Cognition

Psyc 135 sec 1

Instructor: Dr. Steven Macramalla

Pre-requisites: Psyc 1

Tu-Th 10:30 – 11:45 pm DMH 355

Office Hours: DMH 230, TuTh 12:00-1:30

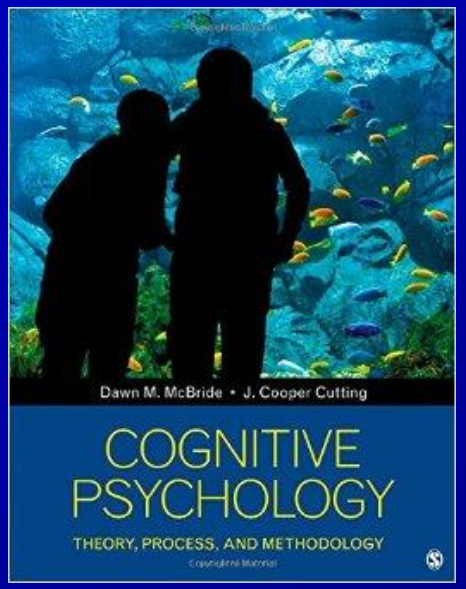
Email in advance, please steven.macramalla@sjsu.edu

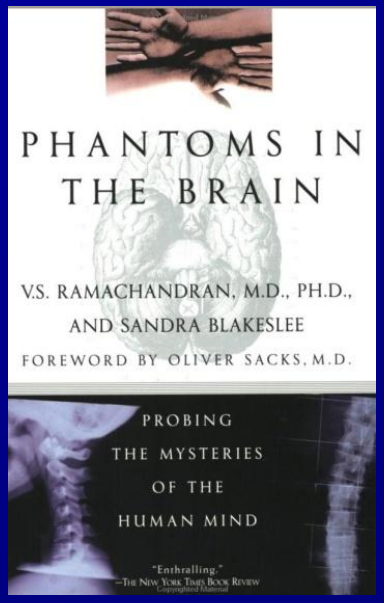
Class Website: http://www.sjsu.edu/people/steven.macramalla/


Psyc 135
To Drop: Mon Fe
dd: Mon Feb.
XAM Thurs
1715-

Texts

- Mcbride & Cutting, *Cogntiive Psychology*
-
- V.S. Ramachandran, *Phantoms in the Brain*





Course Structure

- Attendance is your responsibility, but highly recommended
- 3 Tests @ 50pts each ……150 pts
  - 50 x-choice questions
- Class Presentation……20 pts
- Paper ……100 pts
- TOTAL……270 pts

Group Project

- Working in teams of 4-5 (request my consent for larger group size)
- Each member will write a minimum 1500 word section or ‘chapter’
- All Papers due the same day Tuesday April 26th
- Each member will do a presentation (5-10 min) on their paper section.
- This week? Next Week? Groups will self-select, select topics. In-class workshops on project

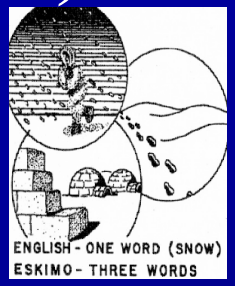
What Is Cognitive Psychology?

- **Cognition Definition**: *Co* (together) + *gnoscere* (to know) = *coming to know*.

- **Cognitive Psychology is the science of how the brain processes information and generates your illusion of reality.**

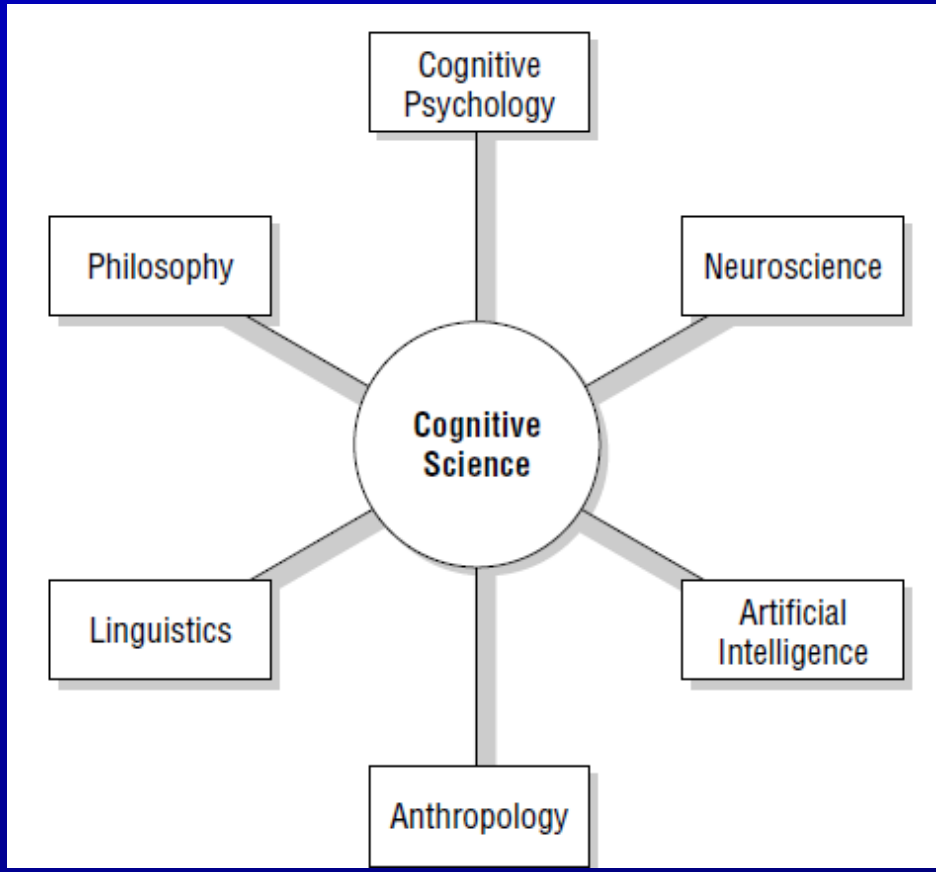
Applications of Cognitive Psychology

- Know Thyself *(I think therefore I am)*
- Clinical / Neurology *(I think therefore I'm wired)*
- Human Factors *(I think therefore iPhone)*
- Education *(I learn therefore higher ed)*
- Commerce *(I shop therefore I debt)*



What Is Cognitive Psychology?

- What do we study?
  - Perception, attention, emotions/affect, memory, language, learning, reasoning & decision making, problem solving , creativity
  - Flow of information from input (stimulus) to output (response)
  - Under the microscope:
    - Illusions & Errors
    - Inconstancies & Constancies



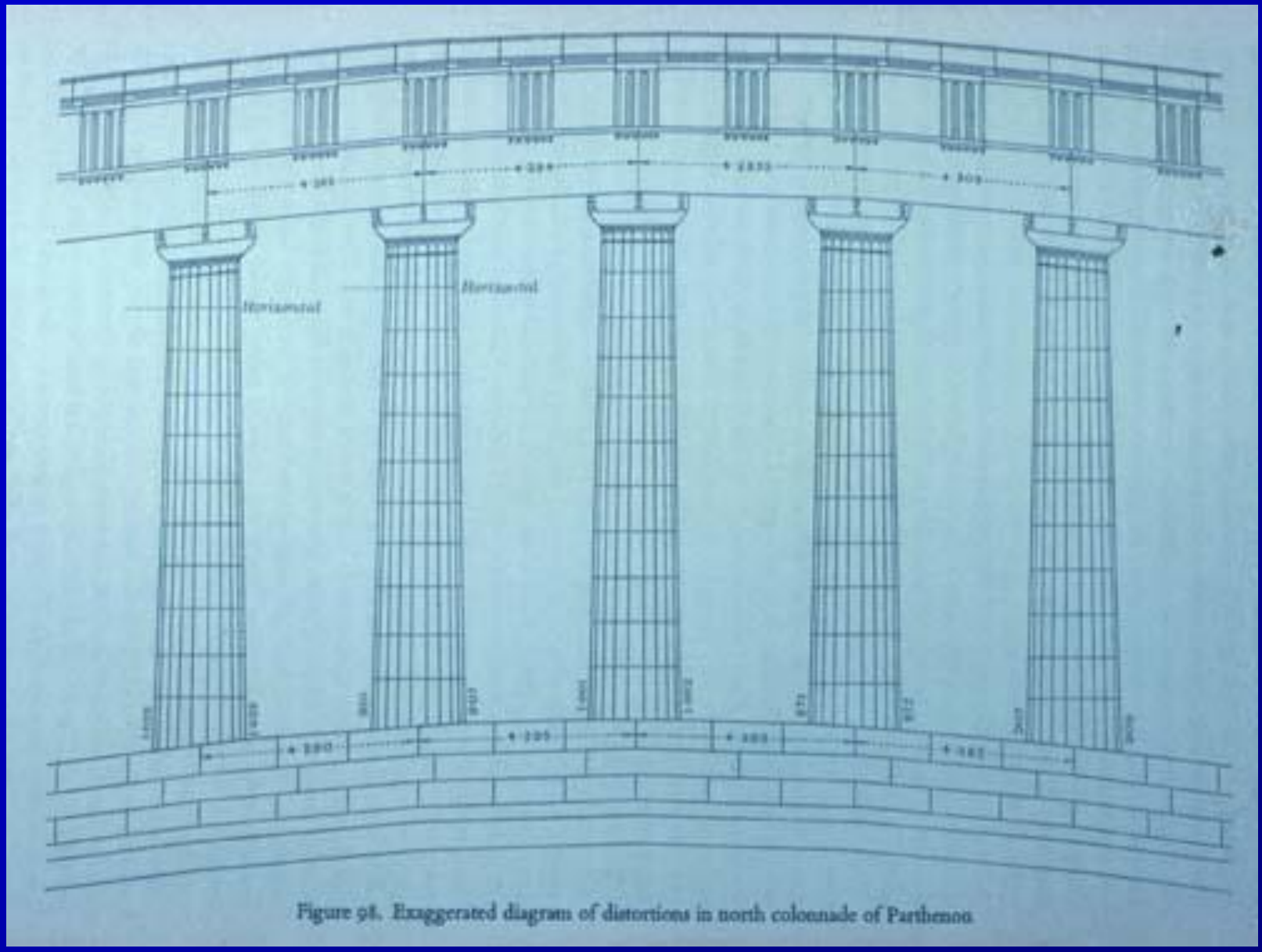
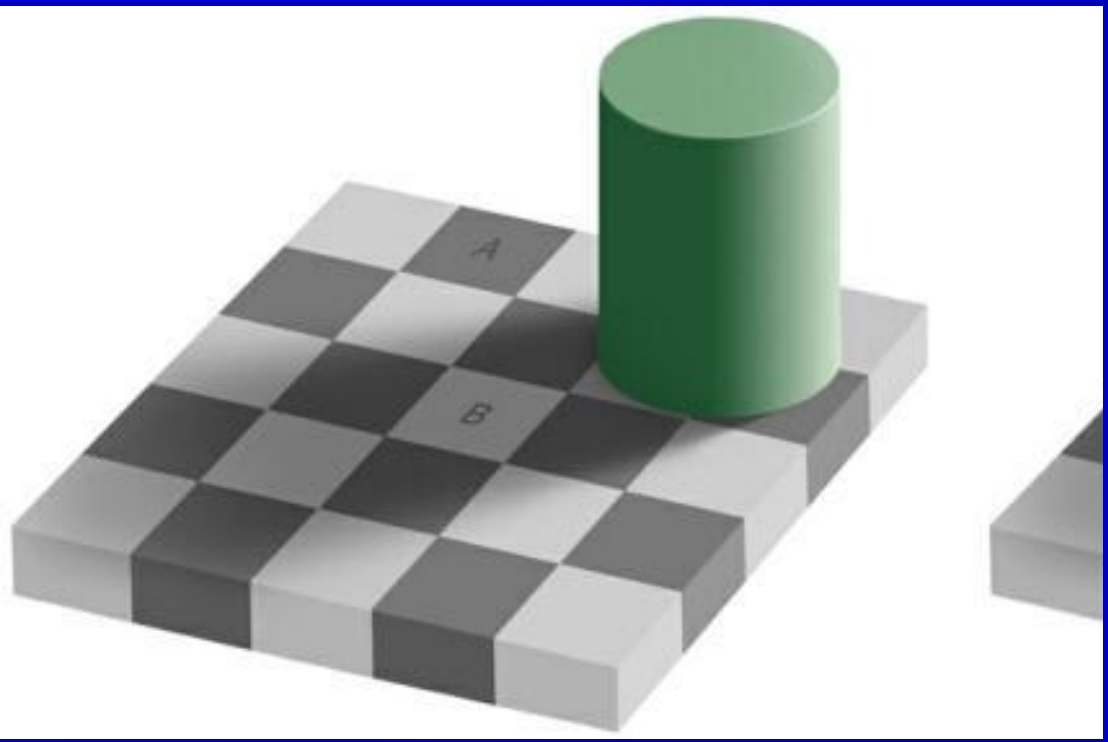


