Knowledge
Chapter 9

Learning Objective Topics

• Categorization: How are objects placed into categories?
  o Prototype Model
  o Exemplar Model

• Organization: How is it all organized?
• Neuroscience of Knowledge
What are concepts?

- Concept: mental representation used for a variety of cognitive functions

- “Without concepts, mental life would be chaotic.” Smith & Medin 1981
- “Concepts are the glue that holds are mental world together .. They tie our past experiences to our present interactions with the world” Murphy 2002

Why do concepts matter?

- How concepts are defined may have serious consequences, and can be at the basis of political and legal debate:
- Examples:
  - abortion and euthanasia - how to define “human” and “murder”
  - marriage - should it include gay relationships
  - drugs - cannabis legislation
How do we use concepts?

• Categorization is the process by which things are placed into groups called categories.
• What would a world be like without categorization?
  What wouldn’t we be able to do?

What is going on here?

You learn all sorts of info by knowing something is in a particular category!
How do we categorize things?

• Definitions??

Define the following:

• bathing suit
• music
• pie
• Door

• What are the problems/challenges?
Categorization

• If definitions don’t work, how DO we put information into categories?

Ludwig Wittgenstein (1953)

• Philosopher
• Family resemblance
  o Things in a category resemble one another in a number of ways
• Inspired:
  o Prototype Approach
  o Exemplar Approach
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What is a prototype?

• Best, most typical member of a category
• Usually a typical member because averages features

• What is the prototypical bird?
• What is the prototypical hero?
• What is the prototypical residence?
• What is prototypical music?
• What is the prototypical meal?

• How would each of these vary across cultures, world regions, or other individual differences?
• How could we determine what most people feel is prototypical more systematically?
Rosch (1975)

- Level of prototypicality
- Participants rated category members:
- Scale from 1-7
  - “1” means the member is a “poor example”
  - “7,” which means the member is a “good” example of the category
- Rate these:
- Furniture:
  - Mirror
  - China
  - Chair
  - Sofa
  - Telephone

(b) Category = furniture
(c) 2003 Carnegie Mellon
Compare to the prototype.

• Is this music?
• [Video Link]
• [Video Link]
• [Video Link]
• [Video Link]

How does prototypically compare to family resemblance?
Prototypes are special!

• Name five articles of clothing
• Time your partner:
  o T/F Pants are clothing
  o T/F A footstool is furniture
  o T/F A vest is clothing
  o T/F A divan is furniture
  o T/F A table is furniture

Prototypes are special!

• Prototypical objects named first:
• Name five articles of clothing
• Typicality effect: Sentence verification = faster:
• Time your partner:
  o T/F Pants are clothing
  o T/F A footstool is furniture
  o T/F A vest is clothing
  o T/F A divan is furniture
  o T/F A table is furniture
Priming

- Rosch (1975)
  - Press a key if colors are same or different
  - Hearing "green" primes a highly prototypical "green" (faster)

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What is an exemplar?

- Why could this be better than prototypes?

Exemplar Theory

- Exemplar theory
  - Make judgments by comparing to memories
  - New cat is compared to memories of previous cats
The Exemplar Approach

- Similar to prototype view
  - Representing a category is not defining it
- Different: representation is not abstract
  - Descriptions of specific examples
- The more similar a specific exemplar is to a known category member, the faster it will be categorized

Prototypes can’t explain all data:

- Medin et al’s (1982) “burlosis” experiment
- Create a new “category”: a fake disease called burlosis
- Give subjects example case studies with symptoms
- How do people create the burlosis category?
  - Prototype: Average cases together
  - Exemplar: Use information about each case
Training: Category creation

- **Correlated condition:**
  Nosebleed & discolored gums always occurred together

- **Uncorrelated:**
  Those two symptoms did not occur together

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Burlosis: Predictions

- If **prototype**, average case should be created (all symptoms together)
  - All symptoms were similar in both conditions
  - Correlation of the last two symptoms should not matter

- If **exemplar**, common example should be used (correlation of two symptoms)
  - Correlated symptoms were good exemplars of burlosis
  - Correlation should matter
Test: New case categorization

- Subjects given test cases to diagnose (classify new objects in a category)
  - All test cases had the same average number of symptoms

<table>
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<th>Roger</th>
<th>Susan</th>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Unc</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

- Prototype: Correlation should not matter
  - cases should be selected equally
- Exemplar: Correlation should matter
  - should select correlated one more

Burlosis: Results

* Participants based diagnosis on patterns/exemplars
What does this show?

