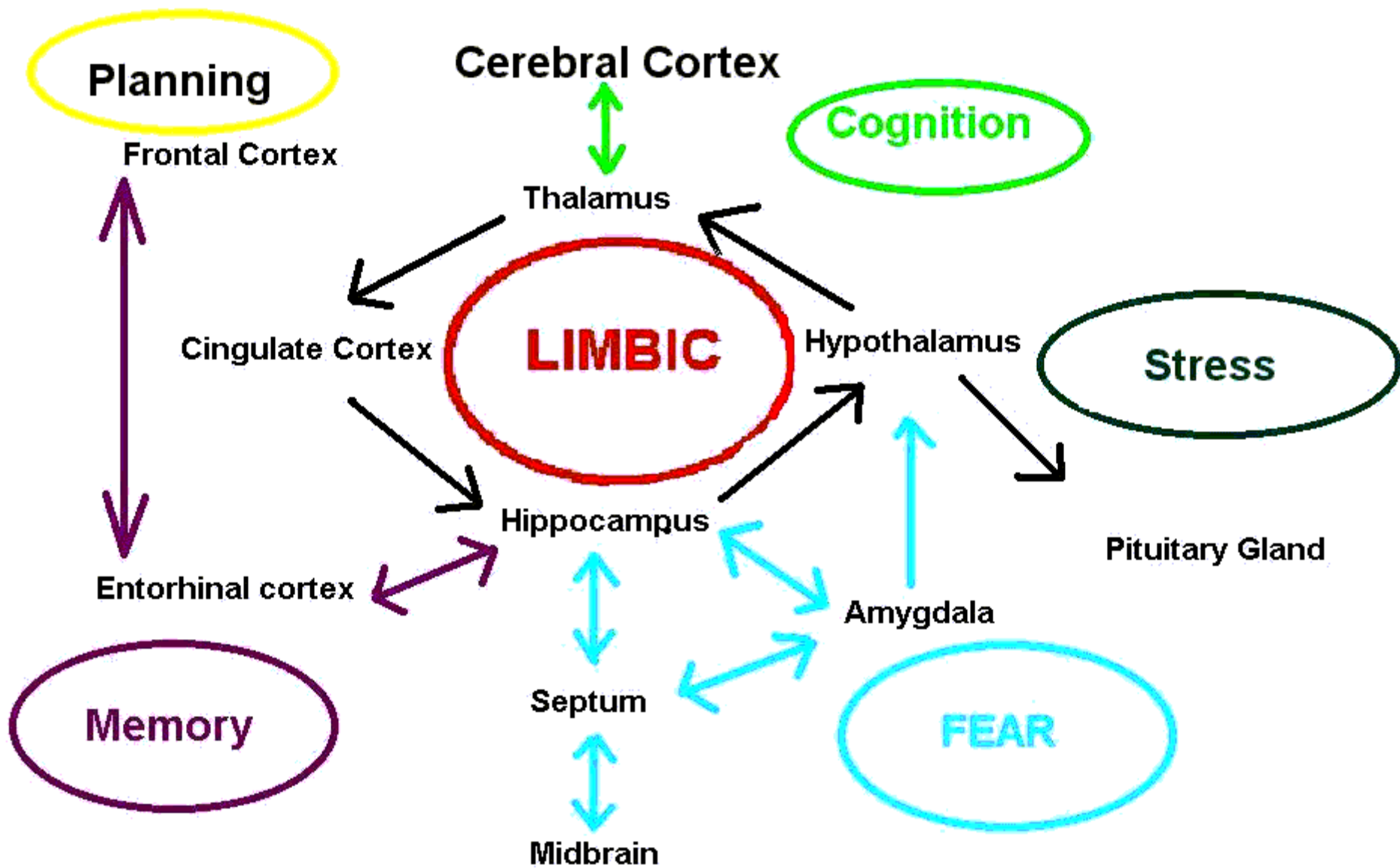
Electrode Studies (Hess, 1940s):

- 1. Superfine electrode stimulation of rats' LS**
- 2. Rats respond to jolts as if hugely rewarding:**
 - a. Go to where jolts occurred**
 - b. Work long to get jolts**
 - c. Learn tasks paired with jolts**
- 3. Refers to this as "self-stimulation behavior"**
- 4. 85 % of limbic system --> self stimulation behavior, rare outside of limbic system**

EVIDENCE THAT LIMBIC SYSTEM REGULATES BEHAVIOR

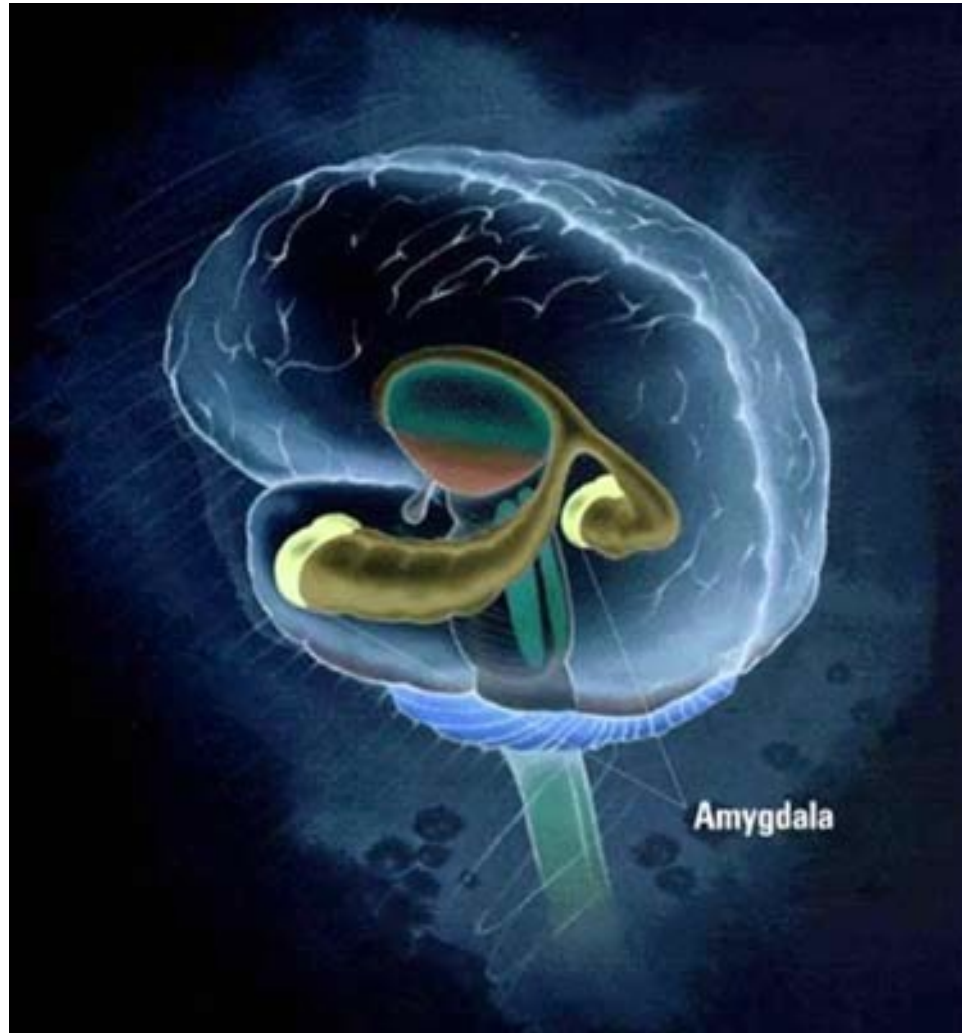
PSYCHOMOTOR EPILEPSY

1. Occurs when brain cells in certain area fires in waves
2. Psychomotor epilepsy restricted to limbic system
3. Has similar effect in humans as electrode shocks in rats.
4. Results of limbic epilepsy:
 - a. **Happiness:** Dostoevsky reports "indescribably happiness."
 - b. **Other emotions:** desire, sadness, affection, fear, anger.