Figure 98. Exaggerated diagram of distortions in north colonnade of Parthenon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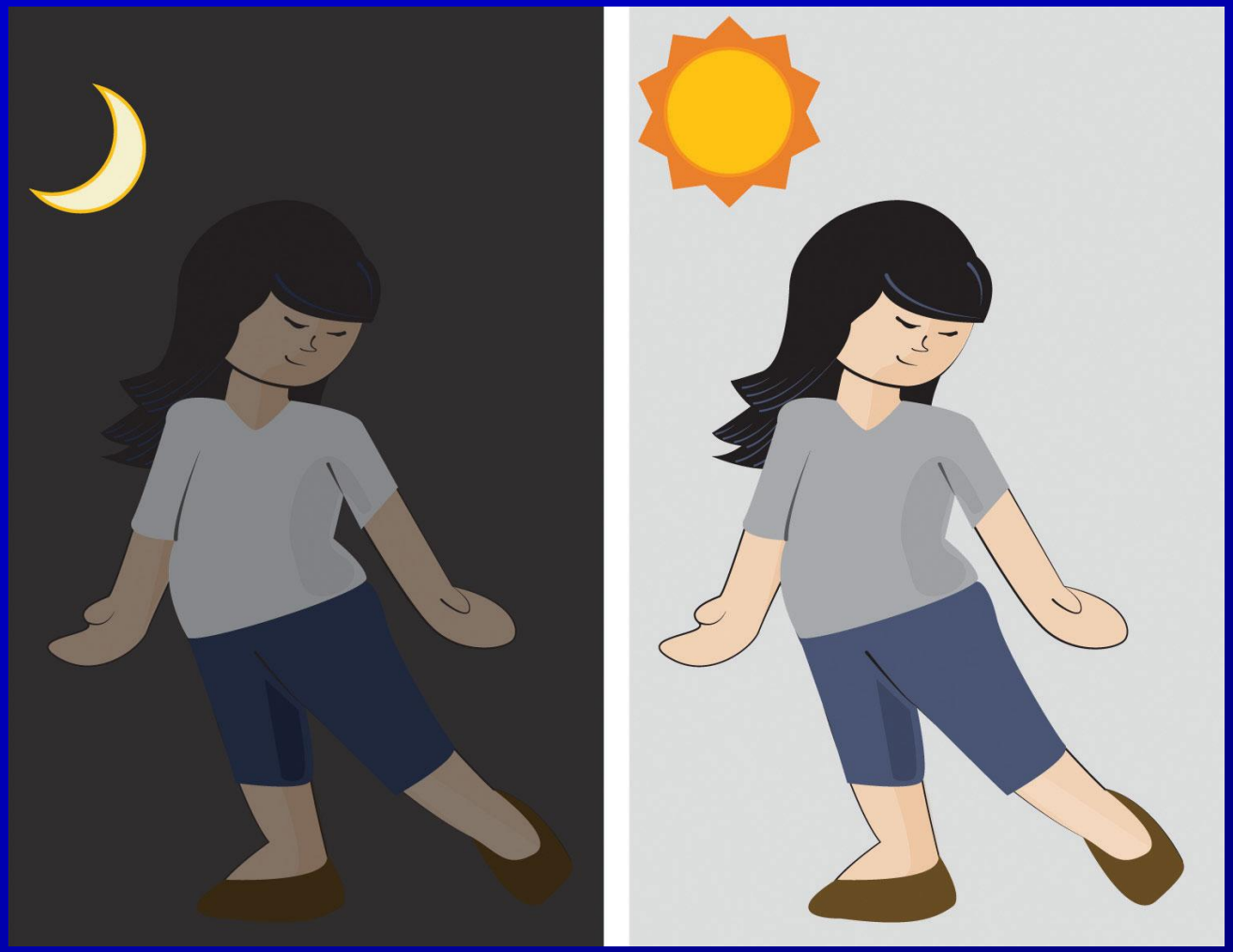
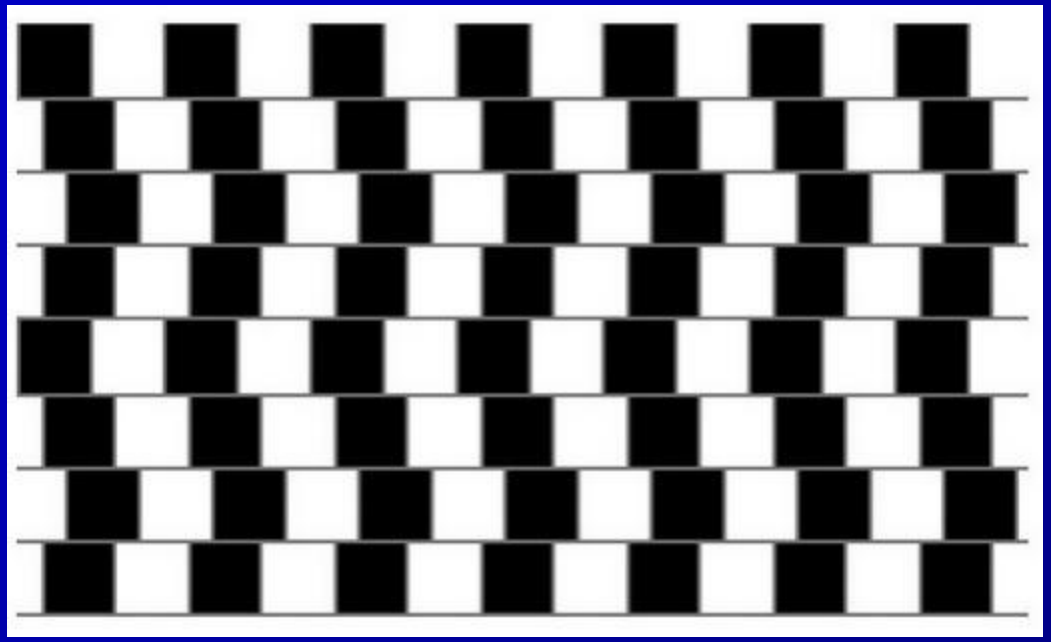
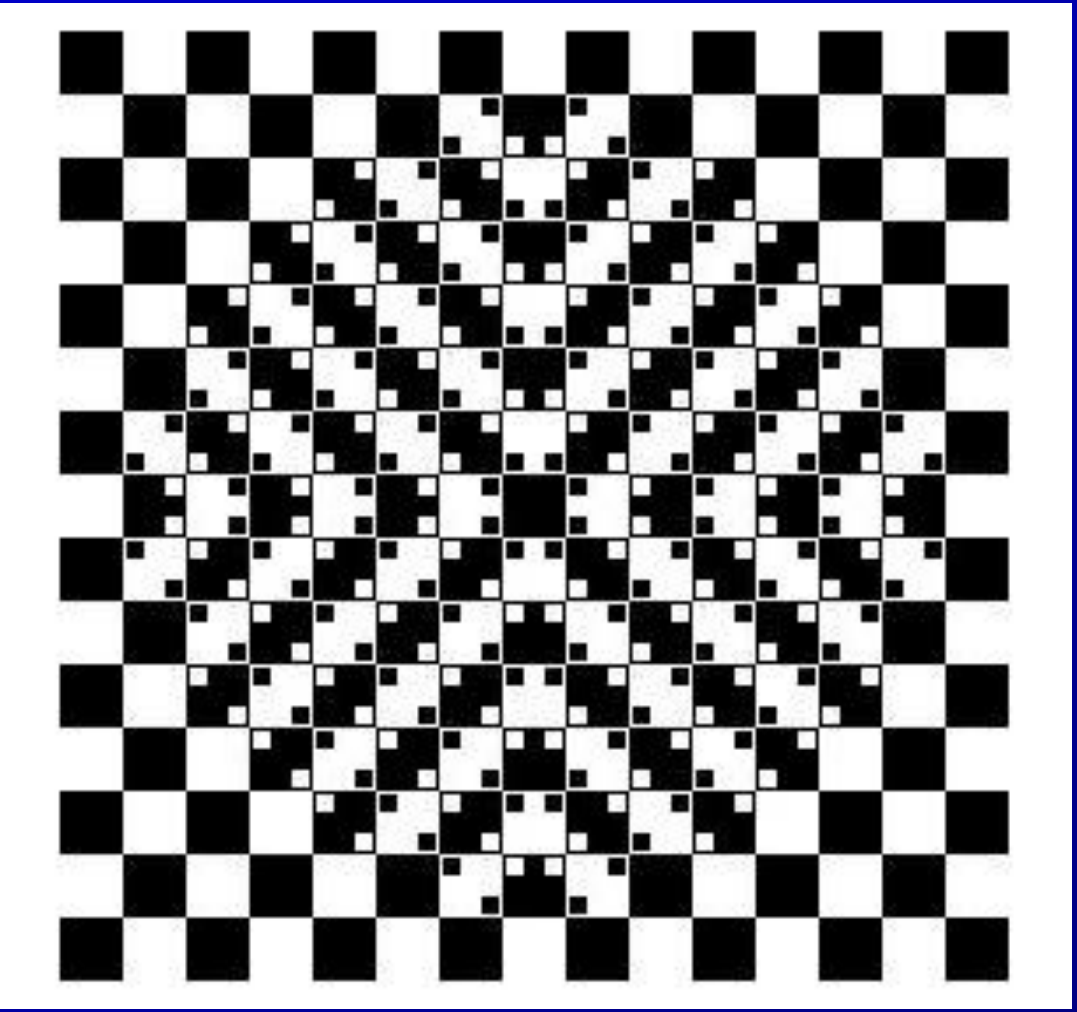
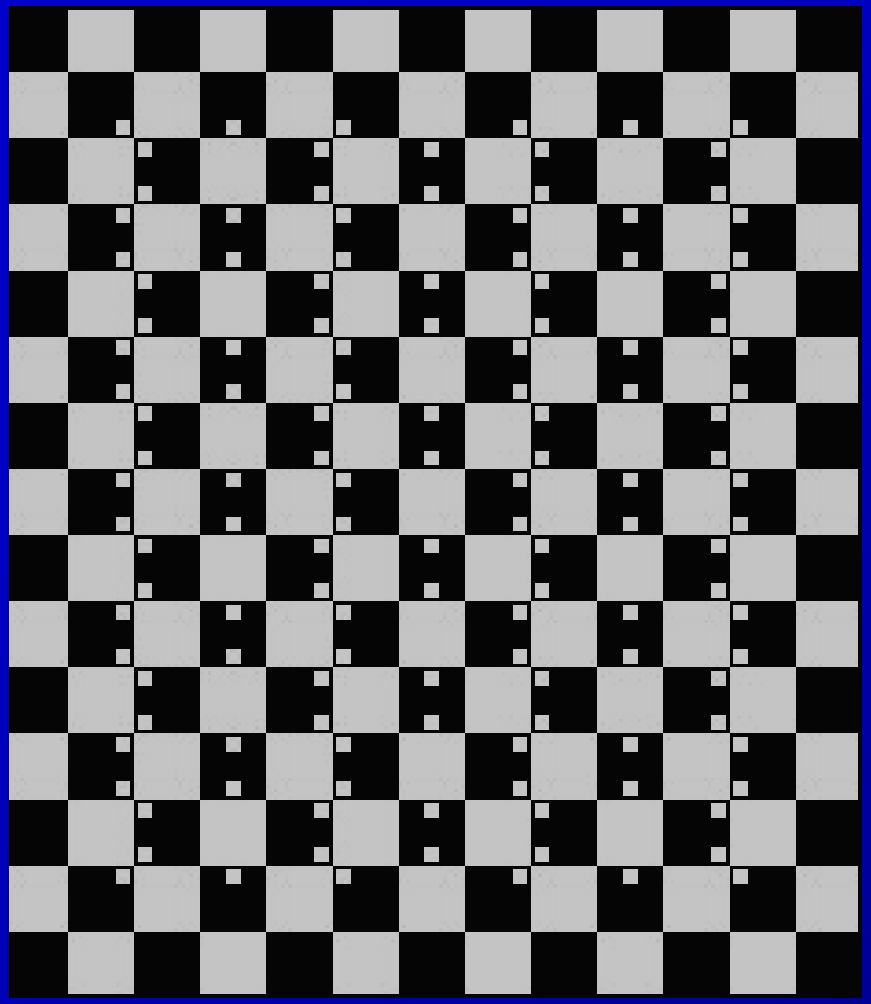
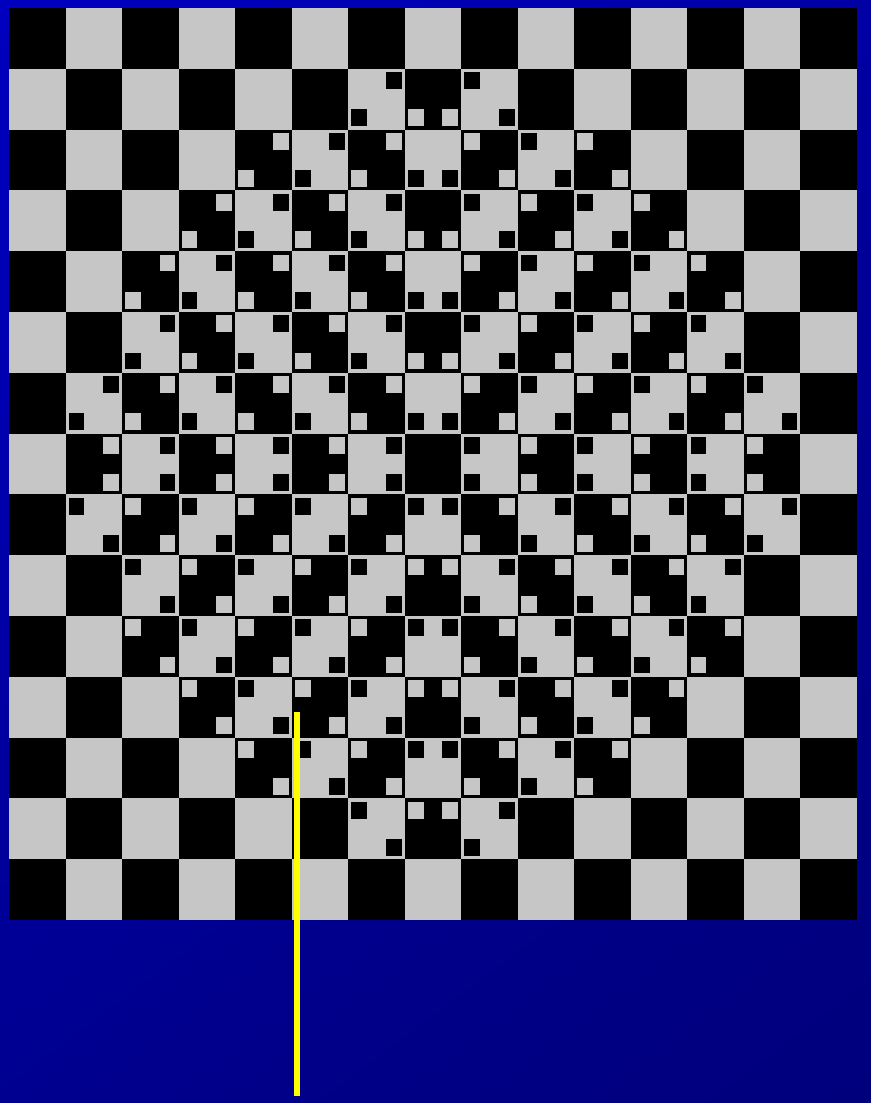
B

