

## COGS 101B

- Web Page
  - <http://www.cogsci.ucsd.edu/~coulson/101b/>
- Instructor
  - Dr. Coulson
  - Email: coulson "at" cogsci.ucsd.edu
  - CSB 161
  - Thursday: 12-2pm
- TAs
  - Alan Robinson
  - Nate Harrison
  - Zack Weinberg

## Slides

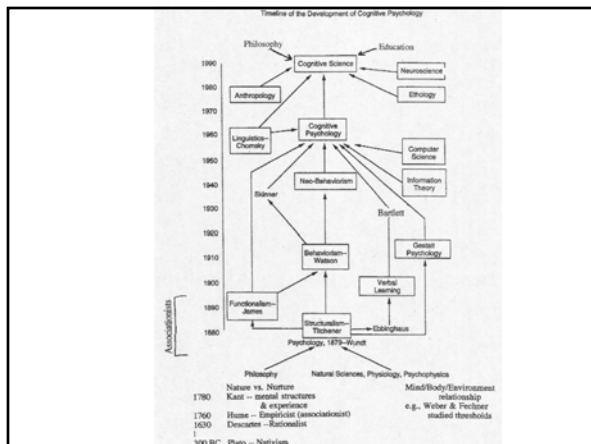
- PDF version of Powerpoint slides available on the course website
  - <http://www.cogsci.ucsd.edu/~coulson/101b/>

## Outline

- History
- Methods
- Paradigms

## History

- Philosophical Origins
- Structuralism
- Functionalism
- Gestalt Psychology
- Genetic Epistemology
- Behaviorism
- Cognitive Revolution

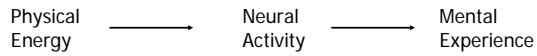


## Descartes



- Epistemology
- Radical Skepticism
- Evil Demon
- “Cogito ergo sum.”
- Leap of Faith

## Premises & Problems



*qualia* – “raw feels”, raises problem of how to relate physical facts to mental facts

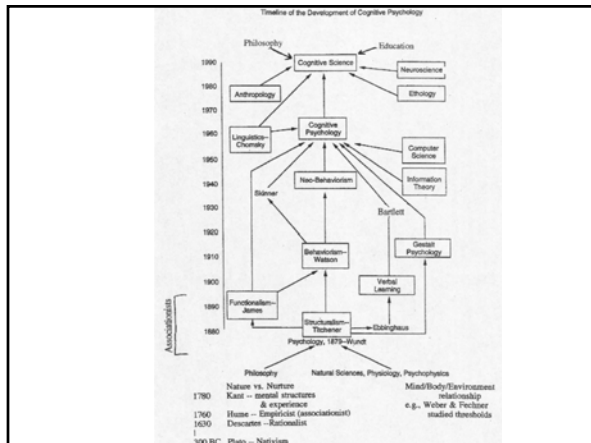
## Rationalism vs. Empiricism

Kant

- Knowledge begins w/experience but is constructed by mind
- Experience mediated by mental categories or schemata

Locke, Hume

- All knowledge originates in experience
- Mind is a blank slate



## Structuralism

- Philosophical Motivation
  - Belief in reductionism
  - Consciousness can be broken down into basic elements
- Goal
  - Discover basic structures of mental life
- Methodology
  - Introspection

## Wundt

- Founded first experimental psychology laboratory
- “Tell me your sensations of this rock”
- BUT: Also did lots of psychophysics
- Most introspection was people saying “yes” or “no” to targeted questions about their perceptions



## Titchener

- Took introspection to new level
- Not just sensations but thoughts
- Tell me your reactions to “green things”
- Unfortunately, inconsistencies abounded



## Pros & Cons of Introspectionism

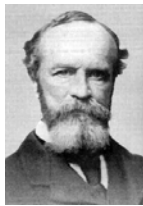
- Creative Synthesis
- Chief Virtue
  - Acknowledged volitional character of human behavior
  - Not mechanistic
- (Not Mechanistic)
- **Irrelevance:** cognitive processes not always available to consciousness
  - People confabulate
- Subjective
  - Not public
  - Not replicable
  - Often results in **contradictory findings**

## Functionalism

- Psychology of mental *operations*
  - Not mental *elements*
- Evolutionary Motivation
  - Consciousness must have a function
- Consciousness still central
  - mediates between needs of organism and demands of environment
- Asks
  - What do people do?
  - How do they do it?
  - Why do they do it?

