Language acquisition, perception and production

Lecture 1 – Word meaning

Word meaning

- Some questions
  - How many eyes does a dog have?
  - How many ears does an elephant have?
  - Do lions eat fish?
  - Does a canary have lungs?

- How do you know all these things?

Outline for this lecture

- Some intuitions about meaning
- Word meaning in cognitive models
- Neuropsychological investigations of meaning

Word meaning

- The meaning of a word is different from the word itself
  - Some words have multiple meanings:
    - Bank = money related institution
    - Bank = side of river (river bank)
  - "Tip of the tongue"
    - Know the meaning, not the form of the word

Word meaning

- Some words seem related
  - Dog, mouse
  - Apple, strawberry
  - Hammer, saw
  - Mouth, ear

Word meaning

- They can be related in many different ways
  - Hierarchically
    - {Dog, mouse,…} → animals
    - {Apple, strawberry,…} → fruit
  - Associative
    - Mouse → cheese
    - Ghost → white
  - Part-of
    - Car → engine
    - Body → arm

Word meaning

- Cognitive economy
  - Organization of semantic memory is to avoid excessive duplication

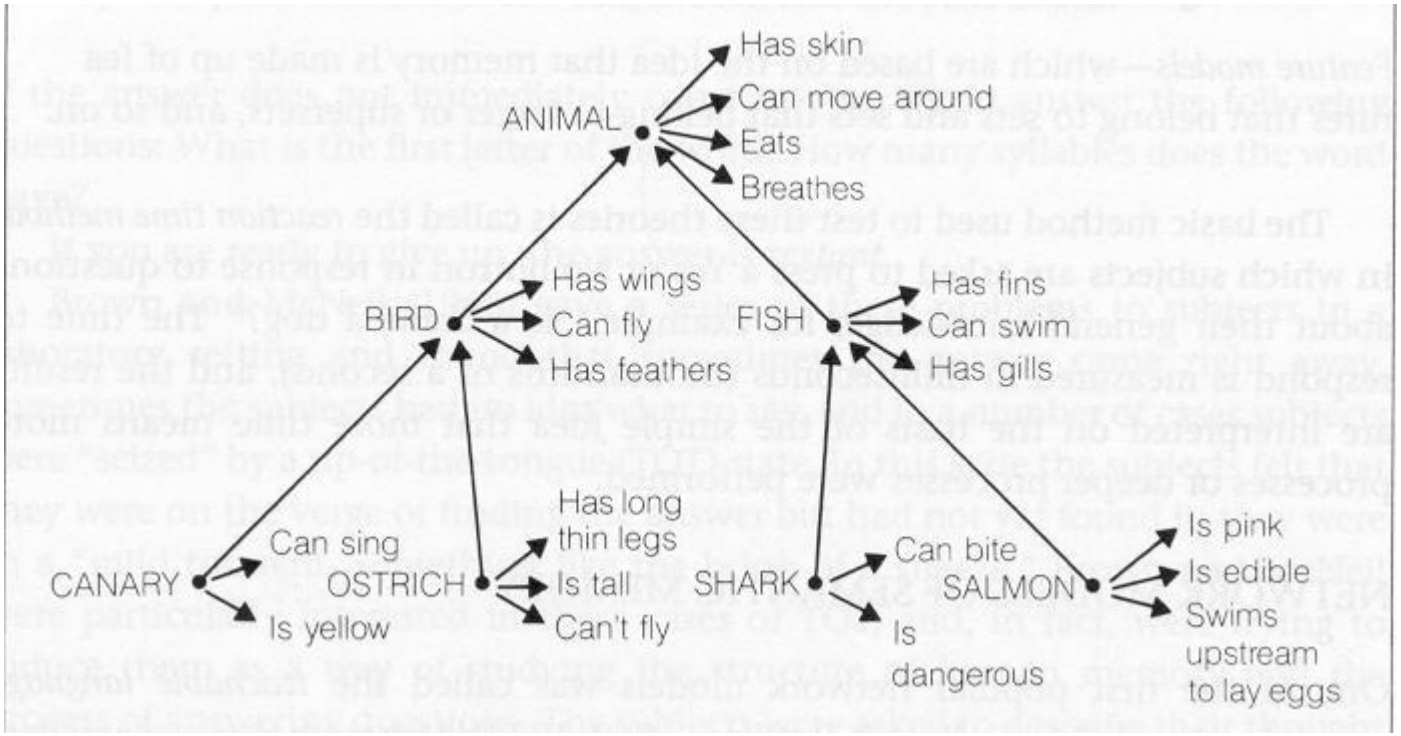
- If I know animals eat, and I know dogs and cats are animals, I know they also eat
  - You do not need to remember that dogs eat, cats eat, etc.