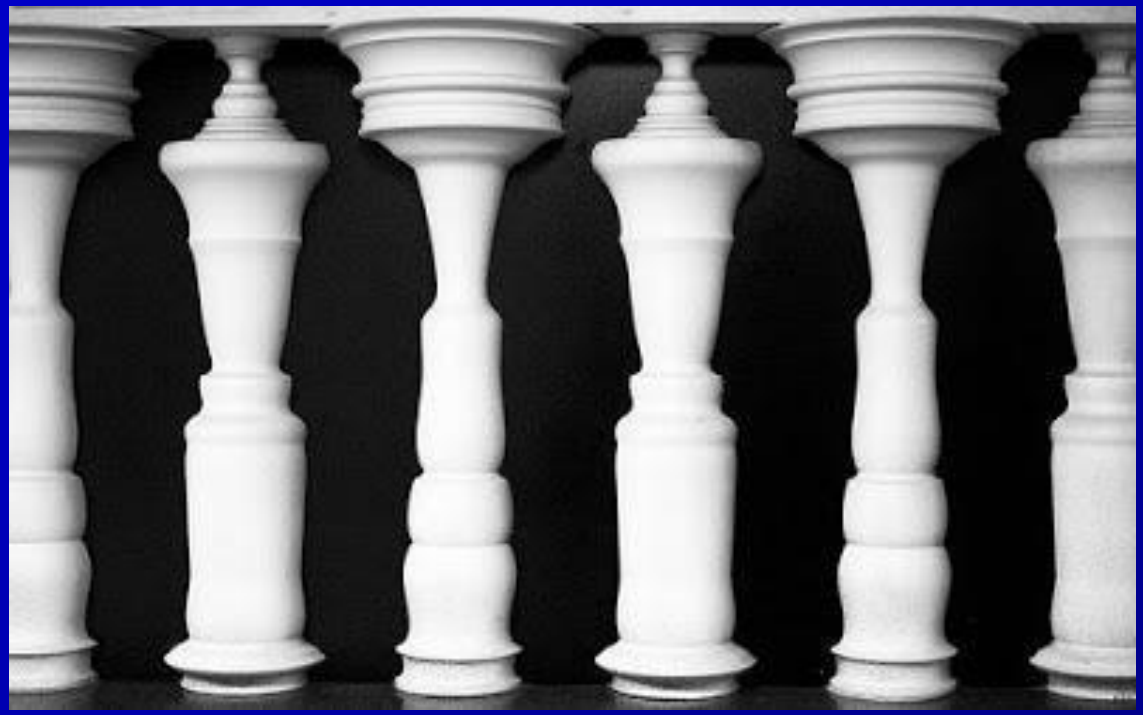


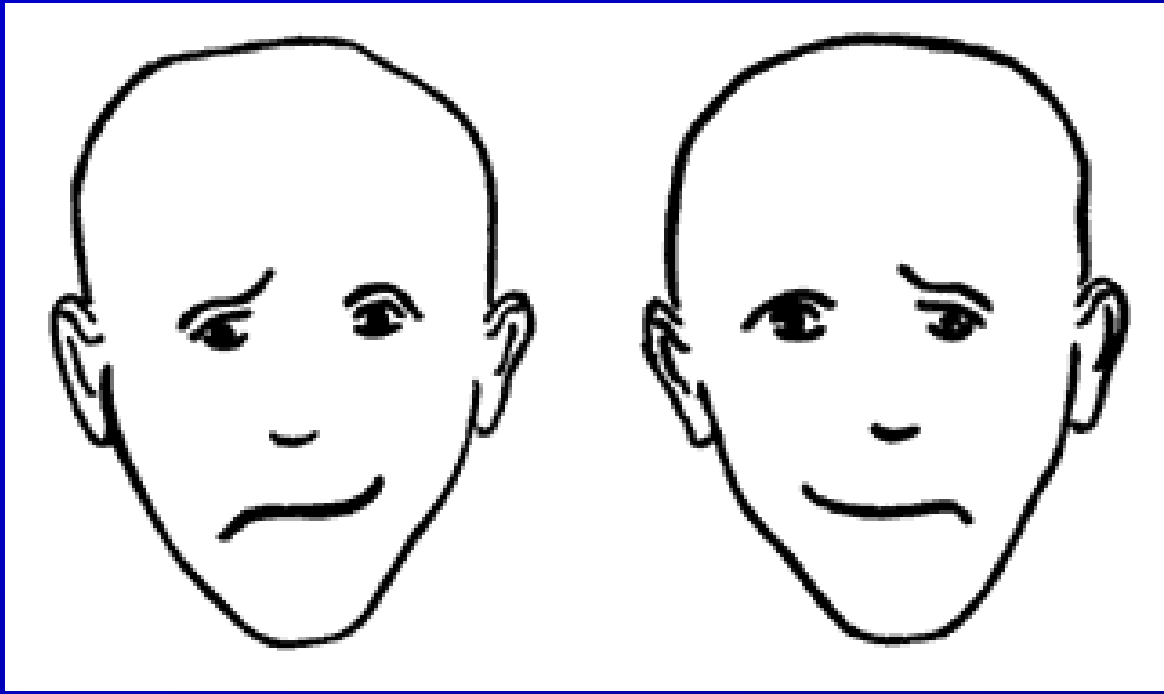










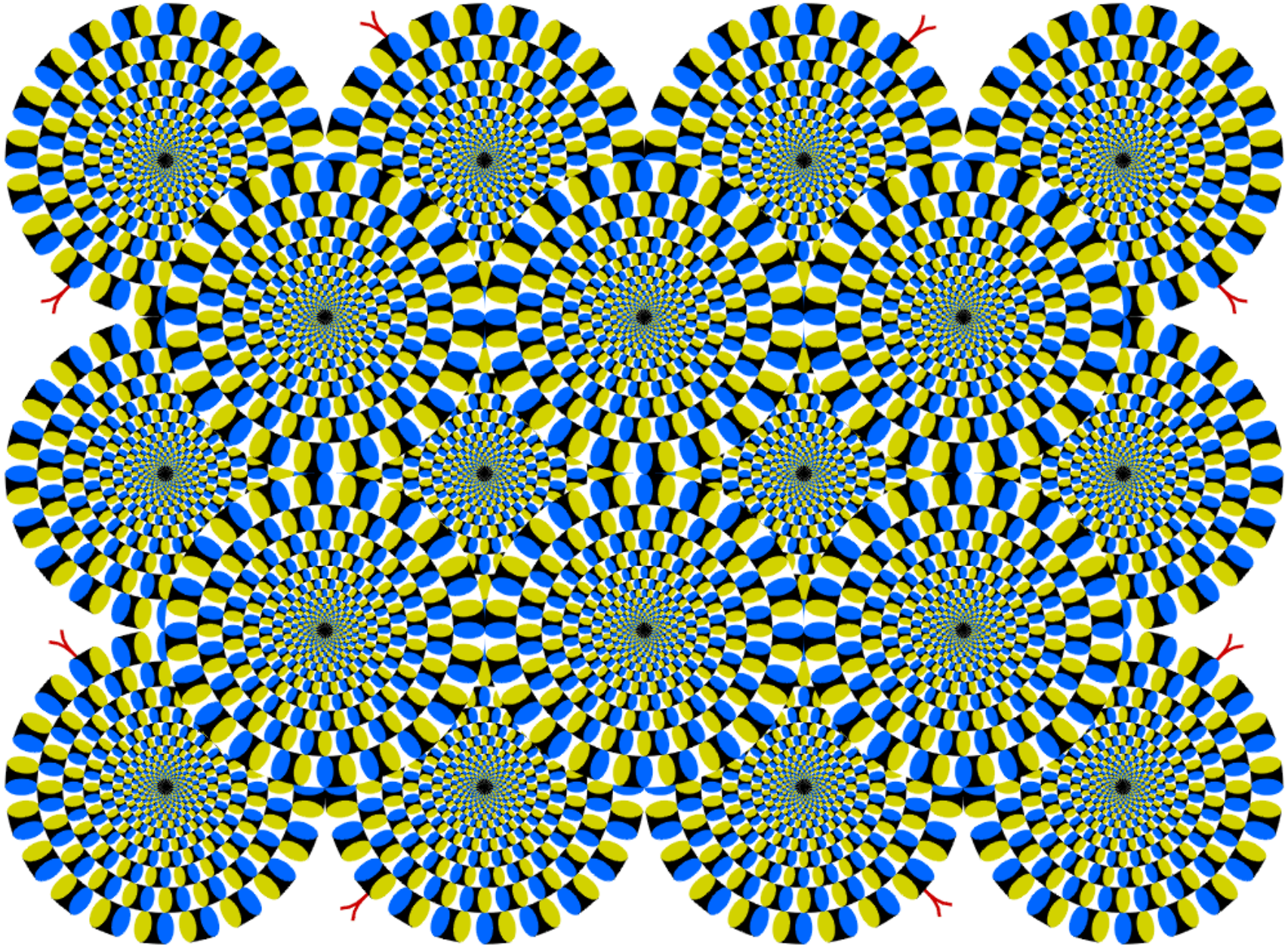


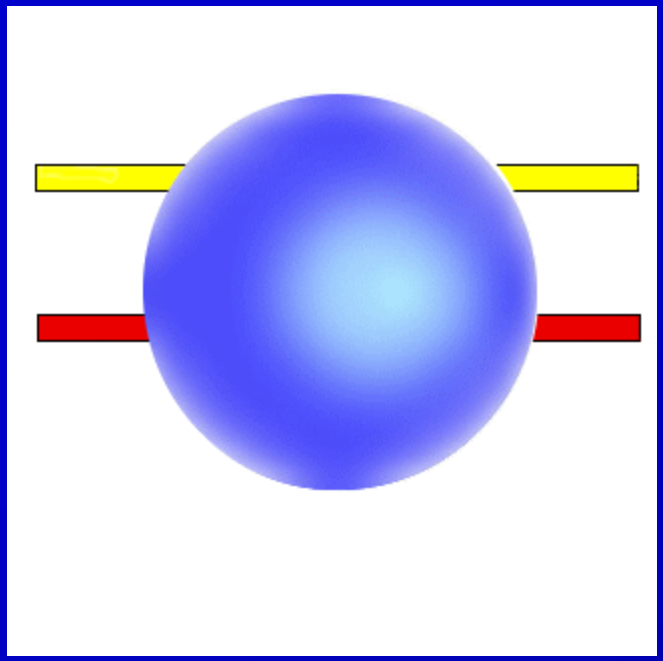
"Age, It's All In Your Head"

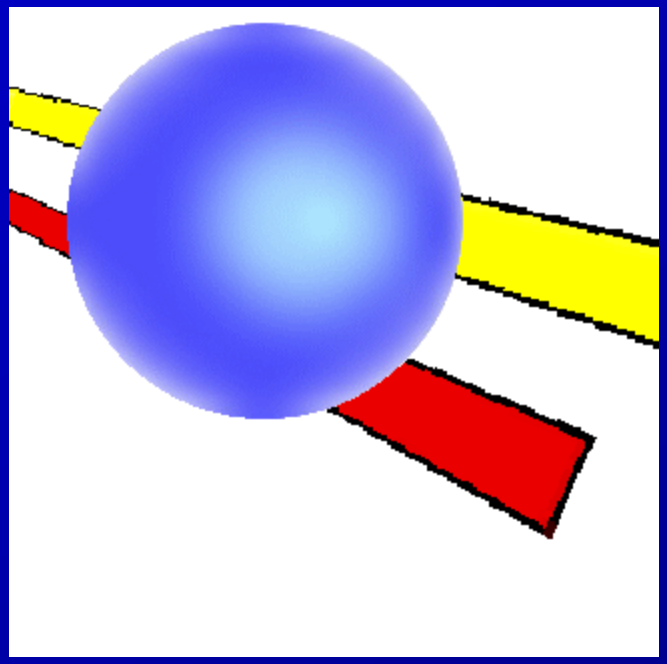
younger perspective | original photo | older perspective

by Victoria Skye

photo of Wayne Conley







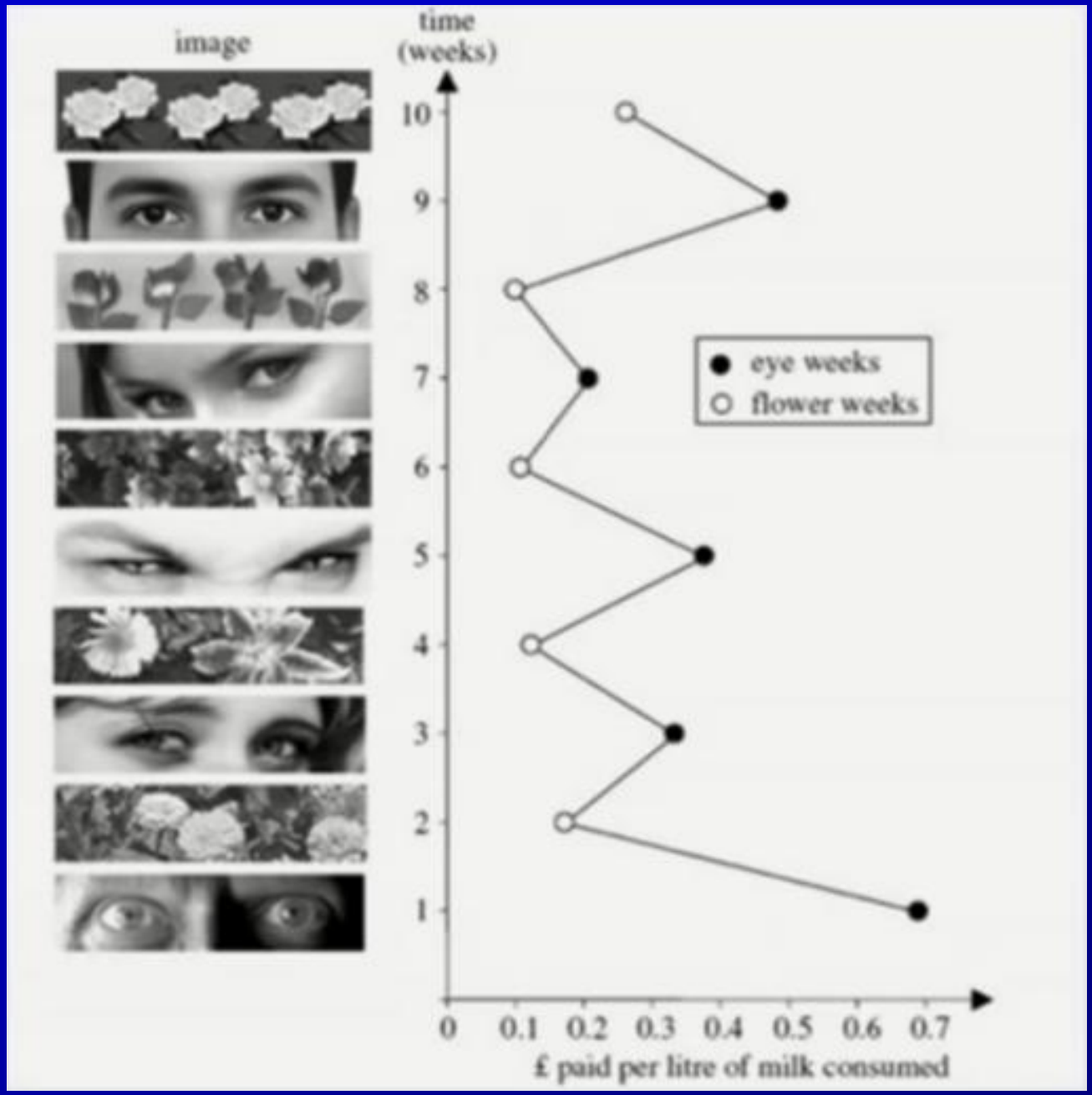
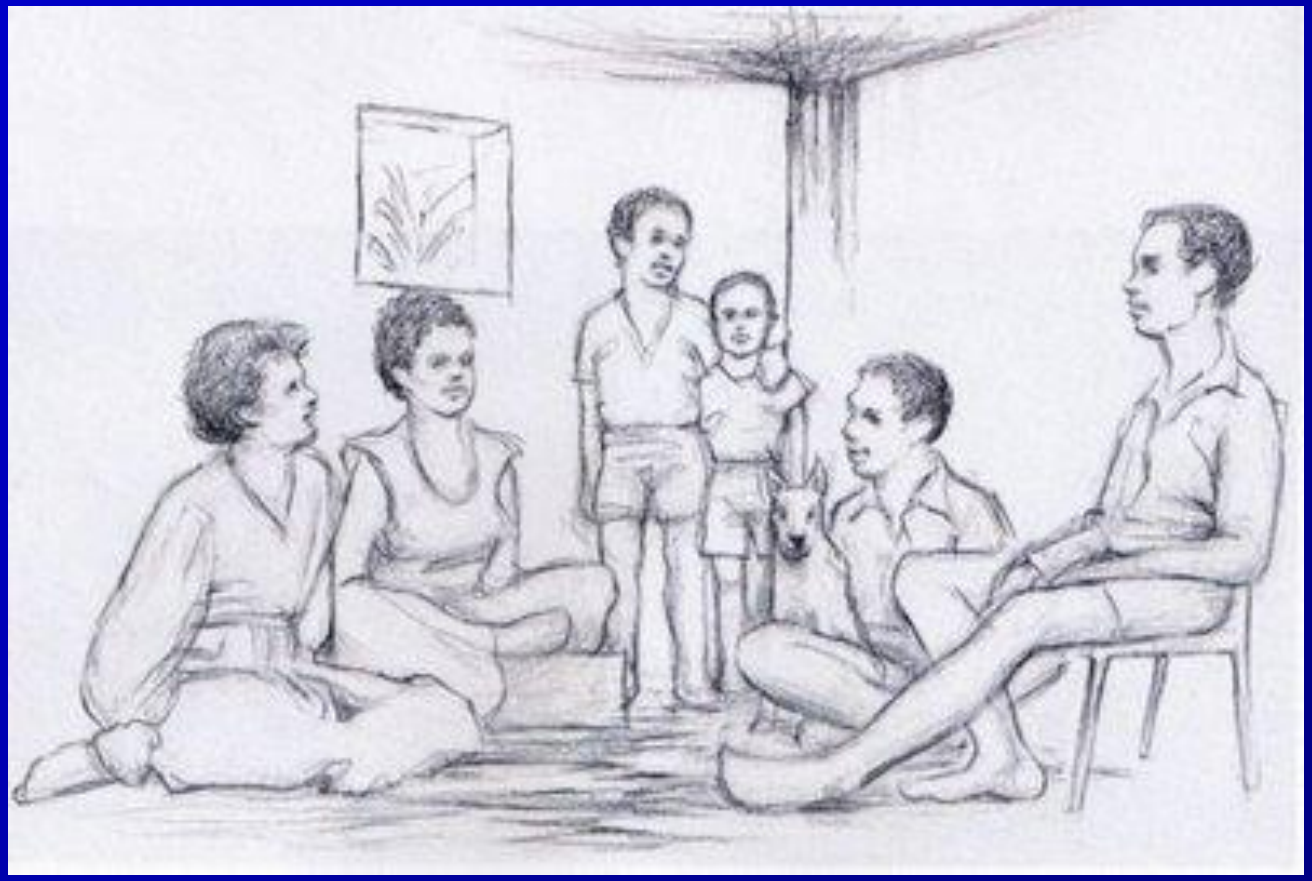


image
time
(weeks)
10
9
8
7
6
5
4
3
2
1
eye weeks
flower weeks
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
£ paid per litre of milk consumed



What Is Cognitive Psychology?

- We *reverse engineer* – we take apart (the brain) to learn how it works.
- Each age uses latest technology to describe how mind works
- Today: Computer Metaphor

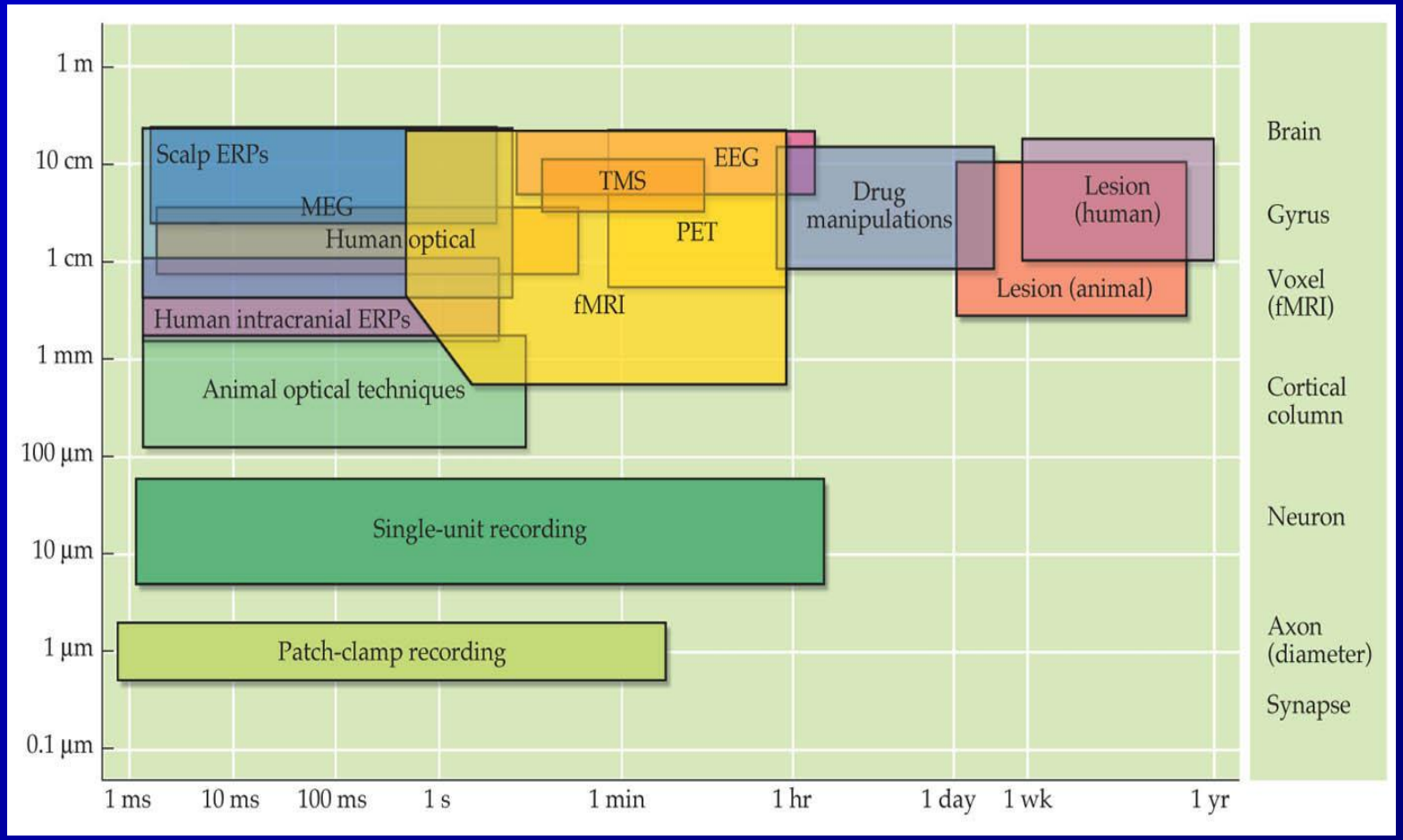
History of Cognitive Psychology

- Looking at history helps see the central issues
- Studies of mind and brain has only been amenable to scientific approach recently (125 years)
- Important persons represent a philosophical approach you may or may not have thought of or agree with
- Each age uses the technology of its day as a metaphor for the mind

