Memory 2

Types of Memory (Intro)
More Brain Areas and Memory
Storage of Semantic Memories

The encoding-specificity principle implies that memory is _____ .

Choose one

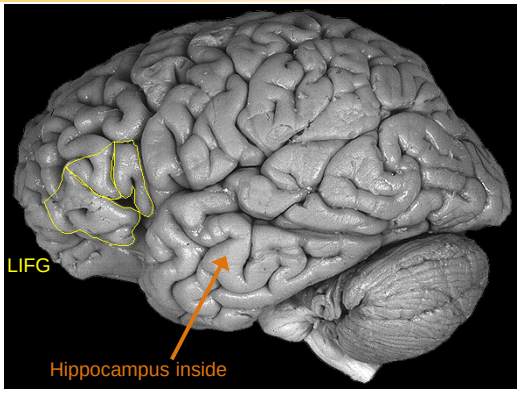
A. objective
B. subjective
C. inaccurate
D. emotional

Functional Categories of Memory

- Explicit
  an address, telephone number, the capital of India
- Implicit
  riding a bike, recognizing faces, conditioned responses and operants
- Explicit memory can be further divided
  - Semantic memory
    Memories for facts, including word meanings, that are not tied to any specific time or place
  - Episodic memory
    Memories for specific events and experiences

Other Brain Areas Associated with Episodic Memory Formation

- Neuroimaging: fMRI & PET, EEG & MEG
- Encoding study: Comparing fMRI activation of brain areas during a study phase
  - For items that were later recognized
  - For items that could NOT later be recognized
- Regions identified by Wagner & Buckner
  - Hippocampus in the left hemisphere
  - Left inferior frontal gyrus (LIFG)



Two Neural Learning Mechanisms that Underlie Memory

- Hippocampus
  - Specialized for rapidly learning and later reinstating neural activity associated with specific events
  - Assigns distinct representations to each stimulus
    - Allowing rapid learning without interference between memory traces
- Medial temporal lobe (MTL)
  - Specialized for slowly learning about the statistical regularities of the environment
  - Assigns similar representations to similar stimuli
  - Use of overlapping representations
    - Captures the shared structure of events
    - Makes it possible to generalize to novel stimuli as a function of their similarity to previously encountered stimuli.

Summary: Brain Areas Involved in Long-Term Memory

- The hippocampus is critical for creating episodic memories.
- Frontal lobe areas are important for engagement with material (deeper processing).
- Medial temporal lobe is important for creating generic/semantic (i.e. non-episodic) memories

Summary: Brain Areas Involved in Long-Term Memory & Learning

- The hippocampus is critical for creating episodic memories.
- Frontal lobe areas are important for engagement with material (deeper processing).
- Medial temporal lobe is important for creating generic/semantic (i.e. non-episodic) memories
- The amygdala is critical for fear conditioning
  - Also for triggering the creation of memories with emotional content

Storage of Semantic Memories: Mechanisms and Codes

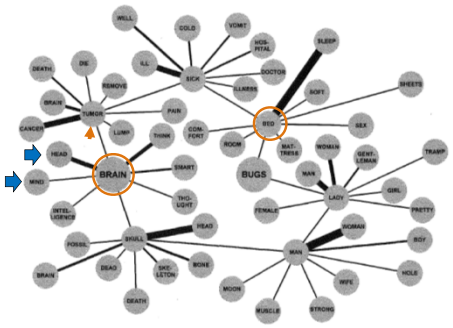
Memory requires two things

- Storage mechanism
  Something physical that is changed
  - In the brain, the strength of neural connections
- Code
  A convention that gives meaning to the physical changes

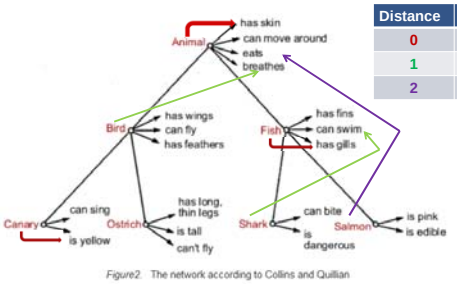
Semantic Memory is Associative

- Web is also an associative network
  - Many nodes (Web pages or Web sites)
  - Each linked to a subset of other nodes
- The pattern of links encodes information
- Free associations

Word Association Norms



Sentence Verification Zap



Distance	RT (secs)
0	1.100
1	1.165
2	1.307

Figure2 The network according to Collins and Quillian

Nodes and Links in the Brain

- Nodes and links are convenient abstractions to describe the structure of human semantic memory
- But the brain is made of neurons and synapses
- Concepts are represented by activity in sets of interconnected neurons
  Nodes (concepts) ≠ Individual Neurons

Nodes and Links in the Brain – 2

Quiroga et al. (2005). *Nature, 435,* 1102-1107

- Some neurons in the human brain, respond reliably whenever the subject is seeing pictures of specific people
- Just from the activity of these cells, the experimenters were able to get a good idea which picture subject is viewing
- Each of these neurons also responds to many unrelated pictures

Forming Associations

- Associations in semantic memory are formed using synaptic plasticity following Hebb's rule
- This process is *self organizing*

An Experiment

1. What continent is Kenya in?
2. What are the two opposing colors in the game of chess?
3. Name any four-footed animal.

What animal did you name?

Choose one

A. Dog
B. Cat
C. Horse
D. Zebra
E. Something else

Priming

- Knowledge is stored associatively as a network of associated concepts
- Memory retrieval initiates a process of spreading activation
  - Automatic and unconscious
- Spreading activation and priming are critical for
  - Language comprehension
    "Your dog ate my hot dog!"
  - Thought and behavior
- Also the source of many memory "problems"

Lexical Decision Results

Strongly associated words: Doctor – Nurse	0.54 s
Weakly associated words: Coffee – Roof	0.58 s
NonWord then a Word: prenkt - table	0.59 s
NonWord then a NonWord: human - stolp	0.68 s
Word then a NonWord: reptur - nosmok	

- Spreading activation
- Priming

Looking Ahead

- For Wednesday
  - Gleitman: Ch. 8, pp. 317-327
  - Zap #7: Recalling Information
  - Zap #8: Memory Bias
- Coffee at Phoenix Grill?