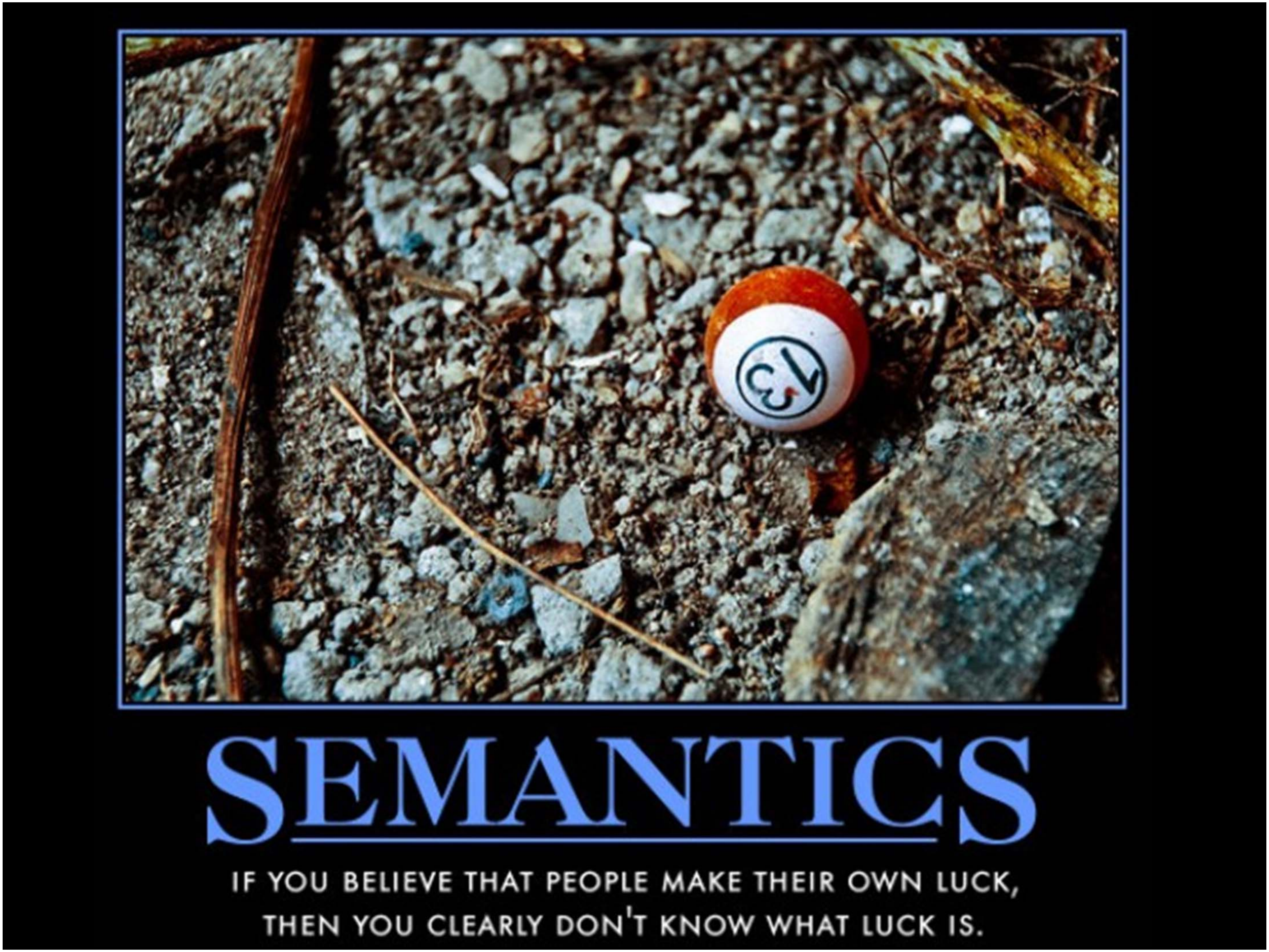
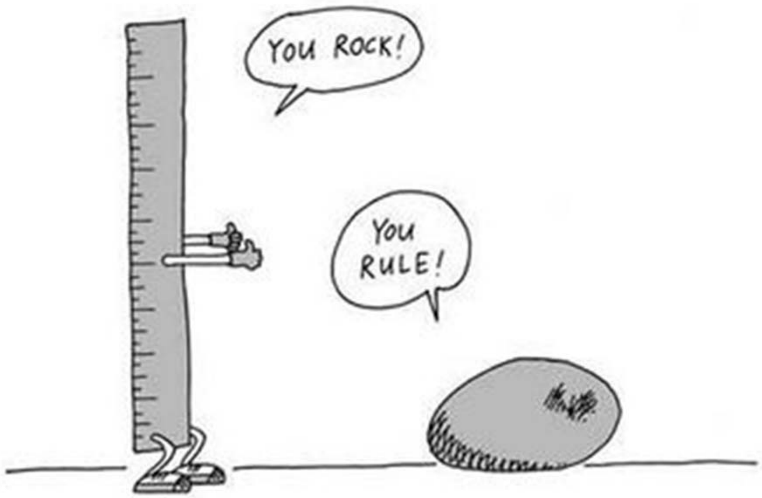

SEMANTICS
IF YOU BELIEVE THAT PEOPLE MAKE THEIR OWN LUCK,
THEN YOU CLEARLY DON'T KNOW WHAT LUCK IS.



Semantic Memory

Learning & Memory

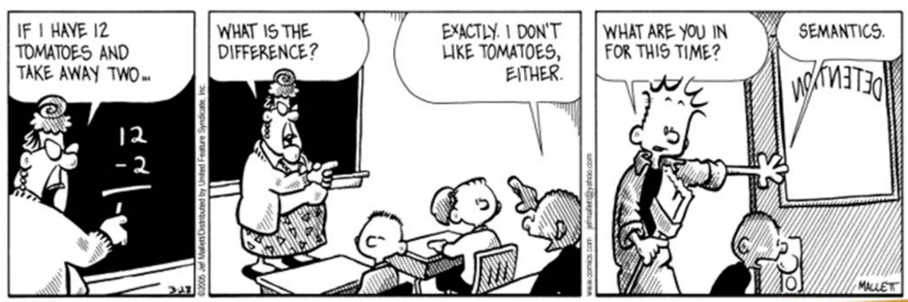
Semantic Memory

- *General knowledge about the world, not linked to any time or context*

  Some examples:

  - What is the capital of North Dakota?
    - Bismarck
  - What is the population of Detroit?
    - ~951,000
  - Is a tomato a fruit or a vegetable?
    - Fruit, but it tastes like a vegetable
  - What is the easiest way to get a message to your best friend?
    - Text message? Phone call? Email? Letter? Carrier Pigeon?

1. How do our brains organize and store the vast amount of information we learn about geography, history, baseball, etc.?\
2. Where is all this information stored and how do we access it?
3. How is new information added to an existing framework?



Hierarchically Organized

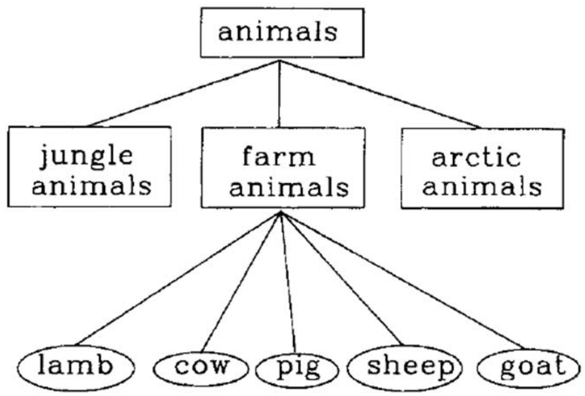
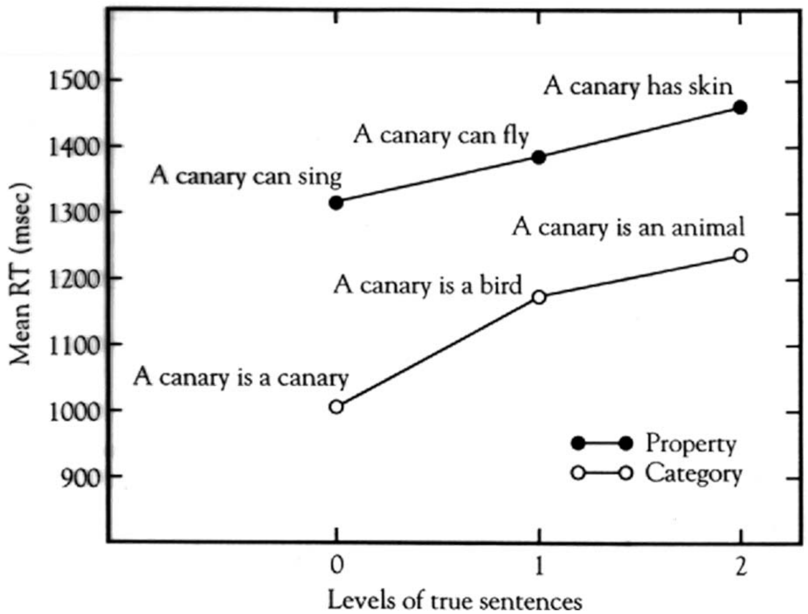