Biological Approach

Methodologies

- They differ in
  - *Temporal* resolution, *Spatial* resolution



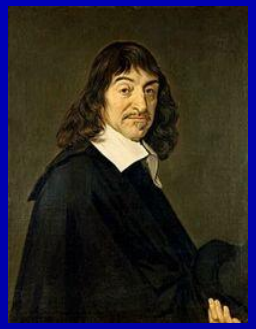
Chatterjee (2005)

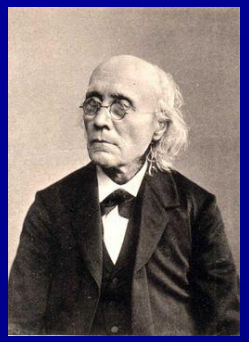
- Investigated prevalence of neuroscientific technique use

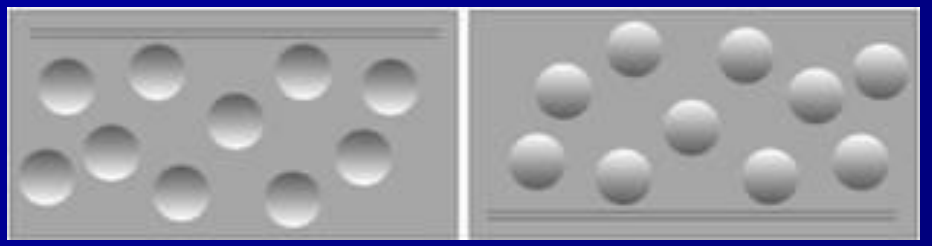
Technique	%
Imaging	35
EEG	25
Brain damage and legions	15
TMS	2
Other	

Biological Approach

- **Rene Descartes –** water pumps
- **Hermann von Helmholtz (1821-1894)**
  - Measured the speed of neural impulses: psychophysicist.
  - Unconscious inferences.
- **Fechner:**
- •Measured Sensation – "How much of a stimulus must there be in order to experience it" (Weber's law)
- •measured connection between the physical magnitude of a stimulus input and the psychological sensation associated output: It is not a one-to-one ratio.

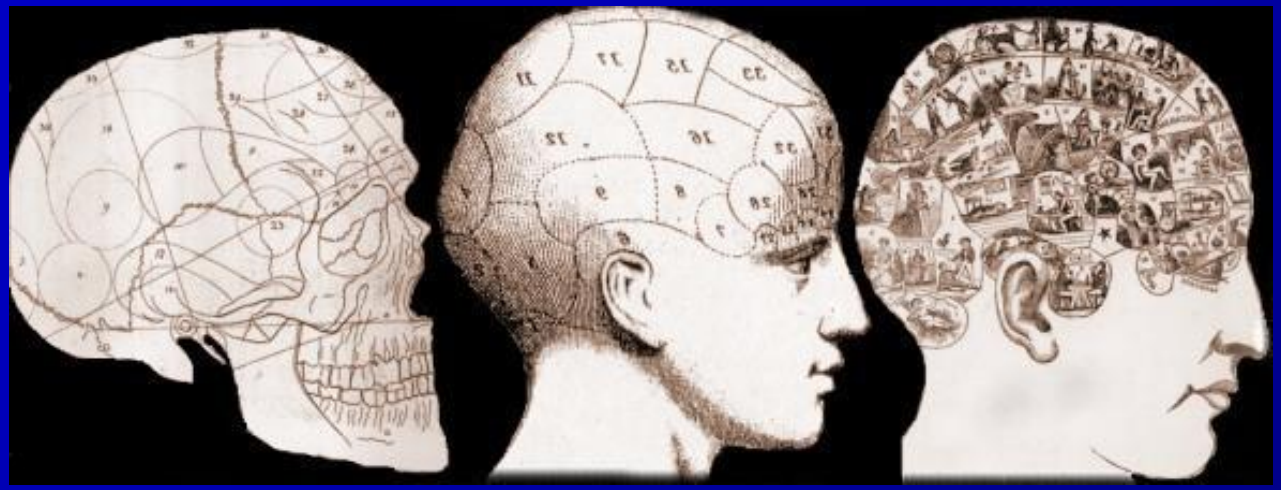




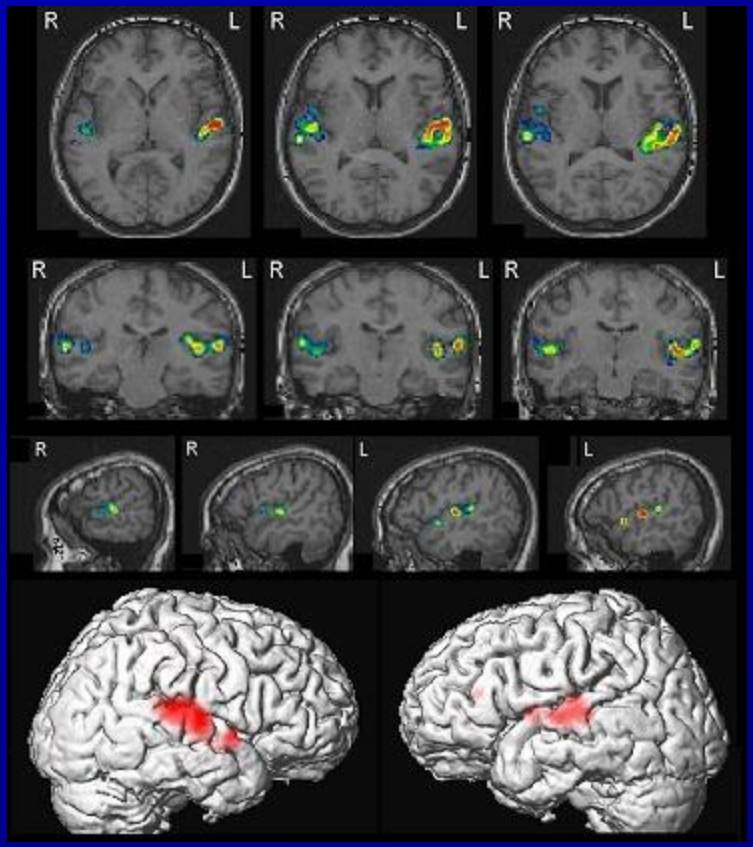


Biological Approach: Case Study

- Phineas Gage & Orbito-Frontal Cortex
  - Impulse control and personality



- Methodologies
  - Biological
    - fMRI (functional Magnetic Resonance Imaging)

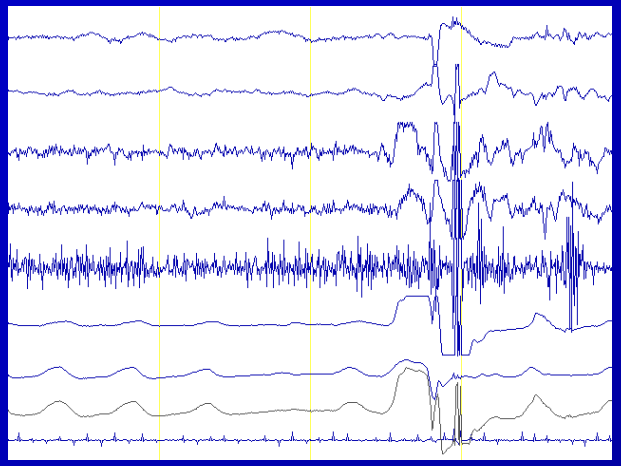


- Single and Double Dissociations
  - Single dissociation
    - Examine patient with one area of brain damage
    - Compare performance on two tasks proposed to differ in the use of one cognitive process
      - Damage to brain area A shows deficits in process X, but not process Y
      - Weak evidence that brain A area is responsible for process X, but not process Y
        - Damage may not be severe enough to show deficits in process Y

- Double dissociation
  - Examine two patients with different areas of brain damage
    - Patient with damage to brain area A shows deficits in process X, but not process Y
    - Patient with damage to brain area B shows deficits in process Y, but not process X
    - Strong, yet inclusive evidence that brain area A is responsible for process X and brain area B is responsible for process Y

Methodologies

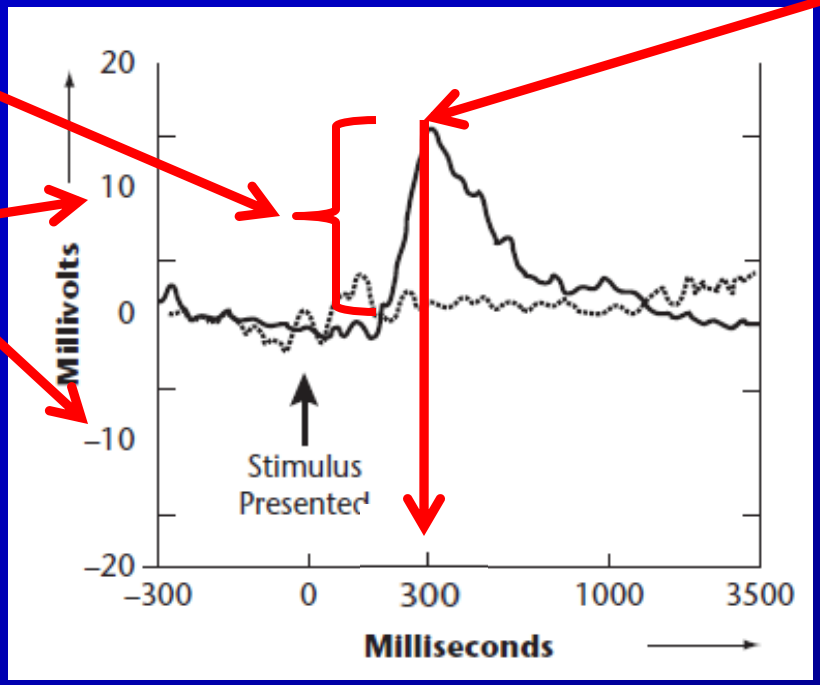
– EEG (electroencephalogram) & ERP's (Event Related Potentials)



– Very good Temporal, very poor spatial

Amplitude of response

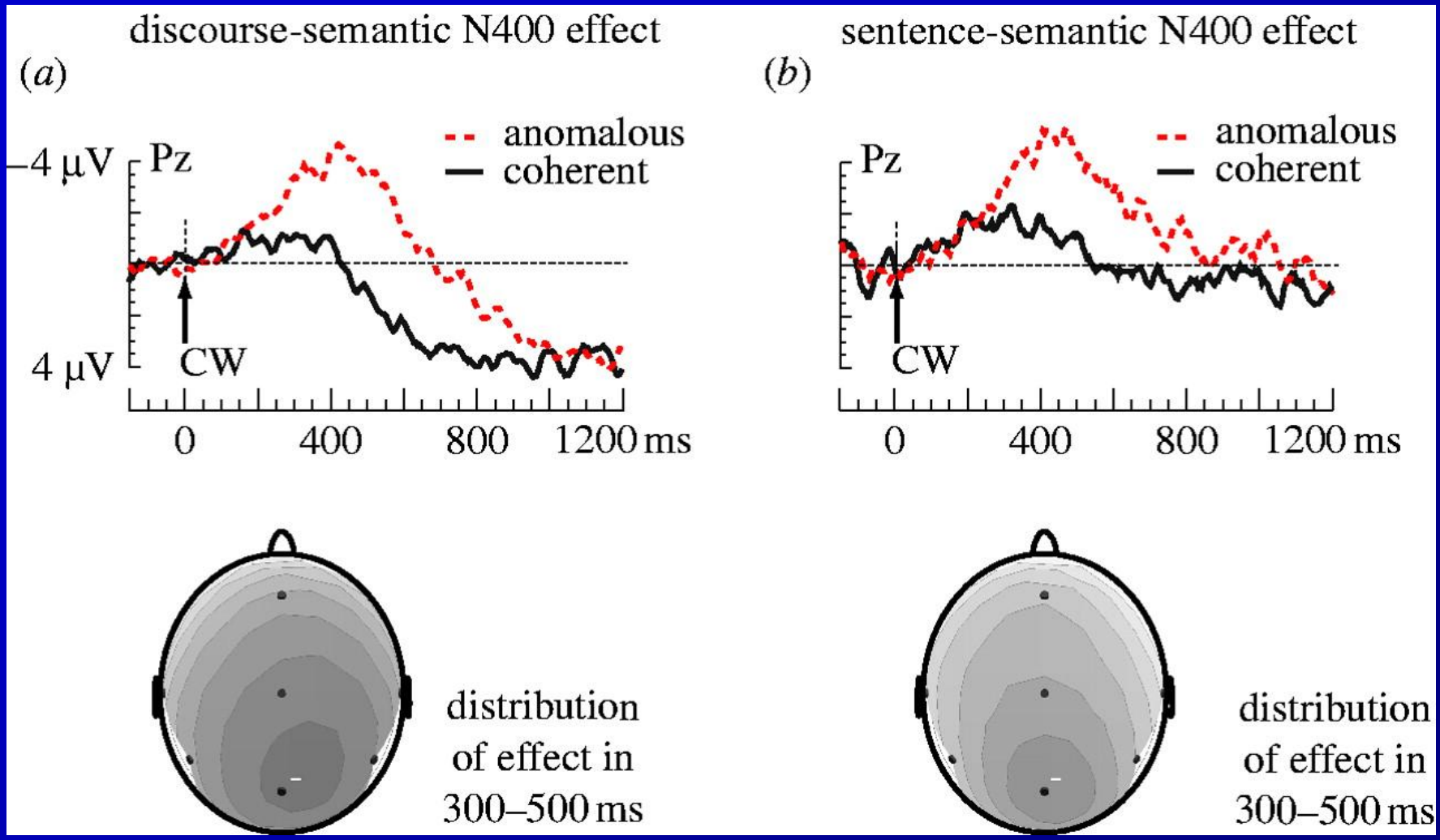
Direction of Response (+ or -)



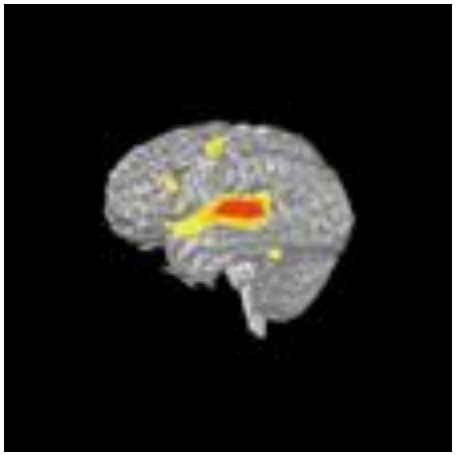
Peak Level of response relative to stimulus presentation

P300

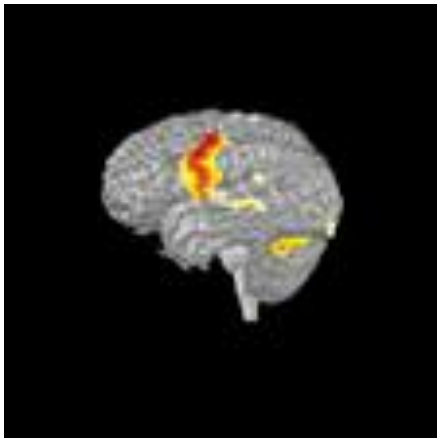
Positive deflection 300 milliseconds after stimulus presentation


discourse-semantic N400 effect
(a)
−4 μV
4 μV
Pz
anomalous
coherent
CW
0
400
800
1200 ms
distribution
of effect in
300–500 ms
sentence-semantic N400 effect
(b)
Pz
anomalous
coherent
CW
0
400
800
1200 ms
distribution
of effect in
300–500 ms

