Outline

- I: Introduction to Object Recognition 1. What is object recognition, why study it, and what are the questions we need to answer to understand it? 2. LOC: A Cortical Region involved in Representing Object Shape
- II: Category-Specific Mechanisms? How specialized is the cortex for specific classes of objects?

III: Effects of Experience How does visual experience change the cortical representation of objects?

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III: Effects of Experience

(Potter, 1976).

How does visual experience change the cortical representation of objects?

1. Why Study Object Recognition?

OR is an important problem: Critical for survival We are very good at it how good?

Remarkable Fact:



Within a fraction of a second of viewing a completely novel and unpredictable image of a complex scene, human perceivers have already extracted its gist

demo...









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Within a fraction of a second of viewing a completely novel and unpredictable image of a complex scene, human perceivers have already extracted its gist (Potter, 1976).

No current computer vision system comes even close to this.

1. Why Study Object Recognition?

OR is an important problem: Critical for survival We are very good at it so an understanding of human visual recognition might provide important clues for machine vision A distinct domain of cognitive/ neural processes i.e. not just the same mechanisms engaged by the rest of reasoning/thought. how do we know?

Visual Object Recognition: A Distinct Domain of Cognition

<u>Visual Agnosia:</u> specific deficit in visual object recognition without impaired cognition/reasoning without impaired visual acuity without impaired object recognition by touch, sound, smell

For example.....



Object Recognition: A Distinct Domain of Cognition

<u>Visual Agnosia:</u> specific deficit in visual object recognition without impaired visual acuity without impaired object recognition by touch, sound, smell

The fact that visual OR can be selectively lost in brain damage implies that it has its own special neural hardware, distinct from low-level visual processing, and from knowledge of the meanings and names of objects.

Thus, OR is a distinct domain of cognition, which should be investigated as such







a. Characteristic motion (e.g. a fly). b. Color/texture (e.g., lawn, ocean, beach)

Kinds of Cues Available for Visual Object Recognition

c. Stored knowledge plus minimal cues (e.g. I left newspaper on dining table, that's what that blob must be).

d. The most important cue: SHAPE! (which is the primary focus of most theories of object recognition)















































Characterizing Representations and Processes in the LOC

Does the LOC represent shapes independent of the visual cues that define the shape, e.g.

- photographs
- ✓ line drawings
- $\sqrt{}$ shape from luminance, local motion, texture

Are representations in the LOC

- of shapes, or of the contours defining the shapes?
- based on parts/convexities?
 - invariant to changes in size and position
 - inv. to changes in viewpoint and direction of illumination



Question:

Does LOC represent complex contours, or full-fledged shape?

Test with "fMRI adaptation"...

fMRI Adaptation

Basic idea: Any measure that is sensitive to the sameness vs. difference between 2 stimuli can reveal what discriminations the system can make.

Example: can brain region X discriminate between two similar stimuli, say.... Measure fMRI response in that region to same vs. different trials like this:



- OK, back to this question:
- Does the LOC merely represent the contours that define a shape, not the shape itself?
- How can we use event-related fMRI-Adaptation to answer it?



















































So: Representations in LOC are: • To some degree size and position inva Viewpoint and illumination But 2 other studies found different results for viewpoint: James et al (2002): viewpoint invariance Vuilleumier et al (2002): viewpt invariance in left hemisphere

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Outline

- I: Introduction to Object Recognition Why study it, what is entailed in OR, and what are the questions we need to answer to understand it?
- II: Brain Regions involved in Representing Object Shape Where are they and what kinds of representations do they contain?
- III: Category-Specific Mechanisms?
- How specialized is the cortex for specific classes of objects?
- IV: Effects of Experience How does visual experience change the cortical representation of objects?



Object-Selective Activations in DF & Normal Subjects Intact> scrambled line drawings:



little/no reponse. For greyscale and color photos, some response but diffuse.

Apparently, normal LOC is necessary for object recognition.

So: what does LOC do? What kind of information does it represent about objects?