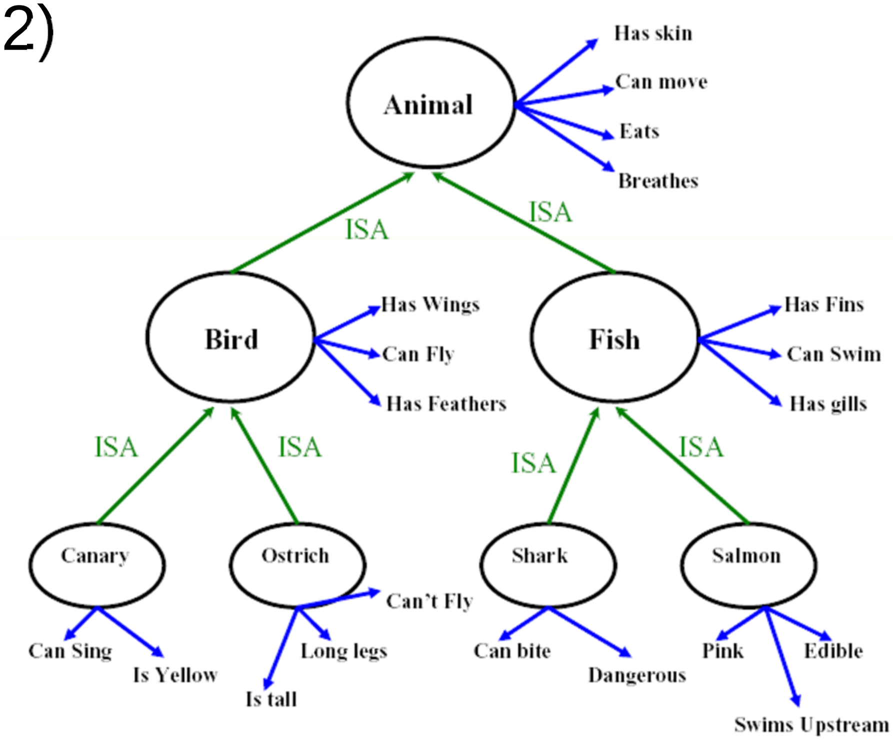
Figure 1. Hierarchical network model of semantic memory.

- Semantic Network Models
  - Collins & Qullian (1969)
  - Nodes, ISA, and Property Links

Semantic Network Models

- Collins & Qullian (1969; 1972)
  - Spreading Activation



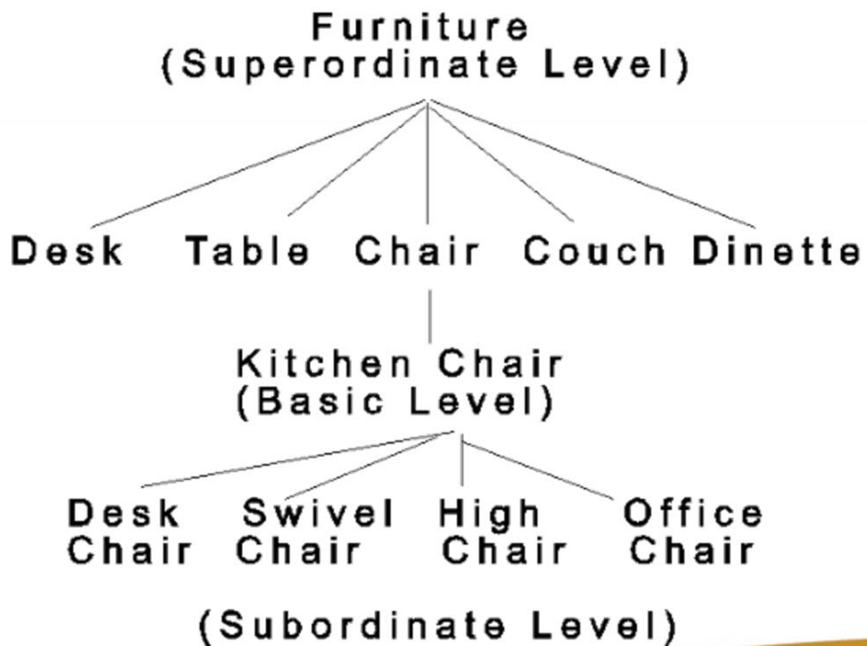


Category Learning

- Instance Learning Theories
  - Exemplars
- Feature Abstraction Theories
  - Property inheritance (aka Inferential Power)
    - Semantic Network Models
- Prototype Theories
  - (Rosch, 1970)

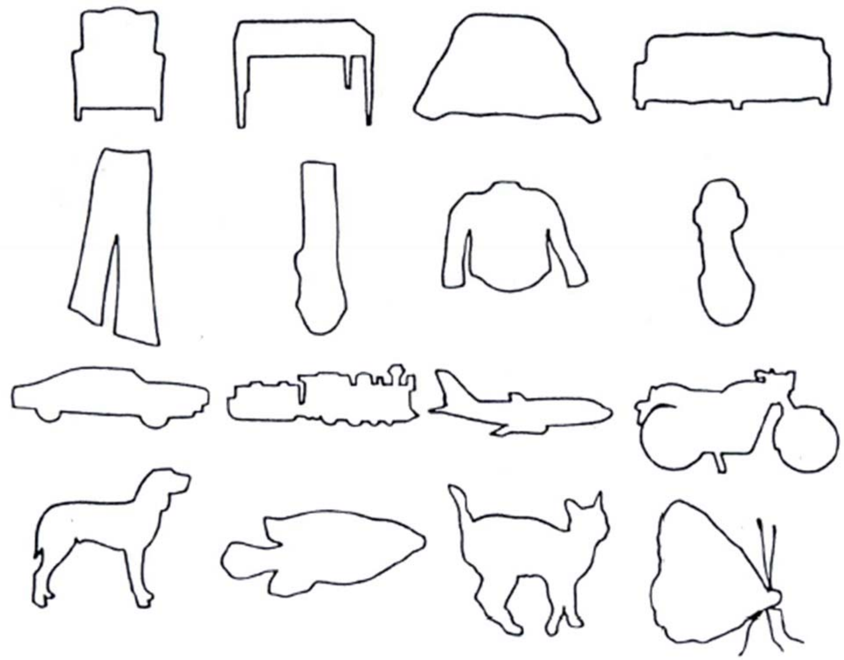
Aspects of Categorization

- Eleanor Rosch (aka Heider)



Converging Operations for Basic Level

- Common attributes
- Shape Overlap
- Labeling
- Verification
- Grouping of items by children



More than just categorical hierarchy?

- Miller's Junkbox Metaphor
- Rips et al. (1973)
  - RTs slower "*A dog is a mammal*" compared with "*A dog is an animal*"
- Rosch on ***Typicality*** and ***Family Resemblance***
  - Good examples of a category

    $r = 0.89 \pm .05$
  - Fuzzy Categories (McCloskey & Glucksberg, 1978)

Typicality

(Rosch & Mervis, 1975)

Item	Furniture	Vehicle	Fruit	Weapon	Vegetable	Clothing
1	Chair	Car	Orange	Gun	Peas	Pants
2	Sofa	Truck	Apple	Knife	Carrots	Shirt
3	Table	Bus	Banana	Sword	String beans	Dress
4	Dresser	Motorcycle	Peach	Bomb	Spinach	Skirt
5	Desk	Train	Pear	Hand grenade	Broccoli	Jacket
6	Bed	Trolley car	Apricot	Spear	Asparagus	Coat
7	Bookcase	Bicycle	Plum	Cannon	Corn	Sweater
8	Footstool	Airplane	Grapes	Bow and arrow	Cauliflower	Underpants
9	Lamp	Boat	Strawberry	Club	Brussel sprouts	Socks
10	Piano	Tractor	Grapefruit	Tank	Lettuce	Pajamas
11	Cushion	Cart	Pineapple	Teargas	Beets	Bathing suit
12	Mirror	Wheelchair	Blueberry	Whip	Tomato	Shoes
13	Rug	Tank	Lemon	Icepick	Lima beans	Vest
14	Radio	Raft	Watermelon	Fists	Eggplant	Tie
15	Stove	Sled	Honeydew	Rocket	Onion	Mittens
16	Clock	Horse	Pomegranate	Poison	Potato	Hat
17	Picture	Blimp	Date	Scissors	Yam	Apron
18	Closet	Skates	Coconut	Words	Mushroom	Purse
19	Vase	Wheelbarrow	Tomato	Foot	Pumpkin	Wristwatch
20	Telephone	Elevator	Olive	Screwdriver	Rice	Necklace

TABLE 2

Number of Attributes in Common to Five Most and Five Least Prototypical Members of Six Categories

Category	Most typical members	Least typical members
Furniture	13	2
Vehicle	36	2
Fruit	16	0
Weapon	9	0
Vegetable	3	0
Clothing	21	0

Converging Operations for Typicality

- Reaction time (RT): Yes/No category judgments
- Development: Naming and identification
- Priming
- Word Frequency

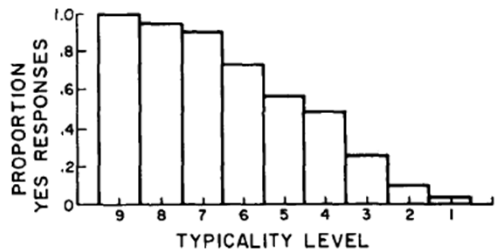


Figure 1. Mean proportion of "yes" responses as a function of typicality level.