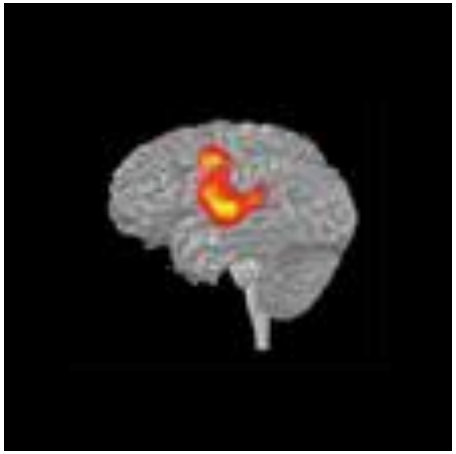
- Methodologies
  - PET (Positron Emission Tomography)



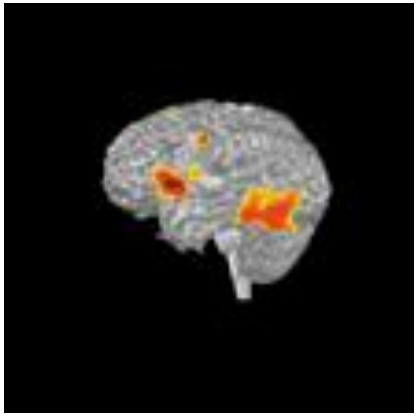
Hearing Words



Seeing Words



Speaking Words



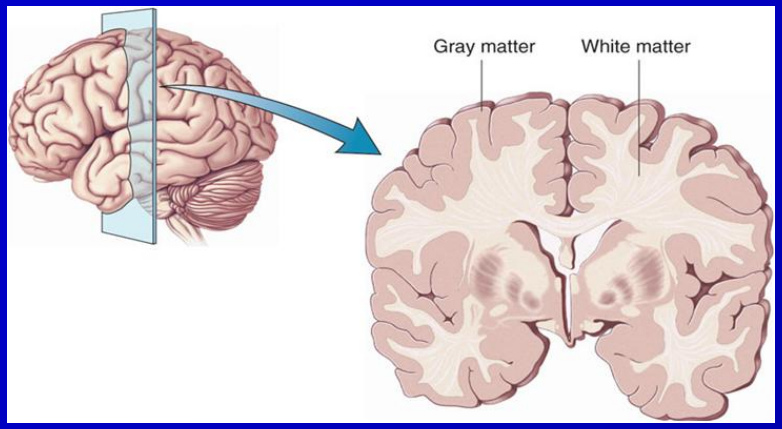
Thinking about Words

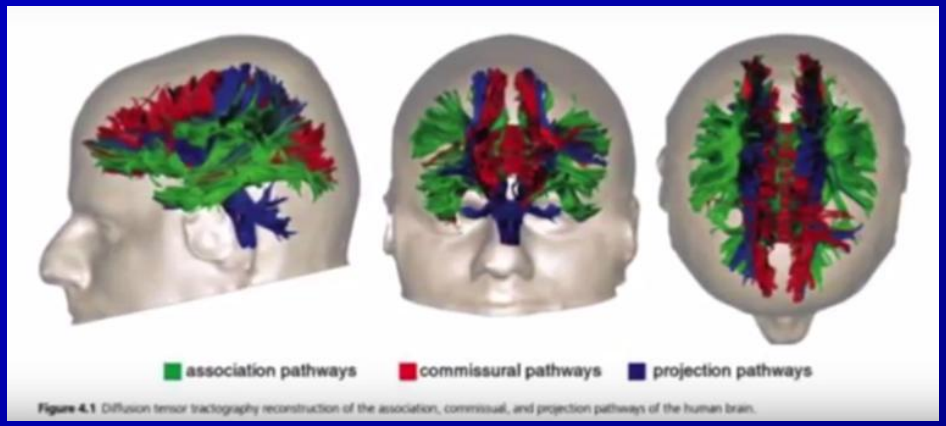
Electrical and magnetic detection

- TMS
  - A magnetic pulse near a brain area will briefly cause random activity
  - Temporarily makes one part of the brain not work

Transcranial Magnetic Stimulation

Diffusion Tensor Imagery fMRI





- Captures the direction of ionic flow in the axons of the cortex (most of the water in the brain located in axons)
- Association pathways (begin and end in same hemisphere, language, emotion, memory, praxis)
- Commissure pathways (b/w hemisphere, movement)
- Projection pathways (vertical connection to the lower levels)

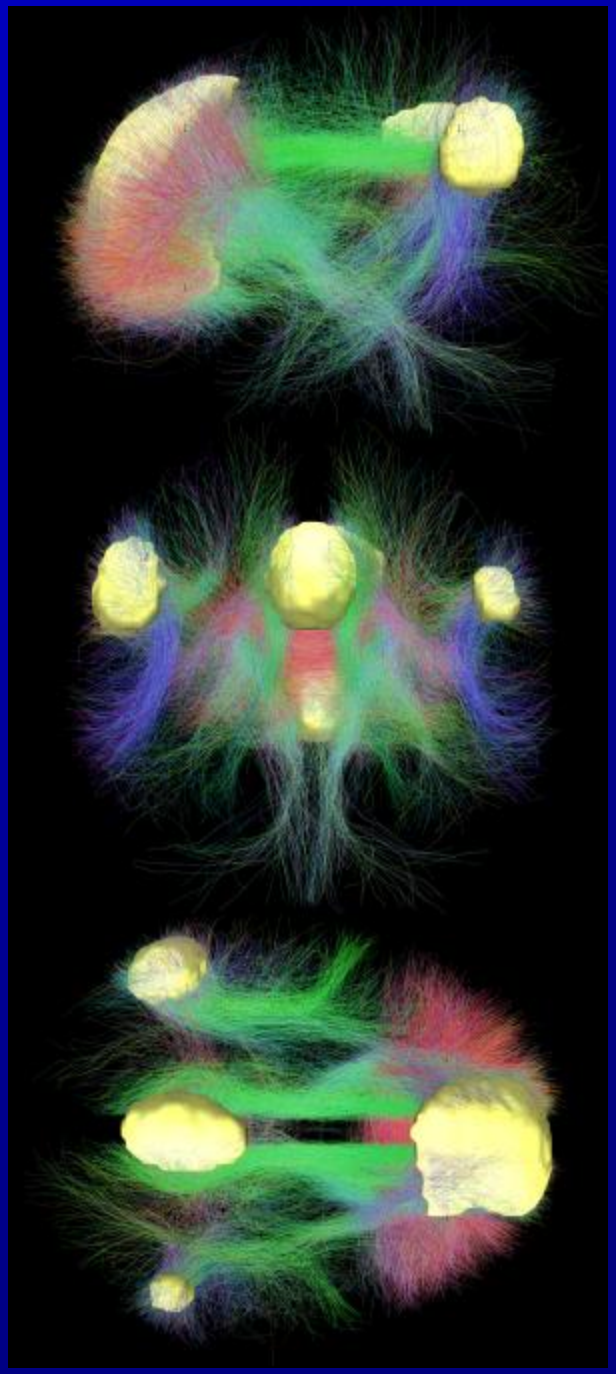
The Default Mode Network

Involved in

Information regarding the self
Autobiographical information
Self-reference
Emotion of one's self

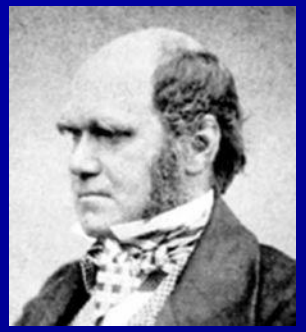
Thinking of Others
Theory of Mind
Emotions of other
Moral reasoning
Social evaluations
Social categories

Past and Future Memories
Remembering the past
Imagining the future
Episodic memory
Story comprehension



Biological Approach: Psychology & Natural Selection

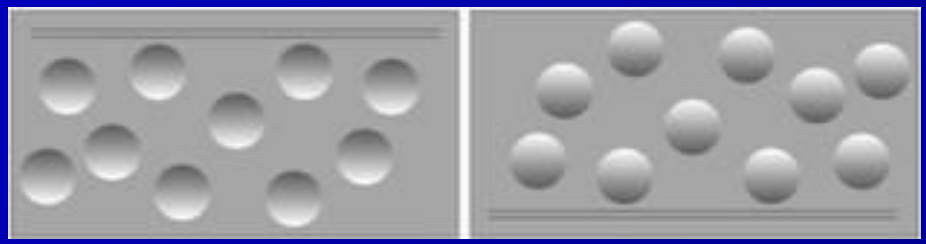
- Darwin—*The Origin of Species* (1859)
  - Individuals possess unique traits
  - Traits are heritable through reproduction
  - Successful traits are retained through natural selection
- James (1842–1910)
  - functional approach
  - All behavior and mental processes fulfill a function, costing energy and confering a benefit to reproductive fitness.



Cognition & Evolution

The brain is an information processing device.

Composed of different neural mechanisms.



Mechanisms specialize in solving specific problems.

Problems from deep inside our evolutionary past.

Successful mechanisms passed on by natural selection.

Most mechanisms operate unconsciously

- problems that seem easy to solve are actually extremely difficult problems that are solved unconsciously by complicated neural mechanisms.

Our behavior is the sum total of these mechanisms at work.

Cognition & Evolution

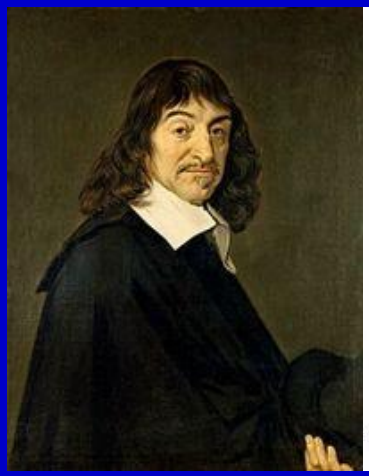
Animals and humans share emotional expressions in common.

Why?

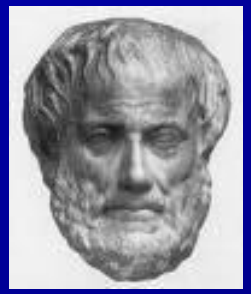
Solve common problems of signaling our intentions to others, which can save energy

Gambler's Fallacy, after a win we expect the likelihood of the next win to increase (Lucky Streaks). Not true for dice, but true for finding plants and insects to eat.

Behavioral Approach



Behavioral Approach: Experiments



Aristotle

Descartes
Rationalism

- Pre-defined Hypothesis
- Dependent vs. independent variables
- Experimental & Control conditions
- Establishing Cause and Effect
- Statistical validation
- (Peer Review…usually a good thing)

History of Psychology

- Titchener (1867–1927) Introspectionists
  - hard introspective labor
  - Elemental qualities of consciousness

- Wundt (1832–1920) —Structrualism, chemistry as a metaphor for consciousness

DEMO: What can reaction time tell us?

- Allows us to make fine distinctions not available via accuracy measures.
  - Example: Jersild's 1927 Task-switching experiments

Let's try this together:

For each pair of white numbers, shout out their sum. For each pair of green numbers, shout out their difference.

7	5
6	3
2	1
8	4
9	0
5	2
4	1
8	6

5	2
6	3
8	4
7	5
8	6
4	1
9	0
2	1

After just a little practice, most people will get every trial correct in this sort of experiment—but they will be quicker to perform the same operation several times in a row than to keep switching operations.

This is referred to as a switch cost, and can be much easier to investigate with response time than with accuracy measures.

Subtractive method

By F.C. Donders

Detection: Say “YES” when you see my hand open.

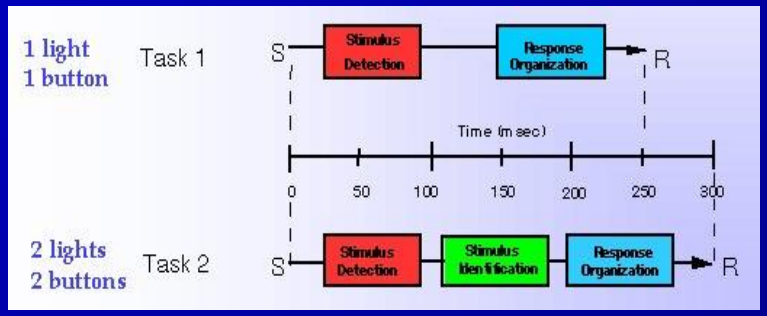
vs

Discrimination: Say “YES” when you see my right hand open, say “GO” when you see my left hand open.

Detection

vs

Discrimination



Detection Task RT = Detection Time + Response Time

Discrimination Task RT = Detection Time + Identification Time + Response Time

Identification time = Discrimination time - Detection Task RT

Additive Method

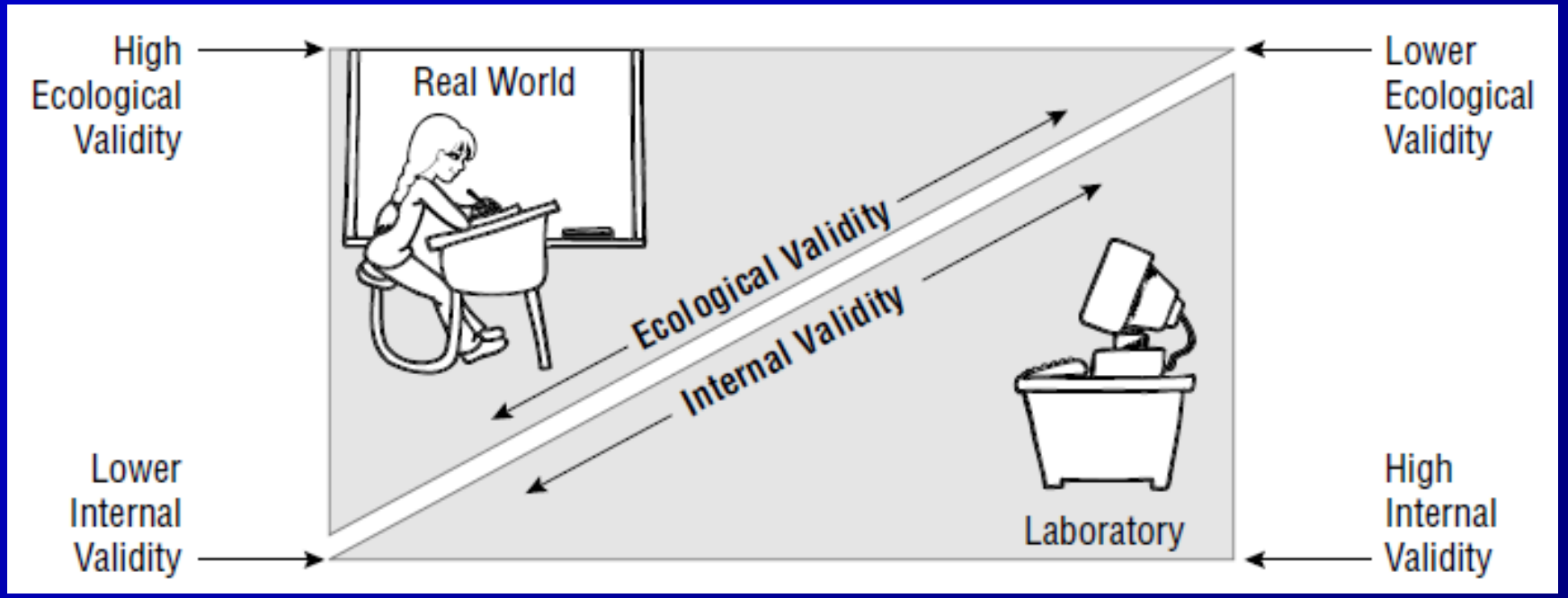
- Allows us to break mental tasks up into functionally independent stages.
  - Example: Sternberg's 1968 additive factors logic

- The (simplified) Additive Factors logic:
  - If the RT effects of two manipulations on a task are additive, those manipulations must affect separate stages of processing. This implies that the task must be decomposable into at least two independent stages of mental processing.

- Example: I ask you to read a sentence aloud.
  - It takes 10 seconds in Arial font written normally.
  - It takes 20 seconds in Old English font written normally. (10 sec cost)
  - It takes 30 seconds whenIleaveoutallthespaces. (20 sec cost)
  - How long does it take to read the sentence in OldEnglishwithoutanyspaces?

