Thinking about Thought

- Introduction
- Philosophy of Mind
- Cognitive Models
- Machine Intelligence
- Life and Organization
- Ecology
- The Brain
- Dreams and Emotions
- Language
- Modern Physics
- Consciousness

"Show me a sane man and I will cure him"
(Carl Jung)

Session Seven: Dreams and Emotions

for Piero Scaruffi's class
"Thinking about Thought"
at UC Berkeley (2014)

Roughly These Chapters of My Book “Nature of Consciousness”:

9. Dreams

10. Emotions

The Interpretation of Sleep

- Why do we sleep in the first place?
  - Evolutionary reason: Natural selection rewarded individuals who were capable of hiding still at the time of the day when they were most vulnerable
  - Energetic reason: Sleep optimizes an individual's energies at the time of the day when it is least efficient to search for food
  - Restorative reason: During sleep the body performs maintenance (muscle growth, tissue repair, protein synthesis, etc. occur during sleep)
  - Cognitive reason: During sleep the brain self-organizes.

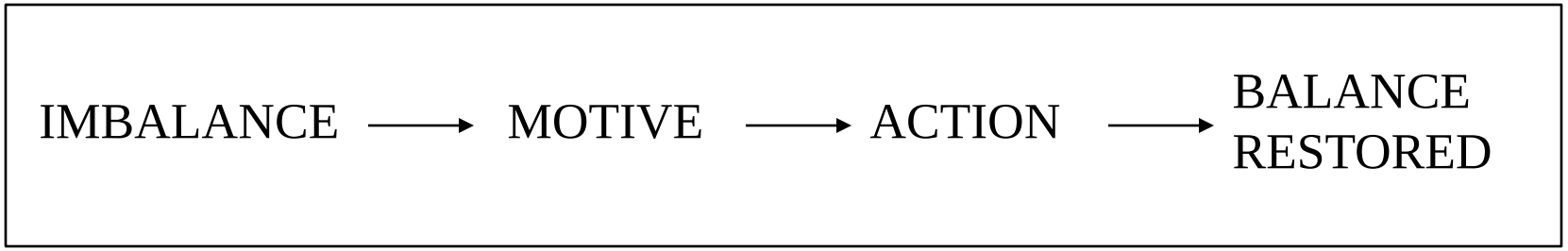
Prehistory of Dreaming Science

- Classical world of psychology (eg, Wilhelm-Max Wundt, 1874)
  - Actions have a motive
  - Motives are mental states, hosted in our minds and controlled by our minds
  - Motives express an imbalance in the mind, between desire and reality
  - Action is an attempt to regenerate balance by changing the reality to match our desire

IMBALANCE → MOTIVE → ACTION → BALANCE RESTORED

Prehistory of Dreaming Science

- Classical world of
  - Dreams?



Prehistory of Dreaming Science

- The subconscious
  - Schopenhauer's will
  - Nietzsche's covert instinct
  - Johann Herbart's "Textbook of Psychology" (1816): the mind arises from the dialogue between conscious and unconscious processes
  - Pierre Janet's "psychological analysis" (hypnosis + automatic writing)

Prehistory of Dreaming Science

- The subconscious
  - Eduard von Hartmann's "Philosophy of the Unconscious" (1868)
    - The absolute subconscious permeates the universe
    - The physiological subconscious is inherited biologically by each individual
    - A study that mixed biology, anthropology, linguistics, art, poetry
  - Max Dessoir's "Double Ego" (1890)

Prehistory of Dreaming Science

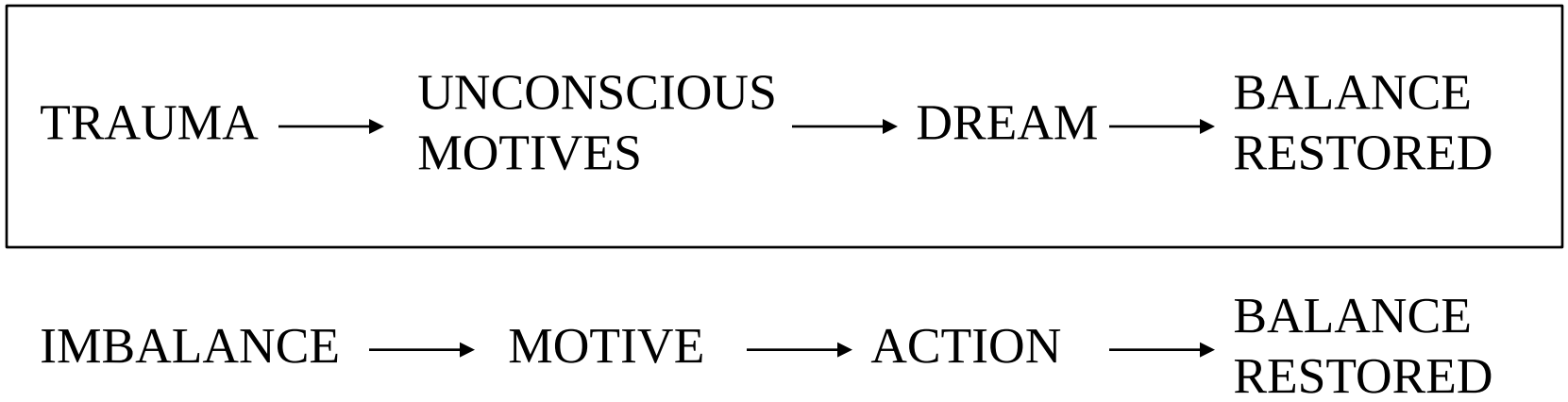
- Sigmund Freud (1900)
  - All mental life is driven by motives/desires
  - There is a repertory of motives that our mind, independent of our will, has created over the years, and they participate daily in determining our actions
  - A dream is meaningless if interpreted from the point of view of conscious motives
  - However, the dream is a perfectly logical construction if one also considers the unconscious motives
  - It appears irrational only because we cannot access those unconscious motives.

Prehistory of Dreaming Science

- Sigmund Freud
  - Dreams rely on memories and are assembled by the brain to deliver a meaning
  - The meaning of dreams is hidden
  - Unfortunate consequence of Freud’s work: psychiatrists look for the "meaning" of dreams, rather than for the process of dreaming
    - How is the unconscious created?
    - How are some motives selected over others?
    - How are motives repressed but kept active?
  - Dreams remain outside the sphere of science for five decades

Prehistory of Dreaming Science

- Classical model of Psychology
  - Dreams are actions caused by motives
  - Motives of dreams have been created in our mind while we were not aware of it
  - Motives were caused by traumas
  - A dream is an attempt to regenerate balance



Prehistory of Dreaming Science

- Carl Jung (1912)
  - Dreams reflect the "collective unconscious", a shared repertory of archaic experience represented by "archetypes" which spontaneously emerge in all minds
  - Predispositions by all human brains to create some myths rather than others (compare with Chomsky's theory that there is a predisposition by all human brains towards acquiring language)

Prehistory of Dreaming Science

- Erich Fromm: “The Forgotten Language” (1951)
  - There is a universal language of symbols, expressed through dreams and myths
  - Modern people have forgotten that language, but not when they sleep
  - Both dreams and myths have multiple layers of meaning
  - The subconscious understands the deeper layer, the conscious self understands only the surface layer

Prehistory of Dreaming Science

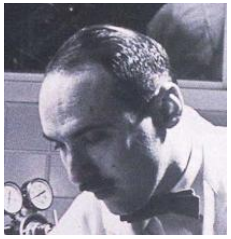
- Norman Malcolm (1959)
  - The accuracy of dream reports cannot be verified
  - "The only criterion of the truth of a statement that someone has had a certain dream is, essentially, his saying so."