AMYGDALA

1. Emotion central:
pleasure and pain
2. Sensitive to unfamiliar
stimuli
3. Makes first assessment
of event's emotional
significance
4. Neural pathway to
amygdala bypasses
the cortex



AMYGDALA AND EMOTIONS

- 1. Input connections – visual centers, auditory centers**
- 2. Output connections – hypothalamus**
- 3. Activation leads to self stimulation behavior, a range of emotions**
- 4. Assigns emotional significance to events**
 - * Conditioning occurs without cortex (just amygdala)**
 - * Directs attention to important events**
 - * Sets up species specific action systems**

Klüver-Bucy Syndrome

Removal of monkey amygdala leads to:

- 1. Lose fear to/aggressiveness towards humans**
- 2. No facial expression**
- 3. Examine things regardless of danger: fire, broken glass**
- 4. Eat everything: meat, feces**
- 5. Mate everything: other sex, same sex, inanimate objects**

LeDoux's Neural Pathways

STANDARD ROUTE:

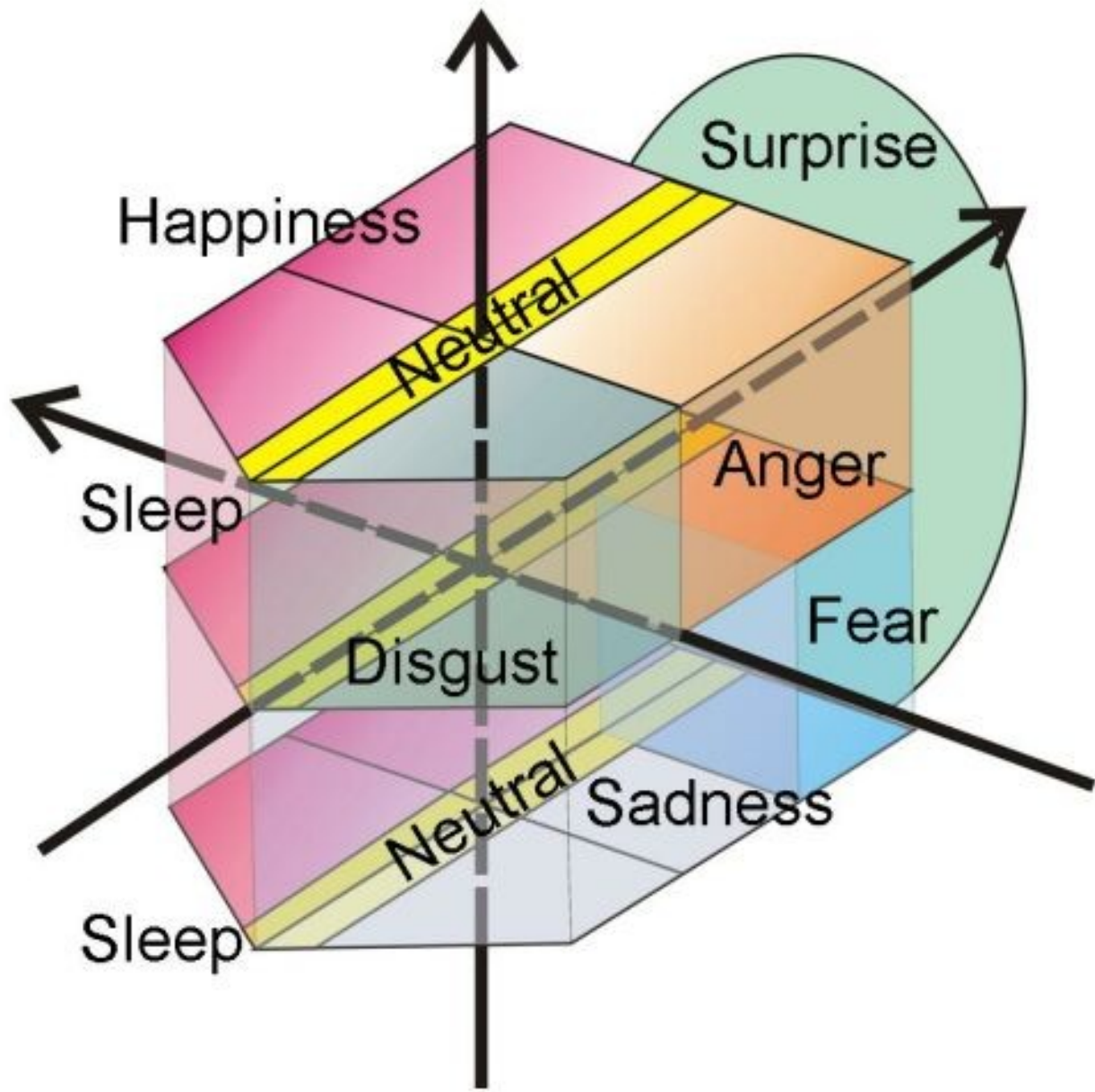
SENSORY ⇒
THALAMUS ⇒
CORTEX ⇒
AMYGDALA

Thinking comes first :
cortex precedes
amygdala.

EMERGENCY ROUTE:

SENSORY ⇒
THALAMUS ⇒
AMYGDALA

Feeling comes first :
direct line to
amygdala.



HORMONES AND EMOTION

- **You perceive the sensory stimulus.**
- **The adrenal gland sends two hormones: epinephrine and norepinephrine.**
- **They activate the sympathetic nervous system.**
- **That produces a state of arousal or alertness that provides the body with the energy to act (the pupils dilate, the heart beats faster, and breathing speeds up).**

NEUROCHEMICALS

- 1. Neurotransmitters: fast, nerve-to-nerve**
- 2. Hormones: slower, longer-lasting
(endocrine-based)**
- 3. Neuromoderators: endorphins (body's opiate)**

RELEVANCE TO EMOTIONS

- * Different emotional systems employ different neurochemical messengers**
- * Different chemicals lead to different emotional states**

L-Dopa

- 1. Precursor to dopamine
(neurotransmitter)**
- 2. Acts on striatum – motor activity**
- 3. “Re-awakens” sleeping sickness
patients**

REVIVED EMOTIONS:

joy, excitement, also extreme mood swings, powerful passions.

