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### The History of Cognitive Psychology

***If I have seen further, it is by standing on the shoulders of giants.***  
 ~ Sir Isaac Newton

***Those who ignore history are doomed to repeat it.***  
 ~ George Santayana

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### Philosophical Roots of Cognitive Psychology

➤ **Where does knowledge come from?**

- **Empiricism** - Experience; cf. *tabula rasa*.
- **Rationalism** - Reason; intuition.
- **Nativism** - Innate abilities.  
- Biological constraints.

➤ **What is the relation between mind and matter?**

- **Idealism** - Everything is mental.
- **Materialism** - Everything is matter.
- **Dualism** - Mind and matter are two distinct forms of reality.

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**Philosophical Roots of Psychology**

➤ **Dualism & the mind-body problem.**

- Rene Descartes (1596-1650).
  - "cogito ergo sum".
- Body & Soul.
  - Animal reflexes (body) vs. human reason (mind/soul).



Rene Descartes



"Cartesian Dualism"

➤ **How does the mind control the body?**

➤ **How can one scientifically study the mind?**

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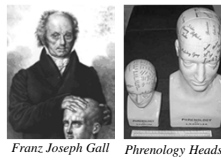
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**Physiological Bases of Mind**

➤ **1810 - Franz Gall creates the "science" of Phrenology; associating specific mental abilities with specific brain areas.**



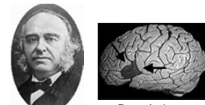
Franz Joseph Gall Phrenology Heads

➤ **1848 - Phineas Gage has his brain pierced by an iron rod, confirming Gall's conjecture & helping elucidate the role of the frontal lobes (in personality & judgment).**



Phineas Gage

➤ **1861 - Paul Broca describes his work on the neural localization of language.**



Paul Broca

Broca's Area

➤ **Development of EEG (1920s), CAT (1970s), PET & MRI (1980s), & fMRI (1990s).**

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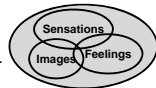
**The Birth of Scientific Psychology**

➤ **1879 - Wilhelm Wundt creates the first psychology laboratory in Leipzig Germany.**

- Focus on *consciousness*, the one aspect of psych that makes it unique from the other science.
- Introspection as a key method.
- Goal: Describe the *elements* of conscious experience.
- "Mental Chemistry".
- **Structuralism**.



Wilhelm Wundt in his lab



➤ **William James.**

- Rejects Structuralism as too static & artificial.
  - "*stream of consciousness*".
- Advocates **Functionalism** - a focus on the *use & adaptive value* of mental functions & processes.



William James

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## Introspection



- To "look inward" and *systematically observe* one's own mental processes.
- Limitations?

- **Subjective:** Mental events are private & hard to objectively verify.
- **Unreliable:** Data often doesn't agree across people, contexts, etc.
- **Restrictive:** Introspection requires training, thus excluding many groups from study (children, animals, mental patients, etc.).
- **Flawed:** Observing mental events necessarily changes them.

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## Behaviorism

- Psychology should be a science of behavior, not mind.
- Emphasis on observable stimuli & responses
  - "S-R" ("black-box") psychology.
- Primarily uses animals (rats & pigeons) as test subjects, on assumption that the laws of learning are universal.
- Focus on learning.
  - classical & operant conditioning.



J. B. Watson



I. P. Pavlov



B. F. Skinner

**Pros:** Very objective; has discovered important principles of learning; forced cognitivists to focus on behavior as their primary source of data.

**Cons:** Fails to address *consciousness, memory, & other "mental" phenomena* (e.g., *expectation; interest; knowledge; covert attention; false memory, etc.*).

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## Behaviorism

- Psychology should be a science of behavior, not mind.
- "Behaviorism holds that the subject matter of human psychology is the behavior of human beings. Behaviorism claims that consciousness is neither a definite nor a usable concept".
- "Consciousness is nothing but the soul of theology".
- "[I provide] no discussion of consciousness and no reference to such terms as sensation, perception, attention, will, image, and the like. ... I frankly do not know what they mean, nor do I believe that any one else can use them consistently".



J. B. Watson



I. P. Pavlov



B. F. Skinner

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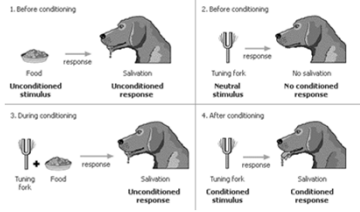
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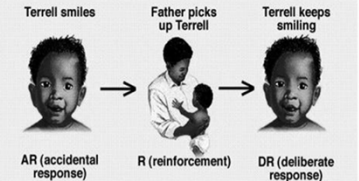
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**Classical (Pavlovian) Conditioning**  
[Cf. Association]



**Operant (Instrumental) Conditioning**  
[Cf. The Law of Effect]




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**Classical Conditioning: Examples**

Existing reflex	<b>US:</b>	Chemotherapy	Romance
	<b>UR:</b>	Nausea / Vomiting	Happiness
Learned reflex	<b>CS (+US):</b>	Treatment Room	Look, sound, or smell of lover
	<b>CR:</b>	Nausea	Warm feelings

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**Classical Conditioning: Examples**

- **Taste Aversions.**
  - Evolutionary ability: Taste > Nausea.
- **Conditioned Emotional Responses.**
  - Theme from *Jaws*; the *Jeopardy* tune; etc.
  - Cops; late calls; people with unique mannerisms.
- **Phobias.**
  - John B. Watson and Little Albert.
- **Advertising...**

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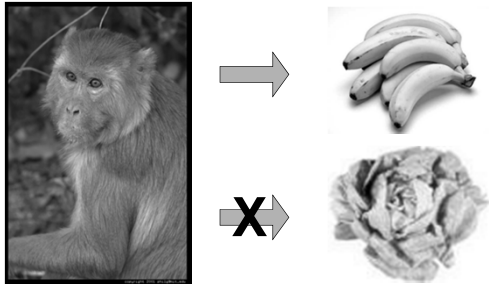
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**Can all behavior be explained by S-R associations?**



Tinklepaugh (1928)

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**Gestalt Psychology**

➤ Early German school of Psychology which, like Functionalism, emphasized the active, interrelated nature of mental events.