Prehistory of Dreaming Science

- John Hughlings Jackson (1882)
  - A loss of a brain function almost always results in the gain in another brain function
  - The brain's functions have different evolutionary ages: newer ones took over older ones, but the older ones are still there
  - "Balance" of brain states

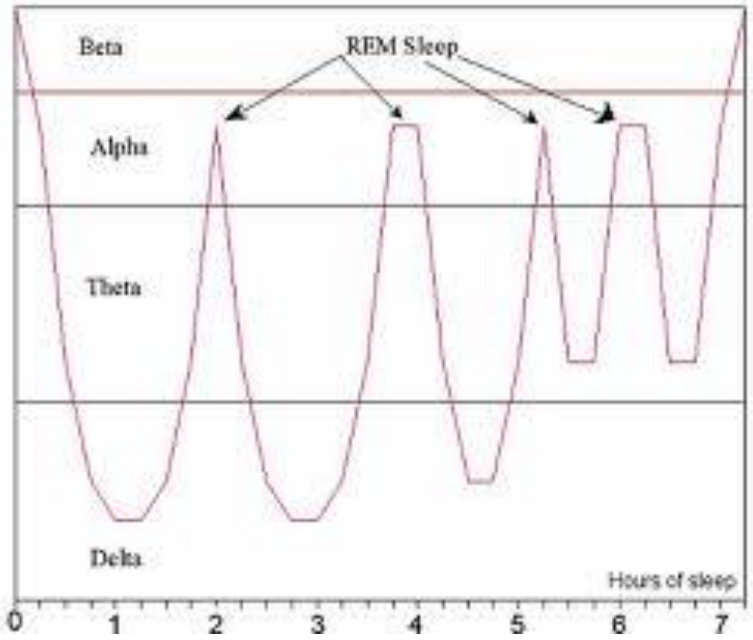
The Interpretation of Dreams

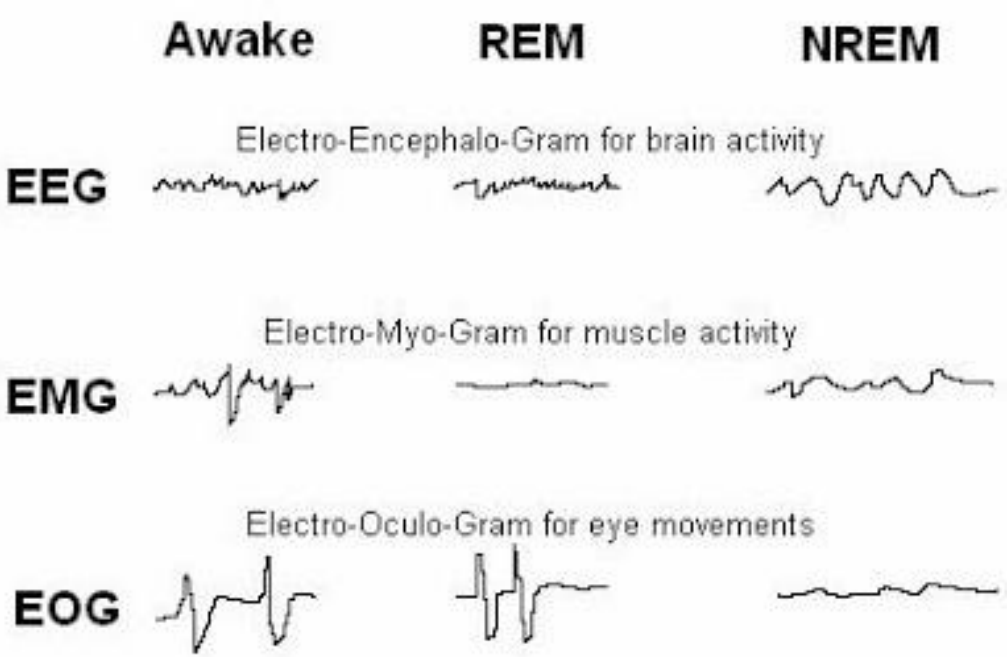
- Eugene Aserinsky / Nathaniel Kleitman's "Rapid Eye Movement" sleep (1953)
  - A low level of brain activity
  - Inhibition of muscle tone
  - Waves of excitation from the pons
  - Rapid eye movement
    - A brain enters REM sleep 4 or 5 times per night, at approximately 90 minute intervals, and each period lasts about 20 minutes
- William Dement (1954)
  - Sleep consists of cycles of different stages of sleep, repeated four or five times a night



The Interpretation of Dreams

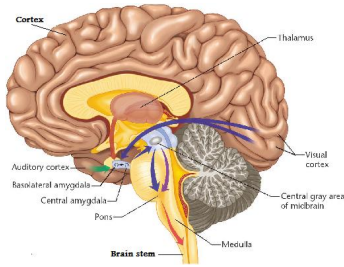
- REM sleep





The Interpretation of Dreams

- Michel Jouvet (1962)
  - REM sleep originates in the brain stem
  - The pons sends signals and excites eye muscles (causing rapid eye movement), the midbrain (causing a low level of brain activity), and the thalamus.
  - The cortex receives a valid sensory signal from the thalamus and interprets it as if it were coming from the senses



	SENSES	→	CORTEX	awake
BRAIN STEM	→	THALAMUS	→ CORTEX	REM sleep

The Interpretation of Dreams

- Michel Jouvet (1962)
  - During REM sleep several areas of the brain are working frantically, and some of them are performing exactly the same job they perform when the brain is awake.
  - The only major difference is that the stimuli they process are now coming from an internal source rather than from the outside world
  - REM sleep is pervasive among mammals. *Whatever its function is, it has to be the same for rats and humans.*

The Interpretation of Dreams

- Michel Jouvet
  - A dream is the vehicle employed by an organism to cancel or archive the day's experiences on the basis of a genetic program
  - REM sleep provides a means to combine genetic instructions with experience
  - *Sleep and dreaming are a survival strategy*

The Interpretation of Dreams

- Frederick Snyder (1966)
  - REM sleep came first and dreams came later
  - REM sleep of mammals and birds is generally followed by a brief awakening
  - The sentinel hypothesis: *REM sleep wakes up an animal periodically* to scan the environment for possible predators
  - REM sleep had a useful function for survival: it kept the brain alert and ready to react to emergencies even during sleep
  - REM sleep was available and was used to host dreams

The Interpretation of Dreams

- Allan Hobson and Robert McCarley (1977)
  - Dreams originate from random brain activity during REM sleep ("continual activation“)
  - *The brain tries to make sense of a flow of random “thoughts”*
  - Dreams have no meaning

The Interpretation of Dreams

- Scott Campbell and Irene Tobler (1984)
  - The standard model of sleep research: a sleeplike state is
    - A reversible state during which voluntary movements do not occur
    - Controlled by a circadian clock
    - Accompanied by an increase in arousal threshold
    - Controlled by a homeostatic system

