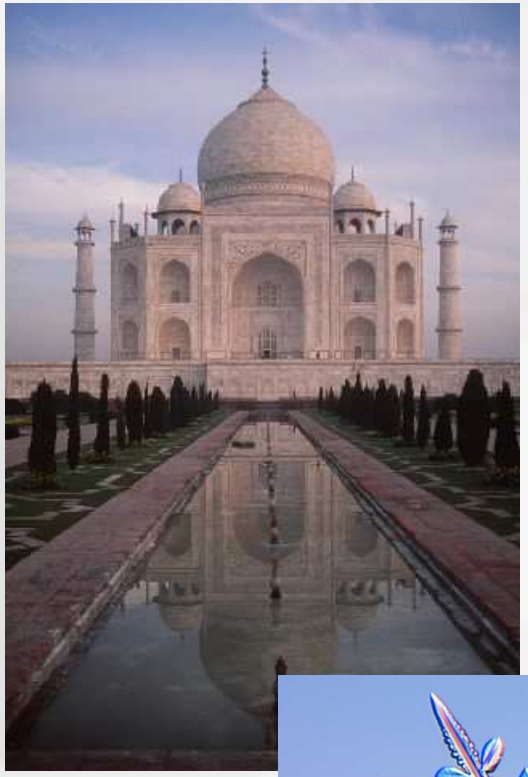
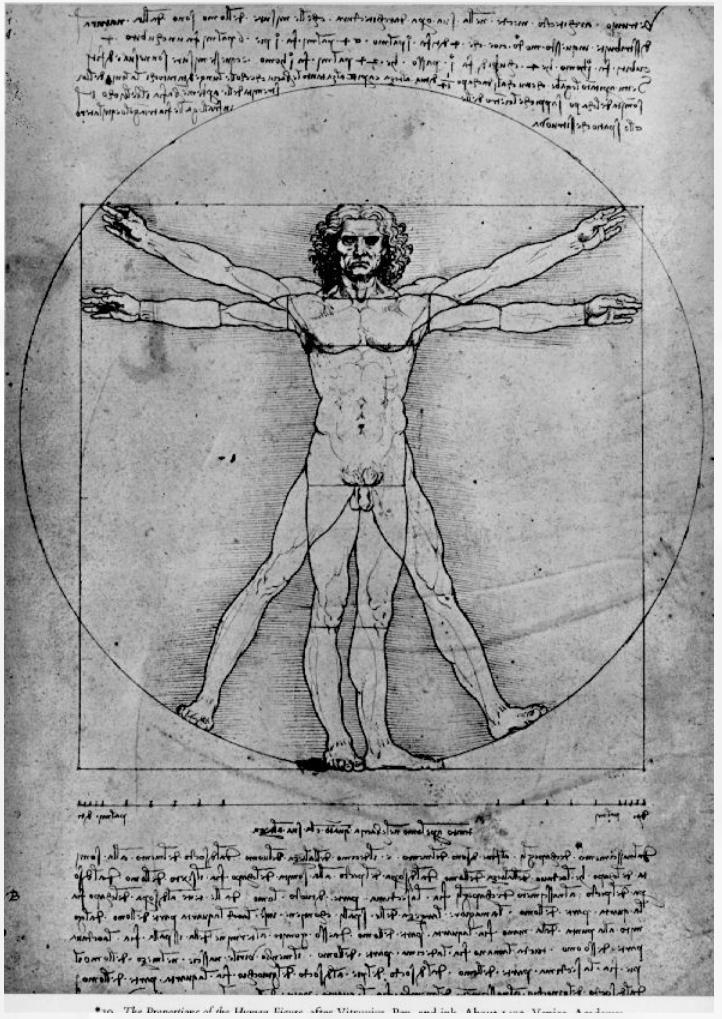