CCK (cholecystokinin)

1. Tied to panic attacks

- * Spontaneous rush of fear, 15-30 minutes**
- * Come out of nowhere, apparently**
- * Feel like will have a heart attack, lose control**
- * Lead to agoraphobia; fear of fear**

2. CCK is peptide, large molecule neurotransmitter

3. CCK --> increased blood to limbic system

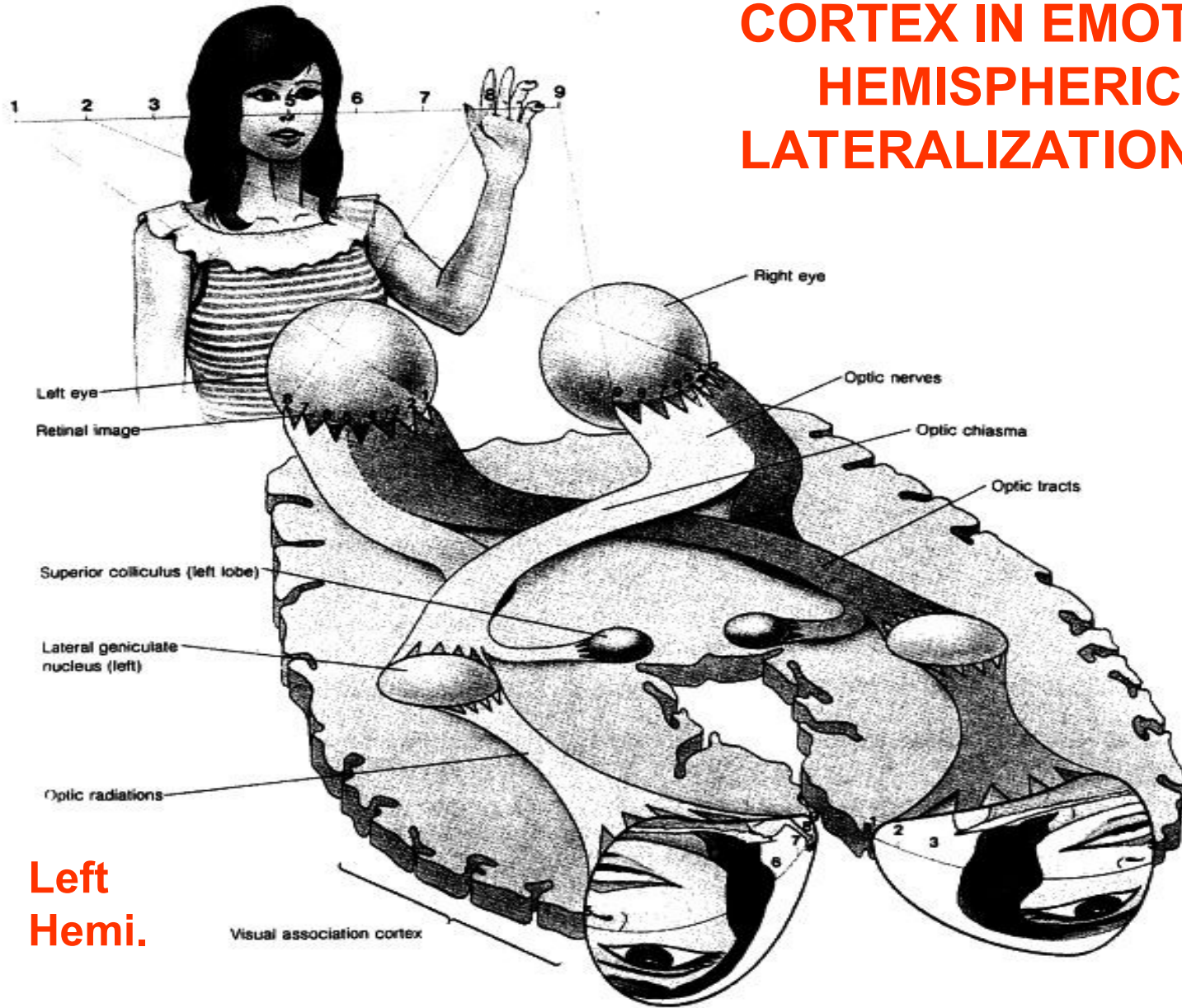
4. Give CCK to humans, monkeys, rats --> panic attack



RATS' MATERNAL BEHAVIOR: EXAMPLE OF AN EMOTIONAL SYSTEM

- **Female becomes pregnant**
- **Pregnancy hormones: prolactin, estradiol, less progesterone**
- **Birth hormone: oxytocin**
- **Hormones affect arousal in mothers**
 - **Most aroused when around own pups vs. with other rats, around food, or alone.**
 - **Affects virgin females: become more nurturing to pups.**
- **Maternal cue sensitivity increases: to separation squeaks, pup odor**
- **Maternal behaviors: nursing, cleaning, protection.**

THE ROLE OF THE CORTEX IN EMOTIONS: HEMISPHERIC LATERALIZATION



HEMISPHERIC LATERALIZATION AND EMOTIONS (right-handed)

Lateralization:

- L hemisphere guides right side of body
- R hemisphere guides left side of body

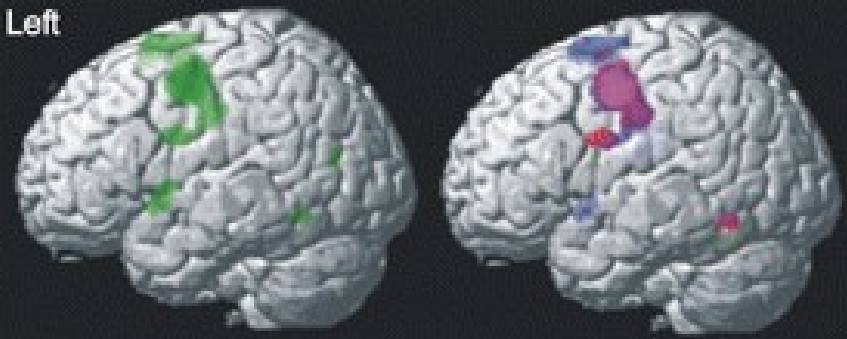
Lateral functions:

- L hemisphere – speech, reasoning
- R hemisphere – emotional recognition and interpretation.

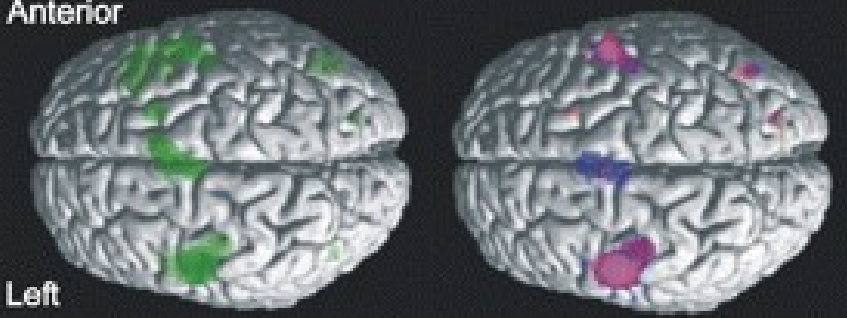
Research on hemisphere lateralization

1. Split-brain studies of epileptics
2. Emotional ID of faces and hemi. dominance
3. Lie detection and hemisphere dominance

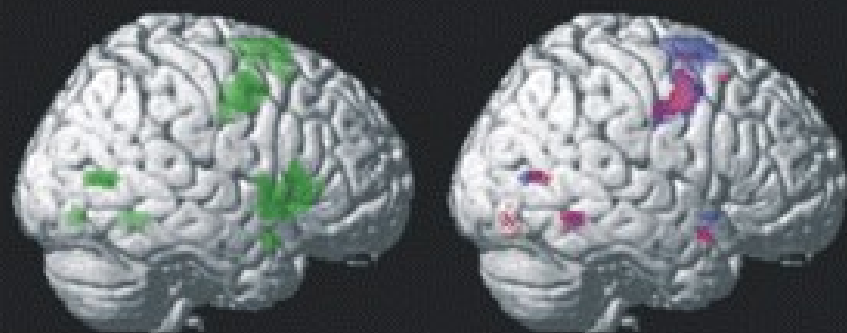
Left



Anterior



Left



Right

● Combined auditory and motor effects

Correlation
with valence



Correlation
with arousal

SPLIT BRAIN STUDIES OF EPILEPTICS

- **Epilepsy treatment – removal of corpus colosum (membrane connects L hemi to R hemi)**
- **Removal permits exclusive presentation to L or R hemi (patients shown emotional displays to L or R side of brain):**
 - 1. can recognize emotions when shown to R side**
 - 2. can verbalize emotions when shown to L side**

EEG Evidence of Lateralization

Subjects see funny or gruesome movie, facial expression and EEG are recorded.