The Interpretation of Dreams

Possible interpretations of dreams (1980s-2000s):

1. Dreams are just an evolutionary leftover
2. Dreams are fossils of a previous form of mind
3. Dreams are a window on some processing that goes on in the brain while we sleep

The Interpretation of Dreams

3. Dreams are a window on some processing that goes on in the brain while we sleep
   - The brain is rapidly processing a huge amount of information in whatever order
   - Our consciousness sees flashes of the bits that are being processed
   - These bits seem to compose stories of their own, and the stories look weird
   - Remembering and forgetting occur during dreams
   - REM sleep is important for consolidating long-term memories

The Interpretation of Dreams

- Jonathan Winson (1985)
  - Clues:
    - At birth, the hippocampus is needed to retrieve information stored in long-term memory, but, after about three years, the brain somehow learns how to access directly such information

0-3 years	long-term memory	→ hippocampus →	awareness
>3 years	long-term memory	→	awareness

    - Lower mammals exhibit a theta rhythm in the hippocampus only on two occasions: whenever they perform survival-critical behavior, and during REM sleep

The Interpretation of Dreams

- Jonathan Winson (1985)
  - Early mammals had to perform all their "reasoning" on the spot, e.g. integrate new information (sensory data) with old information (memories) immediately to work out their strategies.
  - Brains invented a way to "postpone" processing sensory information by taking advantage of the hippocampus: REM sleep.
  - Instead of taking input from the sensory system, the brain takes input from memory
  - Theta rhythm is the pace at which that off-line processing is carried out.
  - Theta rhythm disappeared in primates, but REM sleep remained

The Interpretation of Dreams

- Jonathan Winson
  - During REM sleep, the hippocampus processes the day's events and stores important information in long-term memory
  - During REM sleep the brain relates recent memories to old memories
  - During REM sleep the brain derives "tips" for future behavior

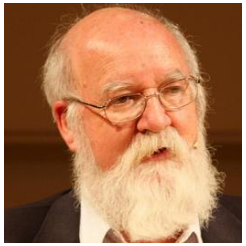
The Interpretation of Dreams

- Jonathan Winson
  - Dreams represent "practice sessions" in which animals (not only humans) refine their survival skills
  - *Dreams are a window on this "off-line processing" of information*
  - Dreaming is essential to learning

The Interpretation of Dreams

- Is the conscious self an evolution of dreaming?
  - Dreams helped us survive a long time before our mind was capable of providing any help at all
  - First the brain started dreaming
  - Then dreams took over the brain and became the conscious self
  - The conscious self could be a continuous dream of the universe

The Interpretation of Dreams



- Compare with Dawkins/Dennett: the mind was created by “memes”
- Joseph Campbell: “a myth [meme] is a public dream, a dream is a private myth

The Interpretation of Dreams

- Francis Crick (1983)
  - The function of dreams is to "clear the circuits" of the brain, otherwise there would not be enough space to register each day's events
  - The brain, in the face of huge daily sensory stimulation, must:
    - understand what matters
    - understand what does not matter
    - remember what will still matter
    - forget what will never matter again
  - Dreams help eliminate useless memories.
  - We dream what is worth forgetting

The Interpretation of Dreams

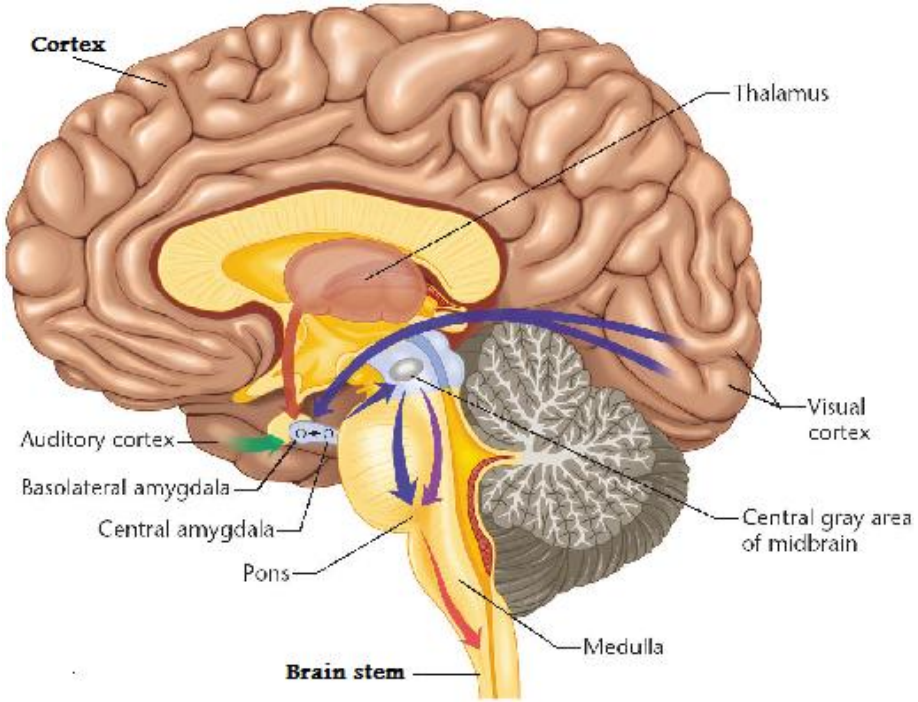
- Allan Hobson (1989)
  - We dream hypothetical situations so that we will be prepared to face real situations of the same kind.
  - When a waking situation occurs, it has hopefully already been played at least once in our dreams, and we know what to expect.
  - By dreaming, we train our brain: dreams are mental gymnastics.
  - In order to see something, we must first create the vision of that something in our mind.
  - We dream what is worth remembering

The Interpretation of Dreams

- Allan Hobson
  - Awake process = sleep proces
  - The input, the output, the processor and the working space of the awake brain are replaced by something else; but the “software” is the same.
  - Waking and sleeping are controlled by two distinct populations of neurons in the brain stem

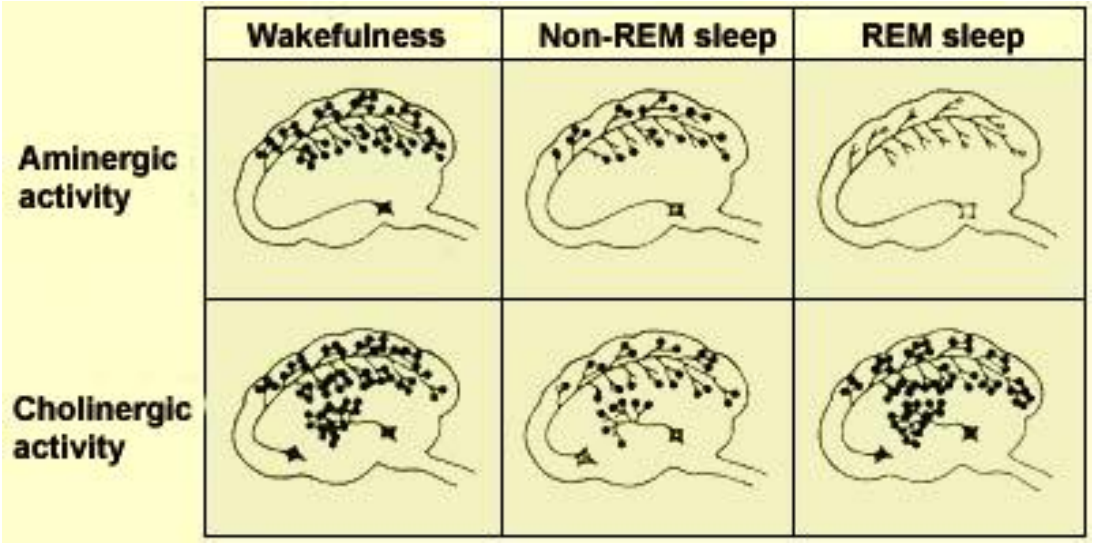
The Interpretation of Dreams

- Allan Hobson
  - Struggle between two rival neurotransmitter pathways
  - Aminergic neurotransmitters originate in the brain stem and terminate in the amygdala.
  - Cholinergic neurotransmitters originate in the basal forebrain and terminate in the cortex.



