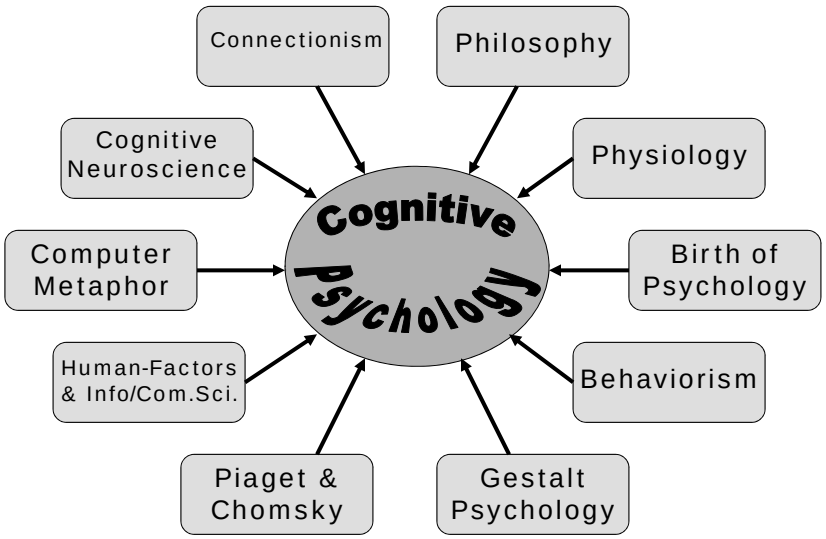
The History of Cognitive Psychology



The History of Cognitive Psychology

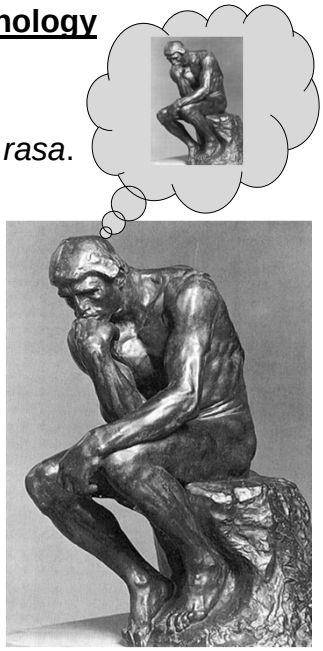
***If I have seen further, it is by standing on the shoulders of giants*.**

~ Sir Isaac Newton

***Those who ignore history are doomed to repeat it*.**

~ George Santayana

Philosophical Roots of Cognitive Psychology

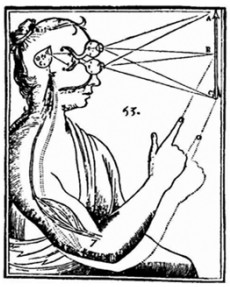


- ***Where does knowledge come from?***
  - **Empiricism** - Experience; cf. *tablula rasa*.
  - **Rationalism** - Reason; intuition.
  - **Nativism** - Innate abilities.
    - Biological constraints.
- ***What is the relation between mind and matter?***
  - **Idealism** - Everything is mental.
  - **Materialism** - Everything is matter.
  - **Dualism** - Mind and matter are two distinct forms of reality.

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?***

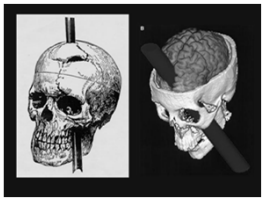
Physiological Bases of Mind

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

Franz Joseph Gall

Phrenology Heads

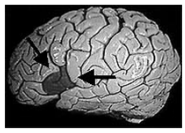
- **1848 - Phineas Gage has his brain pierced by an iron rod, confirming Gall's conjecture & helping elucidate the role of the frontal lobes (in personality & judgment).**



Phineas Gage

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

Paul Broca



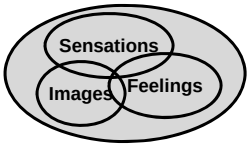
Broca's Area

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

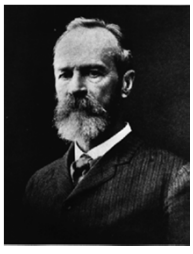
The Birth of Scientific Psychology

- **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

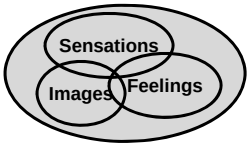


- **William James.**
  - Rejects Structuralism as too static & artificial.
    - "*stream of consciousness*".
  - Advocates **Functionalism** - a focus on the *use* & *adaptive value* of mental functions & processes.