Word meaning

- What is the meaning of the word "dog"?
  - It is an animal
  - It is a mammal
  - Has ears, mouth, eyes, tail, etc
  - Barks
  - Furry

Network theories

- Collins & Quillian (1969)



Sentence verification

- Present sentence to subject
  - Press one button if false, other button if true
  - Measure reaction time

1. A canary is a canary
2. A canary is a bird
3. A canary is an animal
4. A canary is a fish

Sentence verification

- Also found for property

1. A canary is yellow
2. A canary has wings
3. A canary has lungs

Problems with network model

- Works well for natural kinds
  - What about "justice", "truth"?
- Incorrect predictions
  - A cow is an animal
  - A cow is a mammal

Problems with network model

- Incorrect predictions
  - A pine is a church
  - A pine is a flower
  - A canary is a bird
  - A penguin is a bird
- Gradedness

Semantic feature model

- Each meaning is composed of smaller units of meaning

- Example: Kinship terms
  - Terms: Father, mother, daughter, son
  - Features: Human, male-female, old-young

Semantic feature model

- All words can be *decomposed* into features
- Some features are semantic primitives
  - Wilks (1976) described set of 600 words with 80 primitives

Sentence verification

- Model accounts for
  - A pine is a church
  - A pine is a flower
  - A canary is a bird
  - A penguin is a bird
- Gradedness