The Interpretation of Dreams

- Allan Hobson
  - During waking states, the brain is controlled by aminergic neurotransmitters
  - During sleep, the brain is controlled by cholinergic neurotransmitters



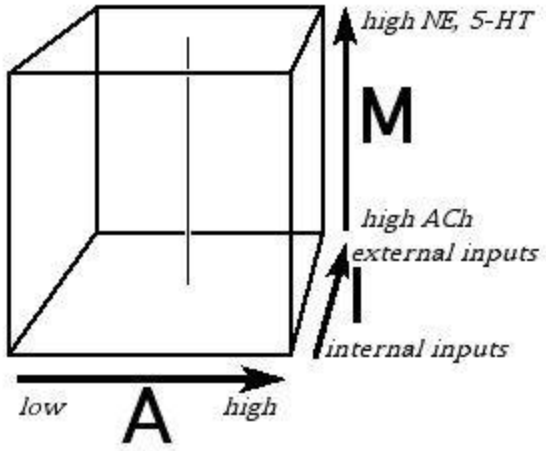
The number of black dots is proportional to the activity of the aminergic and cholinergic systems

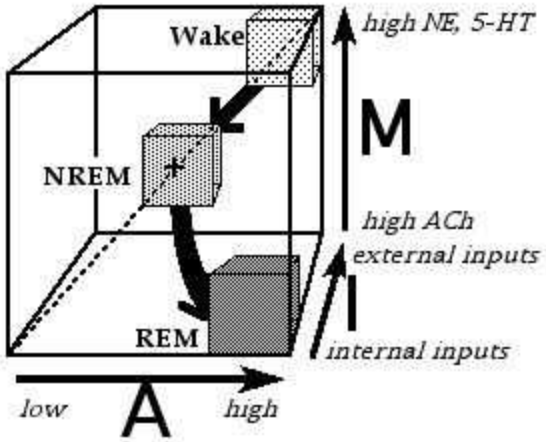
The Interpretation of Dreams

- Allan Hobson
  - Wake and sleep are two different chemical systems hosted in the same processor
  - Dynamic equilibrium: if one chemical system retracts, the other advances
  - The brain never truly sleeps
  - Our consciousness can fluctuate between two extremes, in which either of the chemical systems totally prevails

The Interpretation of Dreams

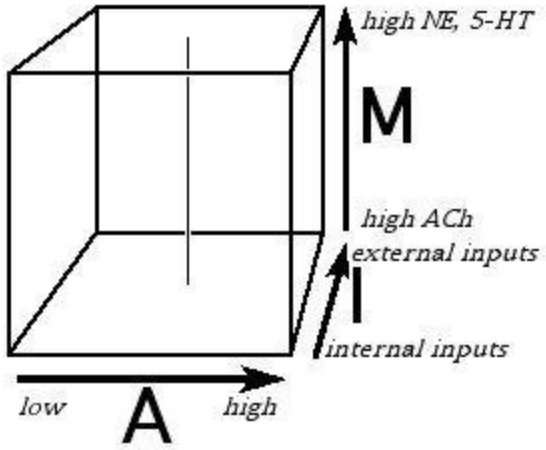
- Allan Hobson (1989)
  - The brain states of wake and sleep are only two extremes
  - Between them there exists a continuum of aminergic-cholinergic interactions, and therefore a continuum of brain states
  - The brain is in awake, dream or (non-REM) sleep mode depending on whether amines are prevailing, cholines are prevailing, or amines and cholines are "deadlocked“
  - Normally, both external and internal sources contribute to cognitive life, and both amines and cholines contribute to the brain state.

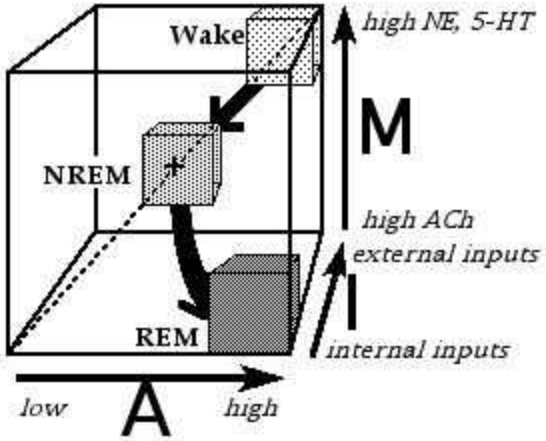




The Interpretation of Dreams

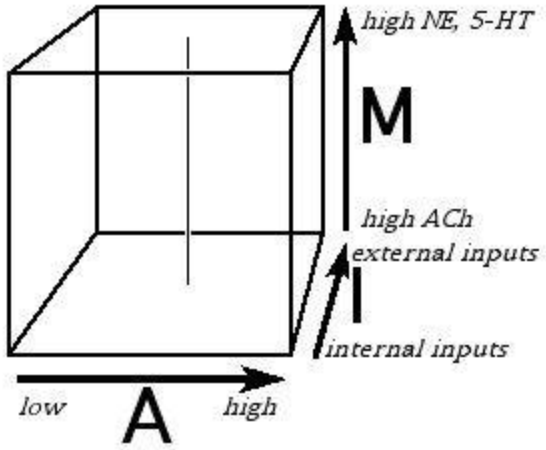
- Allan Hobson's unified theory of brain behavior
  - Brain behavior: activation energy (amount of electrical activity) + information source (internal or external) + chemical system (amines or cholines)
  - Wake: activation energy is high, the information source is external and the mode is aminergic
  - Sleep: activation energy decreases, the external information source fades away and amines and cholines balance each other

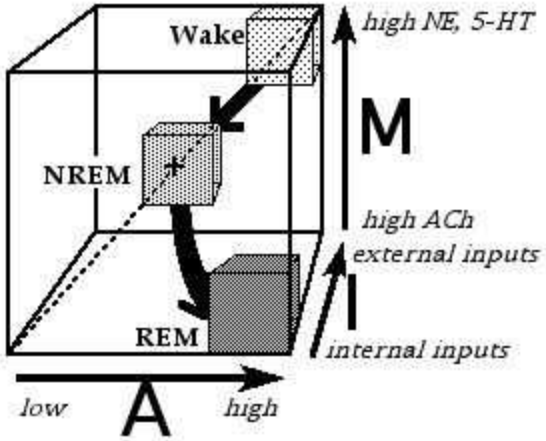




The Interpretation of Dreams

- Allan Hobson
  - Dreaming: activation energy is high, the information source is internal and the mode is cholinergic
  - Hallucination: activation energy is high, the information source is internal and the mode is aminergic
  - Coma: activation energy is low, the information source is internal and the mode is cholinergic
  - Normal state: interplay of amines and cholines, interplay of external and internal sources (perceptions are mediated by memory), interplay of high and low activation energy