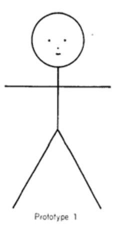
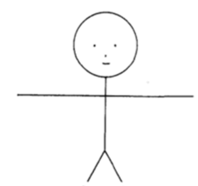


TABLE 2

EFFECT OF DEGREE OF TYPICALITY ON RESPONSE MEASURES (EXPERIMENT 1)

	Response measures								
	Number of errors			Reaction time (msec)			Typicality rating		
Stimulus type	High	Medium	Low	High	Medium	Low	High	Medium	Low
Dot patterns	12.1	14.8	19.8	1,545	1,861	2,334	1.72	2.97	4.66
Stick figures	7.8	10.3	14.5	817	887	1,065	1.80	2.69	4.11
Family resemblance									
Symmetric	2.1	4.0	5.2	557	609	685	1.20	2.50	3.75
Asymmetric	1.6	5.9	9.3	541	630	746	1.45	3.10	4.30

Note. High, medium, and low refer to degree of typicality.



Prototypes

- *A simple model of a category of items that share the basic features of the model*
  - Solves Classical View of categories
  - Fuzzy Categories
  - Goal-Directed categories?

    (Barsalou, 1983)

Ways to Escape Being Killed by the Mafia

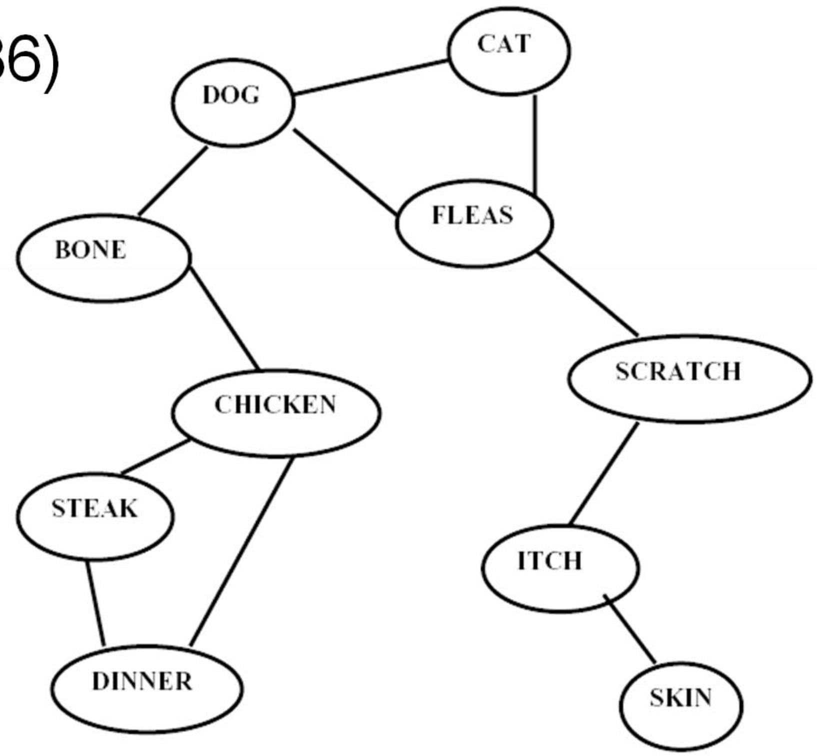
Roy was in big trouble. The Mafia had a contract out on him for double-crossing them. He knew he couldn't continue living in Las Vegas or he'd be dead in a week. So he started thinking quickly about alternatives.

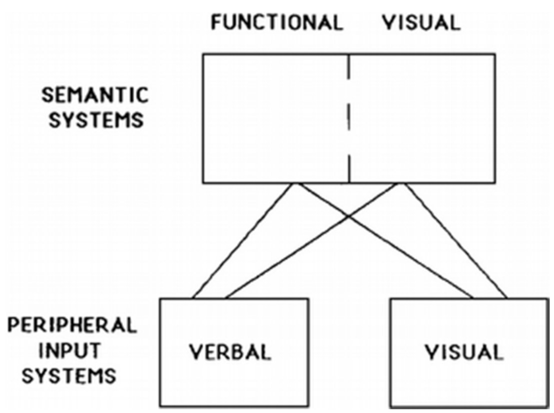
Experiment 1 Item Set

change your identity and move to the mountains of South America
move to the remote reaches of Wyoming*
stay where you're presently living in Las Vegas
move to Reno*
move to the mountains of Mexico
change where you're living in Las Vegas

Distributed Network Models

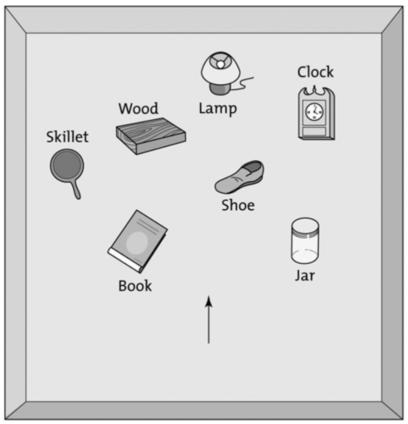
- McClelland & Rumelhart (1986)
- Farah & McClelland (1991)
  - Modules & Connections
  - Graceful degradation

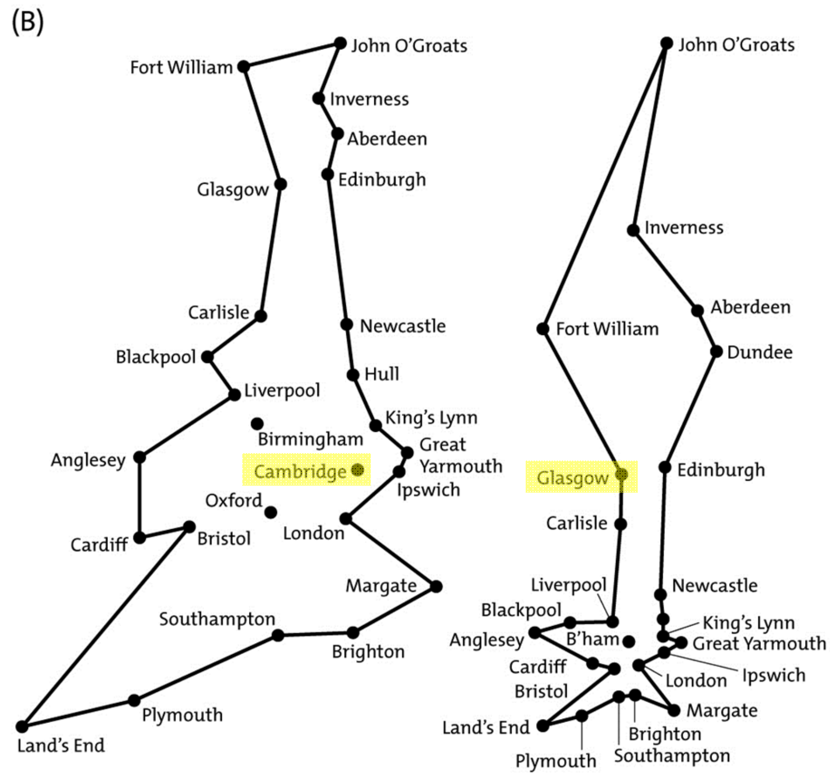




Explicit vs. Declarative

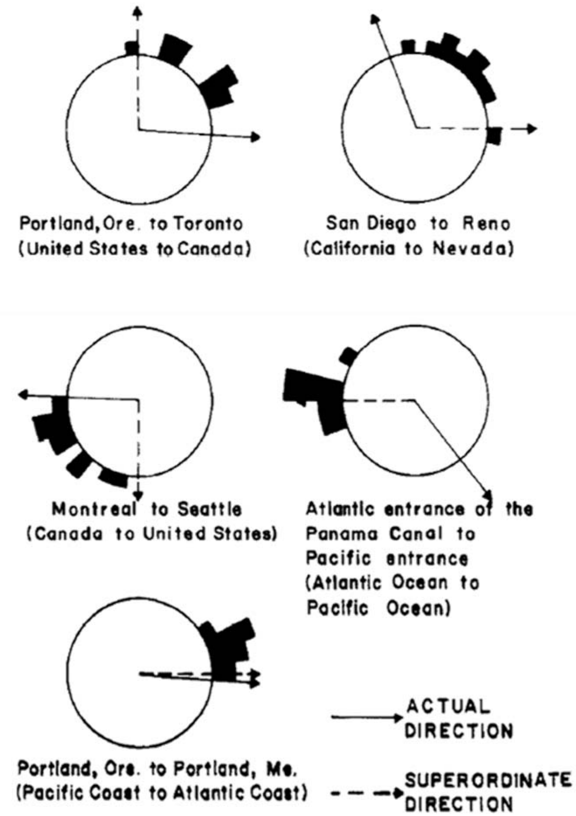
- Spatial Memory (Moar, 1978)
  - Influenced by experience
  - Reference Systems
    - Egocentric
    - Allocentric (Environmental)