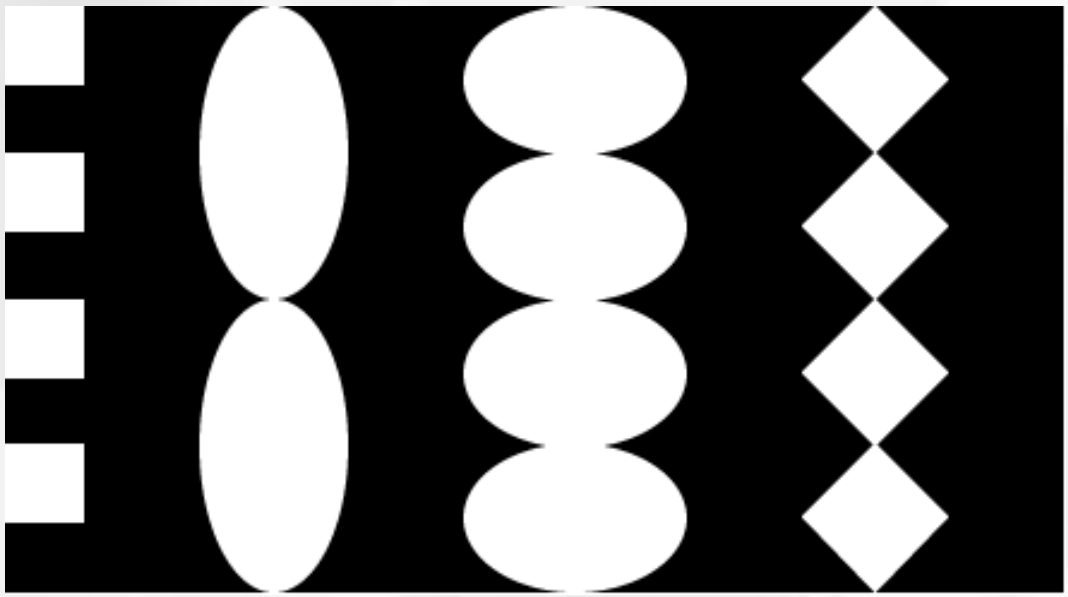
Symmetry