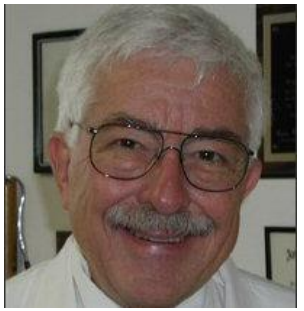


The Interpretation of Dreams

- Craig Heller and Joel Benington(1995)
  - Sleep helps to restore the brain's energy
  - Most of the cells in the brain are actually not neurons but glia: they store and release glycogen
  - The wakeful processes of perception, thought and action use up the glycogen stores
  - The brain releases adenosine whenever the energy reserves are low
  - Adenosine is an inhibitory neurotransmitter
  - Eventually adenosine reaches a level that inhibits signal propagation and triggers non-REM sleep
  - In this state the brain is less active, consuming much less glycogen and energy can be replenished with new glycogen.

The Interpretation of Dreams

- Dale Edgar and William Dement (1992)
  - This homeostatic process works independently from the circadian clock that, instead, keeps us awake during the day, even when we get tired
  - Other animals don’t have such opposing clocks and sleep whenever they need energy restoration.



The Interpretation of Dreams

- William Calvin (1996)
  - The brain works all the time just like Nature works all the time at producing and selecting species
  - The brain is a small ecosystem of "thoughts" that are continuously produced in countless variations and then selected
  - We dream all the time.
  - When we are awake, the rational part of the brain selects the "dreams" that make sense and disposes of the ones that don't make sense.
  - When we are asleep, that "rational" center is not working and therefore our mind is flooded with random dreams

The Interpretation of Dreams

- Anthony Stevens (1997)
  - Dreaming emerged when oviparous animals evolved into viviparous animals
  - “Off-line” processing made possible to limit the size of the brain while leaving brain activity free to grow
  - Brains, and thus heads, would remain small enough to pass through the maternal pelvis

The Interpretation of Dreams

- Owen Flanagan (1999)
  - Both sleep and consciousness are products of evolution, but consciousness during sleep (dreaming) is merely an accident of nature
  - Both consciousness and sleep have a clear biological function, but dreams don't.
  - By accident, pulses that originate from the brain stem also reactivate more or less random parts of memory
  - Thus we dream
  - Dreams are just the noise the brain makes while working overnight.

NREM Dreaming

- Mark Solms (1997)
  - Dreaming is possible without REM
  - The dopaminergic system (originating in the ventral tegmental area) is the neurochemical basis for dreaming
  - Only REM originates in the pons
  - Dreams and REM are physically controlled by two different regions of the brain.

NREM Dreaming

- Jie Zhang (2004)
  - Dreaming and REM sleep are in different parts of the brain
  - Working memory consists of two subsidiary systems: the conscious and the non-conscious
  - NREM sleep for processing the declarative (conscious) memory, and REM sleep for processing the procedural (nonconscious) memory
  - When the unconscious procedural memory is transferred from the temporary memory to the long-term memory during REM sleep, the conscious declarative memory enters Hobson's "continual-activation" mode to interpret the memory stream.
  - Dreaming is only an epiphenomenon

Neurobiology and Genetics of Dreams

- 1996: Clifford Saper identifies the “sleep switch” in the hypothalamus
- 2009: Ying-Hui Fu discovers the gene that regulates sleep length in mammals

Amita Sehgal & Emmanuel Mignot: “Genetics of Sleep and Sleep disorders” (2011)
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3153991/

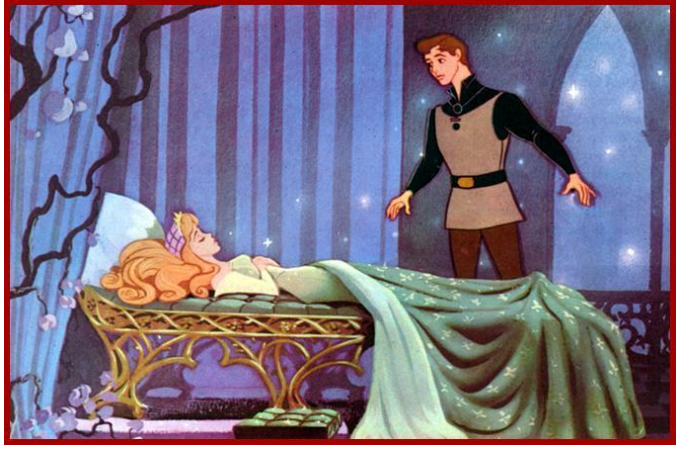
Other Forms of Sleep?

- Many animals hybernate
  - Temperature drops, movement stops and body functions slow down so that the animal can survive off the energy stored in its fat
- Many plants go dormant
- Plants can’t do photosynthesis at night

Lucid Dreaming

- Knowing that one is dreaming
- Frederik van Eeden (1913)
- Celia Green (1968)
- Keith Hearne (1978)
- Stephen LaBerge (1982)

Summary



- An evolutionary leftover?
- Sentinel hypothesis
- Continual activation: dreams could be a window on the offline processing of the brain
- Consolidation of long-term memory
- We dream what is worth forgetting
- We dream what is worth remembering
- Wake and sleep are two different chemical systems hosted in the same processor
- Sleep helps to restore the brain's energy
- We dream all the time
- Dreams are just the noise the brain makes while working overnight (epiphenomenon)

Break

I play the notes, in order, as they are written.
It is God who makes the music
(Johan Sebastian Bach)

Emotion and Consciousness

- William James (1890)
  - Mental life is a “stream of consciousness”
  - Each state of consciousness has both a cognitive aspect and a feeling aspect
  - Feelings are a reflection of a change in the state of the body

Emotion and Consciousness

- William James (1890)
  - Emotion is only a secondary feeling: a situation first generates a primary feeling, which is physiological in nature (for example, shivering) and then this physiological event triggers a corresponding emotion
  - For example, our eyes are wide open and we stop breathing when we witness a car accident, and then these physiological facts trigger the emotion of anxiety.

Universal Emotions?