William James

Introspection



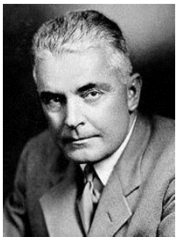
- To "look inward" and *systematically observe* one's own mental processes.
- Limitations?

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

Behaviorism

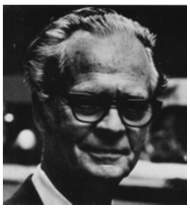

I. P. Pavlov

- 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

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

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

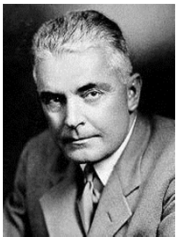

B. F. Skinner

Behaviorism

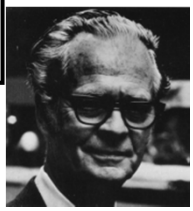
- Psychology should be a science of behavior, not mind.

- "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".

I. P. Pavlov



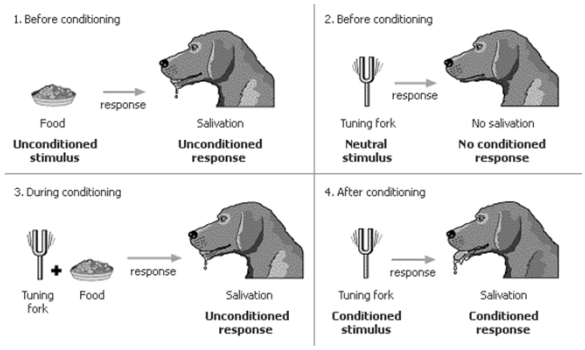
J. B. Watson

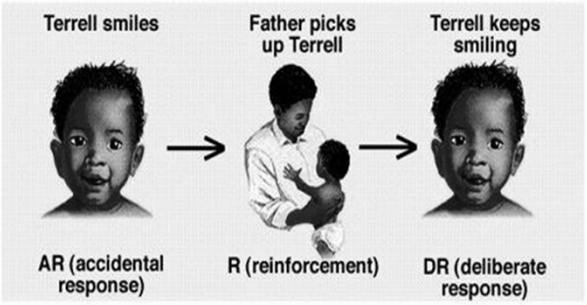


B. F. Skinner

Classical (Pavlovian) Conditioning

[Cf. Association]





Operant (Instrumental) Conditioning

[Cf. The Law of Effect]

Classical Conditioning: Examples

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

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...**

The Use of Classical Conditioning in Advertising

Coca-Cola Turns to Pavlov . . .

Do television commercials make people behave like Pavlov's dogs? The Coca-Cola Company says the answer is yes. In recent years, the Atlanta soft-drink company has been refining an ad-testing procedure based on the behavioral principles developed by the Russian physiologist. So far, Coca-Cola says, its new testing system has worked remarkably well.

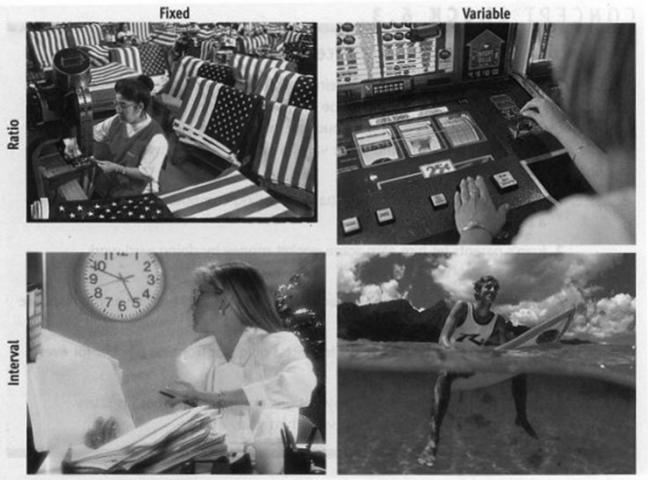
In his classic experiment, Ivan Pavlov discovered he could get dogs to salivate at the ring of a bell by gradually substituting the sound for a spray of meat powder. Coca-Cola says that just as Pavlov's dogs began to associate a new meaning with the bell, advertising is supposed to provide some new image or meaning for a product.