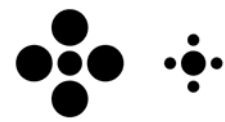
## William James

- Dynamic, streaming quality of consciousness
- Consciousness central to life and biological survival
- Respect for individual differences
  - Different people arrive at the same conclusion via different paths
- Wrote *Principles of Psychology*



## Gestalt Psychology

- Like functionalists, anti-reductionistic
- The whole of conscious experience is greater than the sum of its parts.
- Discovered many visual illusions
- Characterized principles of perception



## Genetic Epistemology

- Piaget
- “Genetic”
  - Not just DNA, but genesis in the larger sense
- “Epistemology”
- Tenets
  - Knowledge arises out of action and has a biological function
  - Knowledge consists of cognitive structures
  - Change via assimilation, accommodation
  - Capacity for abstraction develops over the lifespan

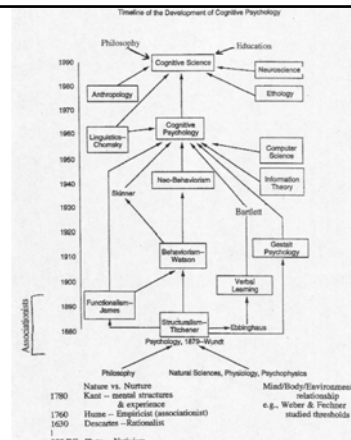
## Behaviorism

- Empirically-based science of behavior
  - Experimental analysis of stimulus-response (S-R)
  - Dominant in American psychology
- Mental or cognitive phenomena are not good candidates for scientific inquiry
  - not meaningful to study
  - (almost) impossible notions for scientific investigation
- Carefully controlled lab studies of animal learning

## Watson



- Attacked Introspectionism
- Concerned only with *external* behavior
- "...consciousness is neither a definite nor a usable concept."
- "dropped from his scientific vocabulary all subjective terms such as sensation, perception, image, desire, purpose, and even thinking ...."



## Paradigms

- What is a paradigm?
  - Experimental paradigm: p
  - Scientific Paradigm: P

## Cognitive Revolution

- Paradigms vs. Hypotheses
- Paradigms organize research programs
- Evaluated based on
  - popularity
  - internal consistency
  - consistency with facts

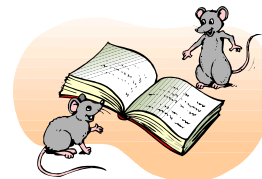
## Downfall of Behaviorism

- Differences between animal species
- Need to postulate intervening variables
- Language behavior



## Garcia Effect

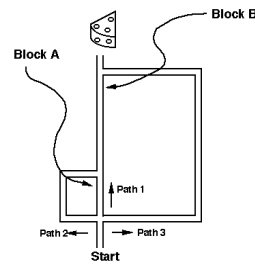
- Does learning proceed the same way in every species?
- *Are all stimuli & responses equally likely to be associated w/one another?*
- Radiation vs. Shock on Taste Aversion vs. Tone Aversion
- Rats drink sweetened water, hear tone
  - Some shocked
  - Some X-rayed (get sick)



## Garcia & Koelling

<b>Shock</b>		<b>X-Rays</b>	
<i>Saccharine</i>	<i>Loud</i>	<i>Saccharine</i>	<i>Loud</i>
<u><i>Taste</i></u>	<u><i>Tone</i></u>	<u><i>Taste</i></u>	<u><i>Tone</i></u>
(no effect)	aversion	aversion	(no effect)

## Cognitive Maps



- Tolman's research suggests need for **intervening variables**
- S [int. var.] R
- Path 1 shortest
- A blocked, take 2
- B blocked, now what?
- Flood!!!

## Chomsky's Critique



- Behaviorism OK in lab, but what about the real world?
- Painting is stimulus
  - It's Dutch.
  - It's hideous.
  - It's hanging too low.
  - I thought you liked abstract art.
- Concept of stimulus doesn't explain much

## What constitutes reinforcement?



- "Your money or your life!"
- What reinforces "your life"?
- If Skinner says, "reinforcement can be imagined," he admits to mental events.

## Unicorns

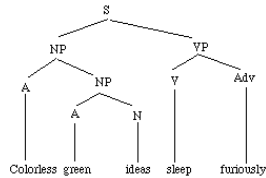
- How do people refer to non-observable phenomena?
- If stimulus must be present for conditioning, it can't explain most language use.



## Creative Use of Language

- Most sentences are novel.
- When associated w/ a stimulus?
- "The ketchup bottle was being used as a weight to hold the money down, but when the ace of spades fell from his right sleeve, the bottle became a lethal weapon."
- Speakers can produce and comprehend an infinite number of sentences!!