- **There evolved fundamental emotions that all humans share, regardless of cultural influences:**
  - **Charles Darwin**
  - **Paul Ekman**
  - **Robert Plutchik (8 emotions shared by ALL animals)**

Adaptive behavior		Emotion
Protection	The behavior that occurs in response to pain or threat of destruction.	Fear, terror
Destruction	"Behavior designed to destroy a barrier that prevents the satisfaction of an important need" (1984, p. 202).	Anger, rage
Reproduction	Any behavior associated with sexual activity, including "approach [and] maintenance-of-contact tendencies" (1984, p. 202).	Joy, ecstasy
Reintegration	Behavior that is in response to a loss of something "pleasureful or nutrient" (1980, p. 145).	Sadness, grief
Incorporation	The acceptance of a stimulus.	Acceptance, trust
Rejection	The removal of something that has been accepted, but has turned out to be harmful.	Disgust, loathing
Exploration	The behavior displayed when organisms explore or examine their environment.	Expectancy, anticipation
Orientation	The brief response—stopping or freezing—when a new stimulus, which has not yet been classified as beneficial or harmful, is encountered.	Surprise, astonishment

Plutchick's basic emotions

Emotion and Cognition

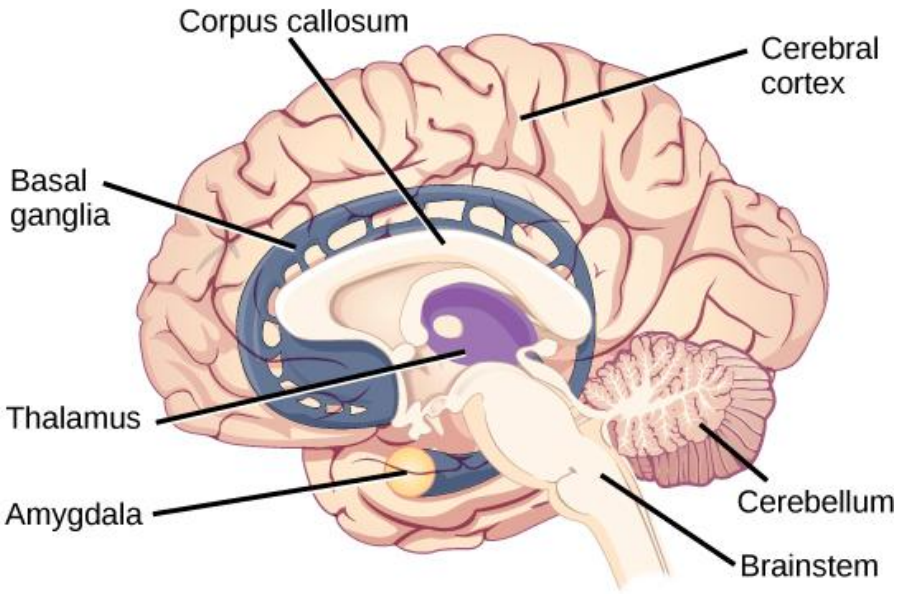
- Robert Zajonc (1980)
  - Contrary to popular belief, *emotion tend to prevail over cognition in decision making*

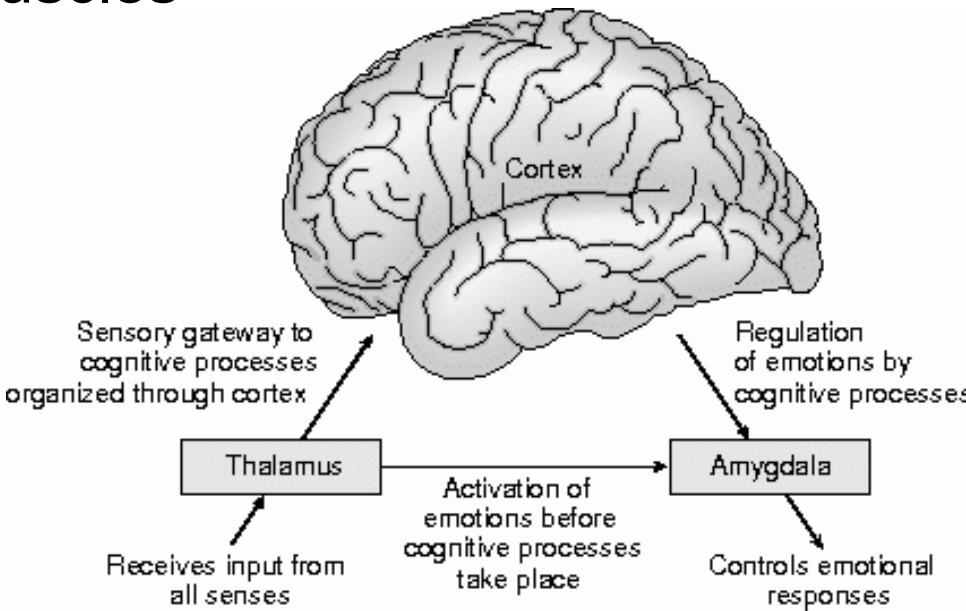
Emotion as Survival Instinct

- Joseph LeDoux (1996)
  - *Emotions help us make fast decisions in crucial situations*
  - Emotions are inferential short-cuts
  - Fear helps act faster than if we used our logical faculties

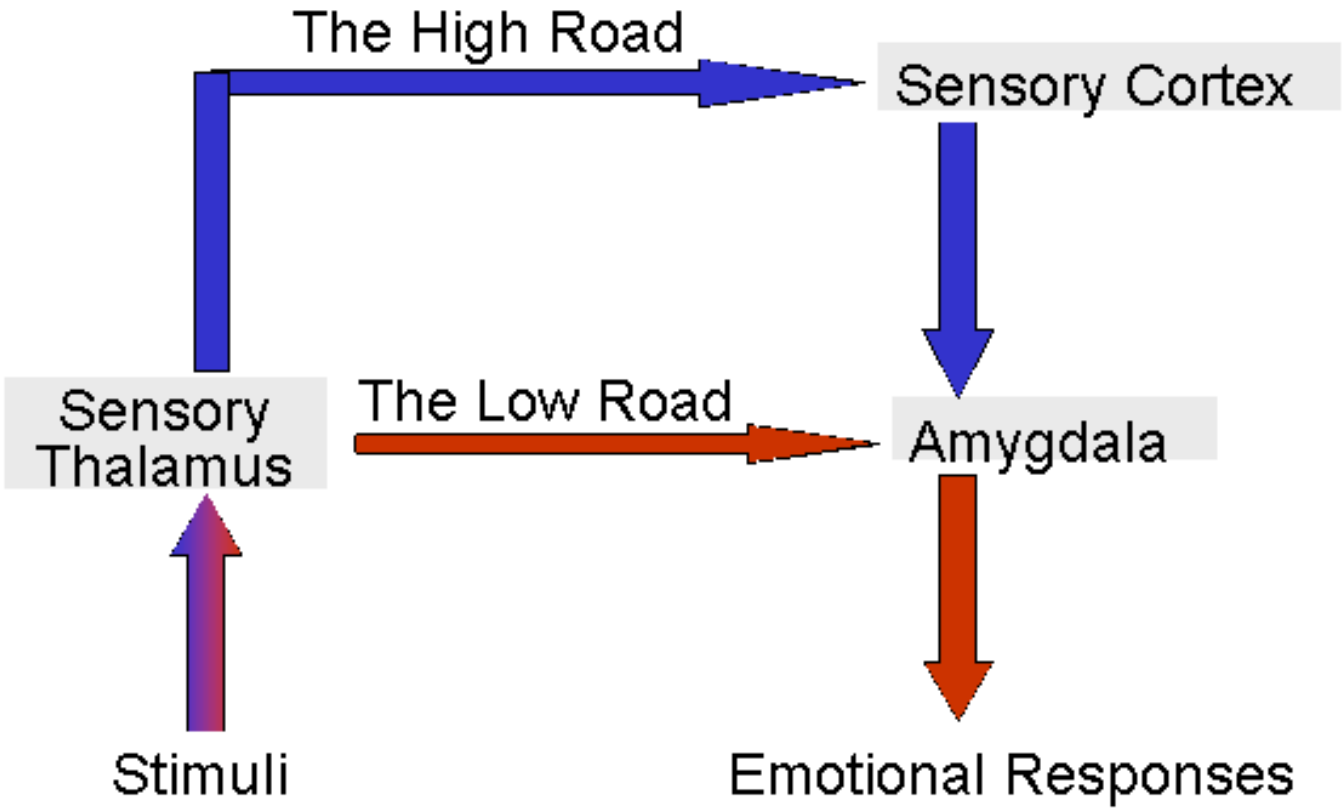
Emotion as Survival Instinct

- Joseph LeDoux (1996)
  - The central processor for emotions is the "amygdala"
  - The thalamus connects senses to the cortex, and the cortex to the muscles
  - The route from senses to amygdala to thalamus to muscles is much faster than from senses to thalamus to cortex to muscles





