

PSYCH 207: Cognitive Processes

Chris Thomson

Winter 2013, University of Waterloo

Notes written from Jonathan Fugelsang's lectures.

1 Introduction & Course Structure

1.1 Course Structure

The grading scheme is four in-class non-cumulative multiple-choice exams, equally weighted. There is also a 4% bonus for research participation through SONA. You should get the textbook.

See the course syllabus for more information – it's available on Waterloo LEARN.

1.2 Introduction to Cognitive Processes

“Cognitive psychology refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used.” – Neisser, 1967

Cognitive psychology involves perception, attention, memory, knowledge, reasoning, and decision making.

Cognitive processes are everything that goes on in our mind that affects our environment. Many of these processes are completely unconscious.

Conscious experience is an active reconstructive process. The external world and our internal representation of that world is *not* an exact match. Our brain ends up filling in many gaps, making many assumptions.

Our brain cannot decontextualize the world.

2 Historical Overview & Approaches

Attention (notice *something*) → Perception (perceive that *something*) → Pattern Recognition (recognize what that *something* is) → Memory (recall previously-known attributes about the *something*).

Our cognitive apparatus is ultimately an efficient simplification process.

2.1 Antecedent Philosophies and Traditions

Many researchers take very strong views on empiricism vs. nativism, however reality is most likely somewhere between the two. The debate for structuralism vs. functionalism is similar.

2.1.1 Empiricism

- Locke, Hume, and Stuart Hill.
- Emphasis is on experience and learning.
- Key is the association between experiences.
- This is observational learning – the nurture side of the nature vs. nurture argument.

2.1.2 Nativism

- Plato, Descartes, and Kant.
- Emphasis is on that which is innate.
- Innate causal mechanisms.
- This is the nature side of the nature vs. nurture argument.

2.1.3 Structuralism

- Wundt and Baldwin.
- The focus is on the elemental components of mind.
- Very reductive – it's about stripping out context to understand the very basic elements.
- Introspection (method)
 - Report on the basic elements of consciousness.
 - Not internal perception, but experimental self observation.
 - Must be done in a lab under controlled conditions.
 - Basic elements of the conscious experience include processes like identifying colors.

2.1.4 Functionalism

- William James.
- Regarded the mission of psychology to be the explanation of our experience.
- Key question: why does the mind work as it does?
- The function of our mind is more important than its content.
- Introspection in natural settings (method)
 - Must study the whole organism in real-life situations.
 - Must get out of the lab to conduct functionalist research.

2.1.5 Behaviorism

- Watson and Skinner.
- Started in the 30s and was the dominate focus of academic psychology until the 60s.
- Originally evolved as a reaction to the lack of progress provided by introspection.
- A behaviorist sees psychology as an objective, experimental branch of science. Psychology's goal is the prediction and control of behaviour. Therefore, they make behaviour (not consciousness) the focus of their research.
- Focus is on the relation between input and output, but the steps in between (which make up cognitive psychology) do not matter to behaviorists.

2.1.6 Gestalt Psychology

- Wertheimer, Koffka, and Kohler.
- Focus is on the holistic aspects of conscious experiences.
- Key question: what are the rules by which we parse the world into wholes?
- Introspection (method)
 - Experience is simply described, never analyzed.
- A unified whole is often different than the sum of its parts. How do we impose structure on what's already out there? For example: 8 line segments in groups of 2 are interpreted differently than the 8 lines being all scrambled together in a seemingly random way.
- How does the mind simplify the world to focus our attention on things/objects that matter?
- We need to study phenomena in their entirety, since a unified whole is different than the sum of its parts.

2.1.7 Individual Differences

- Sir Francis Galton.
- Intelligence, morals, and personality are innate.
- Mental imagery was studied in both a lab and in natural settings. The vividness of mental imagery differs from person to person.
- Galton invented the process of using questionnaires to assess abilities. This process has been used by cognitive psychologists ever since.

2.2 The Cognitive Revolution

- The speed of information publishing, sharing, and retrieval has become very fast.
- We're now running into the cognitive speed limit as our limiting factor, whereas before communication channels (snail mail, travel) slowed down research.
- Recent advances in neuroimaging are also a mini-revolution in cognitive psychology.

2.2.1 Human factors engineering presented new problems

- A machine should be designed for human use – for use in the most efficient way possible. Knowledge of human cognition is required in order to increase efficiency.
- We have to think about the 7 ± 2 information limitation of the human mind, and how to get around the limit.
- NASA hires cognitive psychologists to study how the human mind operates in extreme conditions. Cognitive psychologists develop the user interfaces that astronauts use.

2.2.2 Behaviorism failed to adequately explain language

- Skinner in 1957 (behaviorism): children learn language by imitation and reinforcement.
- Chomsky in 1959 questioned Skinner's explanation of language.
 - Children often say sentences they have never heard before, such as "I hate you mommy." (Not imitation.)
 - Children often use incorrect grammar, such as "The boy hitted the ball", despite a lack of reinforcement.

2.2.3 Localization of functions in the brain forced discussion of mind

- Donald Hebb stated that some functions, like perception, are based on cell assemblies (collections of neurons).
- Hubel and Weisel demonstrated the importance of early experiences on the development of the nervous system. Early experiences actually change how some cell assemblies physically develop.
- Many things seem to happen without observational learning coming into play.

2.2.4 Development of computers and artificial intelligence gave a dominant metaphor

- A computer takes input into short-term memory (RAM), may access long-term memory (a hard drive), and returns some output.
- The mind may work in a similar way.
- Perhaps we introspected and that's why we developed computers the way we did?

2.3 Paradigms of Cognitive Psychology

- Emphasis is on serial processing.
- Information is stored symbolically.
- The mind is an information processing system with systems of interrelated capacities.
- All of these attributes are similar to that of typical computer systems.

2.3.1 Localist models

- A symbolic concept, such as a letter, word, or meaning, is represented in your mind with a node.
- You may have a node for 'cat', 'dot', or 'house' (lexical knowledge). You may also have a node for 'provides shelter', 'barks', or 'has four legs', all of which are boolean attributes (semantic knowledge).

2.3.2 Connectionism – Neural network models

- Parallel processing across a population of neurons.
- Multiple neurons are used to represent complex concepts. For example: the representation of a person may have a neuron for their name, a neuron for their profession, a neuron for their cat's name, and so on.
- The pattern of activation of the neurons represent a symbolic concept.
- Semantic knowledge and lexical knowledge for a particular symbolic concept have different activation patterns.
- Units in neural networks are connected by weights that are modified by learning (positive weight \rightarrow activation, negative weight \rightarrow inhibition).

2.4 Major Assumptions of Approaches

The major assumption of these approaches is that research must be done in the lab. This is believed for two key reasons:

- We must uncover the basic processes underlying cognition in order to fully understand it.
- Processes are stable across situations, and can only be researched under controlled conditions (such as in a lab).

2.5 Other Approaches

2.5.1 The Evolutionary Approach

- Mental processes are subject to natural selection.
- Cognition is based off our history, and special processes have developed over time.

2.5.2 The Ecological Approach

- Cognitive processes develop with culture and differ depending on the context and situation.
- Analyzes how humans behave in context-specific situations. As a result of this approach, natural observation must be used instead of lab research.
- People focus on the eyes of others, because they show attention, desires, and more. This behavior might differ depending on the context.