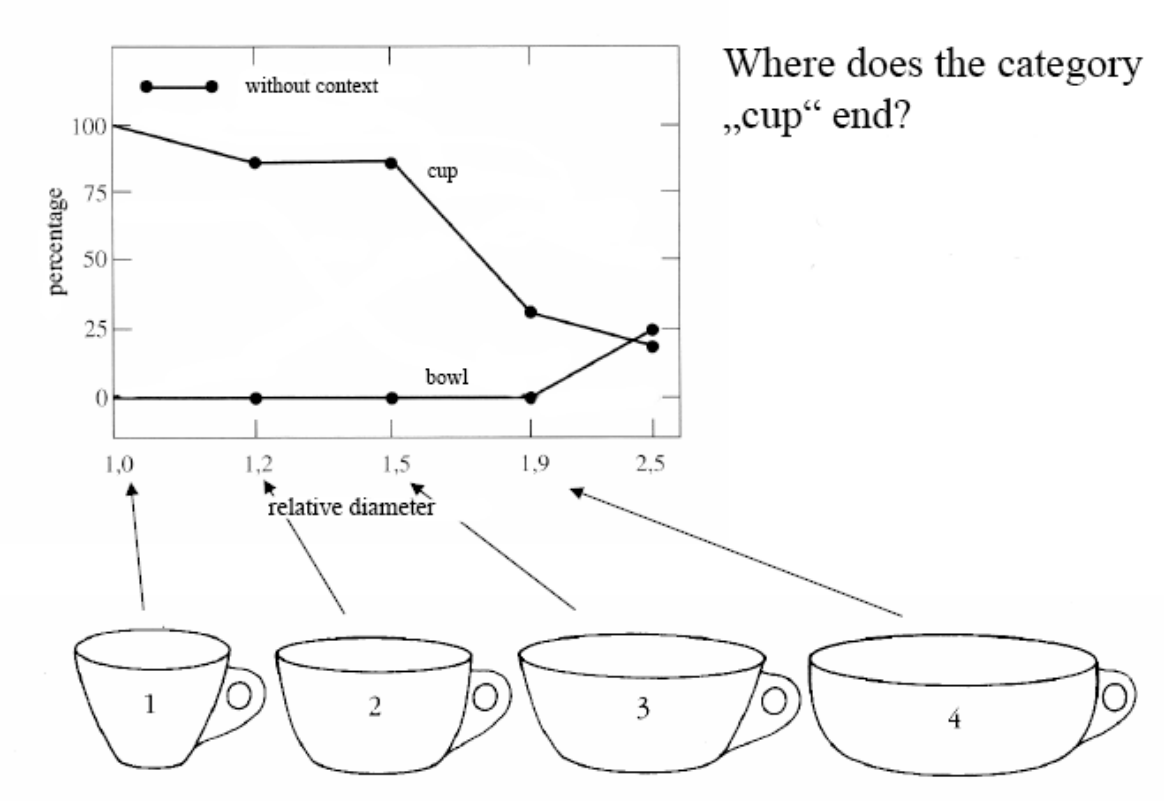
Problems with feature model

- Some words do not have clear features
  - Wittgenstein (1953) concept "game"
    - Boxing, chess, football, bowling, solitaire
      - Winning/loosing, teams, competition

- Finding the features seems arbitrary

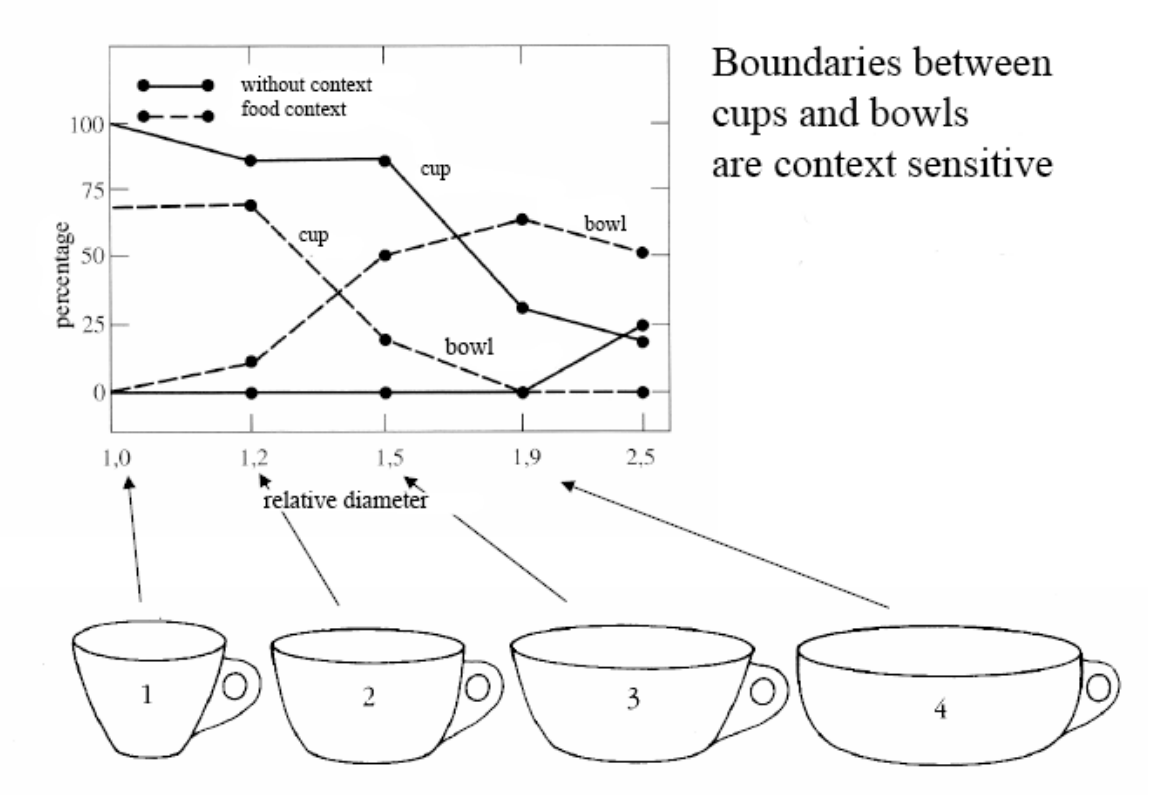
Fuzzy boundaries

- Labov (1973)



Fuzzy boundaries

- Labov (1973)



Boundaries between cups and bowls are context sensitive

Semantic features

- Despite these problems many current models have semantic features

- They provide explanation of many empirical results
  - Priming effects
    - doctor – nurse