Symmetry and Convexity



Symmetry vs. Convexity

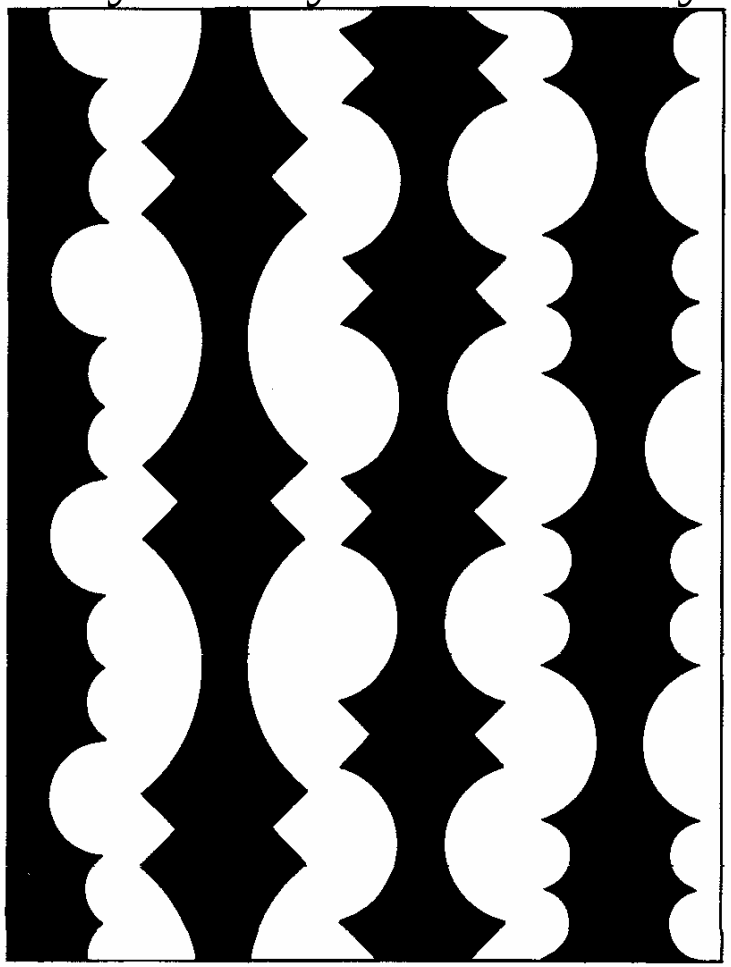
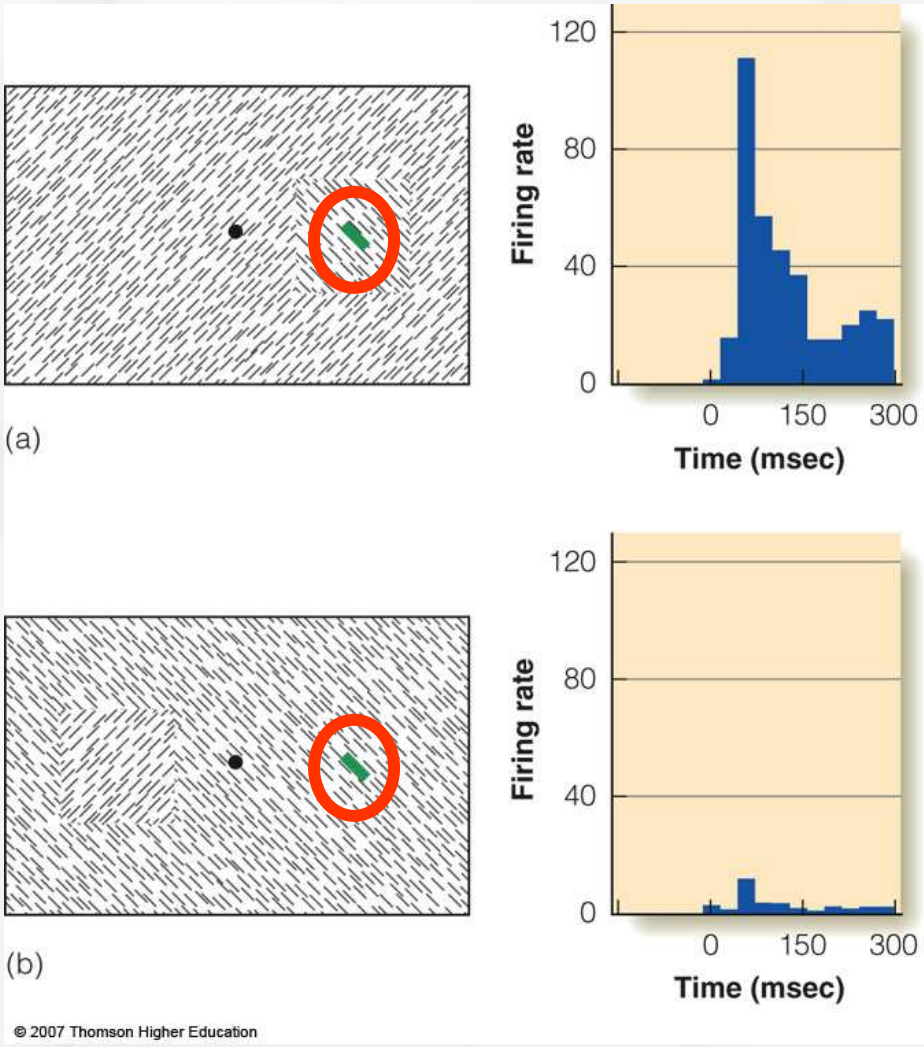


Figure 5.27

The black columns are symmetrical and the white columns are convex. Which are seen as figure (Kanizsa, 1979)?