Movie	Facial expression	Hemi activated
1. Funny	Smiling, happy	Left side
2. Gruesome	Nose wrinkle, disgust	Right side

PSYCHOLOGY EVIDENCE OF LATERALIZATION

THEMATIC APPERCEPTION TEST (TAT used as a clinical psychology device):

people see pictures, and tell stories about them.

- **L-side activity → R-hemi
→ More negative interpretations**
- **R-side activity → L-hemi
→ More positive interpretations**



THEMATIC APPERCEPTION TEST



EMOTIONS AND MENTAL DEVELOPMENT

INFANTS

- **Cognition is basic.**
- **Do not feel shame.**
- **Cerebral cortex is not fully developed.**
- **Cognitive appraisals are basic.**
- **Emotions are not complex.**

ADULTS

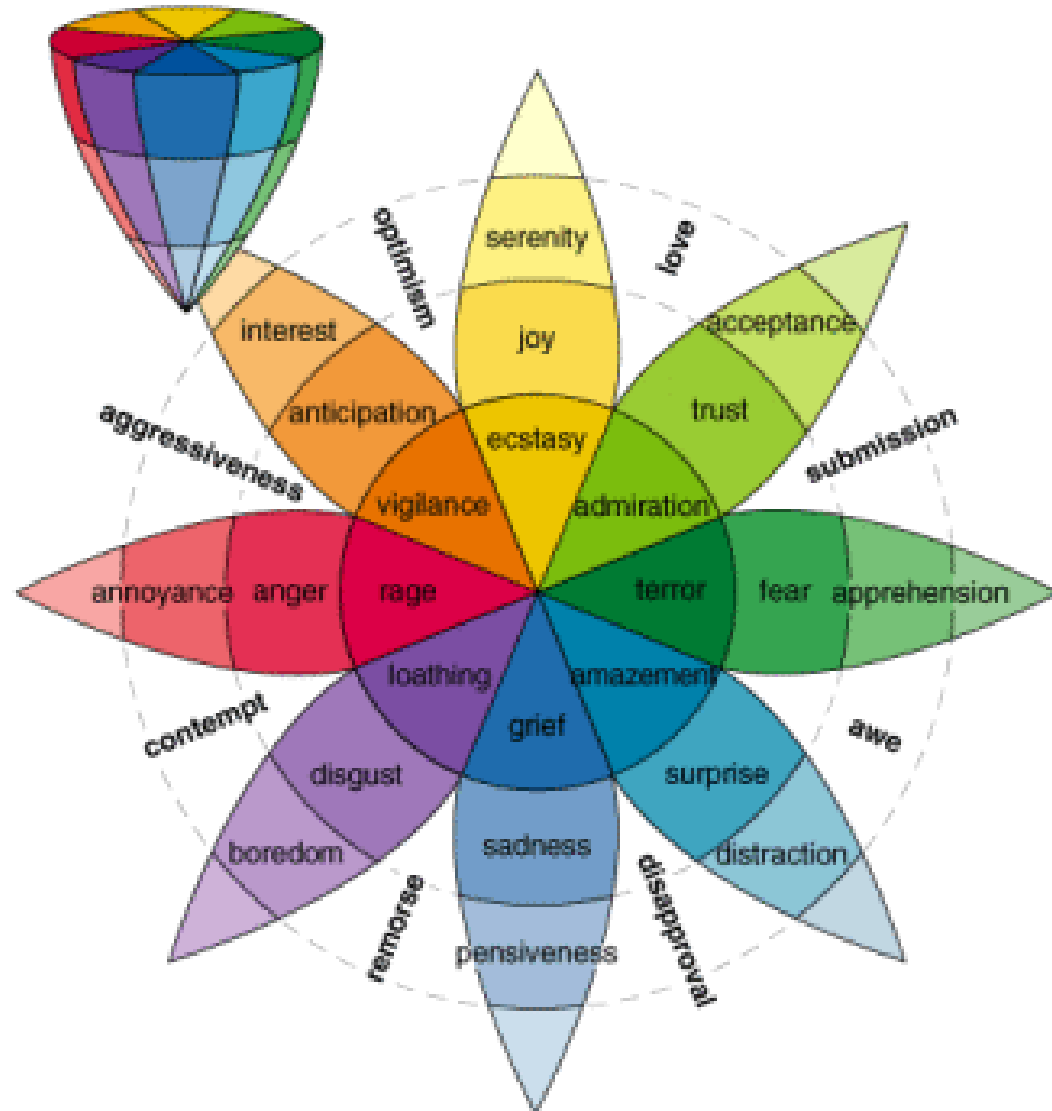
- **Cognition is complex.**
- **Cerebral cortex is developed.**
- **Cognitive appraisals and emotions are complex.**
- **Emergence of self-consciousness**

