Introduction to Cognition
& Cognitive Psychology

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What is cognition?

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Cognition

The basic mental processes that are part of mind, for example: perception, attention, pattern recognition, memory, language, reasoning, etc.

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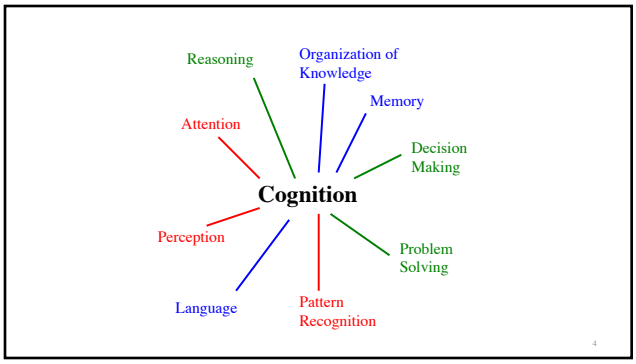

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Question

- Answer this question as quickly as you can:
- How many hands did Aristotle have?
- What mental processes were involved in answering that question?

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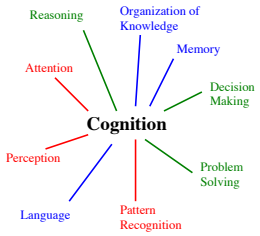
So…

How many hands did Aristotle have?

What did you write down?

What aspects of cognition were involved in that task?



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What is Cognitive Psychology?

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Our Definition of Cognitive Psychology

A specific theoretical approach to the study of mind (cognition) in which cognitive structures & processes are inferred from performance (behavior) on specific, carefully designed cognitive tasks.

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Digit Span Demo

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Digit Sequences I Read

3 7 1	(03)
4 9 8 2	(04)
7 8 4 6 3	(05)
5 8 1 4 9 6	(06)
2 4 5 3 8 7 1	(07)
6 9 1 4 3 8 2 5	(08)
4 7 5 3 9 8 1 7 4	(09)
3 1 9 6 8 2 3 5 4 6	(10)
5 4 7 5 6 3 9 8 1 4 3	(11)
2 9 6 4 2 5 8 4 3 9 1 5	(12)
6 9 8 2 5 3 4 7 4 9 5 4 3	(13)

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What can we infer from your performance?

- Short-Term vs. Long-term Memory
- Capacity of STM
- Duration of the memory
- Type of Code

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Key Ideas

- Cognition (cognitive structures & processes) inferred from behavior (performance).
- Cognitive process occur over time in a sequence (early versus late processing)
- Cognitive processes occur at different levels (lower versus higher level processing)

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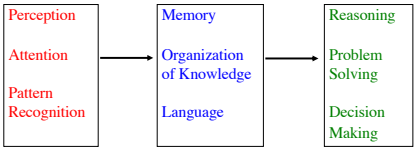
Levels (low versus high) of Cognitive Structures/Processes



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Another Key Idea

Cognition or Memory and Thinking are conceptualized in Information Processing terms – a sequence of processing steps and a series of transformations as the information is transferred from one stage to the next.

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Another Key Idea

- Cognitive structures and processes (e.g. memory) can be decomposed (i.e. broken down) into simpler structures and processes (e.g. short-term memory vs. long-term memory)

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Representations or Codes

- System of signals used to represent something -- e.g. code for the alphabet
- Cognitive Codes: e.g. the word 'hand' --> phonemic code (language sounds) vs semantic codes (conceptual meaning)
- Neural Codes: e.g. the word 'hand' encoded as a pattern of light on the retina; meaning is encoded as a pattern or neural activity

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Level of Description

- Mental Level (your awareness)
- **Cognitive Level** (inferred from behavior – i.e. abstract description)
- Neural Level

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Approaches to the Study of Mind (Cognition)

- Philosophy
- Introspection
- Behaviorism
- Cognitive Psychology
- Cognitive Neuroscience

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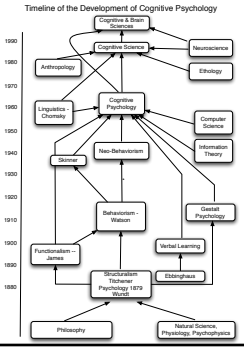

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Philosophy

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The Philosophical Approach

- Interest in the human memory and thought goes back to the Greeks and earlier
- Plato, Aristotle, Descartes, Kant
- Aristotle
  - systematic observation of his own thinking
  - Induce general laws of thought from self-observation
  - Thinking corresponds to a sequence of associations

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Thinking as a Sequence of States

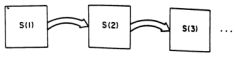

Figure 1. Thinking as a sequence of states. A graphical illustration of Aristotle's reported sequence of thoughts "from milk to white, from white to air, and from this to fluid, from which one remembers autumn, the season one is seeking" [Aristotle translated by Sorabji (1972, p. 56)].