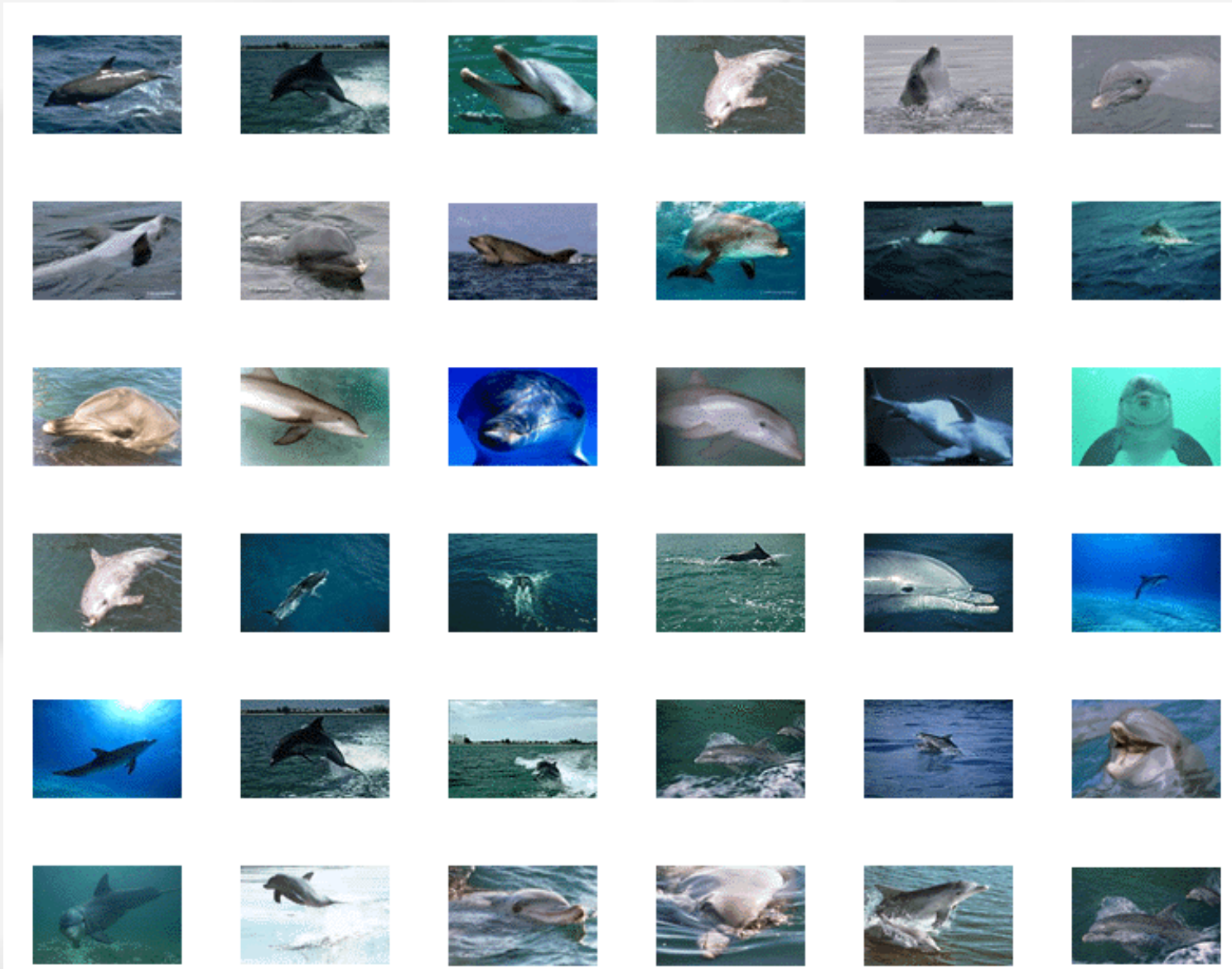
Figure-Ground Segregation - Neural Evidence from V1.

- Recordings from V1 in the monkey cortex show:
  - Response to area that is figure
  - No response to area that is ground



Shape and object perception

Visual input is extremely variable



Shape space is virtually infinite

How Do We Recognize Objects From Different Viewpoints?

Two competing theories:

- Structural description models

- Image description models

Structural-Description Models:

Recognition by Components (RBC)

Biederman (1985)

Geons (“Geometric Ions”)

Each geon is uniquely identifiable from most viewpoints *(viewpoint invariant*).