Prototype theories

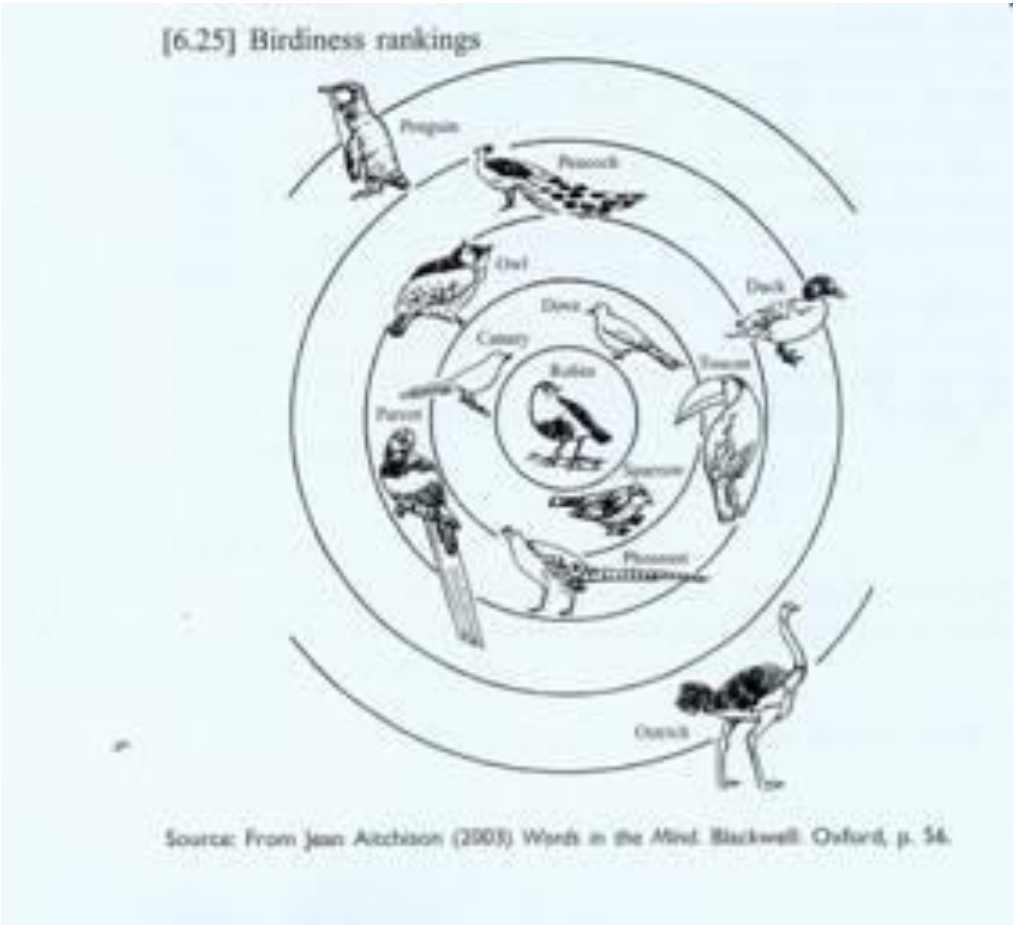
- Eleanor Rosch (1978)

- A prototype is an average member of a category
- A prototype is the best example of a category
  - Compare category of BIRDS

Prototype theory

- Good examples versus bad examples

Prototype theory



Prototype theory

- Concept of "bird" relies on set of features that appear in all birds
  - Across all instances, some features are core features
- Some examples of birds have more of this set of features
  - They are the good examples
  - The fewer of the features you have, the further away from the center

Summary

- Network theory
- Feature theory
- Prototype theory

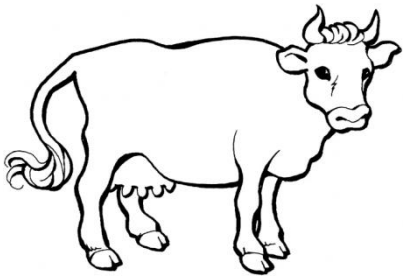
Sentence meaning

1. Sentences contain meaning
   - Sentence meaning is the sum of the meaning of the words

2. Sentences "prompt" meaning
   - Sentences do not contain all meaning

Sentence meaning

- The cow is brown
  - La vaca es marrón



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Sentence meaning

1. The child is safe – "el niño es seguro"
2. The beach is safe – "la playa está segura"
3. The shovel is safe – "la pala es seguro"

In (1) safe means "protected from harm", but not in (2) or (3).