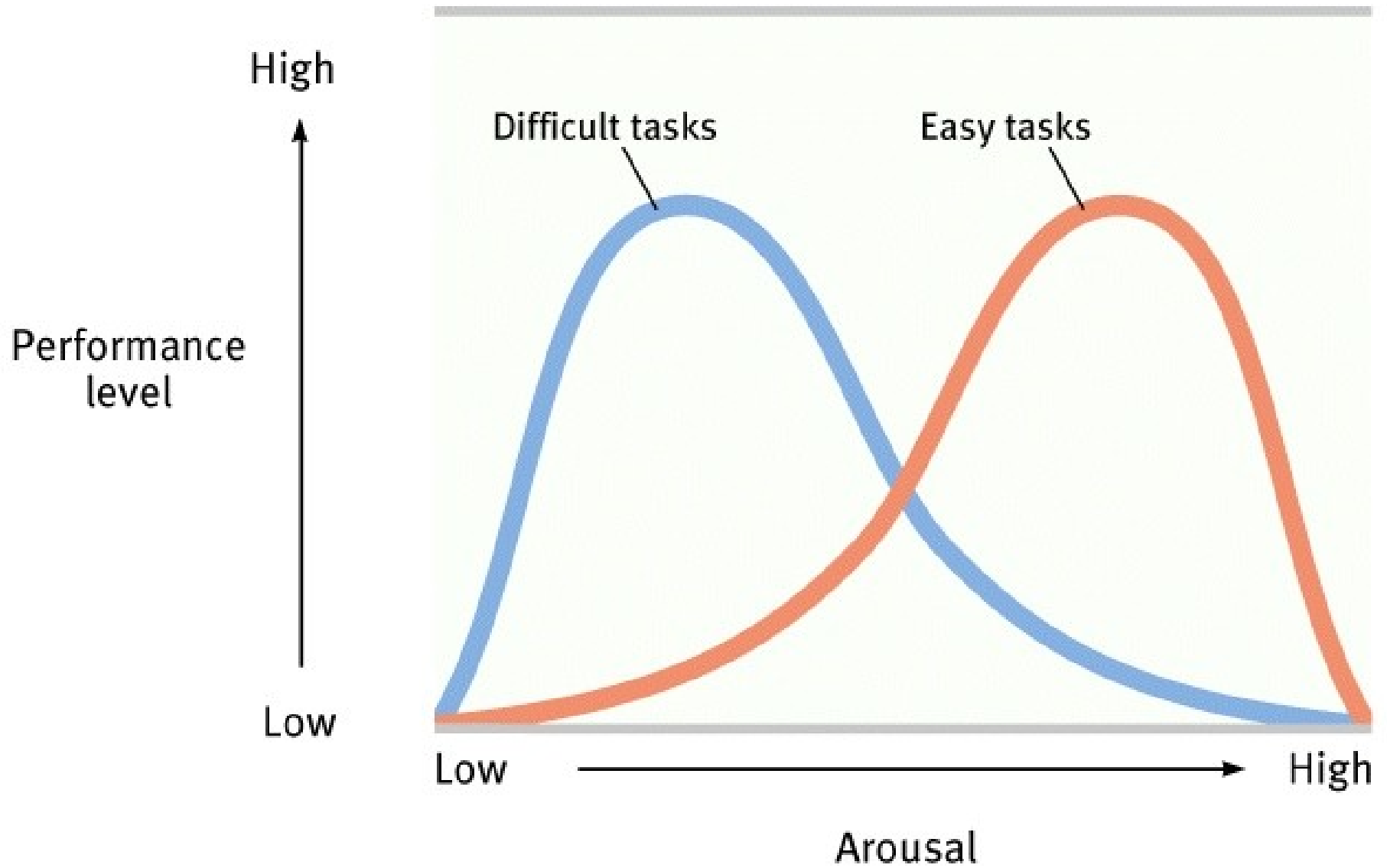
AROUSAL AND PERFORMANCE

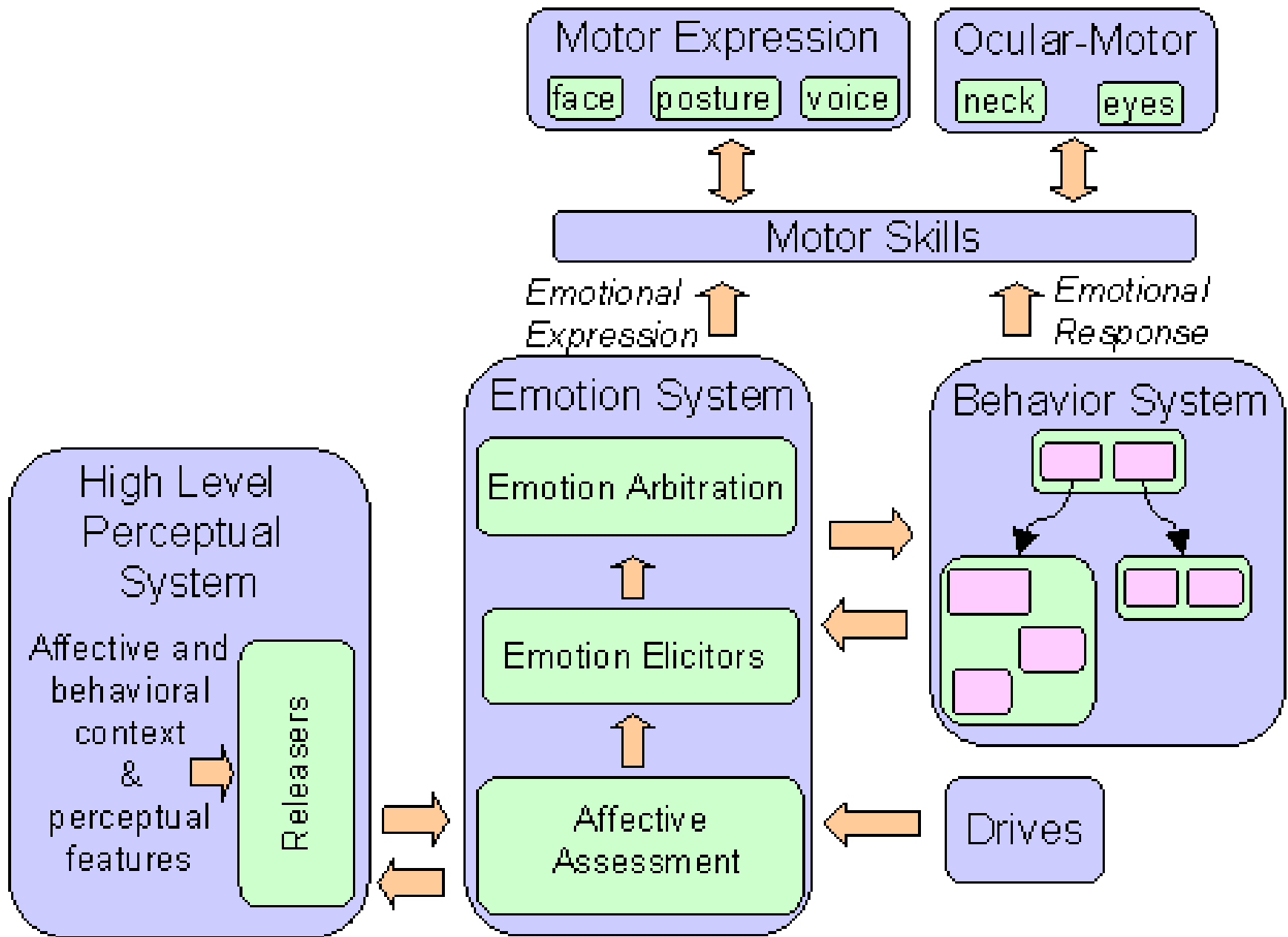
- **WITH *EASY* OR WELL-LEARNED TASKS, PEAK PERFORMANCE COMES WITH RELATIVELY *HIGH* AROUSAL**
- **THIS ENHANCES THE DOMINANT, USUALLY CORRECT, RESPONSE**

AROUSAL AND PERFORMANCE

WITH *MORE DIFFICULT*, OR *UNREHEARSED* TASKS, THE OPTIMAL AROUSAL IS SOMEWHAT LOWER







PHYSIOLOGICAL STATES ACCOMPANYING SPECIFIC EMOTIONS

EXPERIMENT

- **A MOVIE IN EACH OF FOUR ROOMS
(HORROR, ANGER PROVOKING,
SEXUALLY EXPLICIT, BORING...)**
- **COULD YOU TELL WHO WAS
FRIGHTENED, ANGRY, SEXUALLY
AROUSED, BORED?**

PHYSIOLOGY AND EMOTIONAL STATES

- **DIFFERENT PHYS. RESPONSES (FINGER TEMPERATURE, HORMONE SECRETIONS, HEART RATES, MUSCLE TENSION, LIMBIC SYSTEM ACTIVATION)**
- **RIGHT HEMISPHERE MORE ACTIVE WHEN EXPERIENCING NEGATIVE EMOTIONS**

PHYSIOLOGY AND EMOTIONAL STATES

- **LEFT HEMISPHERE ACTIVATES WHEN PROCESSING POSITIVE EMOTIONS**
- **IF LEFT FRONTAL LOBE MORE ACTIVE, TYPICALLY MORE CHEERFUL, LESS READILY THREATENED OR DEPRESSED THAN THOSE WITH MORE ACTIVE RIGHT FRONTAL LOBES**



LIE DETECTION

- **POLYGRAPH MEASURES AROUSAL RESPONSES THAT ACCOMPANY EMOTIONS (CHANGES IN BREATHING, BLOOD PRESSURE, PERSPIRATION)**
- **CONTROL QUESTIONS (BASELINE MEASUREMENTS)**

LIE DETECTION

PROBLEMS: OUR GENERAL PHYS. AROUSAL IS SIMILAR FOR EMOTIONS (ANXIETY, IRRITATION, GUILT)