Although the specifics of Coke's test are a secret, the company says it attempts to evaluate how well a commercial conditions a viewer to accept a positive image that can be transferred to the product. During the past three years, Coca-Cola says, ads that scored well in its tests almost always resulted in higher sales of a soft drink.

"We nominate Pavlov as the father of modern advertising," says Joel S. Dubow, communications research manager at Coca-Cola. "Pavlov took a neutral object and, by associating it with a meaningful object, made it a symbol of something else; he imbued it with imagery, he gave it added value. That," says Dubow, "is what we try to do in modern advertising."

Source: *The Wall Street Journal,* January 19, 1984, p. 31.

Behavioral Control via Operant Condition



Reinforcement schedules in everyday life. Complex human behaviors are regulated by schedules of reinforcement. Piecework in factories is reinforced on a fixed-ratio schedule. Playing a slot machine is based on variable-ratio reinforcement. Watching the clock at work is rewarded on a fixed-interval basis (the arrival of quitting time is the reinforcer). Surfers waiting for a big wave are rewarded on a variable-interval basis.

Shaping

Superstition

Can all behavior (all of psychology) be explained by S-R associations?

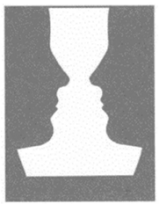
Stimulus

Response

Can all behavior be explained by S-R associations?

Tinklepaugh (1928)

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.

