Concepts

Intro Psychology
Georgia Tech
Instructor: Dr. Bruce Walker

Today

- Categories
- Prototypes
- Networks
- Imagery
- Thinking

Functions of Categories

- Reduce complexity

- Determine appropriate actions

- Provides relations within and between category exemplars

Semantics and Categorization

- Any discussion about representation of meaning requires account for categorization.

- What holds categories together?
- What distinguishes members of a category from nonmembers?
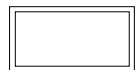

Rules

- Category membership determined by:
  1. *individually necessary* and
  2. *jointly sufficient* conditions.

- What are the necessary and sufficient features for "game" (Wittgenstein)

Bruner, Goodnow, & Austin (1956)

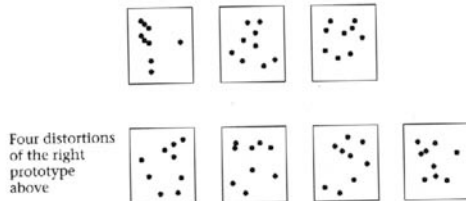Concept?

Bruner, Goodnow, & Austin (1956)

Prototypes

• Take a category like "bird"

• Members of that category are those animals that are similar to the prototypical "bird" (e.g., robin, blue bird)

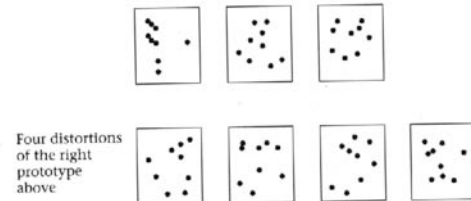## Prototypes

• Posner & Keele (1968; 1970)
  – Subjects studied 16 items from 4 random dot categories (4 distortions of 4 nonpresented patterns)
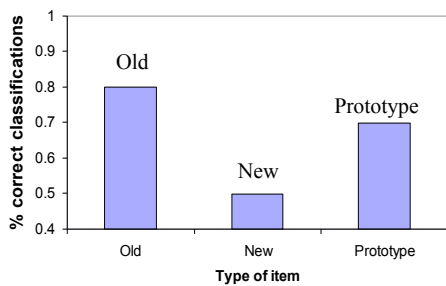

Four distortions of the right prototype above

Prototypes

• Posner & Keele (1968; 1970)
  – Test: Old patterns, or nonpresented prototypes, or new patterns (also distortions of prototype).

Four distortions of the right prototype above

Posner & Keele


Semantic Networks

6 Degrees of Kevin Bacon

- Start with some arbitrary Actor, and trace link to Kevin Bacon
  - Matt Damon - in "Legend of Bagger Vance" with Charlize Theron who was in "Trapped" with Bacon (Bacon number 2)
  - Henry Winkler (2), Marlene Dietrich (2)

Small World Networks

Regular   Small-world   Random

$p = 0$ ⟶ Increasing randomness ⟶ $p = 1$
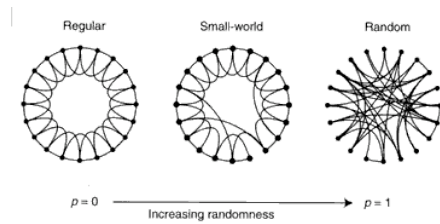
Small World Networks

- Short path links - one node to another usually only takes a small number of links
- Local clustering - some nodes serve as hubs (e.g., Kevin Bacon)
- Power law distribution of links

log (freq)

log(links)
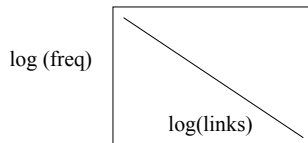
Small World Networks

- Amazing ubiquity of small world networks
  - WWW - Al Barabasi
  - Collaboration of Actors (Kevin Bacon)
  - Neural Network of C. Elegans
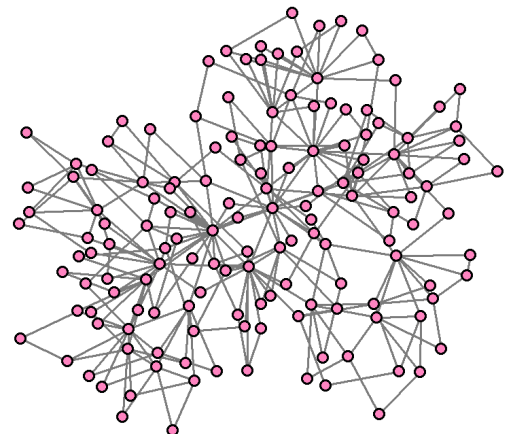 - Sexual Partners
  - Word association

Nelson et al. (1999)

$n_{words} = 5,000+$
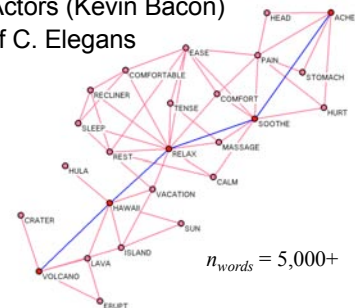
A specific type of growth seems to be what results in small worlds

People, words, concepts acquired early are probably important ("hubs").