Emotion as Survival Instinct



LeDoux: Tracing Emotional Pathways (NY Times Nov. 5, 1996)

Emotion as Communication

- Allan Hobson (1994)
  - Emotions are the fastest way that we can communicate with members of our group
  - Emotions are signals between animals of the same species that communicate one's brain state to another
  - *Emotions may predate language itself as a form of communication*

Emotion

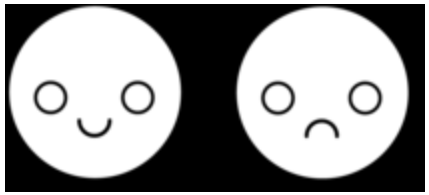
http://blog.sciseek.com

Emotion as Communication

- Karl Lashley (1951)
  - A “syntax” similar to the one for language also exists for actions
- Ray Birdwhistell (1952)

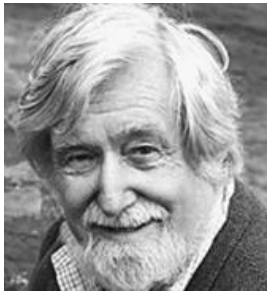
  - “Kinesics”, paralinguistic body communication, such as facial expression
  - All movements of the body have some kind of meaning
  - Non-verbal behavior obeys its own grammar, with a "kineme" being the kinesic equivalent of the phoneme.
  - Facial expression is inevitable like language and universal like language

Emoticons:



Emotion as Rationality

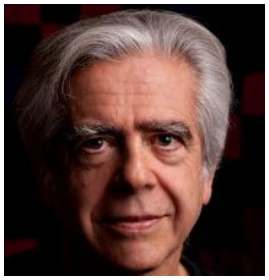
- Social Constructionism
  - Emotions are cultural artifacts
  - Clifford Geertz (1973)
  - Rom Harre (1986)
  - Catherine Luz (1986)



Emotion as Rationality

- Aaron Sloman (1982)
  - The relation between emotional states and cognitive states is the need to draw conclusions when cognition would face combinatorial explosion of possible reasoning threads
  - Complementarity between reason and emotion
  - “Why Robots Will Have Emotions” (1981)

Emotion as Rationality



- Ronald DeSousa (1987)
  - Emotions play the same role as perceptions, i.e. they contribute to create beliefs and desires.
  - Beliefs and desires are necessary elements of any logical system: one attempts to satisfy desires by acting in the environment according to one's beliefs
  - Emotions are learned like a language
  - *Emotions have their own grammar*

Emotion as Heterostasis

- Harry Klopf (1982)
  - Organisms are not hiding in the environment, trying to minimize action and change
  - Organisms actively seek stimulation
  - "Heterostasis" is the seeking of maximum stimulation
  - All parts of the brain are independently seeking positive stimulation (or "pleasure") and avoiding negative stimulation (or "pain")
  - *Emotion provides the sense (a measure) of what the organism needs, cognition provides the means for achieving those needs*

Emotion as Homeostasis

- Ross Buck (1984)
  - The system of emotions is a biologically shared signal system
  - It was created over millions of years through the evolutionary process
  - Communicating an emotion is easy, communicating a theorem is not easy at all
  - Emotions have the important function of speeding up *communication of crucial information* among members of the same species

Emotion as Homeostasis

- Ross Buck (1984)
  - Emotion communicates a "measure" how much goals have been satisfied, how far the organism is from equilibrium with the environment
  - For example, fear is a measure of safety
  - *Emotions are measurement tools*
  - The ultimate function of emotions is homeostasis

Emotion as Cognition

- George Mandler (1984)
  - Cognition is mainly interested in environmental regularities
  - There is a goal (e.g.: "eat"), there is a need (e.g.: "food") and there is a situation (“bananas”)
  - The function of the emotion (“desire bananas”) is to provide the individual with *the most general view of the world that is consistent with current needs, goals and situations*

Emotion as Survival Strategy

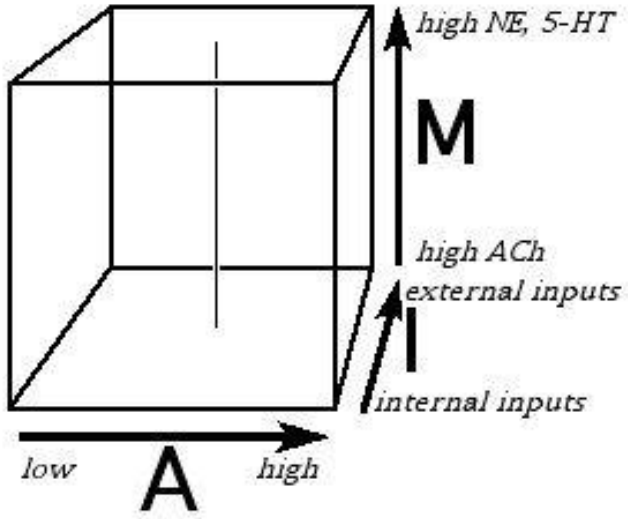
- Peter Lang (1985)
  - Emotions encode survival strategies that developed over the course of evolution
  - Evolutionarily speaking, the brain regions that preside over emotions are older
  - Two separate "motivational" systems coexist in the brain
    - "appetitive" system leading us towards stimuli that cause pleasure
    - "defensive" system steering us away from stimuli that cause pain

Emotion as Survival Strategy

- Peter Lang (1985)
  - These elementary emotions of pleasure and pain evolved into a whole repertory of emotions
  - *First brains started feeling emotions, then they started thinking*

Emotion as Perception

- Allan Hobson (1989)
  - Perceptions are mediated by memory
  - Anticipatory system: the internal source tells us what to expect next, and thus helps us cope with the external source
  - Emotions are a measure of how well the internal source matches the external source (anxiety vs contentness)



Emotion as Self-communication

- Jose Jauregui (1990)
  - Emotions are rational and predictable events
  - The brain is aware of what is going on in the body, but will inform the self when some correction/action is necessary
  - The communication channel between the brain and the self is made of emotions
  - The importance of the message is the intensity of the emotion
  - The ultimate function of emotions is homeostasis