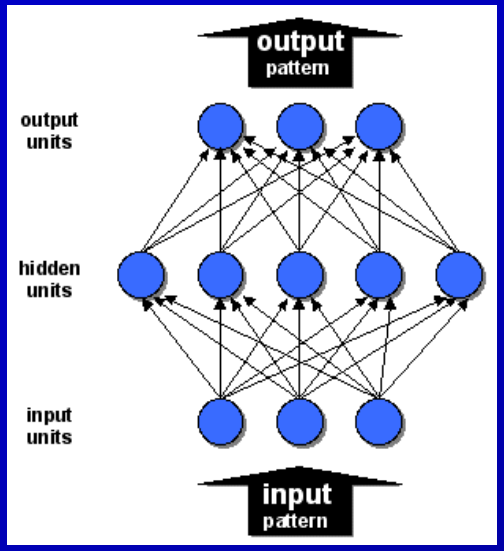
- If font and the presence of spaces affect separate processing stages, the effect of the two manipulations should be additive and the sentence should take 40 seconds to read (a 10 second font cost plus a 20 second no-spaces cost plus 10 seconds normal reading time).

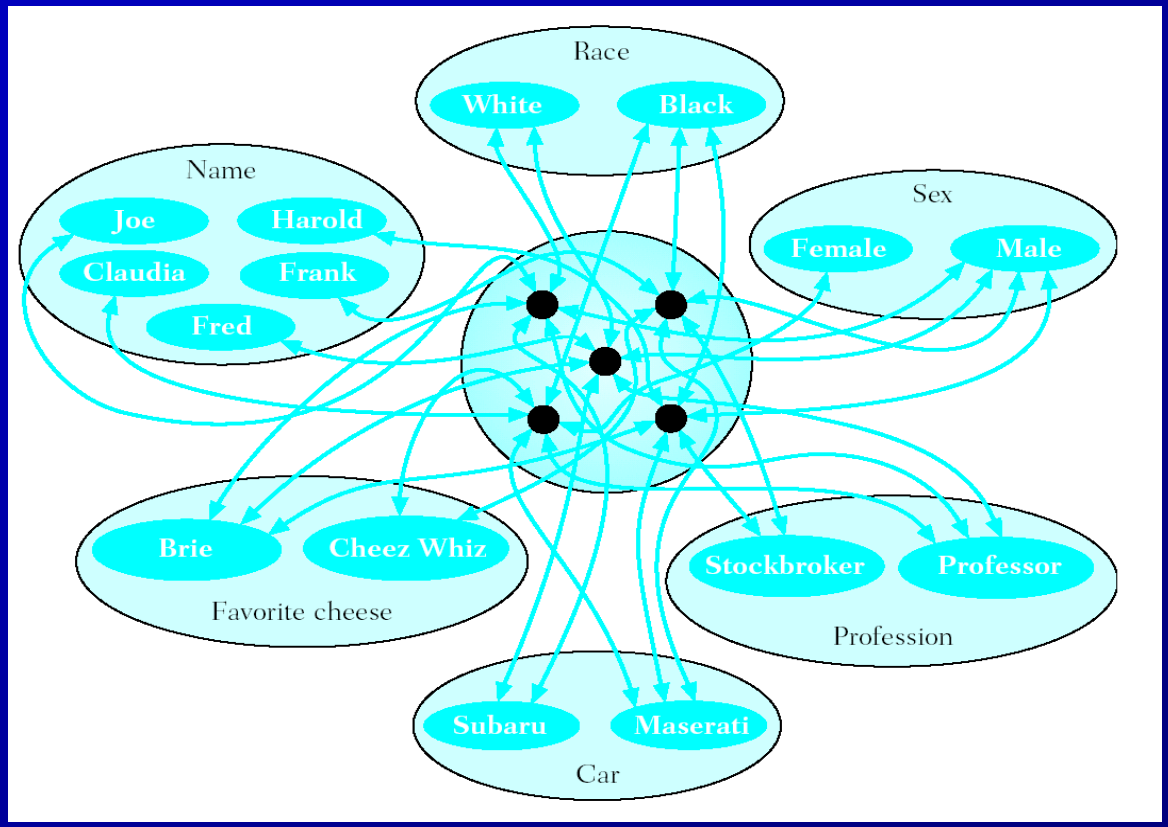
- Difference between Ebbinghaus' and Bartlett's research
  - Ebbinghaus: high in internal validity (experimental control)
  - Bartlett: high in ecological validity (naturalness)



Computational Method

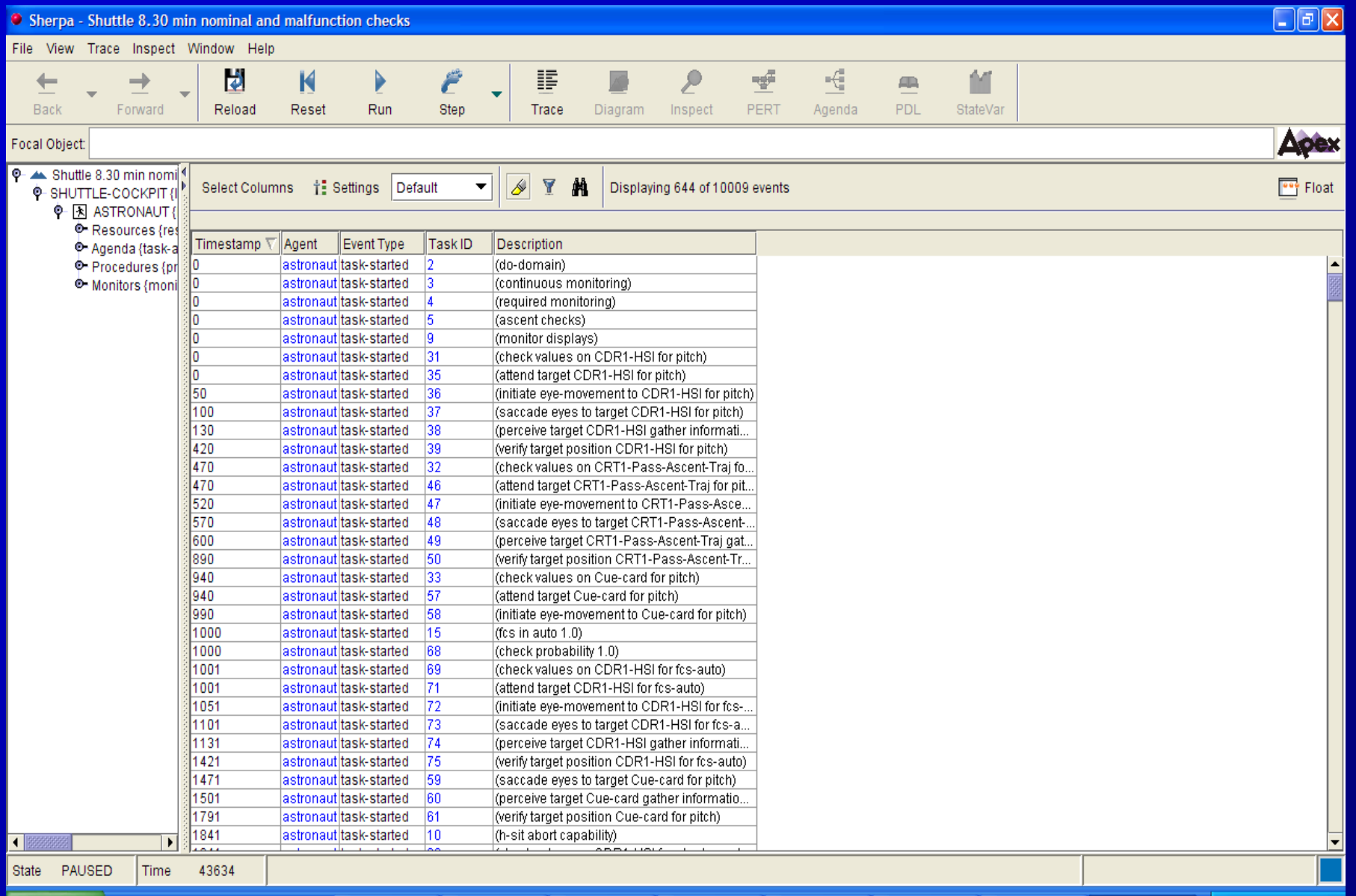
Computational Approach





http://www.youtube.com/watch?v=BWiZG9DgpX0
http://www.youtube.com/watch?v=eDYOH9q2QdA

Computational Approach



The End

- Back-up slides

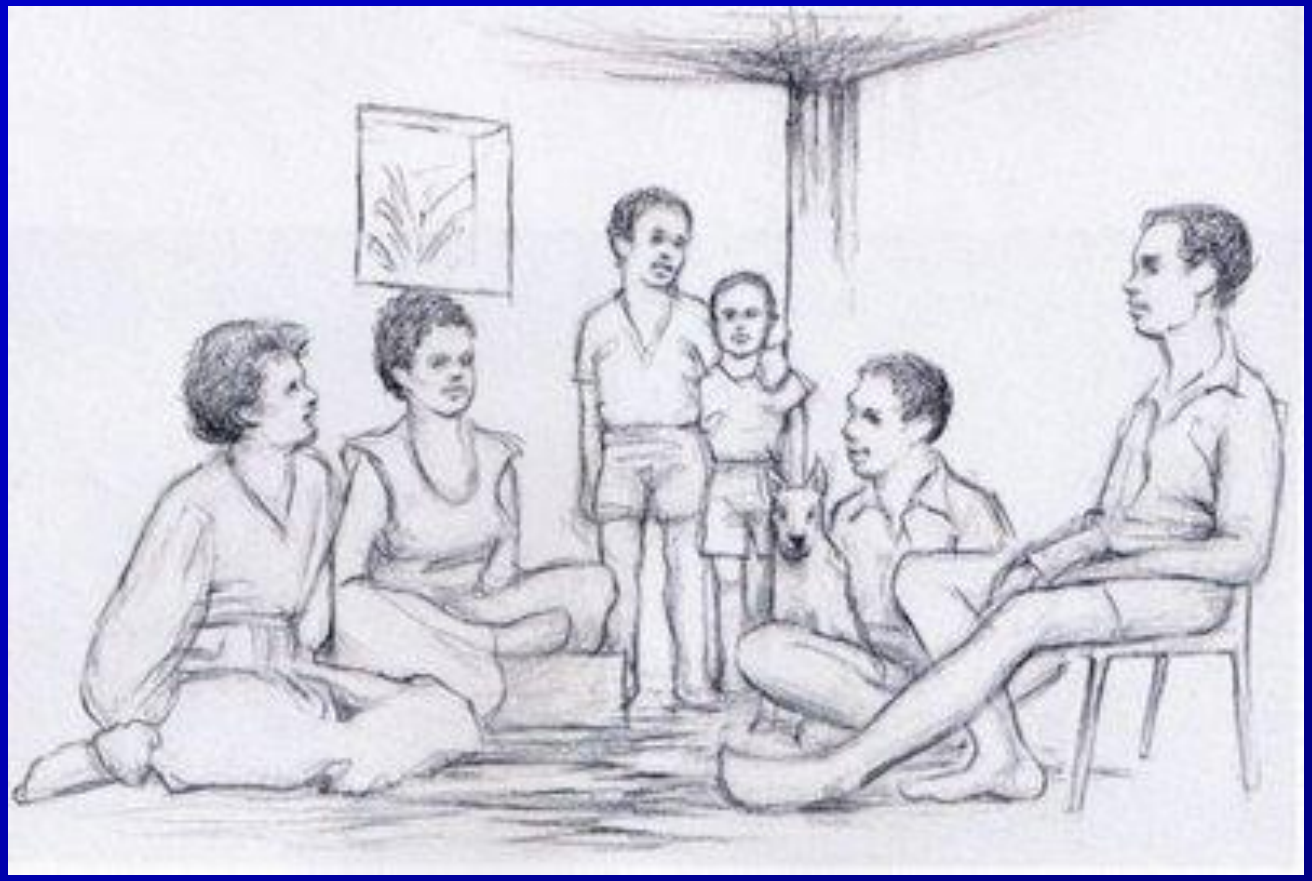
Reverse Engineering & Evolutionary Theory in Action

Profit Conducted a meta-analyses of morning sickness studies:

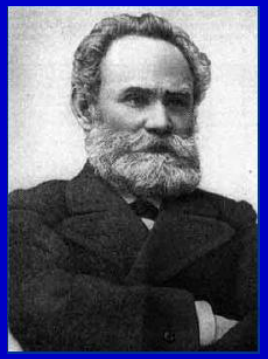
documented that (1) plant toxins in dosages that adults tolerate can cause birth defects and induce abortion when ingested by pregnant women; (2) pregnancy sickness begins at the point when the embryo's organ systems are being laid down and the embryo is most vulnerable to teratogens (birth defect–inducing chemicals) but is growing slowly and has only a modest need for nutrients; (3) pregnancy sickness wanes at the stage when the embryo's organ systems are nearly complete and its biggest need is for nutrients to allow it to grow; (4) women with pregnancy sickness selectively avoid bitter, pungent, highly flavored, and novel foods, which are in fact the ones most likely to contain toxins;

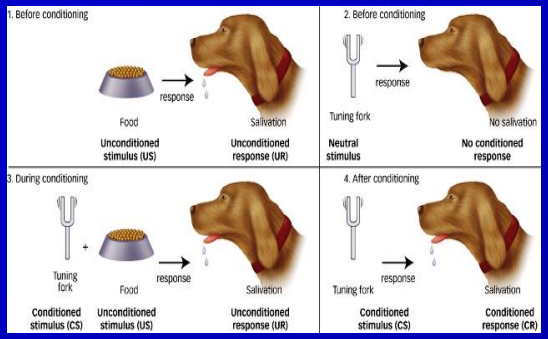
Reverse Engineering: Evolutionary Theory in Action

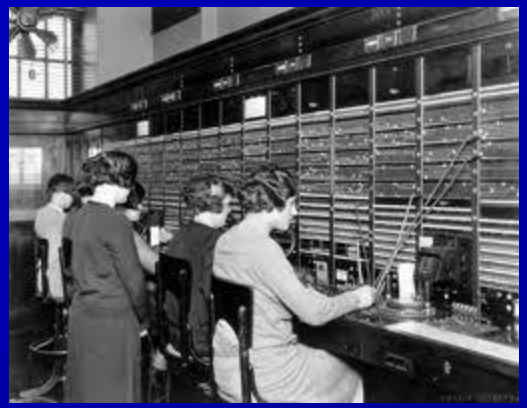
women's sense of smell becomes hypersensitive during the window of pregnancy sickness and less sensitive than usual thereafter; (6) foraging peoples (including, presumably, our ancestors) are at even higher risk of ingesting plant toxins, because they eat wild plants rather than domesticated crops bred for palatability; (7) pregnancy sickness is universal across human cultures; (8) women with more severe pregnancy sickness are less likely to miscarry; (9) women with more severe pregnancy sickness are less likely to bear babies with birth defects. The fit between how a baby-making system in a natural ecosystem ought to work and how the feelings of modern women do work is impressive, and gives a measure of confidence that Profet's hypothesis is correct.



Cognition & Telephone Switchboards: Associationism



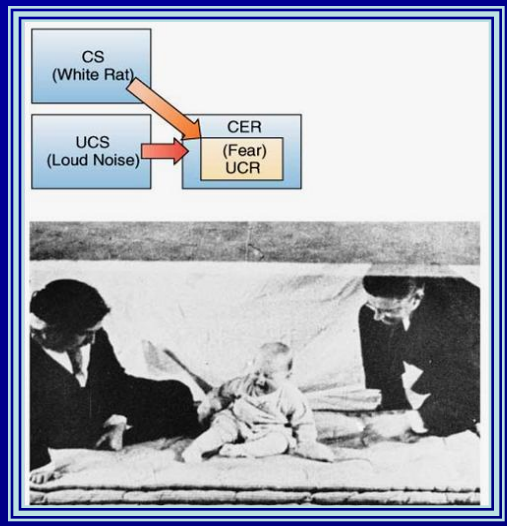




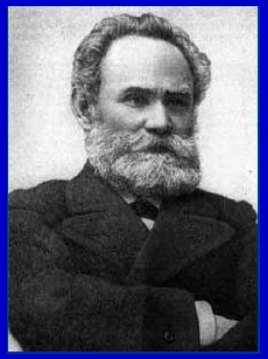
- Pavlov

Watson

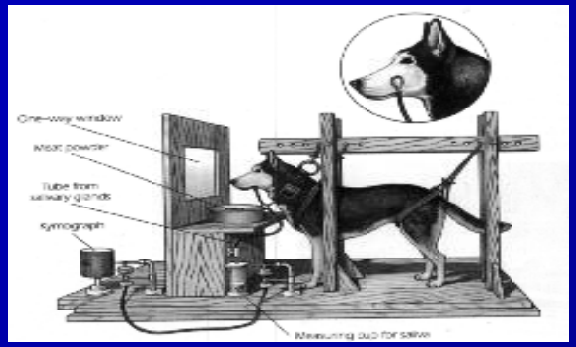
"Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors."



