Cognition and Consciousness

Cognitive Architecture

What kind of computational device is the human brain?
1. How is a computational problem divided up among processors?
   - Serial (one processor handles one part of the data, then another part, etc.).
   - Parallel (many processors handle different parts of the data at the same time.)
2. How many kinds of memory?
3. What format of data representation (alphanumeric, graphics, LISP-like structures, etc.).

Visual Attention

- Parallel vs. Serial processing.

Find the “o”
Find the green letter

Find the red “o”
Find the green “x”

Treisman's Feature Integration Theory:

• 1. Feature maps: one each for color, line orientation, curved/straight, motion, etc.
• 2. Features computed everywhere in visual field preattentively, in parallel
Treisman's Feature Integration Theory:

1. Feature maps: one each for color, line orientation, curved/straight, motion, etc.
2. Features computed everywhere in visual field preattentively, in parallel
3. Odd-man-out computed everywhere in visual field preattentively, in parallel
4. Features are integrated by focal attention, a serial process
Predictions:

- *Single* features “pop out”; they can be detected in parallel
- *Conjunctions* of features have no detectors of their own. They require attentional, serial search.

Two demonstrations of Feature Integration Theory:

1. Compare:
   - Single-feature search (red among greens; X’s among O’s): Fast, no matter how many items.
   - Conjunction search (red X among red O’s and green X’s): The more items, the longer it takes.
Feature integration theory, cont.

- 2. Illusory conjunctions (unattended features float around, recombine randomly)

- WORLD’S BEST COFFEE
- BROTHERS’ HOTEL
- SEMI-ANTIQUE CAMERAS
Visual Attention, continued

- A second distinction: Automatic vs. controlled processing.
9.00 Introduction to Psychology
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Week 6, Lecture 1: Cognition and Consciousness

The Stroop effect:
• Reading is automatic
• Color naming is controlled

Memory
• Short-term (working) versus long-term memory.
• Experimental evidence for the distinction between short-term and long-term memory:
Experimental evidence for the distinction between short-term and long-term memory

- Recency effect in recall of lists of words.
- Elimination of recency effect by task that interferes with rehearsal.

Neuropsychological evidence for the distinction between short-term and long-term memory:

- HM and similar cases: Hippocampus and nearby structures removed.
Effects of Damage to Hippocampus & Surrounding regions:

• Long-term memory OK.
• Short-term memory OK.
• No ability to form new long-term memories.

Subdivisions of Long-Term Memory

• Declarative (explicit) versus Implicit (procedural and emotional) memory.
  – Hippocampus (declarative)
  – Basal ganglia, cerebellum (procedural)

Subdivisions of Long-Term Memory, cont.

• Declarative (explicit) versus Implicit (procedural and emotional) memory.
  – Hippocampus (declarative)
  – Basal ganglia, cerebellum (procedural)
  – Amygdala (emotional, e.g., classical conditioning of fear)
A Division within Declarative (Explicit) Memory:

- Episodic (autobiographical) versus Semantic (encyclopedic) Memory.
- Both (probably) stored throughout the cortex, especially in the temporal lobe

Kinds of Long-Term Memory

The Case of Clive Wearing
Augustine on Memory

Great is the power of memory, a fearful thing, O my God, a deep and boundless manifoldness; and this thing is the mind, and this am I myself.

Leibniz on Memory:

• Let us suppose that some individual were to become King of China at one stroke, but on condition of forgetting what he had been, as if he had been born anew. Is it not as much ... as if he were to be annihilated and a King of China to be created at his place at the same instant? Which this individual has no reason to desire ...

Gottfried Leibniz, Discourse on Metaphysics.

Forms of Mental Representation

• Phonological loop: one component of working (short-term) memory
• Propositions (semantic networks, Mentalese): one component of declarative memory.
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**Forms of Mental Representation, cont.**

- Phonological strings: one part of working (short-term) memory
- Propositions (semantic networks, Mentalese, conceptual representations).
- Mental imagery: another part of working (short-term) memory. “Visuospatial sketchpad.”

**Some Evidence for Image Representations:**

- Memory improvement: imagining concrete nouns improves memory.
- Interference with perception: hard to see and imagine at the same time.
- Mental transformations: Larger mental rotations take more time.
Consciousness

• "How it is that anything so remarkable as a state of consciousness comes about as a result of irritating nervous tissue, is just as unaccountable as the appearance of the Djin, when Aladdin rubbed his lamp."
  ---Thomas Huxley

The Ambiguity of the word “consciousness”

**Introduction to Psychology.** The theory of human behavior. Is there a split between mind and body, and, if so, which is better to have? Special consideration is given to a study of consciousness as opposed to unconsciousness, with many helpful hints on how to remain conscious. --Woody Allen

The “easy” problem of consciousness: Information Access

• Some kinds of information in the brain are accessible to verbal reports and deliberate decision making:
  – Perceived objects; Actions; Contents of Sentences.
• Other kinds of information are not accessible:
  – Retinal image; muscle movements; rules of syntax.
How Cognitive Psychology has Studied the Easy Problem of Consciousness:

- Preattentive (unconscious) versus attentive (conscious) processing.
- Automatic (unconscious) versus controlled (conscious) processing.
- Long-term memory (unconscious) versus short-term memory (conscious).
- Implicit memory (unconscious) versus declarative memory (can be made conscious).

How Neuroscience has Studied the Easy Problem of Consciousness:

- What's the difference between an awake and an anesthetized brain?
- What parts of the brain are directly connected to the frontal lobes? (Crick & Koch)

The “hard” problem of consciousness:

- Subjective experience:
  – “sentience”
  – Raw feels
  – “What it is like” to do or feel something
  – 1st person present tense
  – subjective experience
  – “qualia”

The Hard Problem of Consciousness

- Could a computer program be conscious?
- Walkie-talkies in China
- The Inverted Spectrum (my red = your green?)
- Zombies.
- Other minds (solipsism).
- The transporter room.
- Animal minds.
- Neuron replacement therapy.
Five Theories of Sentience.
Theory 1: Behaviorism
Sentience makes no difference to anything; therefore it is an illusion.
• Problem 1: Descartes’ disproof: Cogito.
• Problem 2: Ethical problem: why shouldn’t we hurt people?

Theory 2. Computation
Sentience comes from information and information processing (computation)
• Problem 1: How?
• Problem 2: Panpsychism (consciousness is everywhere).

Theory 3: Neural reductionism
The brain secretes consciousness.
• Problem 1: How?
• Problem 2: Rules out sentient aliens, robots a priori.

Theory 4: Quantum Gravity
Sentience comes from quantum interactions in neurons.
• Problem 1: How?
• Problem 2: The "weird = weird" fallacy.
Theory 5: Cognitive limitations (The “mysterian” theory)

- Our mind prevents us from understanding sentience.
  - We can’t see in ultraviolet light;
  - We can’t hold 1000 items in short-term memory
  - We know animals can’t understand certain truths
- Why should evolution have made us angels?
- Lack of ability to formulate *incorrect* theory.

- Problem 1: That’s what they said about “life” in the 19th century!
- Problem 2: How do we know what we can't ever know?

• Mind, n. A mysterious form of matter secreted by the brain. Its chief activity consists in the endeavor to ascertain its own nature, the futility of the attempt being due to the fact that it has nothing but itself to know itself with.
  --Ambrose Bierce, The Devil's Dictionary