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Ideas from Philosophical Approach

- Many cognitive issues and ideas began with philosophical investigation
- Plato's notion of ideal forms – innate ideas or knowledge (the *nativist* idea)
- Aristotle's notion that all knowledge derives from experience ("tabula rasa").

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Introspection

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Wilhelm Wundt

- " Conscious processes and immediate experience"
- Introspection or "self observation"
- Rigorous Methods

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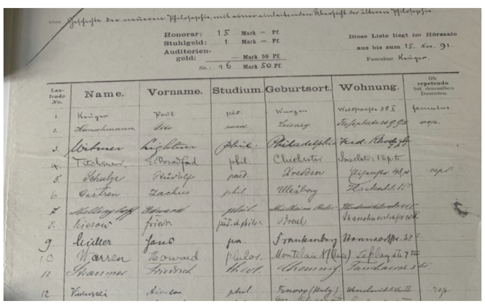

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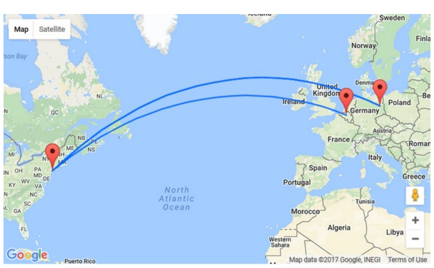

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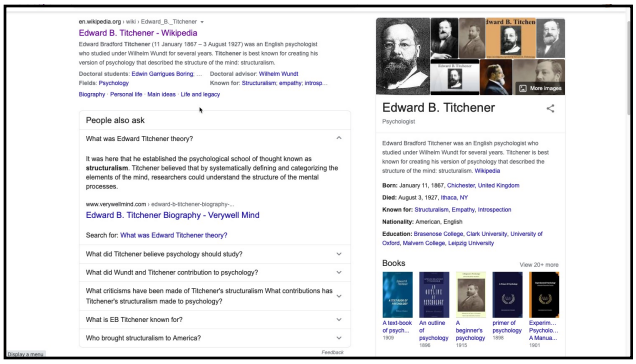

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Behaviorism

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Behaviorism – Principles 1

- John B. Watson (1924)
- Reaction to Introspection
- Emphasis on observable, quantifiable behavior
- No unobservables, no internal mental states, no images, ideas, or thoughts

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Behaviorism – Principles 2

- Psychology = Scientific study of behavior
- Humans as passive reactors to external stimuli
- "Tabular Rasa" - Environmental determinants of behavior
- Rats in mazes, puzzle boxes, etc.

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Behaviorism - Positive Contributions

- Insistence on precise & careful definition of concepts
- Operational Definition
  - e.g. learning= # trials necessary to complete a maze with no errors
- Experimental Controls

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Back in Europe …

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Herman Ebbinghaus

- Study higher mental processes using scientific method
- Process of association formation
- Non-sense syllables
- Savings Method

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Nonsense Syllables

DAX
GIK
TEB
KOV
SUV
HET

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Ebbinghaus' Method

1. Learn list to 2 perfect recitations (# trials)
2. Set aside (varied delay)
3. Relearn (# trials)
4. Measurement of Savings

$$\frac{\text{\# Trials to Learn} - \text{\# Trials to Relearn}}{\text{\# Trials to Learn}}$$

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Measurement of Savings

$$\frac{\text{\# Trials to Learn} - \text{\# Trials to Relearn}}{\text{\# Trials to Learn}}$$

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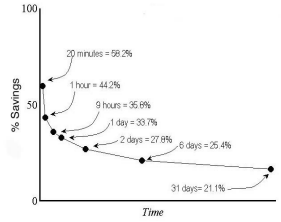
Forgetting Curve



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Gestalt Psychology

- Laws of organization
- Law of proximity
- Law of similarity
- Insight problem solving

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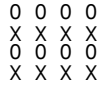
Law of Similarity



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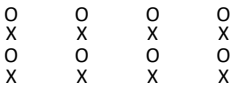
Law of Proximity



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The Cognitive Revolution

- Return to mentalistic ideas (1940's and 50's)
- MIT – Sept. 11, 1956
- Neisser's book Cognitive Psychology (1967)
- Information processing perspective
- Diverse Influences/ Causes

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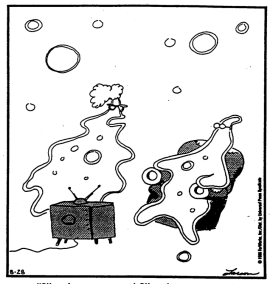

"Stimulus, response! Stimulus, response! Don't you ever *think*?"

