1 🔲 # Cognitive Bases of Behavior
Introduction and Historical Background

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2 🔲 # Cognitive Psychology
- Concerned with full range of psychological processes from sensation to knowledge representation
- Dominated since 1970's by the information processing model
- Domains
  - experimental psychology
  - cognitive neuropsychology   cognitive science
  - cognitive neuroscience
- What does this have to do with clinical or counseling or developmental or school psychology or speech pathology or exercise physiology or...?

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4 🔲 # Key Themes/Continua in the Study of Cognitive Psychology
- Nature v. nurture
- Rationalism v. empiricism
- Structures v. processes
- Domain generality v. domain specificity
- Internal v. external (ecological) validity
- Applied v. basic research
- Biological v. behavioral methods

5 🔲 # Structures vs. Processes
- **Structures**
  - **components** of cognitive apparatus that represent the organization of mental entities
  - are largely metaphorical and static
  - examples: filters, lexicons, storage systems, trees
- **Processes**
  - systems of operations or functions that analyze, transform, or change mental **events**
  - are active, dynamic
  - examples: inhibition, forgetting, encoding, problem-solving

6 🔲 # Historical Antecedents
- *Philosophy*: concerned with understanding experience through introspection - rational
- *Physiology:* scientific understanding of life-sustaining processes in living matter - empirical

7 🔲 # Rationalism vs. Empiricism
- *Plato:* theory of forms, reality resides not in concrete objects, but in the abstract forms (ideas) they represent - forerunner of rationalism; this idea picked up again by **Descartes** in 17th century; idea of innate knowledge
- *Aristotle:* reality resides only in concrete world of objects, abstract ideas are a derivation - forerunner of empiricism; this idea picked up again by **Locke**; humans born without knowledge, experience writes on the mind

8 ⬜ ## Structuralism vs. Functionalism
- *Structuralism:* understand basic parts (akin to anatomy) of the mind (e.g., Wundt)
- *Functionalism:* understand basic processes (akin to physiology) of the mind (e.g., James)

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11 ⬜ ## Associationism and Behaviorism
- *Ebbinghaus* (1850-1909) - studied how associations between stimuli were formed; used empirical methods
- *Thorndike:* (1974-1949) - law of effect - stimulus will produce response if response is rewarded
- *Rise of behaviorism* - Pavlov, Watson, eventually Skinner (1930's-1960's)

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13 ⬜ ## Forerunners of Cognitive Psychology
- *Developments in Psychobiology*
  - *Lashley* (1890-1959): interested in understanding physiological underpinnings of behavior; brain and mass action ("Search for the Engram")
  - *Hebb* (1949): concept of cell assemblies; articulated groupings of cells organized on the basis of experience ("The general idea is an old one, that any two cells or systems of cells that are repeatedly active at the same time will tend to become 'associated', so that activity in one facilitates activity in the other.")

14 ⬜ ## Cognitive Revolution
- **1932**
  - Tolman "Purposive Behavior in Animals and Man"
  - Bartlett "Remembering"
- **1950's-1960's**
  - Chomsky's (1956) theory of language
  - Miller's (1956) magic number seven
  - Newell & Simon's (1958) General Problem Solver
  - Artificial Intelligence movement (1956)
  - Broadbent (1958) information processing account
  - Neisser's (1967) "Cognitive Psychology"

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16 ⬜ ## Rise of Cognitive Theory
- **Associated developments**
  - failures of behaviorism to account for mental events
  - rise of communication theory (e.g., signal detection)
  - rise of modern linguistics
  - memory research
  - advances in computer science; development of dominant metaphor
- **Information-Processing concepts**
  - development of stage models of attention and memory
  - top-down, bottom-up processing
  - perceiver's expectations/schemata

17 ◻ Information-Processing Paradigm

- We are autonomous and intentional, interacting beings
- The mind is a general-purpose, symbol-processing system
- This system represents the outside world symbolically
- Aim of cognitive science is to specify symbolic processes
- Cognitive processes take time (RT)
- The brain is a limited-capacity processor
- The symbol system depends upon a neurological substrate, but is not wholly constrained by it

18 ◻ The Three Main Approaches

- **Cognitive Psychology**
  - experimental cognitive approaches
  - computational modeling
- **Cognitive Neuropsychology**
  - experimental clinical approach
- **Cognitive Neuroscience**
  - electrophysiology and neuroimaging
  - neural modeling

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20 ◻ Serial vs. Parallel Processing

1 SERIAL
- architecture takes the form of a traditional "box diagram"
- discrete 'stages' of processing
- unidirectional
- catastrophic degradation
- imply single inputs and outputs

2 PARALLEL
- architecture is network-like, consisting of units or nodes
- no discrete 'stages of processing'
- bidirectional (typically)
- graceful degradation
- multiple inputs and outputs

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24 ◻ Characteristics of PDP Networks

- Network consists of **elementary nodes** that are connected together so that a single unit has many links to other units
- The unit takes the weighted sum of inputs and produces output to another unit if threshold is exceeded
- Network is characterized by the **pattern of connections and the weights** assigned to each connection
- Networks can have **different structures or layers**; typically "input", "output" , and intermediate ("hidden") layers
- A concept is stored as a **pattern of activation** in the network as a whole, rather than activity in a localized area
- The **same network can store many such patterns**
- Some networks **learn through "backpropagation"**

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Cognitive Neuropsychology
- Major assumption: the way in which cognitive processes degrade in conditions of damage reveal the way they are normally organized in the brain
- Dissociation logic: can isolate important variables through double dissociation

27 A (disputed) example of a double dissociation: Motor skill learning vs. perceptual priming in dementia

Assumptions of Cognitive Neuropsychology
- **Isomorphism**: relationship between physical brain and organization of mental events
- **Modularity**: independent cognitive processors, each of which performs a specific function and could operate in isolation

Modularity (Fodor, 1983)
- **Informational encapsulation** (each module dedicated to a function)
- **Domain specificity** (each module processes one and only one type of information)
- **Mandatory operation** (modular functioning not under voluntary control)
- **Innateness** (hard wired)

30 Framework for Theories in Cognitive Science (Marr, 1982)
- **Computational Level**: what is the cognitive system supposed to do?
- **Algorithmic Level**: how does the system achieve its goals? How does input get coded and transformed?
- **Hardware Level**: how is the algorithm and the computation instantiated physically?

Methods
- Introspection (generally mushy)
- Performance (accuracy)
- Reaction time
- Physiology
  - single unit
  - electrophysiology
  - blood flow
- Ablation (lesion) approach
- Computational modeling

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Major Domains
- **Visual cognition** (e.g., object perception and recognition)
- **Attention** and resource allocation

- **Learning/Memory** - structures and processes
- **Knowledge Representation**: nature and organization of stored knowledge
- **Language** (development/use of symbol systems)
- **Problem-solving** (defining and working toward effective solutions)
- **Reasoning/decision-making**
- **Cognition and emotion** (effect of emotional arousal on cognition, affective nature of cognitive processing)

35 ▣ Relevance to Clinical/Counseling Issues: Some examples

- Selective attention
- Nature of reconstructive memory (e.g., trauma-based memories)
- Nature of categorization (relevance to clinical diagnosis)
- Problem-solving (how people generate novel solutions to ambiguous problems)
- Emotion-cognition interface (e.g., attentional bias in anxiety; interpretive biases in depression)