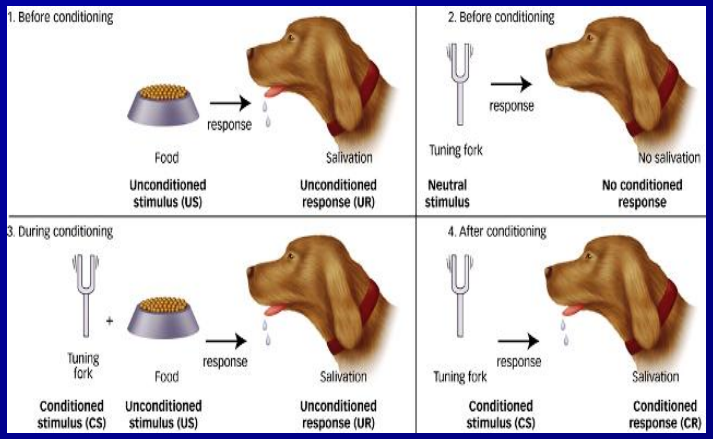
Psychology & Behaviorsims



- Pavlov



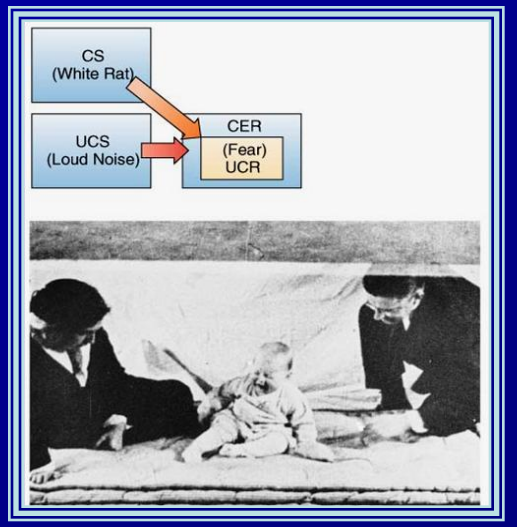
- Classical conditioning
  - Unconditioned stimulus (US)
  - Unconditioned response (UR)
  - Conditioned stimulus (CS)
  - Conditioned response (CR)



Psychology & Behaviorism

Watson

- Watson's goals:
  - Complex reactions can be conditioned using Pavlovian techniques
  - Emotional responses (such as fear) are learned and not result of unconscious processes

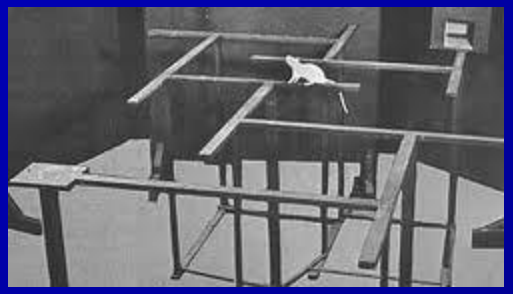


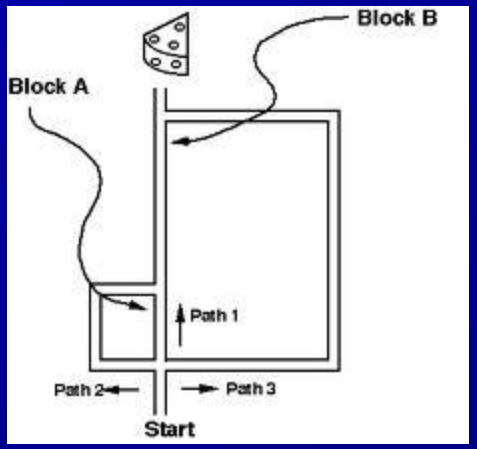
> "Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors."

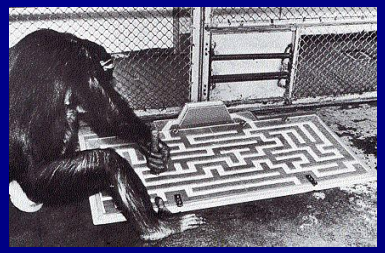
Even Animals Have a Mental Life

Tolman

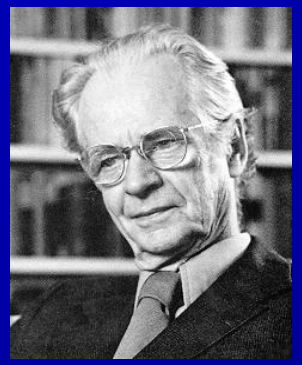
1. S-R is molecular, w/o meaning; behavior includes meaning
2. Behavior is not simple cause and effect (programs) but is purposeful (meta-programs)
3. Watson does not include 'mentalistic' processes – even rats develop **cognitive maps,** exhibit **latent learning** (without reward / punishment / performance) and **expectancies**







Psychology & Behaviorism



B.F. Skinner

Consequences of behavior
Reinforcement & Punishment

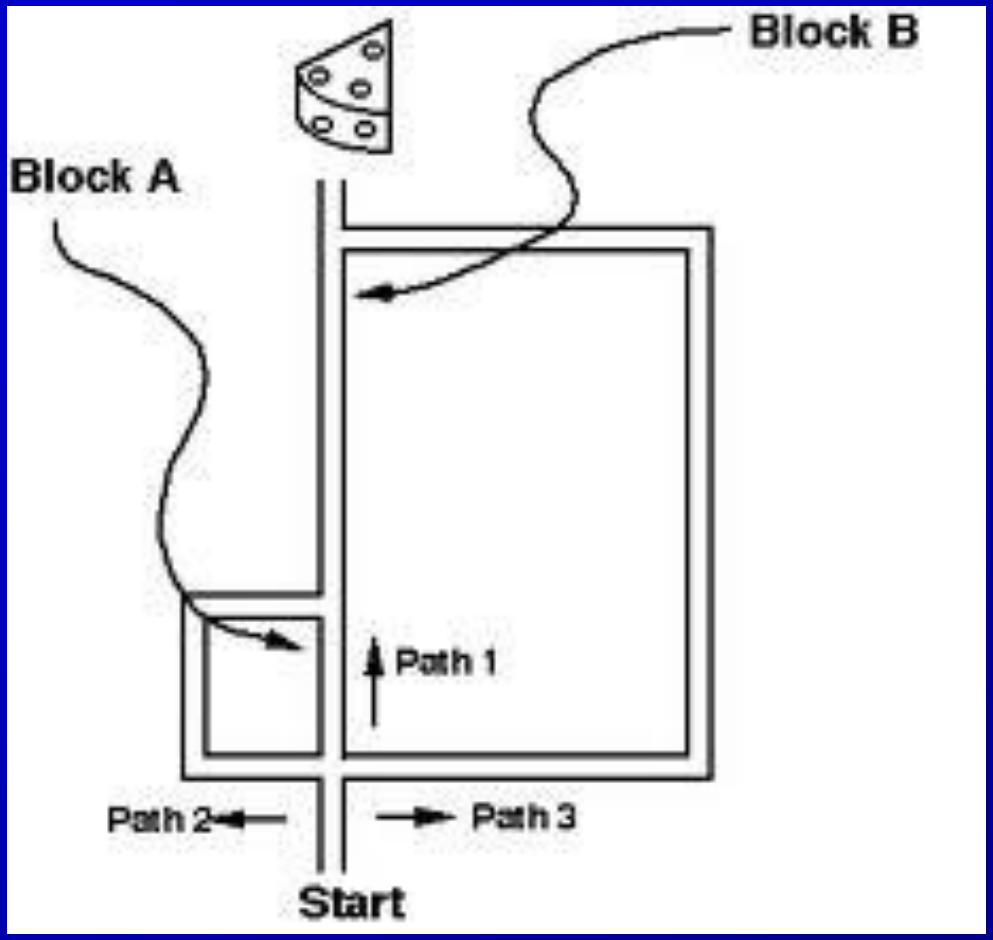
	Reinforce: Increases Behavior	Punish: Decreases Behavior
Present Stimulus: (+)	Positive Reinforcement (give money)	Positive Punishment (give chores)
Remove Stimulus (-)	Negative Reinforcement (take away chores)	Negative Punishment (take away car, take away money)

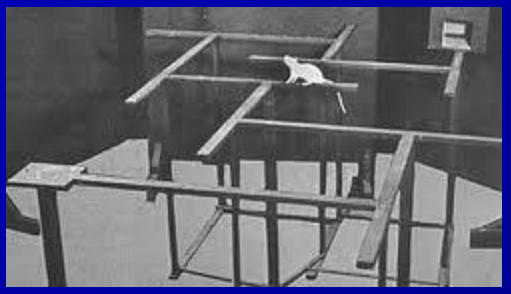
Examples of shaping: animal trainers use the method of Successive Approximations

i.e., reward behaviors that increasingly resemble desired behavior. Works to train astronaut chimps to fly in space and pigeons to guide war missiles.

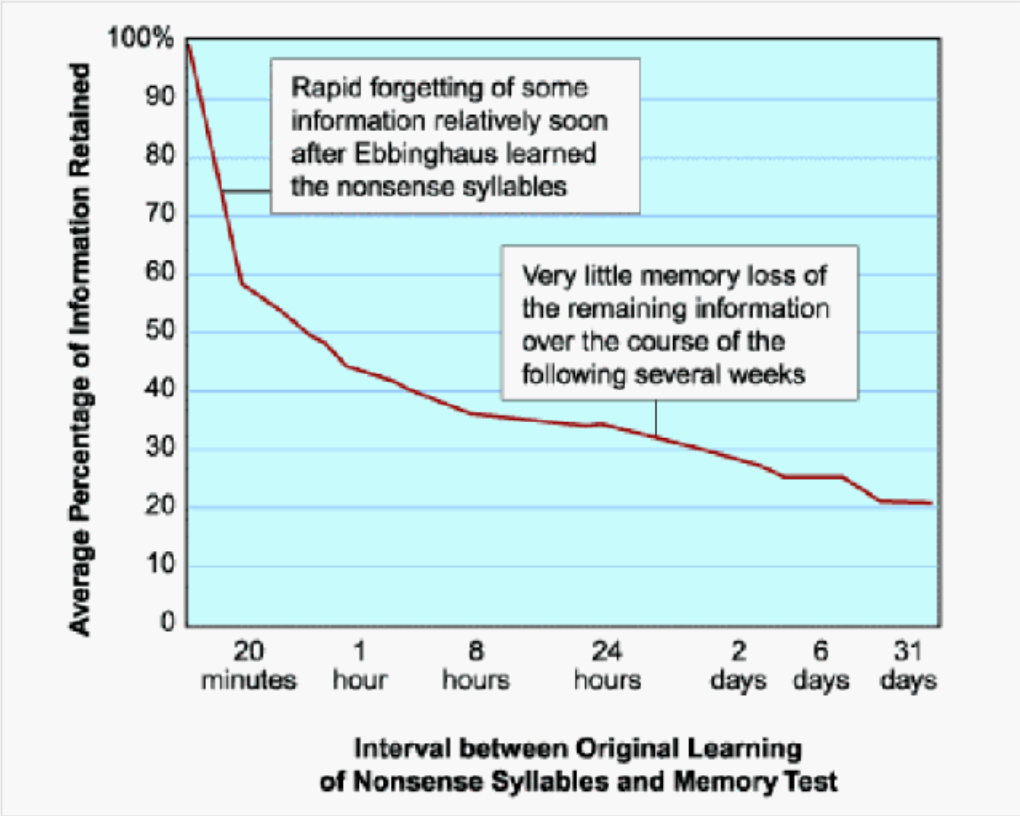
Lab Rat Experiments

Tolman





Ebbinghaus's Forgetting Curve



In Class Exercise

Watch Two Videos and Call me In The Morning

Clever Crows:

http://www.youtube.com/watch?v=BGPGknpq3e0

Artistic Elephants:

http://www.youtube.com/watch?v=He7Ge7Sogrk

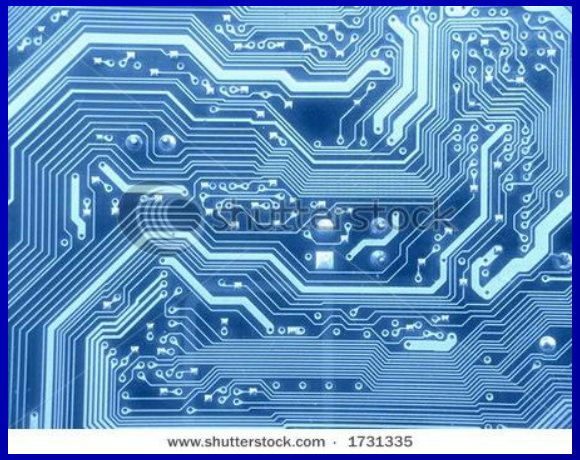
Break out into groups of 3-4, and discuss:

- Use each of these perspectives (bio, evolutionary, associationism, structuralist) to discuss the behavior of the animals.
- How many different skills, and what are the steps involved in one skill?
- What abilities can they learn and what are their innate skills?
- These animals have evolved the skills you saw. How are these skills adaptive?

Psychology & Cognition: Mental Life Exists

Behaviorism fails to explain…

- **How language is acquired with such "poverty of stimulus"**
- **The creative use of language**
- **The comprehension of novel sentences**
- **The speed with which language is acquired**
- **How the stages of language acquisition are so consistent**



Chomsky

Cognitive Psychology To Behaviorism: “This Should Not Be Possible”

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
And the mome raths outgrabe.
"Beware the Jabberwock, my son!
The jaws that bite, the claws that catch!
Beware the Jubjub bird, and shun
The frumious Bandersnatch!"

Lewis Carrol

Cognition & Computers: Homo Informaticus

Chomsky

Behaviorism fails to explain…

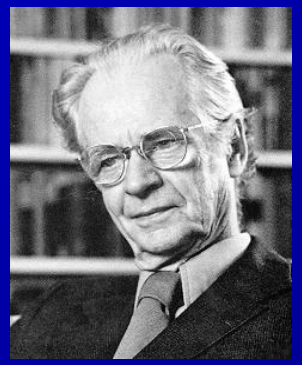
- **How language is acquired with such "poverty of stimulus"**
- **The creative use of language**
- **The comprehension of novel sentences**
- **The speed with which language is acquired**
- **How the stages of language acquisition are so consistent**

Cognition & Chemistry

– Wundt (1832–1920) —structrualism

- Titchener (1867–1927)
  - – hard introspective labor
  - – Elemental qualities of consciousness

Psychology & Behaviorism



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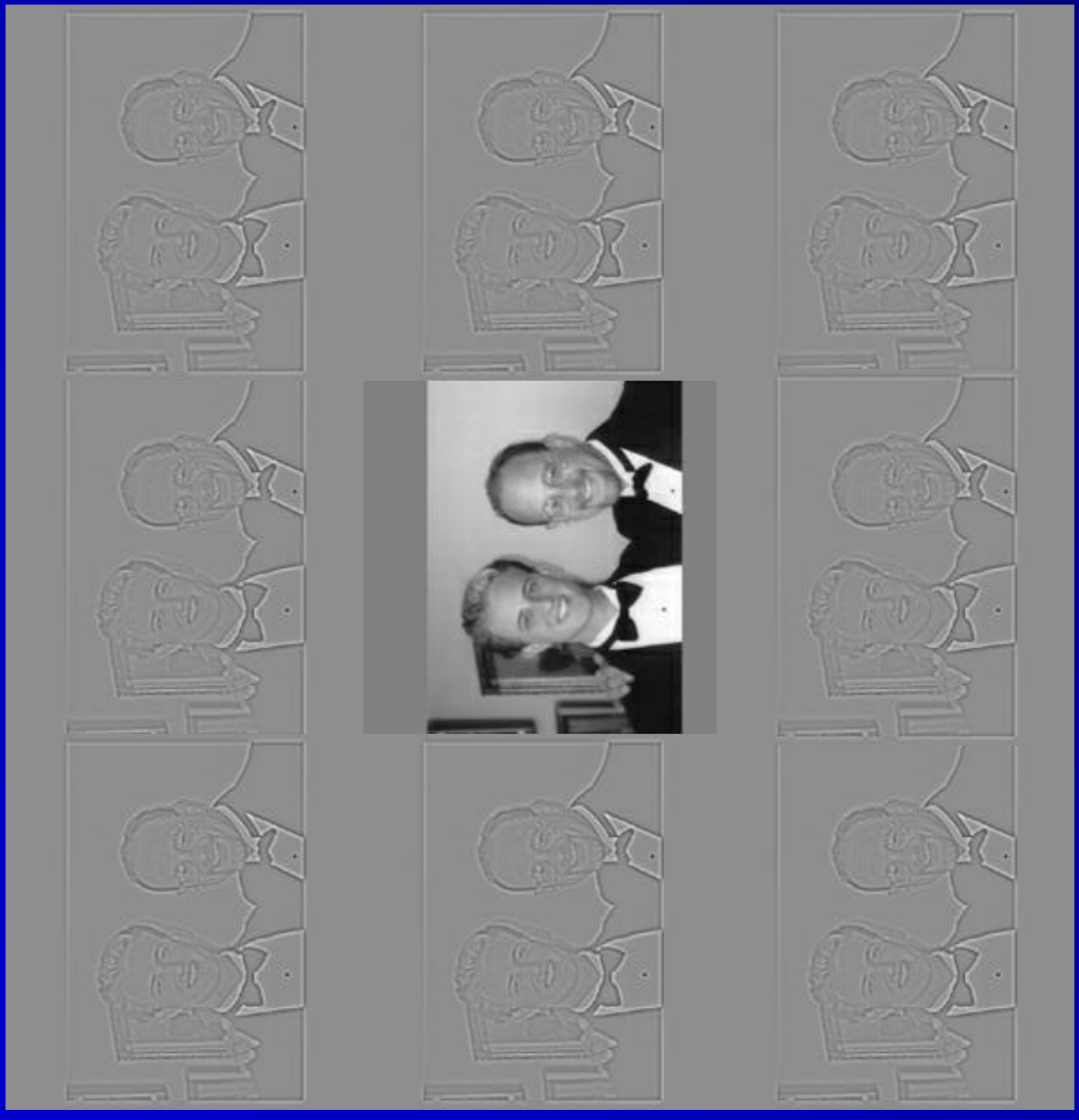
Examples of shaping: animal trainers use the method of Successive Approximations

i.e., reward behaviors that increasingly resemble desired behavior.