INNOCENT PEOPLE MAY RESPOND WITH HEIGHTENED TENSION TO ACCUSATIONS AND CRITICAL QUESTIONS

1/3 ERROR RATE! – CANNOT DISCRIMINATE THE AROUSAL OF GUILT LYING FROM FEARFUL HONESTY

Percentage

80%

70

60

50

40

30

20

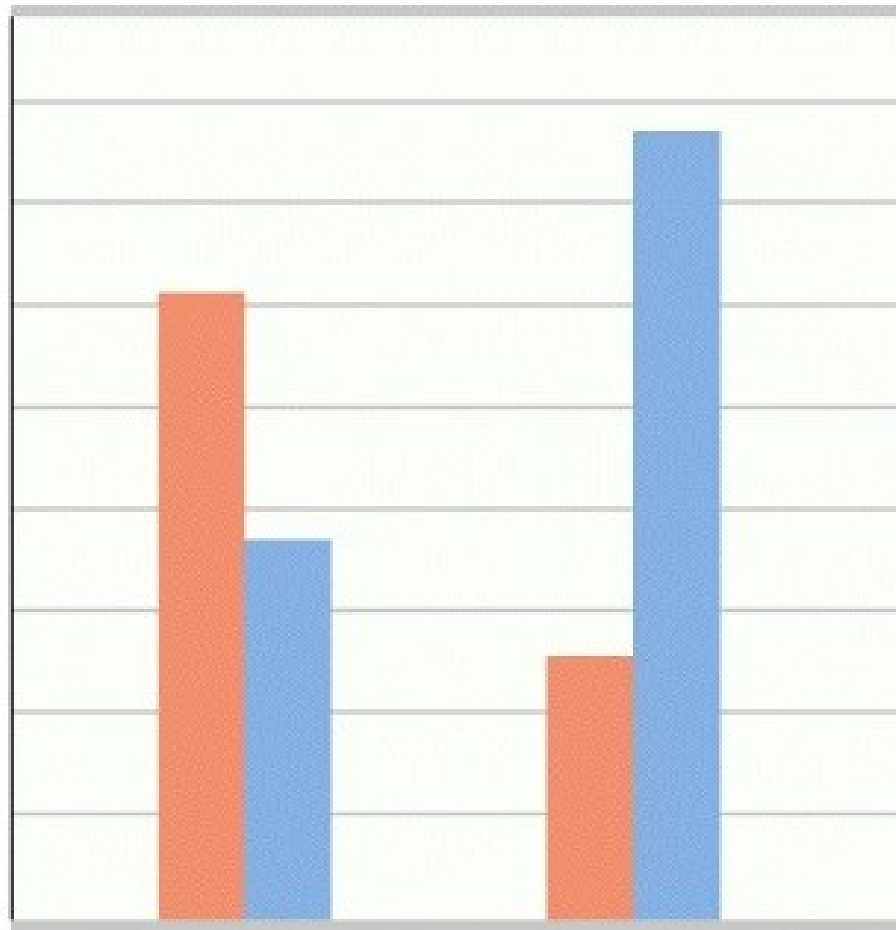
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Innocent
people