Spatial Memory

- Route vs. Survey
  - All experience-based spatial memories start as route maps (Thorndyke & Hayes-Roth, 1982)
  - Reference Systems
- Distortions in Spatial Memory
  Stevens & Coupe (1978)
  - Further west? San Diego or Reno
  - Further north? Montreal or Seattle



Semantic Memory

NEUROLOGICAL BASES

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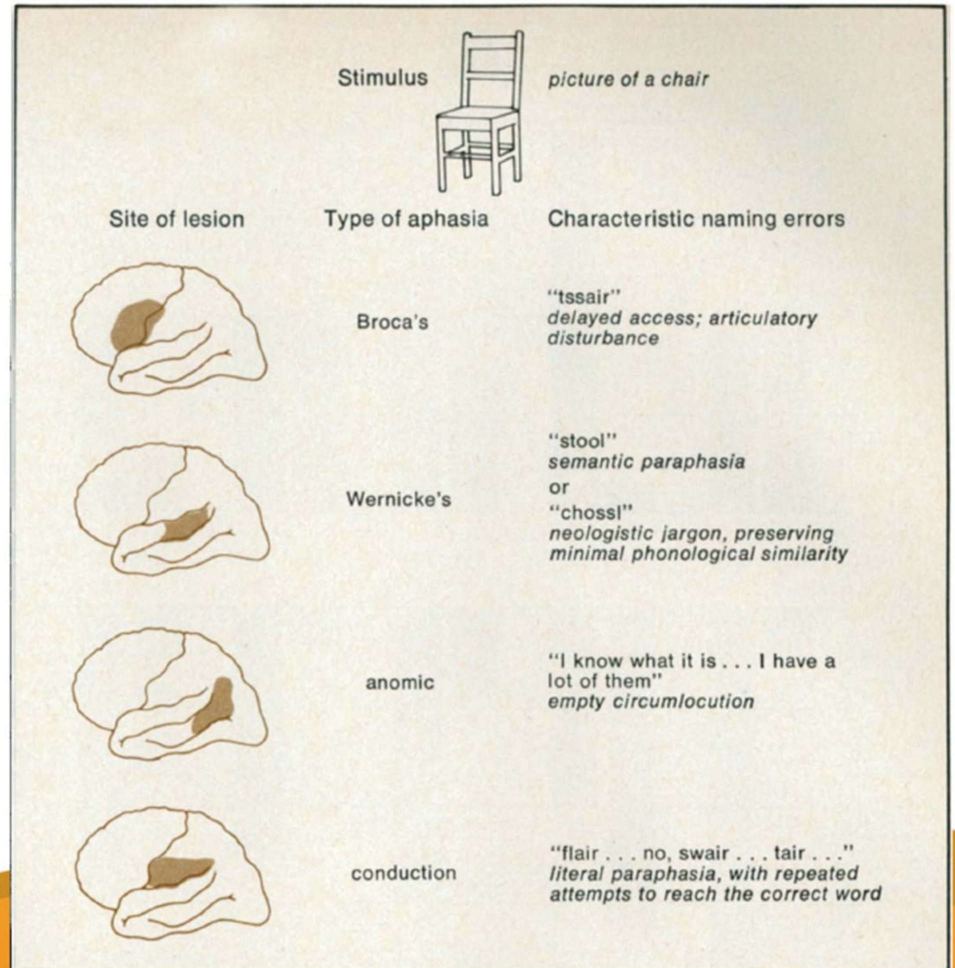
New Terminology

- Aphasia
  Disorder of language comprehension
- Agnosia
  Inability to identify familiar objects
- Anomia
  Inability to name objects



Category-Specific Naming Deficits

- Living vs. Nonliving Objects (Warrington & Shallice, 1984)
  - Double dissociation

	Living things				*Inanimate objects*			
	Visual		*Auditory*		*Visual*		*Auditory*	
	Identified	*Named*	*Identified*	*Superordinate*	*Identified*	*Named*	*Identified*	*Superordinate*
J.B.R. (5.8.80)	6	6	8	90	90	67	79	94
S.B.Y. (27.7.82)	0	0	0	75	75	0	52	85

Percentage correct identification score, naming score and superordinate score.

J.B.R. Parrot—don't know.
Daffodil—plant
Snail—an insect animal.
Eel—not well.
Ostrich—unusual.

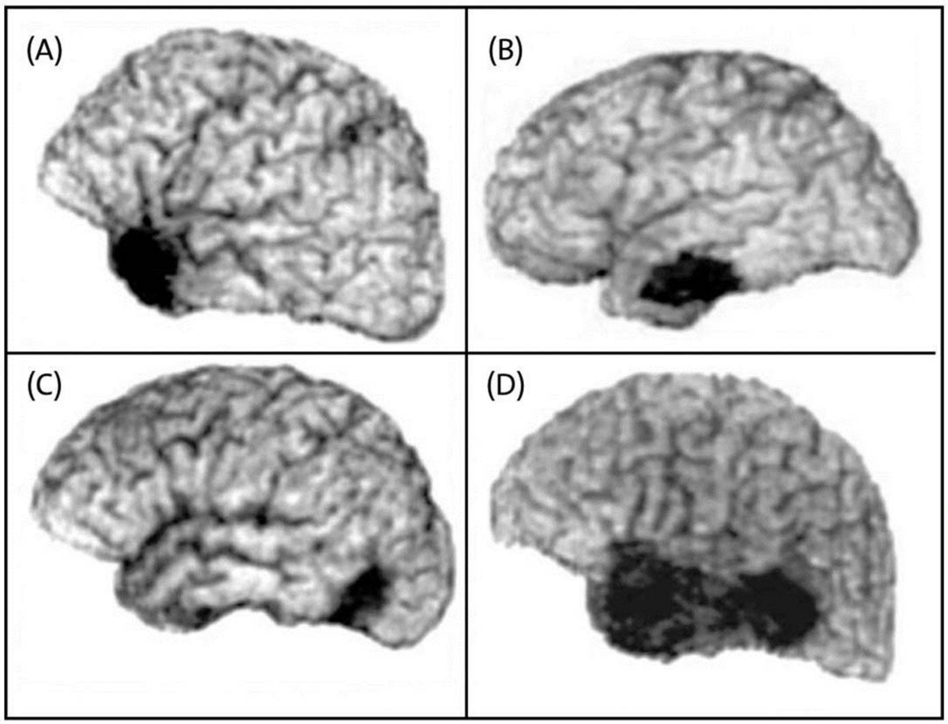
S.B.Y. Duck—an animal.
Wasp—bird that flies.
Crocus—rubbish material.
Holly—what you drink.
Spider—person looking for things, he was a spider for a nation or country.

J.B.R. Tent—temporary outhouse, living home.
Briefcase—small case used by students to carry papers.
Compass—tools for telling direction you are going.
Torch—hand-held light.
Dustbin—bin for putting rubbish in.

S.B.Y. Wheelbarrow—object used by people to take material about.
Towel—material used to dry people.
Pram—used to carry people, with wheels and thing to sit on.
Submarine—ship that goes underneath sea.
Umbrella—object used to protect you from water that comes.

Category-Specific Naming Deficits

- Somatic Marker Hypothesis
  - Damasio et al. (1996)



Prosopagnosia

- Ventral Temporal Cortex
  - Fusiform Face Area (FFA)
    - Farah, Levinson, & Klein (1995)

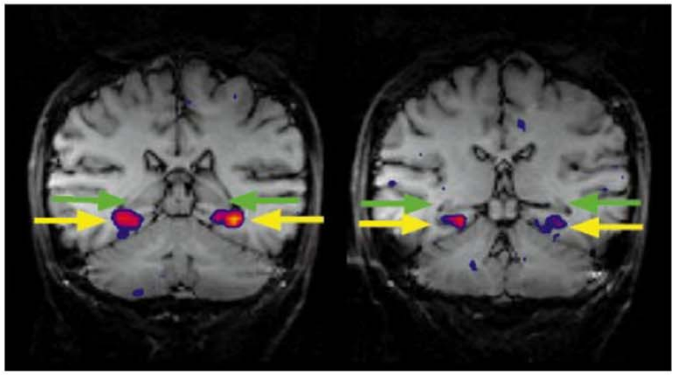


Fig. 1. Examples of face stimuli from Experiment 1.