- The meaning of a sentence is NOT the sum of the meaning of the parts!

Sentence meaning

- A red sunset

- A red apple

Sentence meaning

- Pedro is the father of Maria
  - "Pedro es el padre de María"

- Child is the father of man
  - "El hijo es el padre del Hombre"

The neuropsychology of semantics

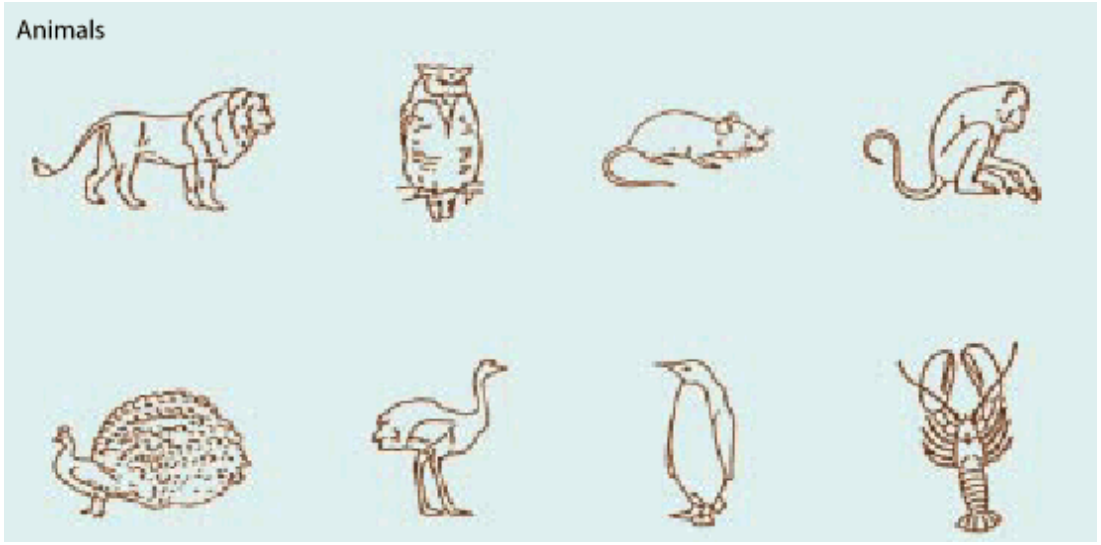
- Can neurological damage tell us anything about meaning?

- Category-specific deficits

Category-specific deficits

- Warrington & Shallice (1984)
  - Patients JBR and SBY
  - Better at non-living things than living things

Category-specific deficits



Category-specific deficits

Table 36.1
An impairment in knowledge of living things: Performance on two tasks assessing knowledge of living and nonliving things

Case	Task	
	Living (%)	Nonliving (%)
Picture identification		
JBR	6	90
SBY	0	75
Spoken word definition		
JBR	8	79
SBY	0	52

Table 36.2
Examples of definitions of living and nonliving things

Case	Definition
Living things	
JBR	Parrot: don't know
	Daffodil: plant
	Snail: an insect animal
	Eel: not well
	Ostrich: unusual
SBY	Duck: an animal
	Wasp: bird that flies
	Crocus: rubbish material
	Holly: what you drink
	Spider: a person looking for things, he was a spider for his nation or country
Nonliving things	
JBR	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
SBY	Wheelbarrow: object used by people to take material about
	Towel: material used to dry people
	Pram: used to carry people, with wheels and a thing to sit on
	Submarine: ship that goes underneath the sea
	Umbrella: object used to protect you from water that comes