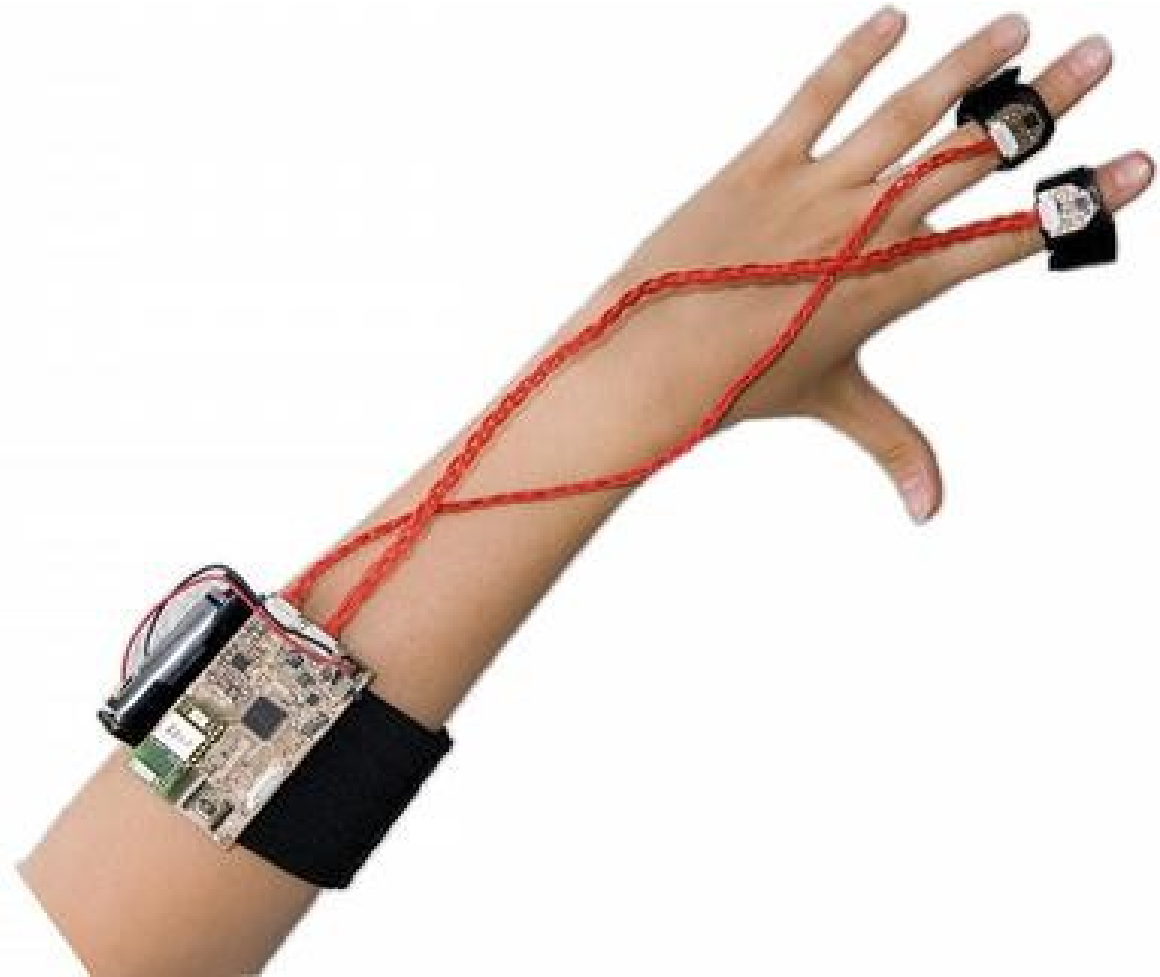
Guilty
people

- Judged innocent by polygraph
- Judged guilty by polygraph



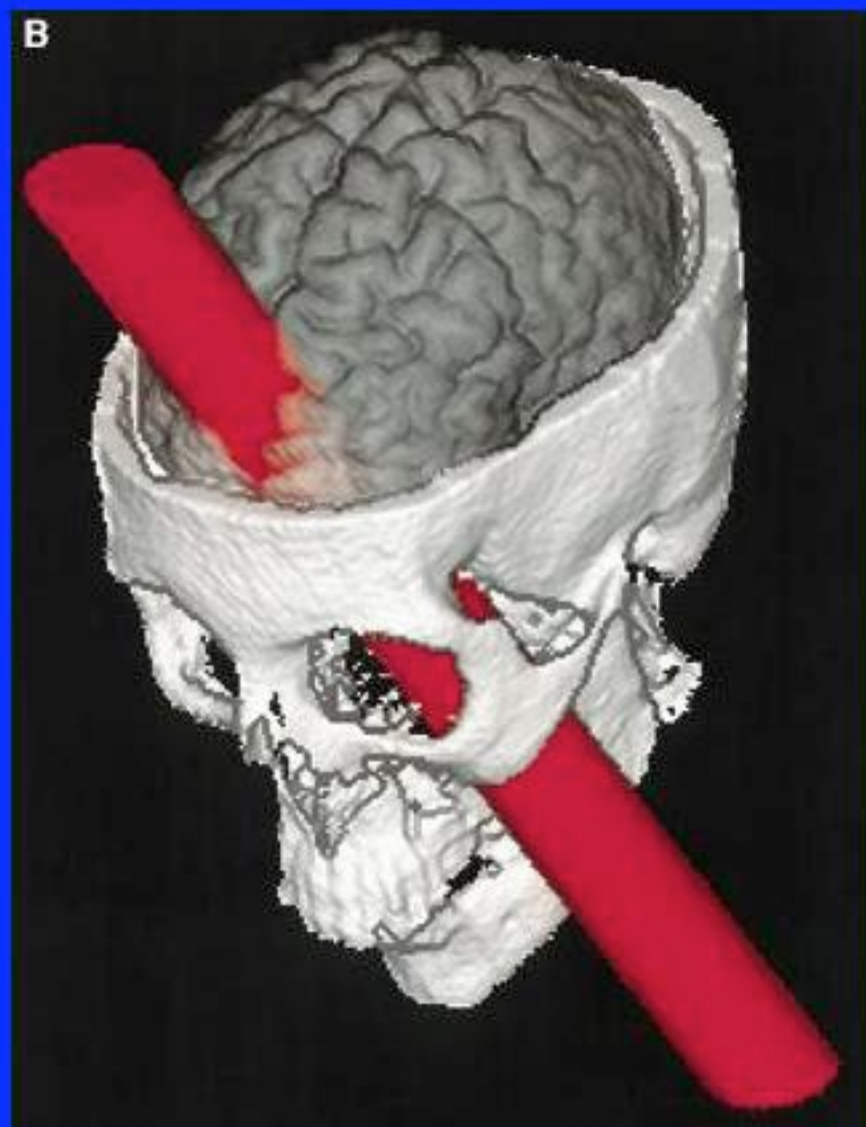
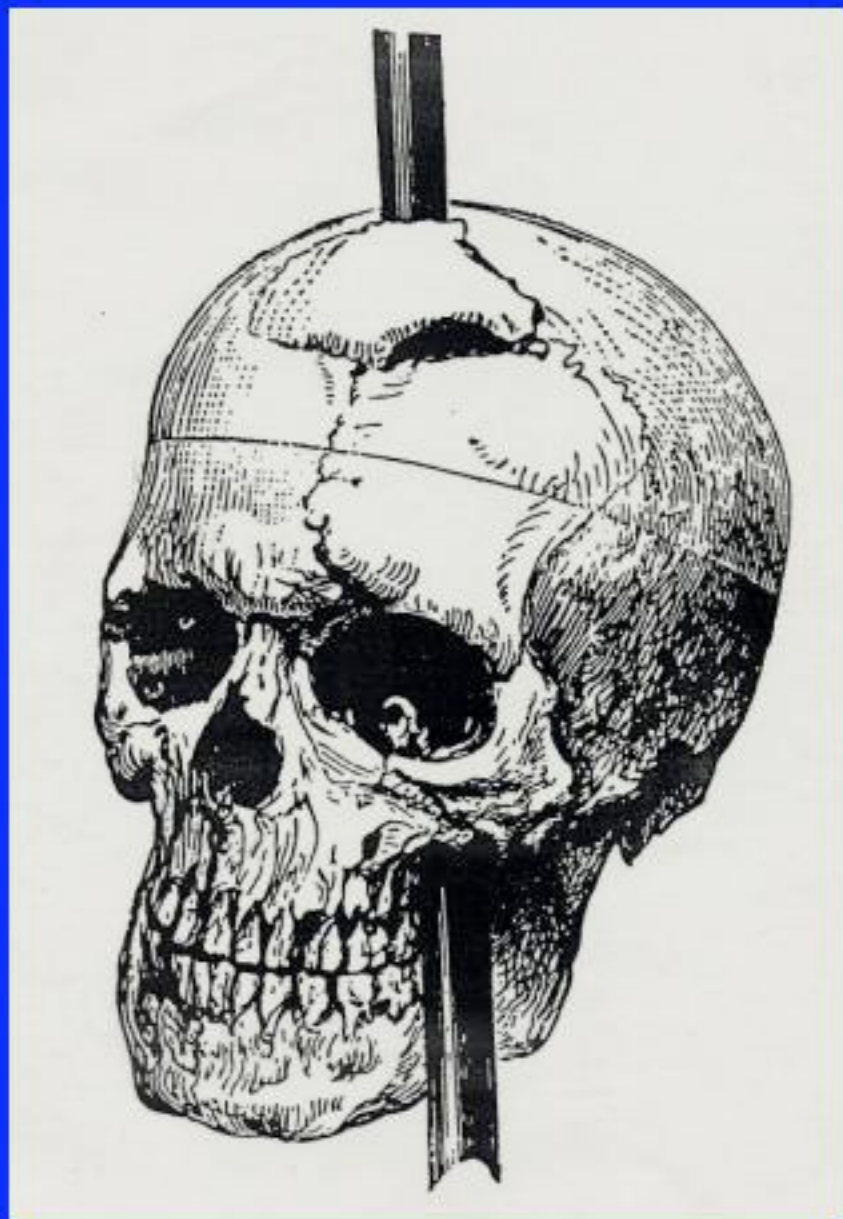
LIE DETECTION