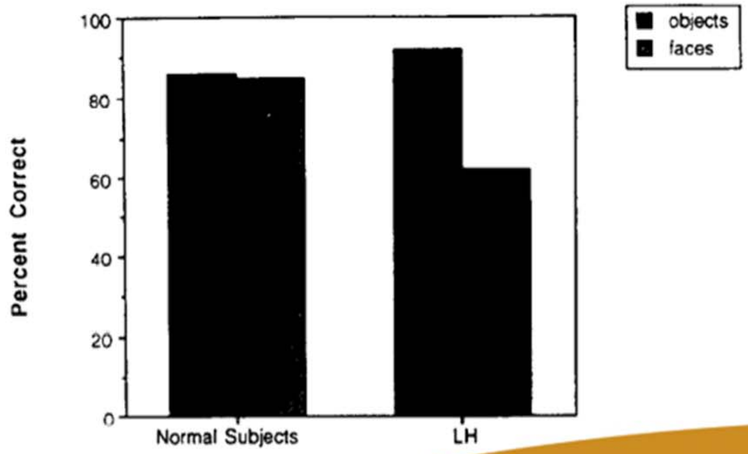
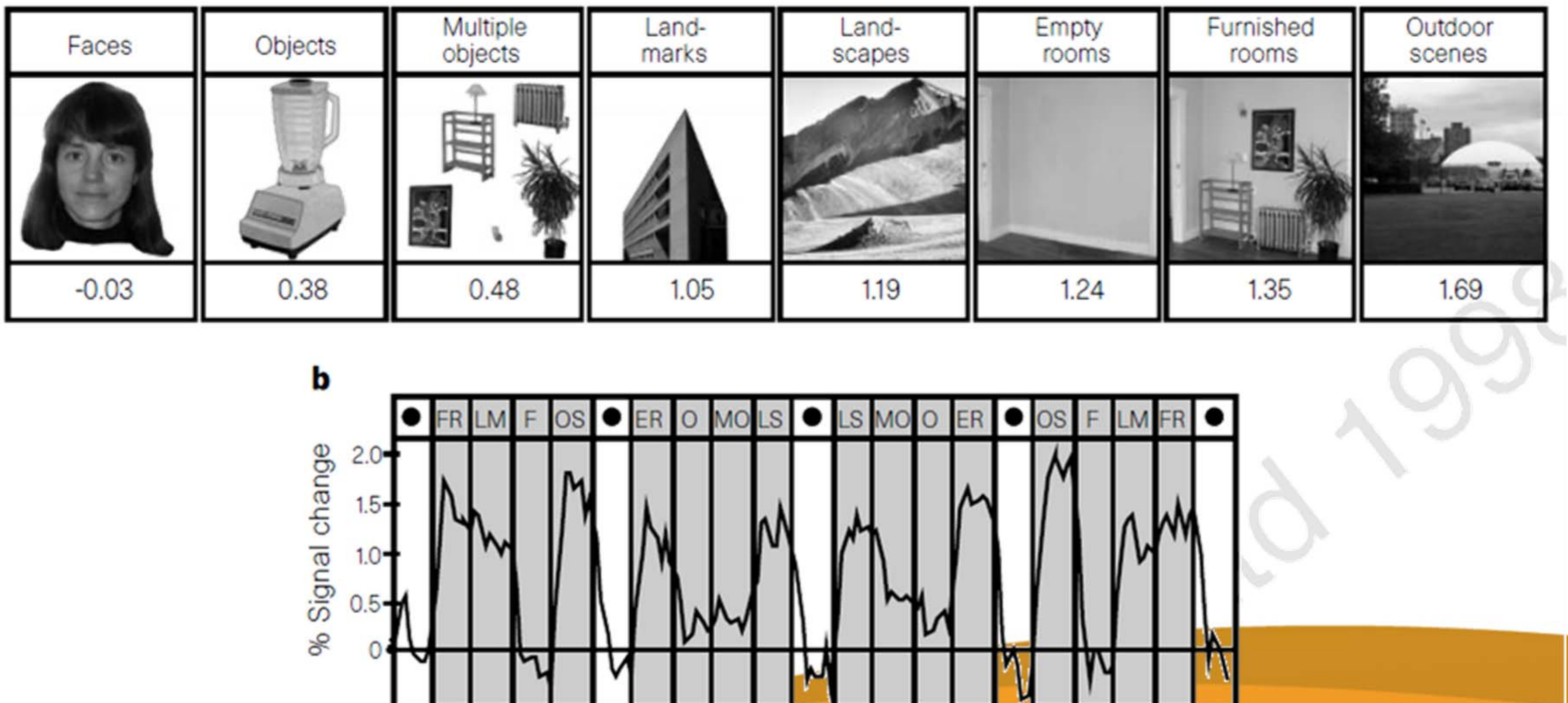


Fig. 2. Examples of object stimuli from Experiment 1.

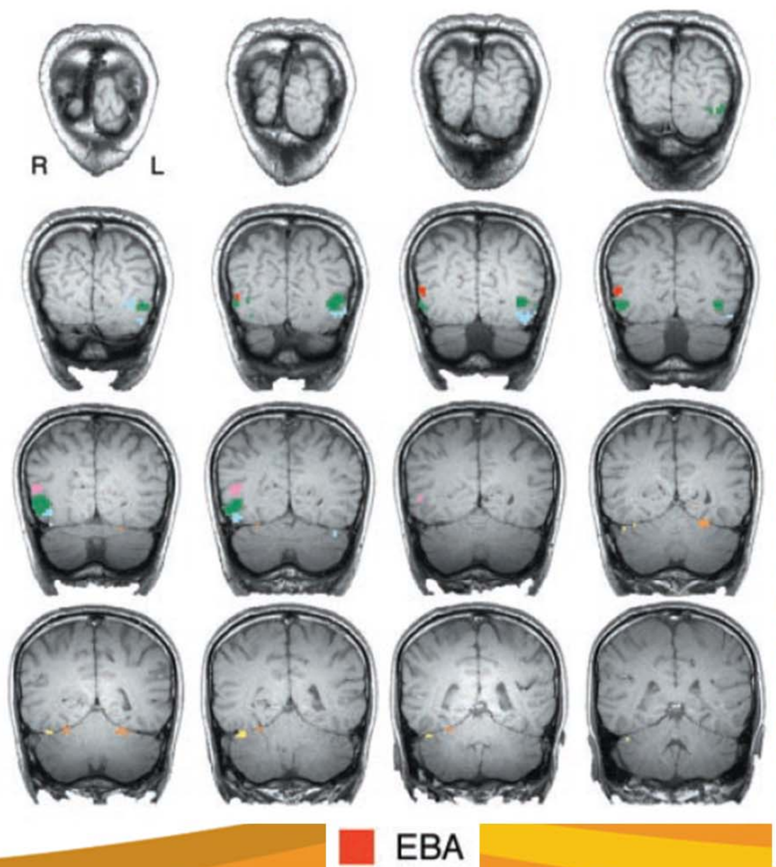
Parahippocampal Place Area (PPA)

- fMRI Signal Change in PPA (Epstein & Kanwisher, 1998)



Extrastriate Body Area (EBA)

- Right Lateral Occipital Cortex (Downing et al., 2001)



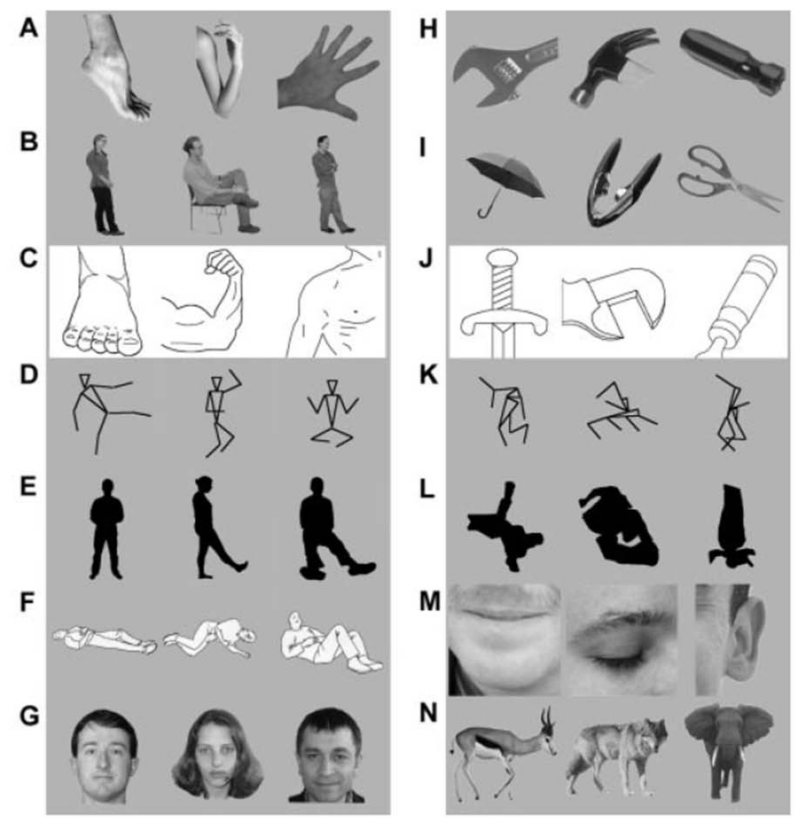
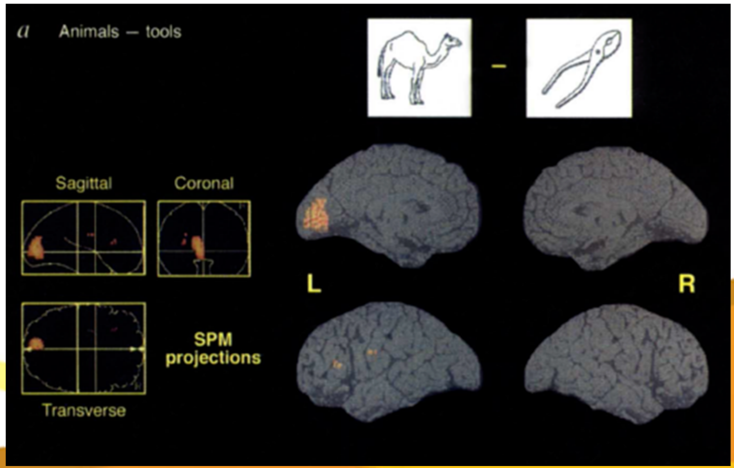