- HAM first primate in space, 1961.
- Red Light: Ham has to press the right lever every 15 sec (faster than 1 / 3sec) or gets shocked.
- Blue Light: press left lever within 5 sec to avoid shock

‘High’ Frequencies













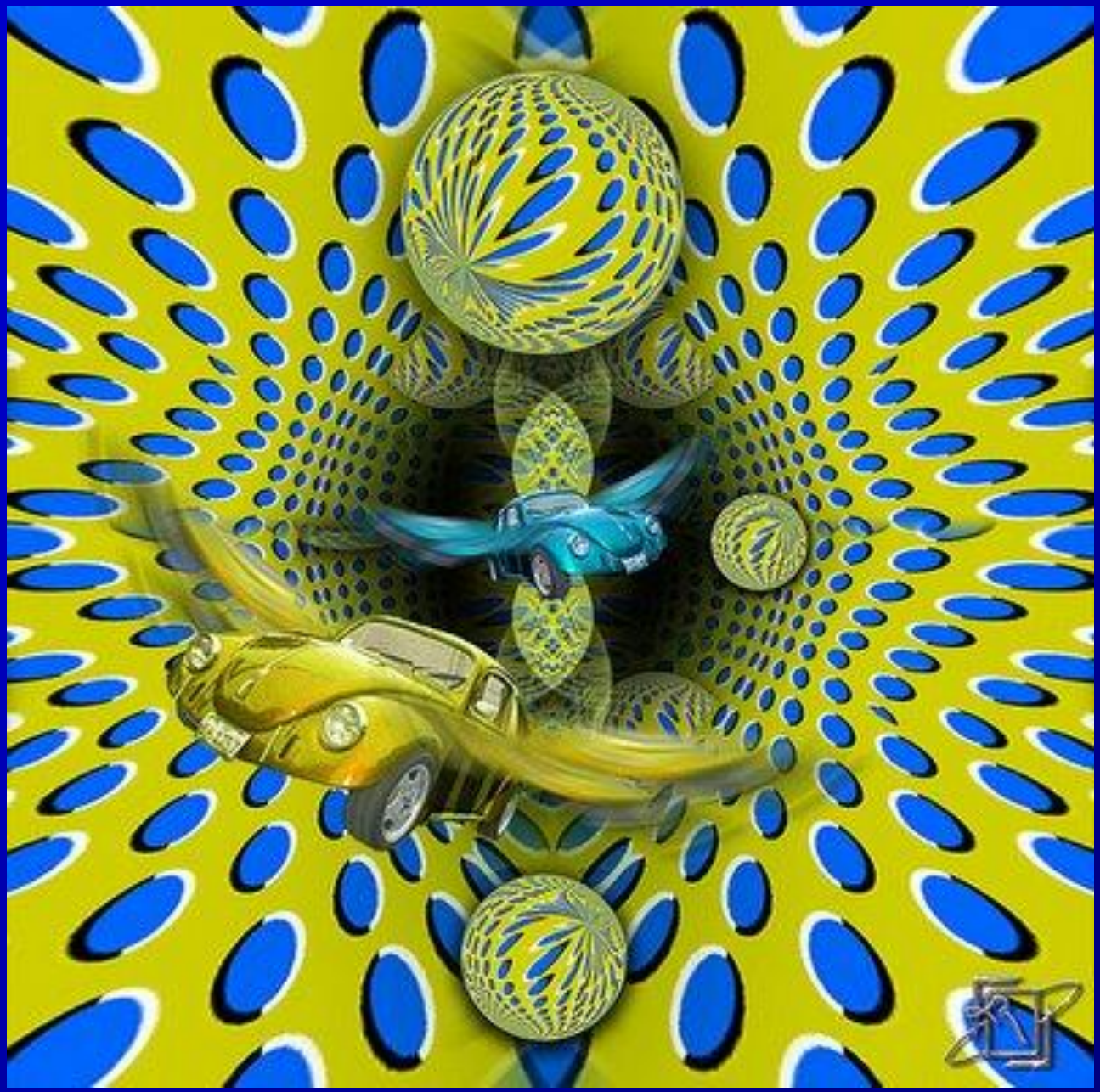






Online Demo

- Change Blindness http://www.youtube.com/watch?v=mAnKvo-fPs0
- Gestalt Common Fate http://dragon.uml.edu/psych/commfate.html



Cognitive Psychology

- Introspectionists
  - How long does it take for an image to enter your mind?
  - Can you think without pictures?
  - What is the speed of thought?
  - Did not establish principles of cognitive function, only observations; did not distinguish between *domains* of cognition (e.g., imagery and memory)
  - Established reaction time method, still used today

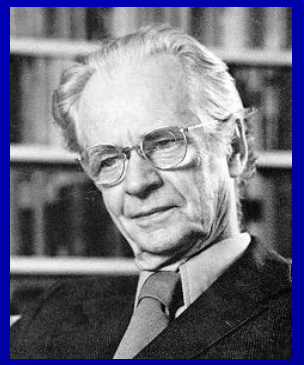
Cognitive Psychology & Behaviorism: Round 1

Watson

Psychology is only concerned with observable behaviors. Get rid of mental life

"Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors."

Operant Conditioning: Schedules of Reinforcement



B.F. Skinner

Behavior

Schedule	RATIO (Work)	INTERVAL (Time)
Fixed / Continuous	Fixed Ratio Piecework ($.10 / tree)	Fixed Interval Bi-weekly Paycheck
Variable / Intermittent	Variable Ratio Slot Machine, Fishing	Variable Interval Surprise Quizz

Behaviorism

- (1) That there is no innate knowledge. All you need is learning.

- (2) That you could explain human psychology without mental notions like desires and goals.
-
- (3) And that these mechanisms apply across all domains and across all species.

These assumptions are all wrong

Behaviorism

- Trained animals revert to instinctive actions
  - Raccoon trained to put coin in bank, washes coin
- Avoidant responses cannot be trained for approach responses
  - Bird flaps wings to escape, will not flap for food
- Not all stimuli are created equal
  - Will avoid food b/c nausea, but not avoid for shock

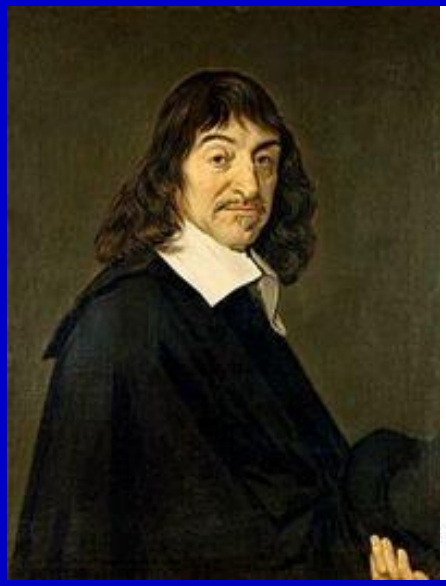
Introduction to Cognition

- Definition
- Demos and Examples
- History
- Methods

Methods in Cognitive Psychology

Three main methods:

- **Behavioral**
- **Biological**
- **Computational**



Descartes
Rationalism

Rationalism **in “Discourse on Methods”**

1) accept nothing as obvious truth that gives you cause to doubt,
2) divide a large intractable problem in smaller manageable parts
3) start reasoning about the simplest and easiest to know problems
4) enumerate conclusions as specifically and completely as possible.

Cognitive – *Science*

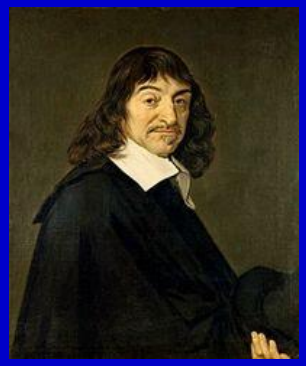
Philosophy of Science

Popper: A claim must be *falsifiable*

1. *Cause → Effect: whenever x occurs, outcome y should result.*
2. *Cause absent → Effect absent*
3. *Cause variation → Effect variation*

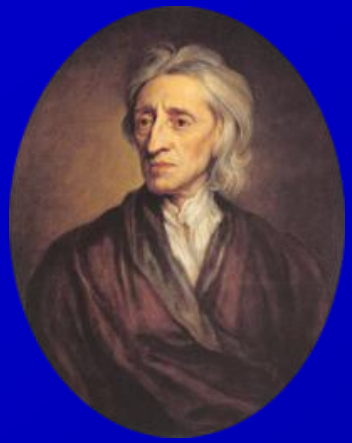
What can reaction time tell us?

- The speed/timing of internal processes (Donders)
- Allows us to make fine distinctions not available via accuracy measures.
  - Example: Jersild's 1927 Task-switching experiments
- Allows us to break mental tasks up into functionally independent stages
  - Example: Sternberg's 1969 additive factors logic
- Allows us to (sometimes) distinguish between Parallel and Serial processing
  - Example: Slope of visual search function



Descartes

Biological Approach



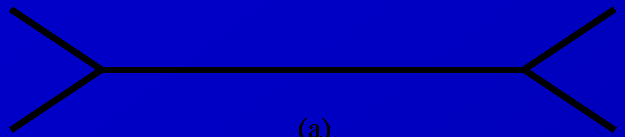
Locke

How we measure brain activity

Each method has strengths and weaknesses

There is always activity in every cell – you are measuring differences of activity

The brain is complex, you often do not know if the activity is inhibitory or excitatory, or disinhibiting (e.g., ‘stop stopping’)



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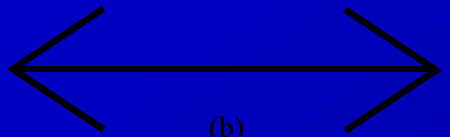

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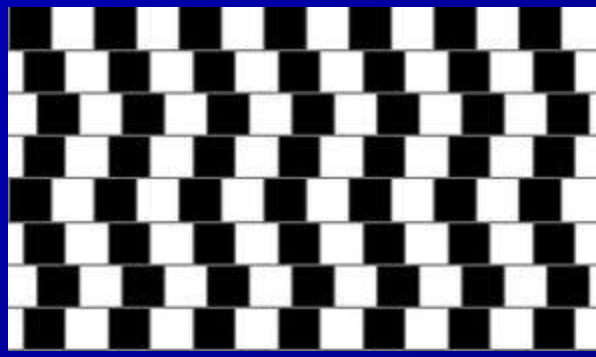
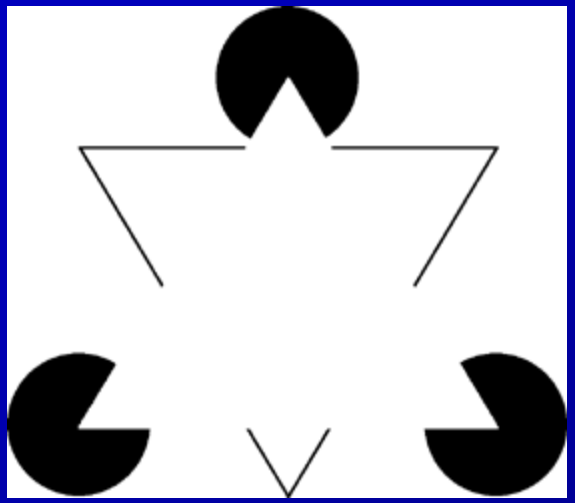
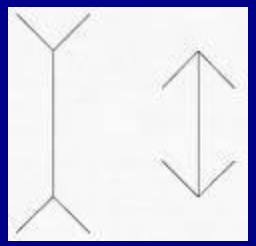
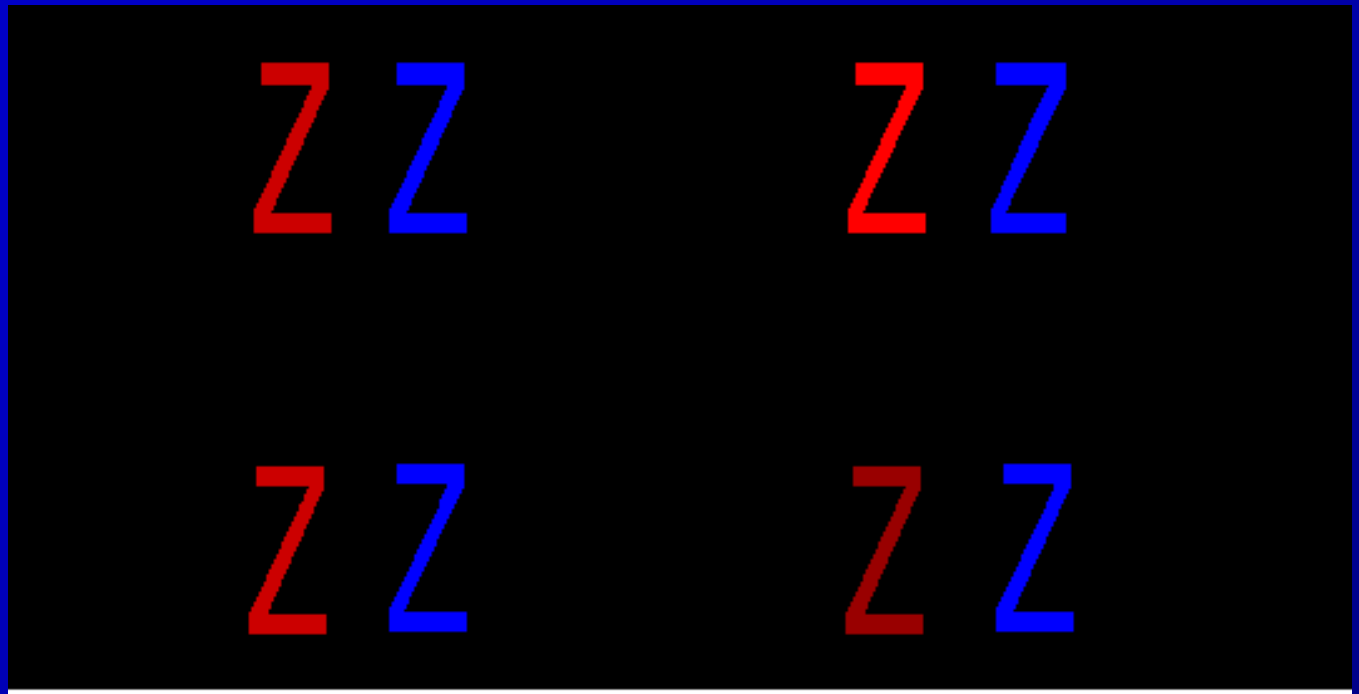






Introduction to Cognition

- Definition
- Demos and Examples
- History
- Methods *(Experiments, Methods and Stats! Oh my!)*



Since these letters are all presented on your video monitor, they obviously are all located in the same plane. But do all the Z's appear to be in the same plane or do some appear closer than others?

more information on this demonstration

History of Cognitive Psychology

- Structuralism – elementary units of thought / consciousness ("IS") ; seeks to understand the configuration of the elements of the mind and its perceptions by analyzing the perceptions into their constituent components (mode, form, quality, duration, etc.)
- Functionalism – Organism in Environment ("IS FOR")… a very pragmatic approach… knowledge is useful in that it can be applied to things (e.g., William James)
- Associationism – The study of the linking together of two events, objects or ideas because they tend to co-occur (Paul Broca: 1861). Behavior occurs because of trial and error. Knowledge come from experience (e.g., British Associationists: John Locke, David Hume, John Stuart Mills; the related Empiricism is the doctrine of the superiority of experience over innate factors [this also influenced the development of Darwinian Evolution]) … "the law of effect" (Thorndike)
- Behaviorism: (extreme version of associationism: only can examine "observables")
- Nativists – Biology/Genetics largely determines abilities and tendencies. This is the classic "Nature" side of the Nature/Nurture Debate