Emotion as Self-communication

- Jose Jauregui (1990)
  - *An emotion makes a detailed explanations of the cause redundant because the emotion contains its own correction mechanism*
  - The emotional life of an individual is mathematically calculated to achieve exactly the kind and degree of response needed for the well-being of the individual
  - If the self disobeys it, the brain may increase the intensity of the message
  - It is emotion, not reason, that directs and informs the daily actions of individuals

Emotion as Cognition

- Richard Lazarus (1991)
  - Emotions arise from the relationship between the individual and its environment, or, better, the regularities of its environment.
  - An emotion arises from an appraisal of the situation and its consequences
  - The meaning of each emotion is about the significance of the situation for the well-being of the individual
  - Ultimately, emotions express the personal meaning of an individual's experience
  - *Cognition is a pre-requisite for emotion*

Emotion as Body-self communication

- Antonio Damasio (1995)
  - Emotion is the brain process, feeling is the… feeling of it
  - An emotion yields visible effects: facial expression, scream, movement…
  - Evolution has endowed us with a basic repertory of emotions that help us survive
  - Emotion is a genetically-driven response to a stimulus, a response that causes a change of state in order to cope with the stimulus

Emotion as Body-self communication

- Antonio Damasio
  - The neural processes that I experience as "my mind" are about the representation of my body in the brain.
  - Mental life requires the existence of a body
  - The brain is about the body, therefore emotions are about the body
  - The emotional system has to spread throughout the body
  - An emotion is registered by the brain when a stimulus is recognized as useful for well-being or damaging for well-being

1. an external stimulus triggers certain regions of the brain
2. those regions cause an emotion
3. the emotion spreads around the body and causes a change in the state of the body
4. the "mind" perceives that change of state as a feeling.

Emotion as Body-self communication

- Antonio Damasio
  - The immune system produces antibodies to fight invading viruses; or, better, the invading virus selects the appropriate antibody
  - *An emotional response is the antibody that reacts to an invading stimulus*, and is selected by that stimulus

Emotion as Body-self communication

- Antonio Damasio
  - The brain's original purpose is to manage the wealth of signals that represent the state of the body ("soma")
  - A somatic markers is a link between a body change and an emotion
  - Somatic markers are the repertory of emotions that we have acquired throughout our lives and that we use for our daily decisions
  - When the brain "learns" the emotion associated to a situation, a somatic marker is created
  - The somatic marker works either steering us away from choices that experience warns us against or steering us towards choices that experience makes us long for

Emotion

- Summarizing Hobson, Lazarus, Jauregui and Damasio:
  - Specific circuits in the brain are devoted to handling emotions
  - They communicate the "emotion" to the rest of the body via the bloodstream and the nervous system
  - They cause a change in the state of the body
  - The emotion works as an "amplifier" of a signal that came from the body
  - A change of state in the body causes an emotion that causes an action that causes a change of state in the body
  - Emotion is about homeostatic regulation

Emotional Intelligence and Empathy

- Peter Salovey and John Mayer (1990)
  - Emotional intelligence:
    - recognizing emotions,
    - using emotions to facilitate reasoning,
    - understanding the meaning of one's emotions,
    - managing one's emotions
- Martin Hoffman (1982), Nancy Eisenberg (2000), etc
  - Emotional intelligence associated with the development of empathy

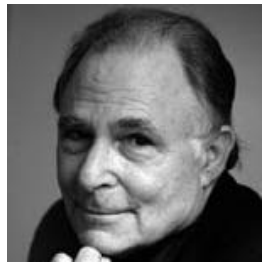
Emotion as Memory

- John Aggleton (1992)
  - There is an emotional memory (stored in the amygdala) and a declarative memory (mediated by the hippocampus and the cortex)
  - Emotional memories can never be erased
  - Emotional memory is primitive: it only contains simple links between cues and responses
  - This actually increases the speed of the emotional response
  - Adults cannot recall childhood traumas because in children the hippocampus has not yet matured to the point of forming conscious memories, but the emotional memory is there.

Emotion as Memory

- John Aggleton (1992)
  - The brain contains two reasoning systems that perform in different manners and use different circuits
  - *We have not one but two brains*, that operate in parallel on the same input but may generate completely different output.

Emotion as Universals



- Paul Ekman (1994)
  - All humans share the same emotions (eg facial expressions)
  - Emotions are basic, universal and hard-wired
- Paul MacLean
  - We all share the regions of the brain that account for emotions

Emotion as Universals

- The Plasticity of Emotions
  - Problem: people from different regions collide because they have a different repertory of values
  - The "avocado-pear" model: there exists a hard core of basic emotions shared by everybody and a less rigid "fruit" of emotions that are created by culture.
  - Peter Goldie’s "clay model“ (2000): there is a window of opportunity when emotions can be shaped, and later they become hard-wired and immutable

Emotion as Memory

- Edmund Rolls (1999)
  - The brain has been designed (by evolution) to deal with reward and punishment
  - The brain as a whole wants to maximize rewards and minimize punishments
  - This process of reward and punishment expresses itself through emotions
  - Emotions are "states produced by reinforcing stimuli"
  - The representation of a "reinforcer" contains information about how to calculate reward/punishment
  - "Reinforcing" stimuli are decoded by special regions of the brain, which generate the neural processes that we call "emotions"

Emotion as Memory

- Edmund Rolls
  - Emotions have several functions
    - the production of an autonomic response (i.e., faster heart beats)
    - the production of an endocrine (i.e., adrenaline)
    - the production of motivated behavior (that will last a lifetime)
    - communication to other members of the group
    - storage of "important" memories
    - etc

Emotion as Cognition

- Keith Stenning (2002)
  - Emotions are a way to abstract situations
  - Similar emotions are used to classify situations and objects into concepts and categories
  - Emotions are the ultimate meaning
  - The solution to Wittgenstein's paradox (we all know what a "game" is, but there is no simple definition of what a "game" is): we know what a "game" is because we know what the emotion related to a game is
  - The reason it is so easy for us to learn something so difficult as language is that language reflects the way our emotions work
  - *Emotions are the foundation of our mental life*

Emotion as Cognition

- Robert Solomon (2007)
  - It is our emotions that guide us in this world
  - Emotions help us conceptualize and evaluate
  - People whose emotional life has been damaged (e.g. by a stroke) are no longer capable of making rational decisions despite the fact that the rest of their brain is functioning like before
  - They do not "care" for the consequences of the decision and therefore are incapable of making a rational one.

Emotion as Cognition

- Lola Canamero's emotional robot (2010)

Summary

- Specific circuits in the brain for emotions
- These regions communicate the "emotion" to the body via bloodstream and nervous system
- This causes a change in the state of the body
- An emotion is an "amplifier" of a signal that came from the body
- The emotion is trying to maintain the "status quo" in the face of destabilizing news
- The brain is endowed with another mechanism for survival, the one that we call "cognition“
- The advantage of emotion over cognition is that it provides a rough and ready short-cut; e.g. fear is the reaction to any kind of danger
- Emotion and cognition work towards the same goal on parallel tracks

Summary

- All emotions can be reduced to the basic emotions of "pain" and "pleasure", of negative and positive reward
- Evolution of emotions from primitive pain/pleasure emotion

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Emotions

"Humans - who enslave, castrate, experiment on, and fillet other animals - have had an understandable penchant for pretending animals do not feel pain."
(Carl Sagan)

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