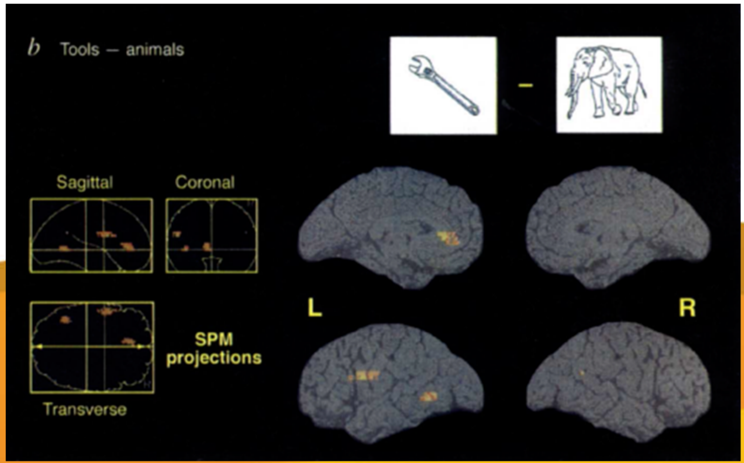
Fig. 2. Stimulus examples. The EBA response was high to human body parts (**A**) and whole human bodies (**B**) whether presented as photographs, line drawings (**C**), stick figures (**D**), or silhouettes (**E**), and was not attenuated to images that depict little implied motion (**F**). The low response to whole faces (**G**) was the single exception found to the preference for human bodies. In contrast, the EBA response was significantly lower to object parts (**H**) and whole articulated objects (**I**), whether represented as photographs or line drawings (**J**), as well as to scrambled control versions of stick figures (**K**) and silhouettes (**L**). The responses to face parts (**M**) and to mammals (**N**) were intermediate.

Localization

- of Function or Process?

- Semantic Memory is broadly represented
  - Different processing demands for different categories (Martin et al., 1996)





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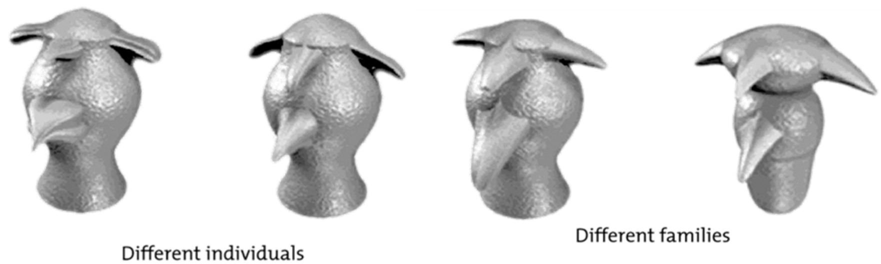
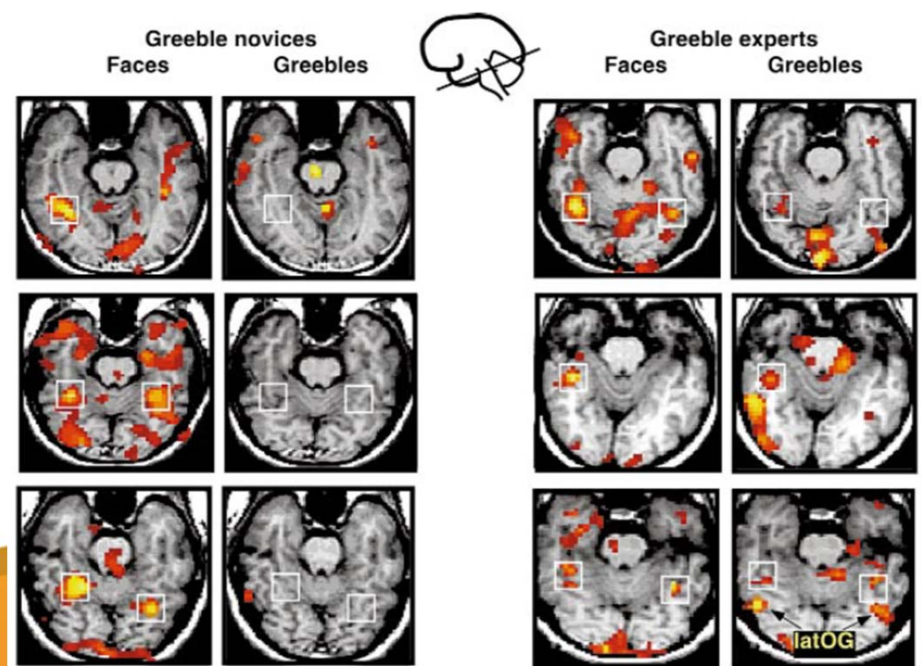
Distributed Processing

- Greebles again!
- Novices vs. Experts
- Categorizing families (object recognition) vs. individuals (FFA)
  - FFA distinguishes between individuals of a category
  - Broad network of semantic memories





Creating Semantic Memories

- Remember to Know Shift (Rajaram, 1993)
  - Episodic to Semantic Shift
- Hippocampus and *Relational Networks* (Eichenbaum et al., 1999)