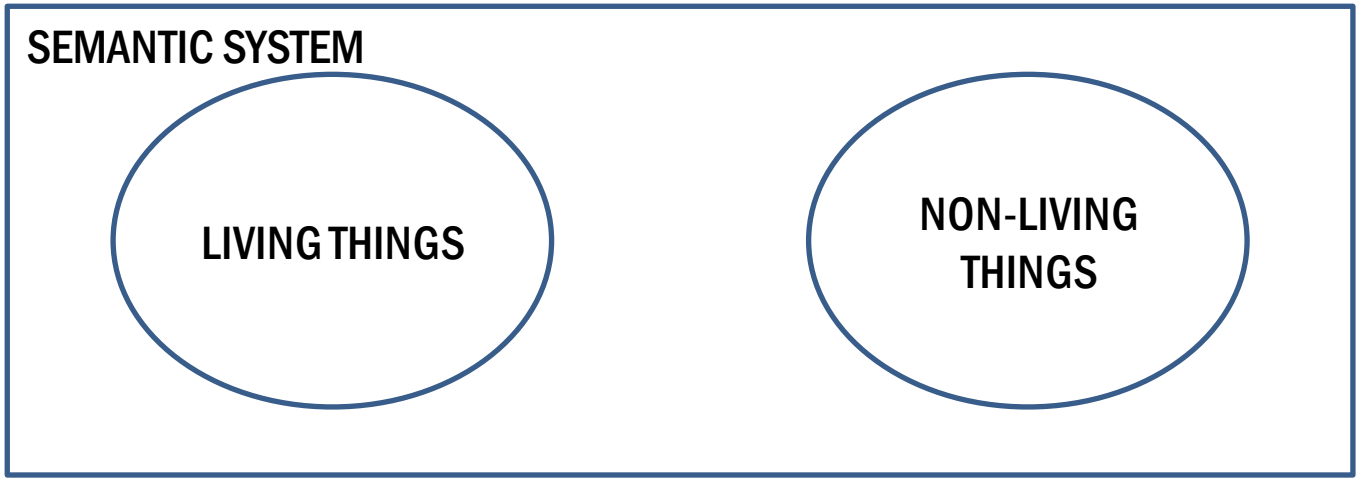
Category-specific deficits

- Are living things more difficult?

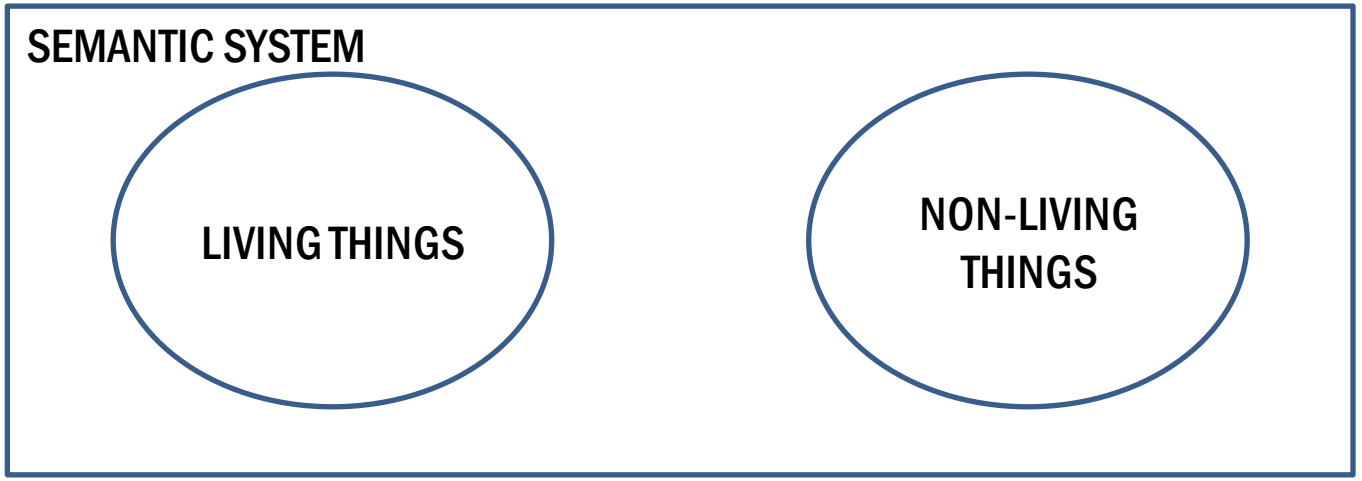
- No – double dissociation
  - Patients YOT (Warrington & McCarthy, 1987)
  - And others (e.g., Hillis & Caramazza, 1991)

Category-specific deficits

- What explains the dissociation?