- TEST CAN BE BEATEN BY AUGMENTING AROUSAL DURING CONTROL QUESTIONS
- GUILTY KNOWLEDGE TEST



EMOTIONS AND DECISIONS

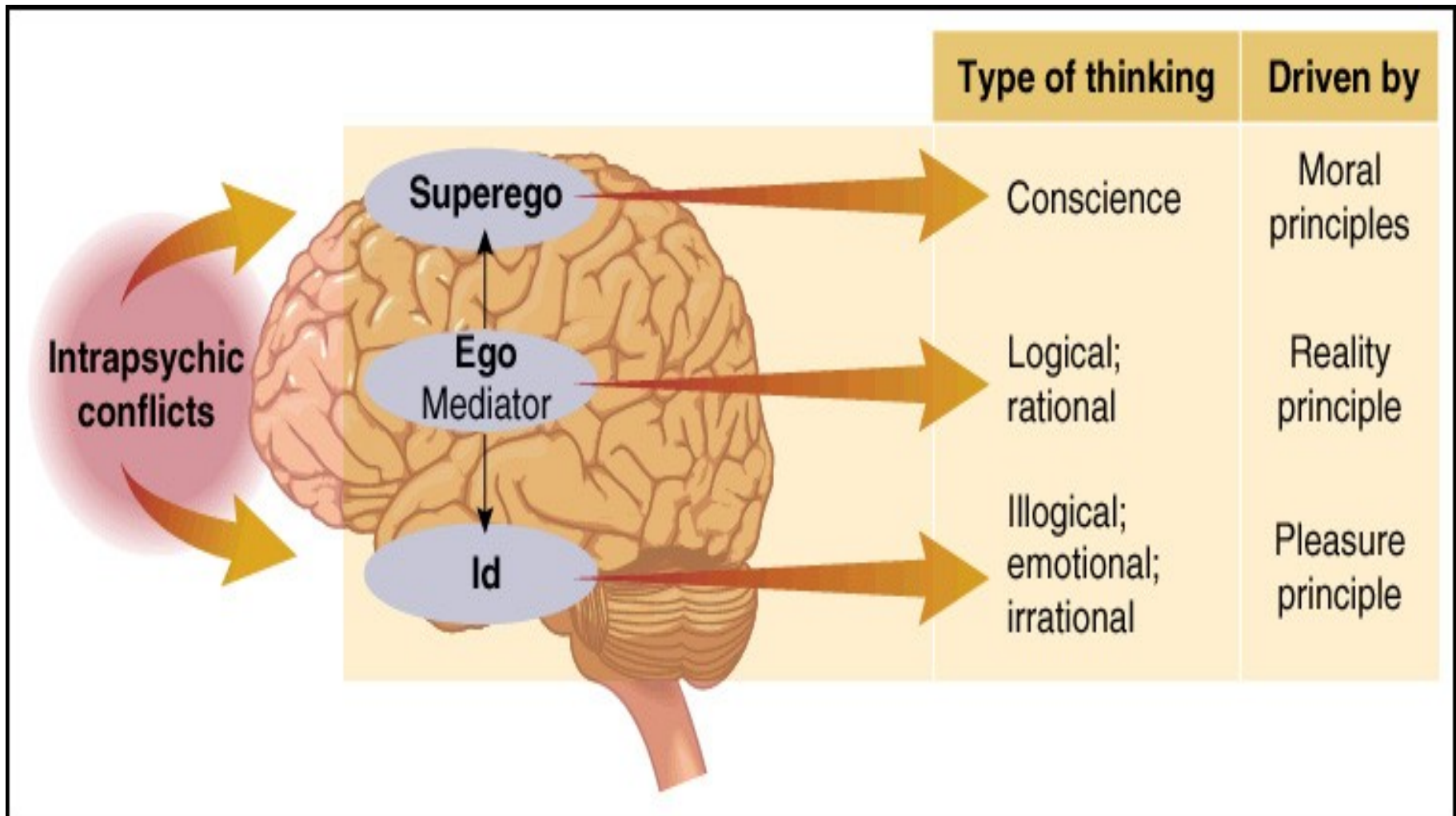
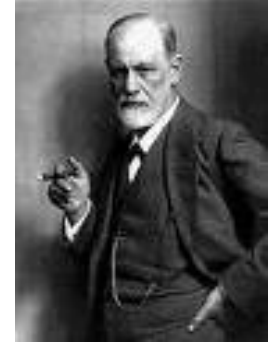
- **The ‘emotion challenge’ is largely a product of the work of Antonio Damasio and his collaborators.**
- **Their patients have ventromedial prefrontal cortex damage.**
- **Patients have serious emotional impairments, that make them poor decision makers.**
- **Yet, they have fairly intact/normal verbal and mathematical abilities.**
- **They seem to have lost (controlled?) emotions, but surprisingly this affects traditionally cognitive abilities.**



EMOTIONS AND PERSONALITY

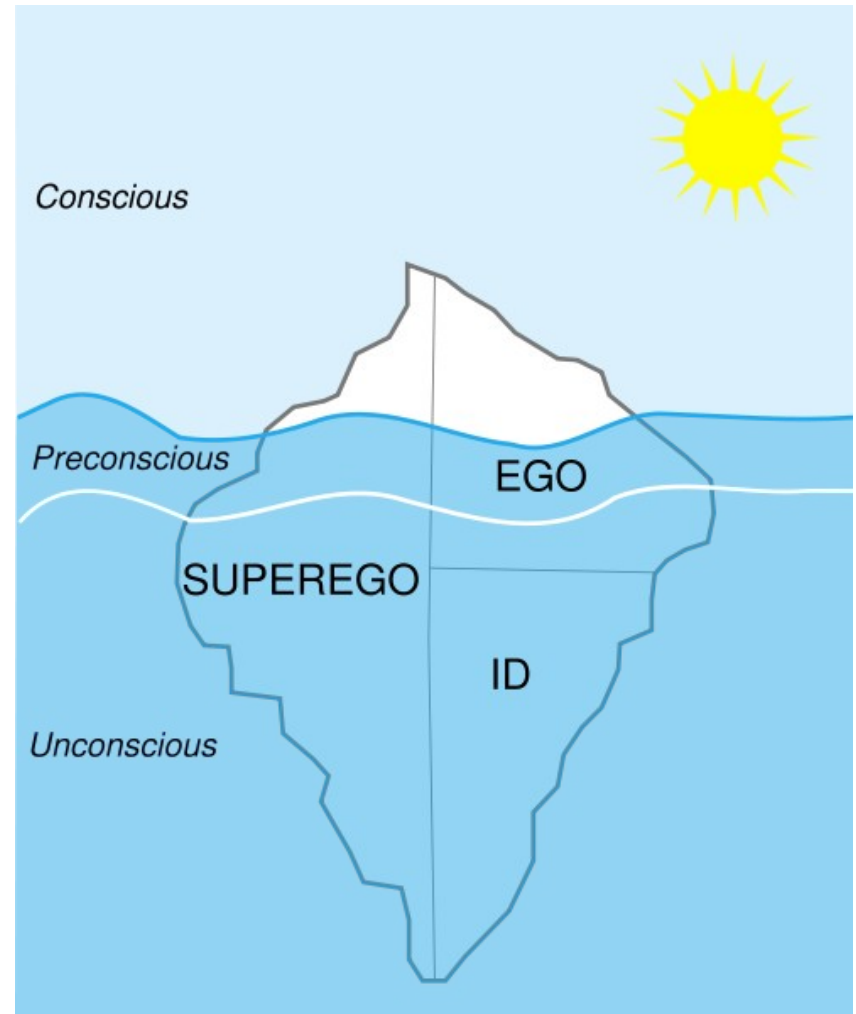
- **Non-technical definition of personality:**
 - A person's general style of thinking, feeling, and behaving
- **Technical definition:**
 - Personality is the system of enduring, inner characteristics of individuals that contributes to consistency in their thoughts, feelings, and behavior (Leary, 2005).

Freud's Psychoanalytic Theory



PSYCHOANALYTIC DEFENSE MECHANISMS

- Displacement
- Denial
- Intellectualization
- Suppression
- Repression
- Unhealthy
- Require energy
- Avoid real problem



PSYCHOANALYSIS

- Unearth hidden intrapsychic conflicts
- Free association and dream analysis
- Long, time-consuming
- Little evidence for efficacy
- Controversy about psychosexual stages



FREUDIAN SLIPS



"A Freudian slip is like saying one thing, but meaning your mother."

TRAITS

Intellectual Talkative Easy-going Loving
Arrogant Calm Timid Kind
Friendly Dominant Conservative Aloof Shy
Cheerful Impulsive Reserved Grouchy
Curious Nice Diligent Fearless
Affectionate Irritable Agreeable Reserved
Anxious Calm Jumpy

English - 2,800 trait terms

CONCLUSIONS

- **Emotions are both in the mind and in the body.**
- **Emotions do not just happen to people. People have some control over how they interpret events and as a result some control over the emotions they experience.**
- **Emotions are choices.**
- **Emotions are universal. This allows us to read other people's emotions, empathize with them, and negotiate our emotional lives together.**

NB: ROLE OF EMOTIONS

- **An essential part of what makes us human, but often making us poor reasoners?**
- **An essential part of what makes us human, and responsible for making us as good reasoners as we are?**
- **Just a pain in the butt (make us bad reasoners, are evolutionary leftovers that are one of the least *human* parts of us)?**

I WISH YOU - STABILITY OF EMOTION

“George was a good little monkey and always very curious...”





**Thank
You
For Your
Attention!**