## Rules



- Words + Rules = Infinity
- A stimulus is tied to particular event
- A rule is general
- Rules explain novelty and productivity in
  - Language
  - Thinking
  - Understanding

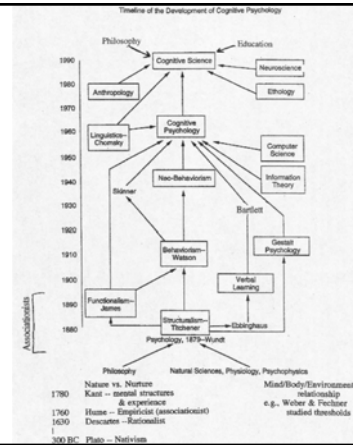
## Paradigm Shifts

- Dissatisfaction with current approach
  - Anomalies
  - Absurdities
  - Perceived Omissions
- New approaches attractive because they resolve absurdities
- Phenomena not explained by old paradigm become focus of new



## Reemergence of Cognitive Psychology

- Introspectionists – naive belief in power of self-observation
- Behaviorists – naive belief in reducibility of intelligent behavior
- Cognitive Psychologists (middle road)
  - Information Theory
  - Artificial Intelligence
  - Linguistics



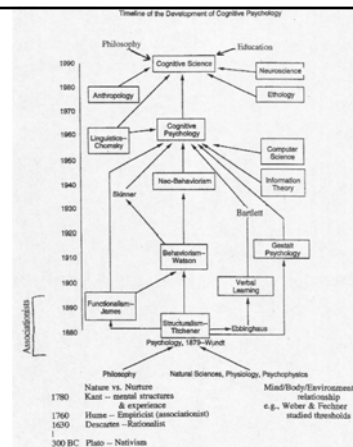
## Information Processing v. Behaviorism

### Both

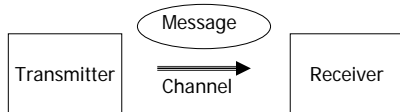
- Committed to theory building
- Believe in scientific observation
- Laboratory experiments with controlled conditions

### IP Psychologists

- Fear not the mental
- Shifted emphasis from learning to
  - Perception
  - Memory
  - Thinking
  - Language

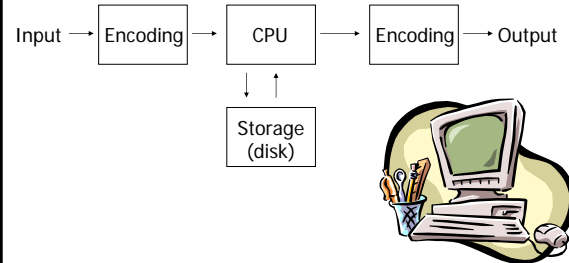


## Information Theory



- Coding – rules for transforming messages, codes, etc. from one representation to another
- Channel Capacity – how many signals can the channel carry?
- Serial vs. Parallel Processing – one vs. many messages

## The Computer Analogy



## The beauty

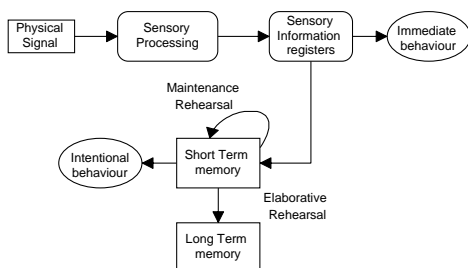
of the computer analogy:

- Computers provide a concrete way of characterizing abstract mental operations.

## Minds, Brains, and Computers

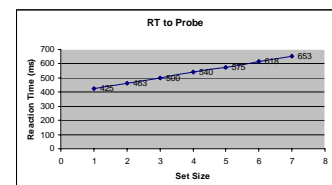
- Abstract
- Concrete
- New Solution to Mind/Body Problem
  - (Don't) Dump the mind
  - Postulate a level of explanation between mind and body
- Marr's Levels of Explanation
  - Computation
  - Algorithm
    - Architecture
    - Program
  - Implementation

## Information Processing Model



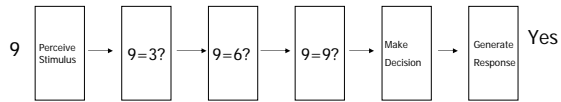
## Sternberg Paradigm

- Give subjects a small set of numbers to remember: {3,9,6}
- Probe: 9?
- Task: Respond as fast as possible



$$\text{Time} = 387 + 38s$$

## Sternberg's Model



## Ways Sternberg's theory exemplifies IP approach

- Discusses IP without reference to brain processes
- Symbolic operations (not subsymbolic, not neural)
- Use of computer metaphor
- Reaction time important for verification
  - Discrete stages
  - Flow-chart

## Paradigms

- Information Processing
- Connectionism
- Cognitive Neuroscience
- Evolutionary
- Ecological

## Research Methods

- Naturalistic Observation
- Introspection
- Behavioral Experiments
- EEG/MEG Experiments
- Neuroimaging Experiments
- Single Cell Recording

## Cognitive Science

- Still often employ computer metaphor
- Characterize cognitive processes in terms of simple computational operations
- Still test theories with reaction time studies
- Parallel processing models popular
- Not exclusively symbolic processes, sub-symbolic processes can be important too
- Also test theories with brain imaging technologies (ERP, fMRI)
- Increased importance of understanding relationship between mind and brain
- Increased importance of social, cultural, and technological contributions