Figure 2. Cognitive Mapping

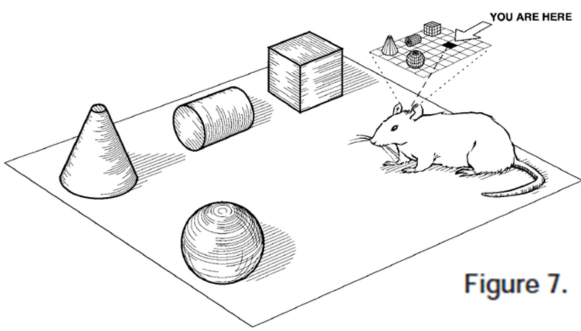


Figure 6. Relational Coding of Space

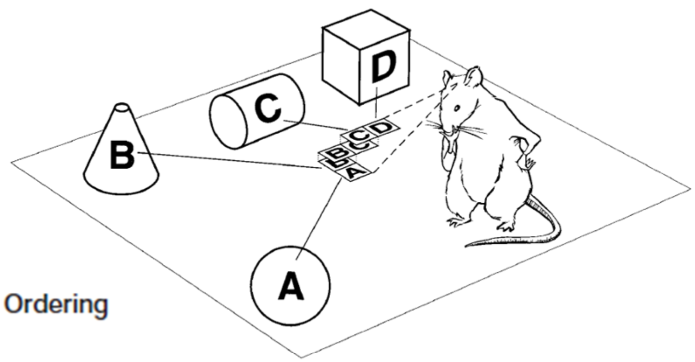
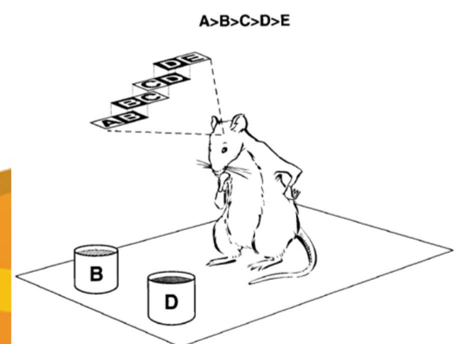
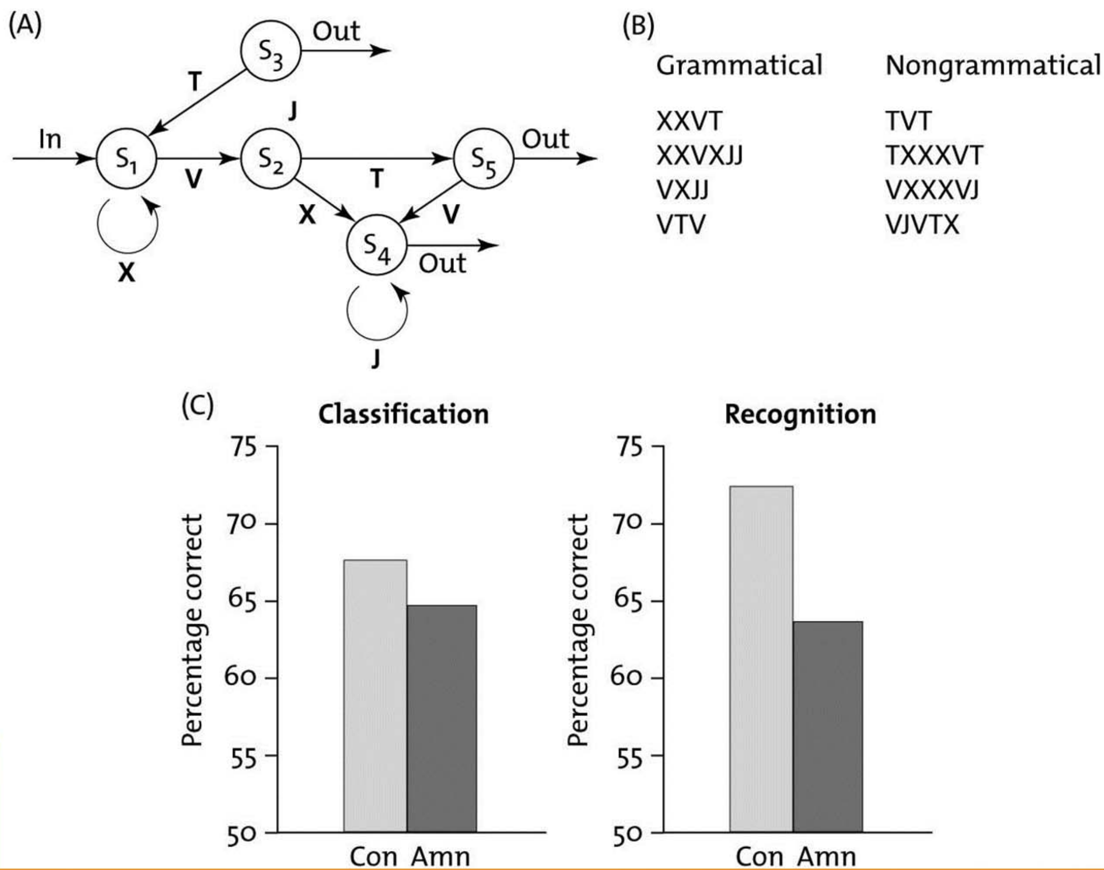


Figure 7. Transitive Inference in Serial Ordering



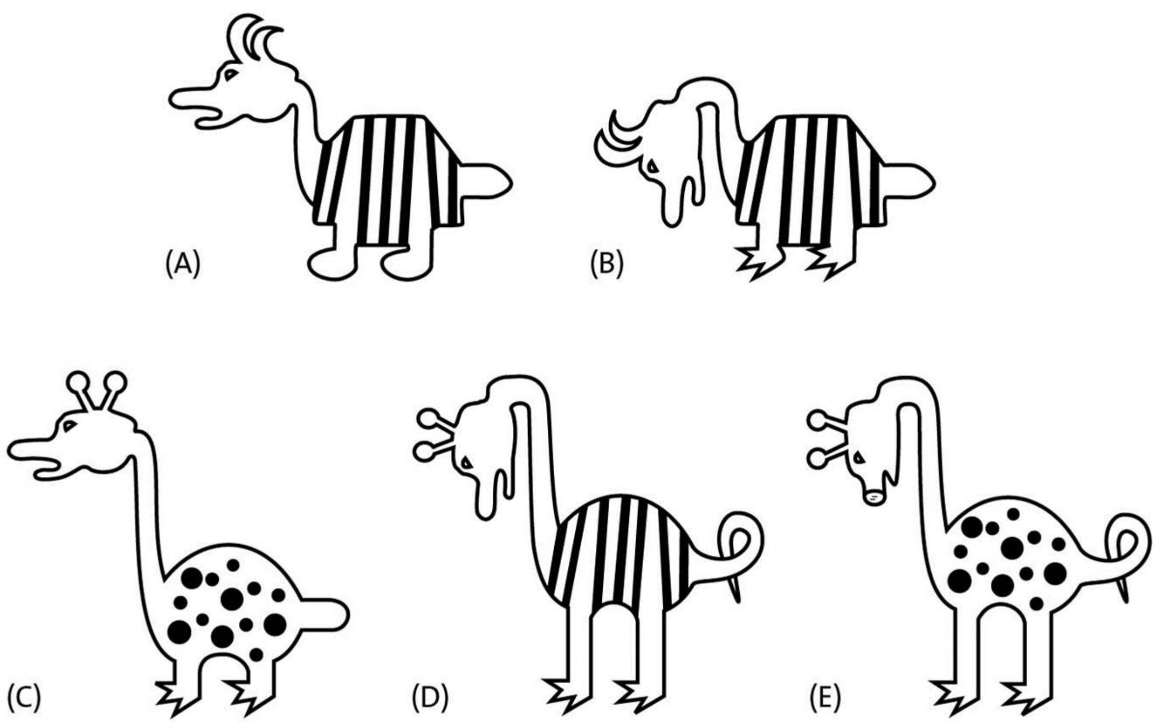
Amnesics

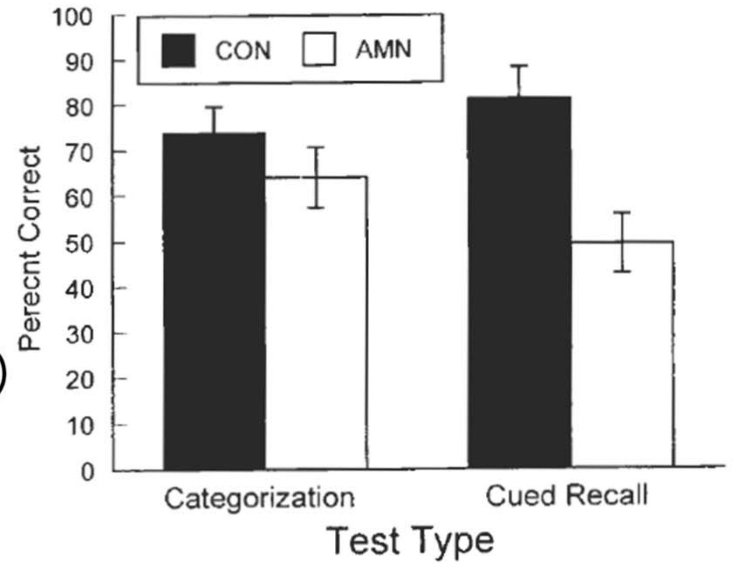
- Artificial Grammar (Knowlton et al., 1992)
  - Can still learn some semantic memories?



Amnesics and Peggles

- Categorization using a prototype (A)
  - General Rules (Reed et al., 1999)





Hippocampus and Semantic Memory

- Some say it's ***hot*** (Maguire & Frith, 2004)
  - fMRI: Hippocampus (and others) active when learning facts

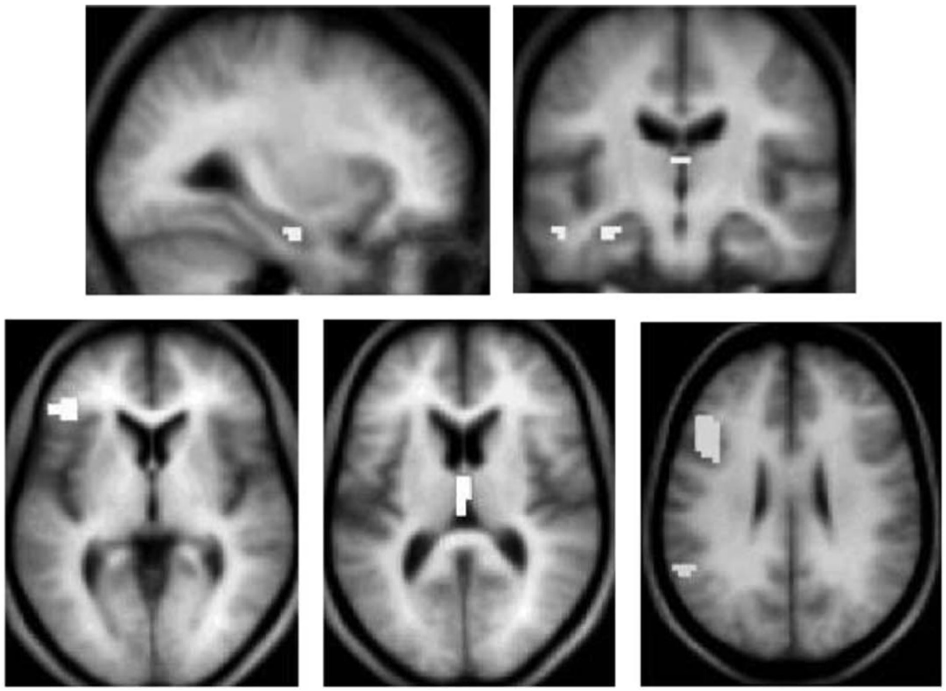
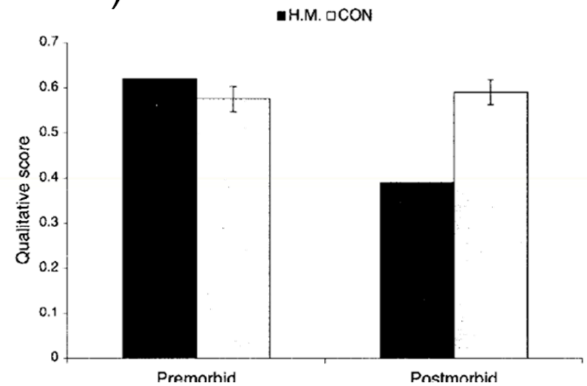