• People were using exemplars because they were using the correlated information in diagnosis

• If people were using prototypes, correlated information should not have mattered in training or in test

• Prototype model cannot explain these data!

Prototypes or Exemplars?

• May use both
• Exemplars may work best for small categories
• Prototypes may work best for larger categories
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What is this?
Hierarchical Organization

- Rosch: most say basic

Semantic Networks

- Prototypes & exemplars are theories of the structuring of information into categories

- Semantic networks are theories of relationships between categories

- Chimpanzees have the T4 gene. How likely is it that gorillas have the T4 gene? How about dolphins?
Collins and Quillian (1969)

Why organize into networks instead of storing all of the information in each node?

Semantic Networks

- **Spreading activation**
  - When a node is activated, activity spreads out along all connected links
  - Concepts that receive activation are primed and more easily accessed from memory
  - Saying “A robin is a bird” primes “animal”, “canary”, “ostrich”
Criticism of Collins and Quillian

- Cannot explain typicality effects
- Cognitive economy might be bogus
  - May actually store info at multiple modes
- Some sentence-verification results are problematic for the model
  - A pig is an animal
  - A pig is a mammal (this should be faster)

Collins and Loftus (1975) modifications

- Shorter links to connect closely related concepts
- No hierarchical structure; based on person’s experience
Semantic Networks and Marketing

Efforts to produce artificial intelligence and marketing tools through semantic networks.

- http://www.duke.edu/~mccann/mwb/15semnet.htm

• How might the following be related to semantic networks, spreading activation, priming/associations between topics?
  - False memories
  - Autobiographical memories
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Categories in the Brain

• Categories are represented by distributed activity
  o More similar patterns of brain activity for categories with similar features
  o Category-specific neurons
Can monkeys categorize cats and dogs?

"Is the test stimulus from the same category as the sample stimulus?"

Inferiotemporal cortex: features/shapes
Prefrontal cortex: abstract, decision-making

Semantic Knowledge and the Brain

- - - Cases where people cannot retrieve semantic information
Visual Agnosia

- Failure to recognize objects from sight
- no low-level visual impairment (can detect color, line orientation, motion, etc)
- two forms of visual agnosia:
  - **apperceptive**: unable to form a stable representation or percept of the object
    (aka: they can’t distinguish the actual shapes, couldn’t copy a drawing)
  - **associative/semantic**: unable to access meaning of object; visual percept is void of meaning
    - (aka: they can describe or copy an object, they just can’t label it)

**Figure 18.11** Drawing used in the overlapping figures test. When asked to name all objects pictured, an agnosic patient can usually name one of them but cannot seem to perceive any of the others. (From Williams, 1973)

- **apperceptive agnosia** (visual perception appears to be affected)
  - cannot copy or draw objects
  - Can recognize by touch
Visual Agnosia

Associative/semantic visual agnosia
- perception appears to be normal, but cannot link to semantic information about the item
  - can copy but not draw (as at right)

Remember this - you’ll need it in a minutes

apperceptive agnosia (perception appears to be affected)

associative visual agnosia (cannot link to semantic information about the item)
• **Video** – they are showing him a combination lock
• Which kind of agnosia does this man have?
• How do you know?
• How would it have been different if he had the other kind of agnosia?
• How could it be tested to determine if someone has associative or apperceptive agnosia?

Based on those cases - what are the brain regions needed for semantic retrieval?
Category Specific Agnosia

• J.B.R.
  o Herpes simplex encephalitis
  o Many deficits including associative agnosia
  o Agnosia
    • Could name living things with only 6% success rate
    • Could name drawings of inanimate objects (scissors, chairs, clocks) = 90% success
  • Other patients can recognize living things, but not non-living things

• Different areas of the brain may be specialized to process information about different categories