➤ "Gestalt" = *whole form; organized shape*.  
 • "the whole is more than the sum of its parts".  
 • melodies, objects, ideas, etc.



➤ Gestalt principles of perception.



• Figure/ground separation.




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**Piaget & Chomsky**

➤ Jean Piaget (1896 - 1980).

- Swiss psychologist interested in the development of reasoning & problem solving in children.
- Argued that increasing sophistication over time reflected the development of *internal mental representations (schemas)* that guided action.



Jean Piaget

➤ Noam Chomsky (b. 1928).

- American Linguist interested in how children learn, and adults use, language.
- Emphasized the *creative nature of language*.
- Claimed that language learning was *innate* and based on "unconscious rules" (not S-R learning).



Noam Chomsky

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**Human Factors**

- Industrialization & WWII produced a need for research on how people interacted with machines ("man/machine interfaces").
  - Seemed to require cognitive concepts such as *attention* and *judgment*.



**Communication Science**

- Development of telephone & telegraph introduced concepts such as *coding*, *channel capacity*, *serial/parallel processing*.
  - provided a language for describing cognitive mechanisms.



**Information Theory**

- Mathematical treatment of information, AI, & invention of the digital computer.
  - provided a physical instantiation of mental-like processing; and a medium by which to create and test theories of mind.



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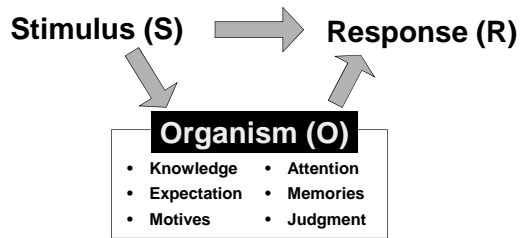
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Theoretical challenges to Behaviorism, findings from other branches of psychology (Gestalt, Developmental/Piaget, Linguistics/Chomsky), the need for R&D on "human factors", and the development of concepts for describing mental events all came together in the 50's to create a "cognitive revolution".



In many ways, this represented a return to the original concerns of the first scientific psychologists: What are the nature of mental events and what role do they play in producing behavior?

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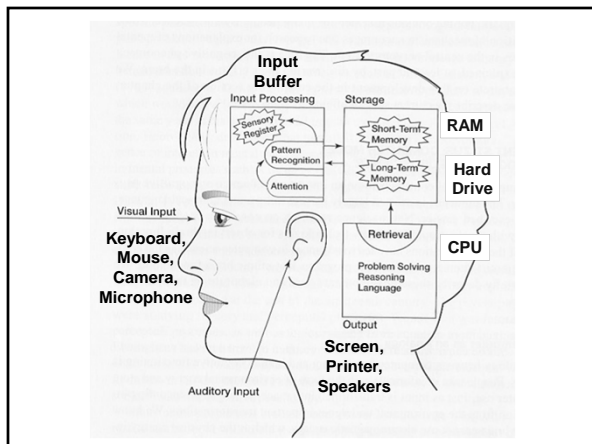
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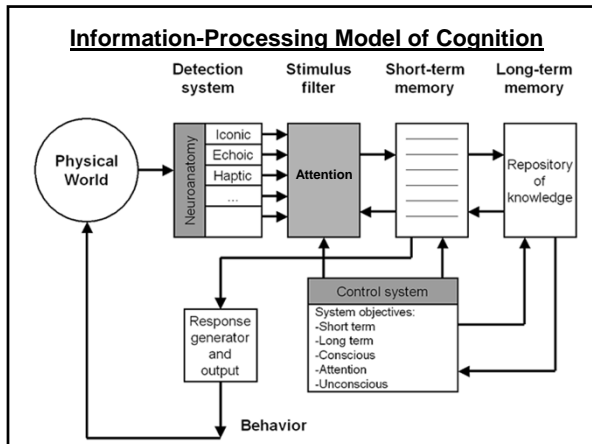
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### Cognitive Psychology

- Believes that psychology should be a science of behavior *and* mental processes.
- Emphasizes how people *acquire, transform, manipulate, retrieve, and use* information.
- Mental processes viewed as similar to computer programs.
- Brain mapping is increasingly important.

**Pros:** Very broad—attempts to explain both mind & behavior; well established methods & principles; close ties to neuroscience.

**Cons:** Difficult to verify the reality of some concepts (dualism?). Theories may sometimes contain a hidden homunculus.

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### Cognitive Neuroscience

MRI  
(structural)

PET  
(functional)

EEG/ERP  
(functional)

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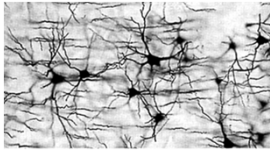
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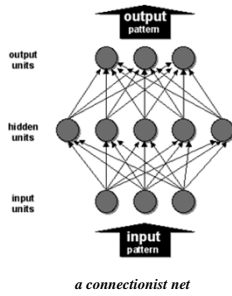
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**Connectionism**  
(aka Parallel Distributed Processing)  
(aka Neural Networks)



*a real neural net*



*a connectionist net*

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