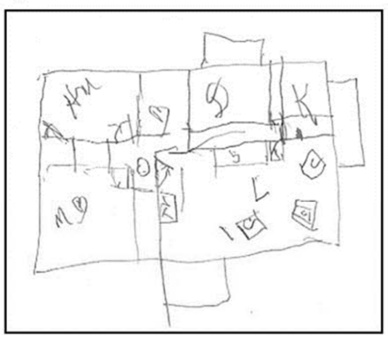
Fig. 1. Comparison of fact acquisition with the baseline task. Activations are shown on appropriate sagittal, coronal, and transverse sections from the averaged structural MRI scan of the subjects. The activations shown here: top left and top right panels, left hippocampus; top right panel, left middle temporal gyrus, medial dorsal nucleus of the thalamus; bottom left panel, left ventrolateral prefrontal cortex; bottom middle panel, medial dorsal nucleus of the thalamus; bottom right panel, left dorsolateral prefrontal cortex, left temporoparietal junction (see also Table 1).

Hippocampus and Semantic Memory

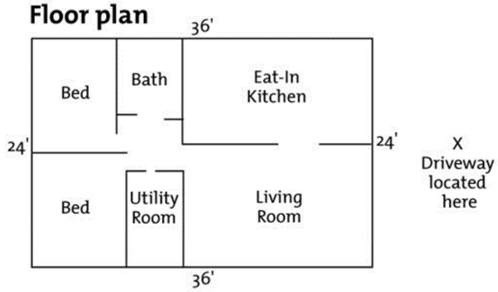
- Some say it's ***not*** (e.g., O'Kane et al., 2004)
  - H.M. moved in 1958 and 1974
  - Memory for home in 1966
  - Famous people



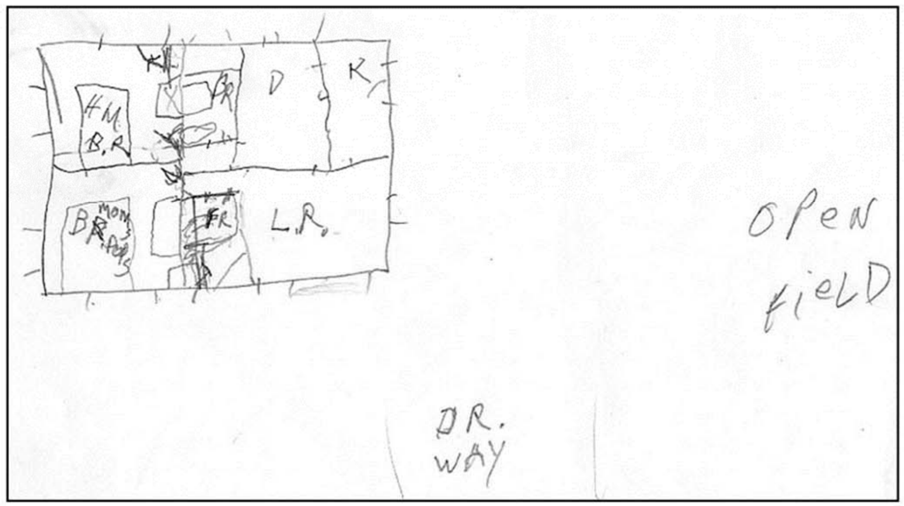
1966



Floor plan

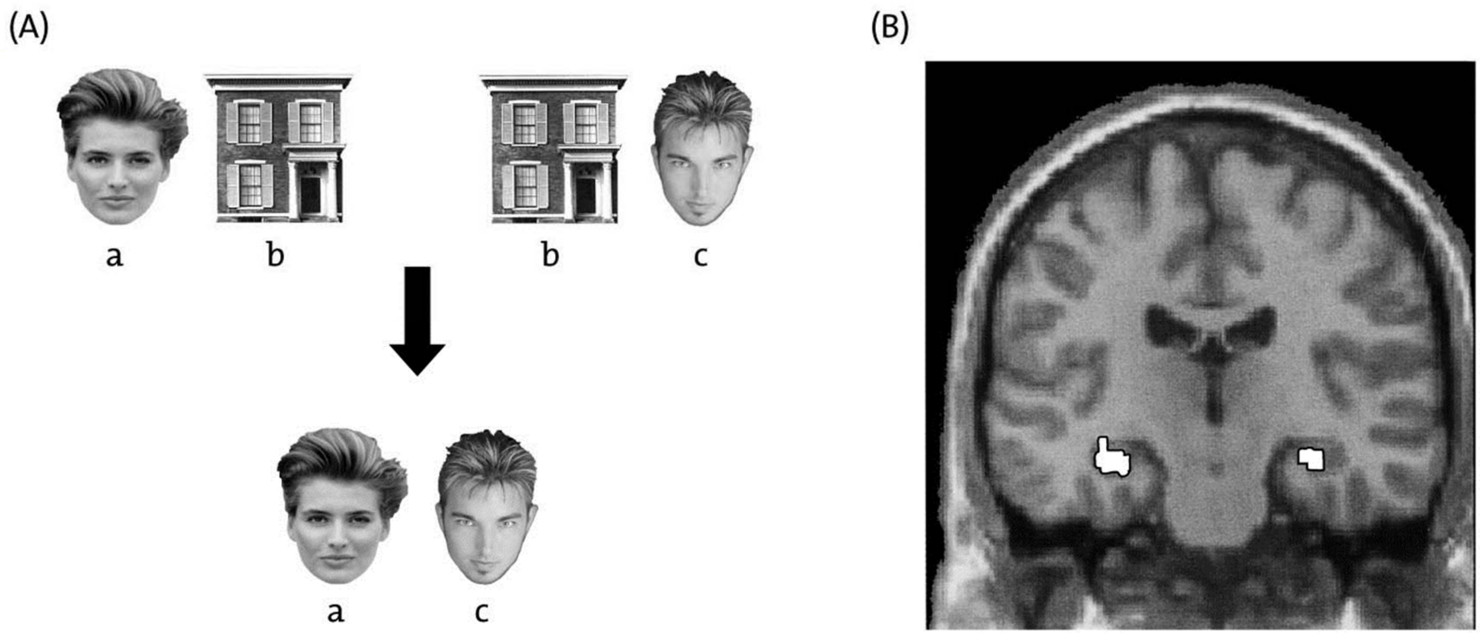


1977



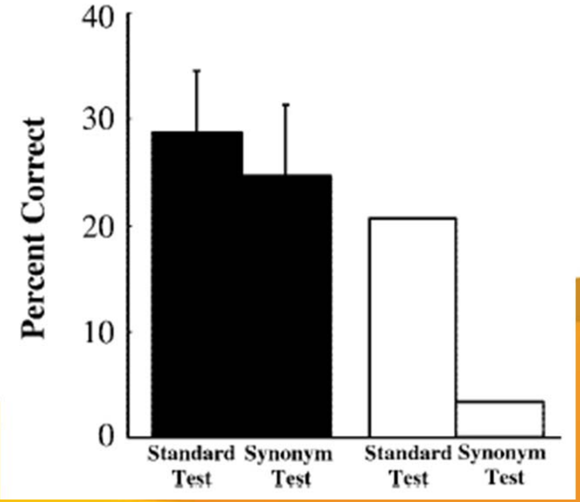
Evidence for Binding of Memories

- Transitive Inference (e.g., Preston et al. 2004)



Evidence for Binding of Memories

- E.P.'s MTL damage (Bayley & Squire, 2002)
  - Learning 3-word sentences
    - Standard Test: Recognition and Cued Recall
      "SPEECH caused LAUGHTER" vs. "SPEECH caused ???"
    - Synonym Test: "VENOM caused" to "VENOM induced"



Summary

- Hierarchically Organized
  - Typicality, Prototypes
- Semantic and Distributed Network Models
- Category-Specific Naming Deficits
  - *FFA, PPA, EBA*
- Distributed Representation vs. Processing
- Amnesics
- Hippocampus and Binding of Episodic Memory