Category-specific deficits



- Living-things deficit correlated with problems in
  - Naming gems, cloths, foodstuffs, musical instruments
- Non-livings things deficit correlated with problems in
  - Naming body parts

Category-specific deficits

- HAMMER
- IRON

- LION
- STRAWBERRY

Category-specific deficits

- Non-livings things
  - Functional properties
    - What is something used for

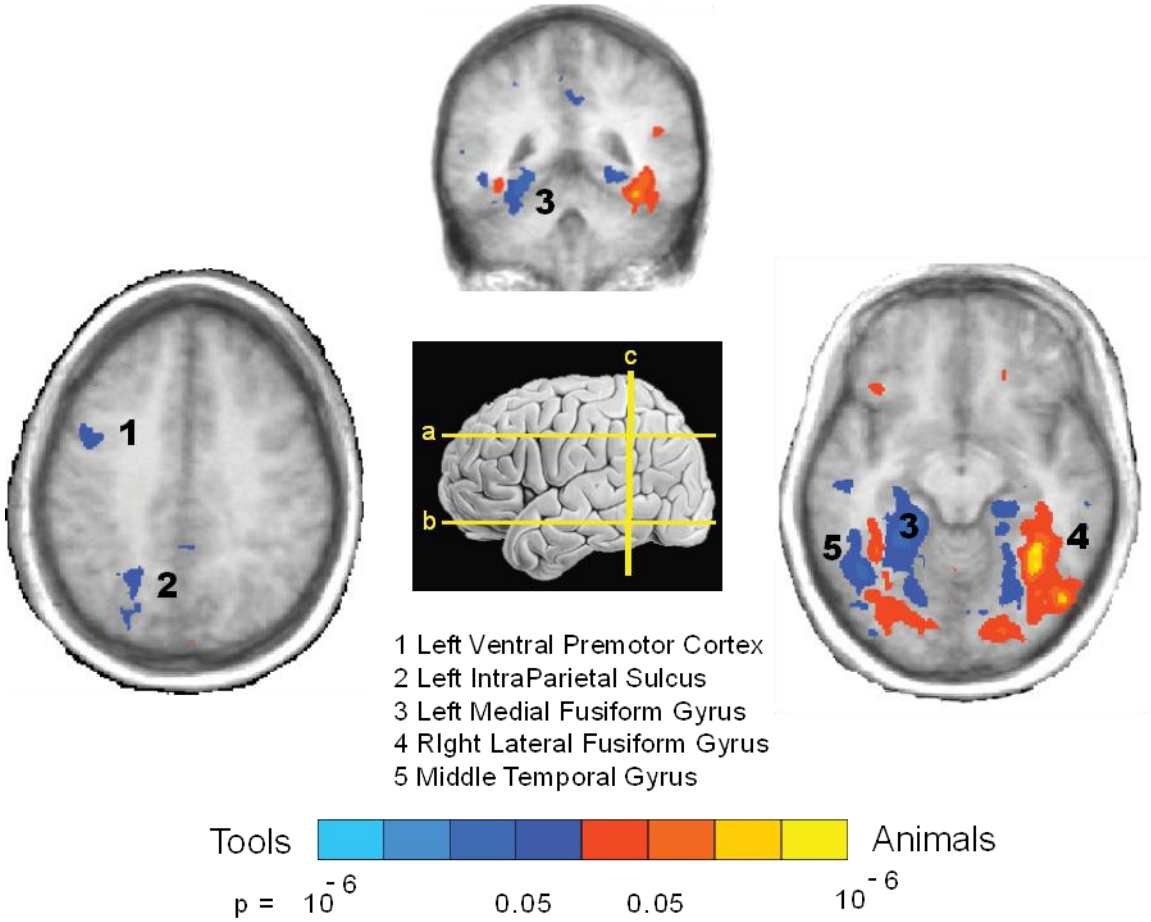
- Living things
  - Sensory properties
    - What does something look/smell/sound/feel like

Category-specific deficits

- Sensory-Motor hypothesis
  - Category-specific deficits are due to damage to sensory or motor systems
- Explains correlations
- In line with how the brain is organized

Category-specific deficits

- fMRI



Chao, Weisberg, & Martin, 2002, *Cerebral Cortex*

Category-specific deficits

- Concepts in the brain are distributed across many different sensory and motor systems
- Impairments in patients can reflect semantic categories
- Maps of functional neuroanatomy (from eg fMRI) also show organization by semantic categories
- A lot of research is currently aimed at understanding what causes this organization

Summary

- Word meaning
- Feature theory, prototype theory
- Category-specific deficits