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Dissatisfaction with Behaviorism

- Challenges to "tabular rasa"
- Innate structure or knowledge
- Complex human behavior not explainable in terms of stimulus-response relations alone

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Verbal Learning

- Flourishing of Ebbinghaus tradition
- Different types of memory, memory organization, models
- Active nature of learner--what is brought to learning
- Formation of new associations --> Use of pre-existing associations.
- Emphasis on Memory over learning

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Bousfield (1953)

Words presented in this order:		But recalled In this order
apple	desk	
bicycle	couch	
shirt	chair	
chair	peach	
banana	apple	
car	hat	
socks	shirt	
desk	dress	
peach	…	
truck		
dress	Etc.	
couch		
orange		
train		
hat		
rug		

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Verbal Learning …

- Existing memory associations lead to reorganization of words during recall
- Mental Processes: rehearsal, storage, organization, retrieval
- Acceptance of objective methods & procedures
- But increased commitment to inferred processes -- e.g. encoding, storage, retrieval

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New Disciplines Emphasizing Information Processing

- Communications Theory
- Information Processing
- Computer Science

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Communications Theory

- Information processing idea
- Similarity between communication devices and people
- 1st approximation analogy for psychology to describe mental processes
- Channel, information processing filters, limited capacity, serial vs. parallel processing.

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Information Theory

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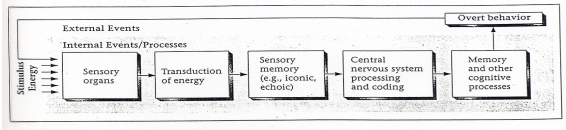
Information Processing of Sensation & Perception

FIGURE 3.1 **Information Processing Model of Sensation and Perception** The model illustrates both observable external phenomena and unobservable internal stages and processes.



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Computers & Computer Science

- Numerous contributions
- Analogy of computers & humans
- Both process information: Take in information, transform, manipulate, store, & output information (or some type of product--e.g. behavior)
- Humans & computers as symbol manipulators

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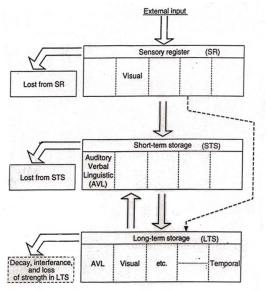
Atkinson & Shiffrin Memory Model



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Many Contributions

- Borrowing of concepts & characteristics of computers to describe human system: sensory store, short-term store, long-term store
- Limited capacity--immediate memory & attention

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Additional Contributions

- Computer programs/processes analagous to mental processes
  - Simulation modeling
  - AI
- Computer as tool
  - Stimulus Presentation

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Current Issues Related to Cognitive Psychology

- Ecological Validity
- Cognitive Science
- Cognitive Neuroscience
- Artificial Intelligence
- Parallel Distributed Processing Approach

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Cognitive Neuroscience

- Investigates the relationships between brain structures & function and cognitive structures & processes.
- Importance of Cognitive Task Analysis
- Many New Tools/Techniques

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Cognitive Neuroscience Techniques

- Brain Lesions
- Brain Imaging Techniques
  - PET (Positron Emission Tomography)
  - MRI (Magnetic Resonance Imaging)
  - fMRI (functional Magnetic Resonance Imaging)
- Event-Related Potential - ERP
- Single-cell Recording Technique

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PET Scanner vs. MRI Scanner

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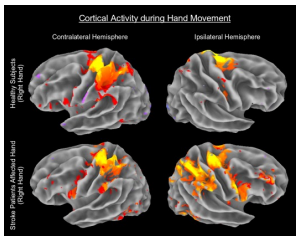
fMRI Scan



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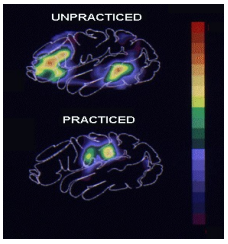
PET Scan

PET Scan while listening to a language task (unpracticed)

versus

PET Scan after practice with on the same language task (practiced)



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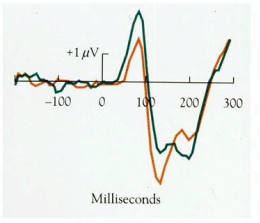
Event-Related Potentials



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Artificial Intelligence

- Machine Metaphor
- Artificial Intelligence (Pure AI) vs.
- Computer Simulation (Weak AI)

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PDP - Parallel Distributed Processing

- Cognitive processes can be understood in terms of networks of 'neuron-like' units
- Connectionism vs. neural networks
- Parallel vs. Serial Distinction

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Themes

- Cognitive processes are active
- Cognitive processes remarkably efficient & accurate
- Cognitive processes handle positive information better than negative
- Cognitive processes are Interrelated
- Many cognitive processes rely on both bottom-up and top-down processing

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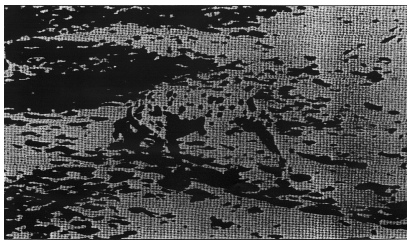
What do you see?



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What letter is this?

A

THE MAN RAN.

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