Later acquired acquaintances, words, or concepts will probably be related in some way with those earlier people, words or concepts.

What's the Point?

- Knowledge representations probably take a variety of forms.
  - Lists of features
  - Prototypes
  - Networks
  - Categories can also be constructed ad hoc
  - Theories…
    - Imagine an animal born as a dog, but through a series of surgeries, dog gets 2 extra legs, compound eyes, etc, so now it looks more like an insect but when it mates with another dog, you get puppies. What is it?

Visual Imagery

Why Imagery?

- Mental image useful in many situations:
  - Often we need to "examine" something after the visual stimulus is gone
  - Often we need to compare a visual stimulus to a memory or prototype
- Properties of mental images have not been explicitly considered previously
- Properties of a mental image cannot be simply deduced from other information.

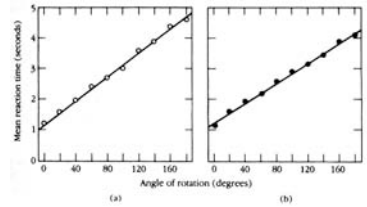# Mental Rotation
Roger Shepard

- Decide if two stimuli are the same or different.

- Stimuli are presented at different orientations.

- Measure the time required for the same/different response.
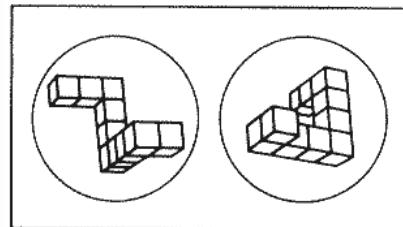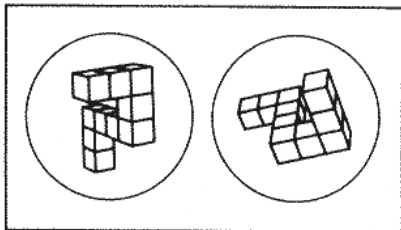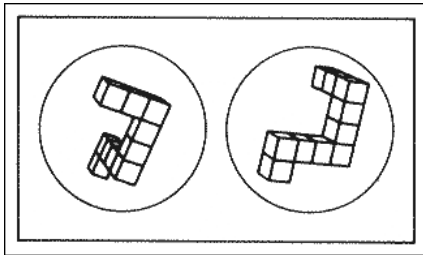
Mental Rotation

- Found that RT was linearly related to degree difference in rotation.
- As if observers mentally rotated one figure before comparing with other.

Retrieving Information from (Mental) Images

- Stephen Kosslyn, Harvard University

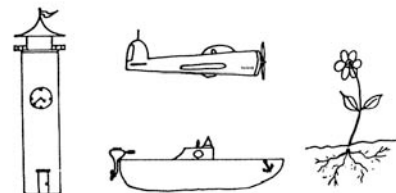## Retrieving Information from Images

- – Memorize the images of several objects.
- – After memorizing, participants asked to close their eyes and "look" at one part of the object.
- – Presented w/ object part, respond "Yes" or "No" if part was on object.
- – Parts could be close or far from current focus.

Retrieving Information from Images
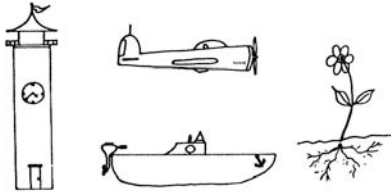
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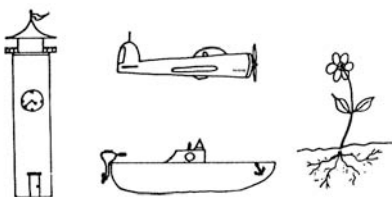
Retrieving Information from Images

RT for far part > RT for near part.

Retrieving Information from Images

– Distance *in picture* for big = distance for small
– RT for big distance > RT for small distance

How might imagery be implemented in the brain?

• If representations are "depictive", then they preserve spatial relations present in real vision
• Where in the brain are representations that are spatially organized - Visual Cortex
• "Re-perception" of visual images, perhaps we use visual cortex.

How might imagery be implemented in the brain?

• fMRI study
• 2 Conditions
  – Participants look at a complex visual display
  – Participants imagine the complex visual display

• Results
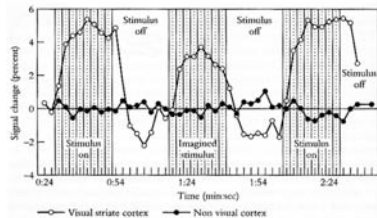
Upcoming

• Reasoning
• Decision making
• Language