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

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*.**

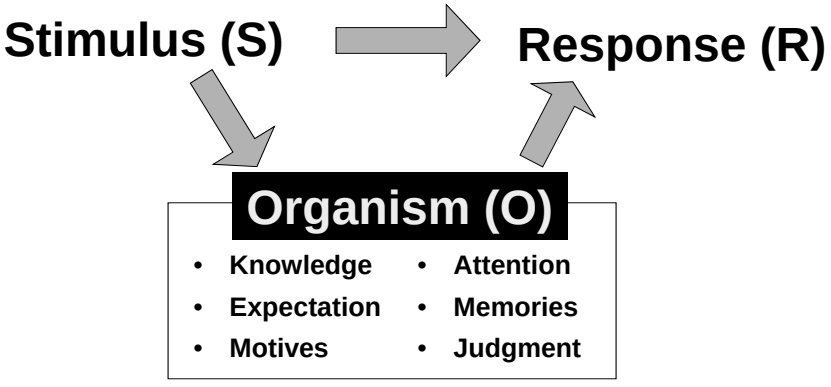
Communication Science

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

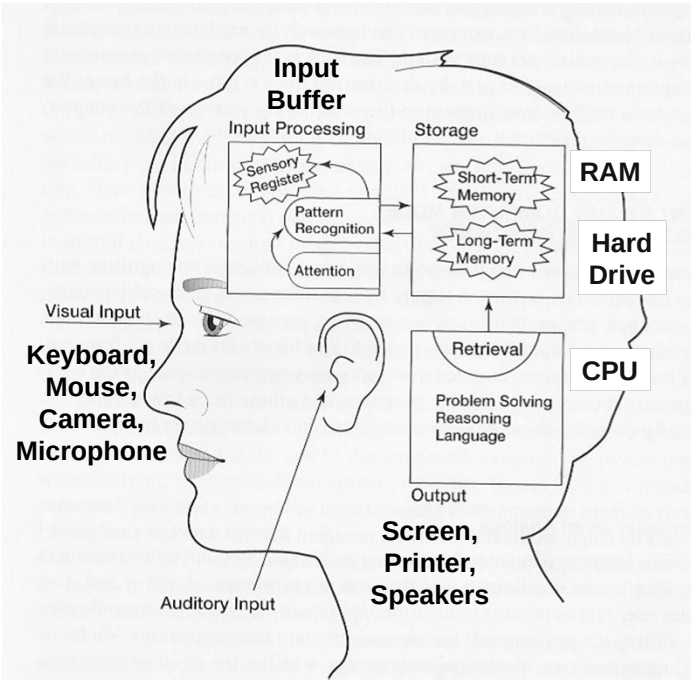
Information Theory

- **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.**

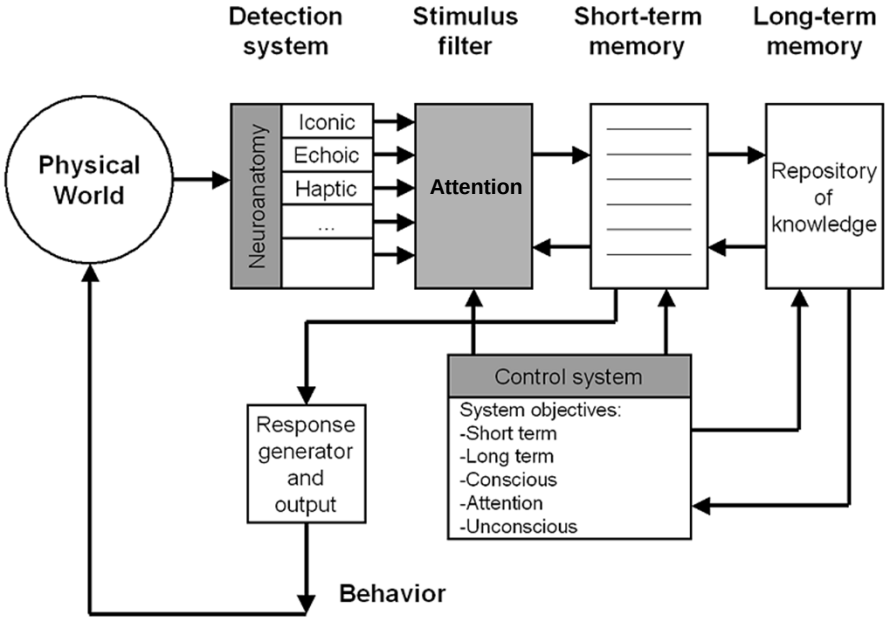
Theoretical challenges to Behaviorism, findings from other branches of psychology (Gestalt, Developmental/Piaget, Linguistics/Chomsky), the need for R&D on "human factors", and the development of concepts for describing mental events all came together in the 50's to create a "cognitive revolution".



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?

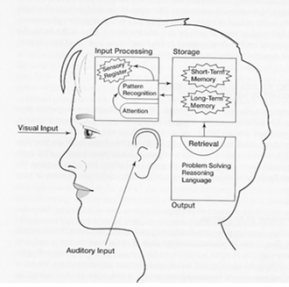


Information-Processing Model of Cognition



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.**

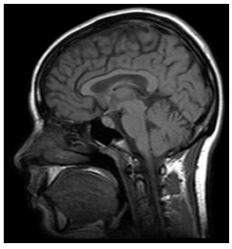


- **Brain mapping is increasingly important.**

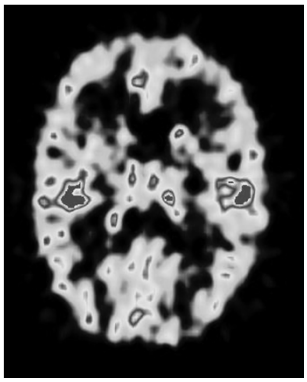
Pros: Very broad–attempts to explain both mind & behavior; well established methods & principles; close ties to neuroscience.

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

Cognitive Neuroscience



MRI
(structural)

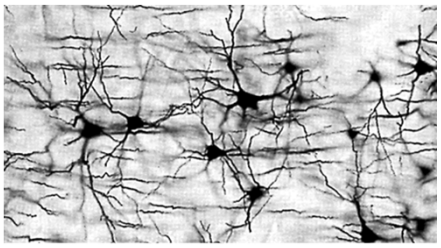


PET
(functional)

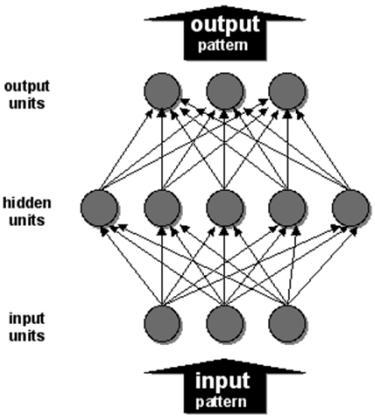
EEG/ERP
(functional)

Connectionism

(aka Parallel Distributed Processing)
(aka Neural Networks)



a real neural net



a connectionist net