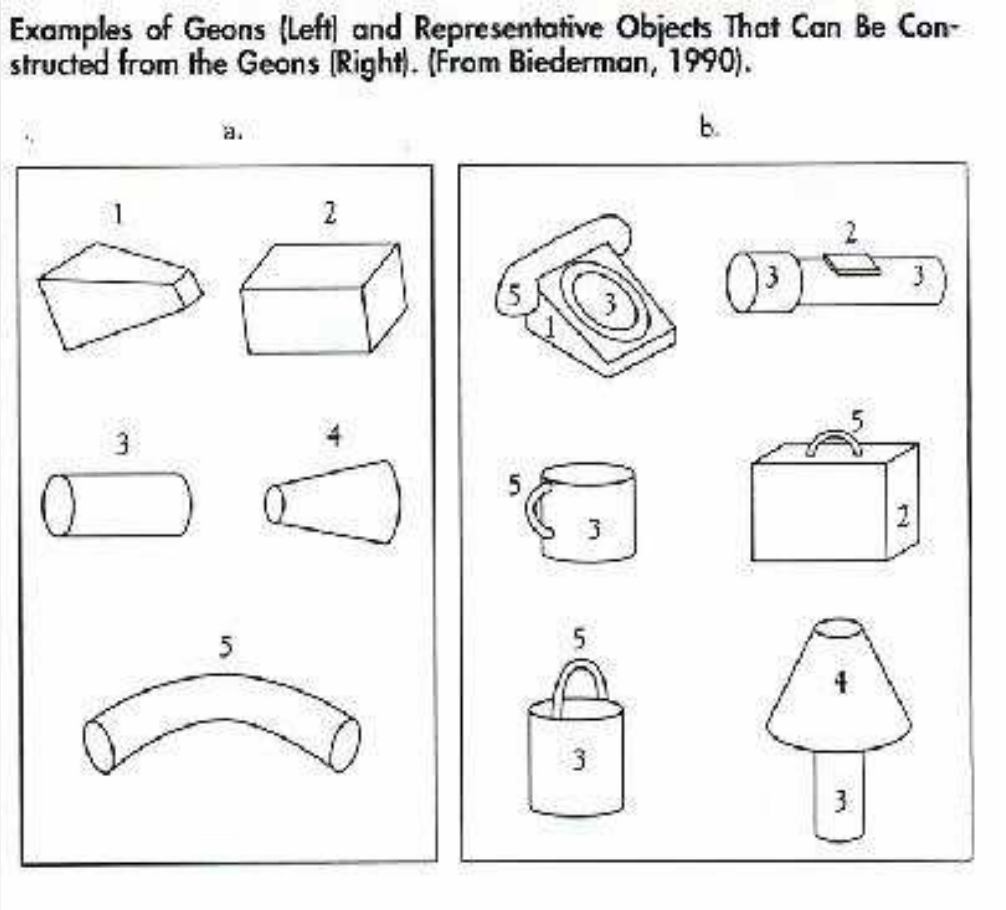
Only 36 geons needed to make thousands of objects.

Objects can be identified if the geons can be identified:

- which geons are present?
- what is the spatial relation among geons?

Structural-Description Models

Recognition by Components (RBC)



(a)

(b)

Figure 5.35 (a) It is difficult to identify the object behind the mask because its geons have been obscured. (b) Now that it is possible to identify geons, the object can be identified as a flashlight.

Recognition by Components

- Strengths
  - Viewpoint invariant
  - Parts-based
  - May be able to deal with partial occlusion via feedback
  - Represent 3-D structure
- Weaknesses
  - Complexity of representation
  - Doesn’t easily represent subtle metric differences (e.g., distance between eyes)
  - Recognition is at the level of categories (chair vs. table) rather than individuals (my office chair vs. my kitchen chair)

Image-Description Models

- Ability to identify 3-D objects comes from stored 2-D viewpoints from different perspectives
  - For a familiar object, view invariance occurs
  - For a novel object, view invariance does not occur
    - This shows that an observer needs to have the different viewpoints encoded before recognition can occur from all viewpoints

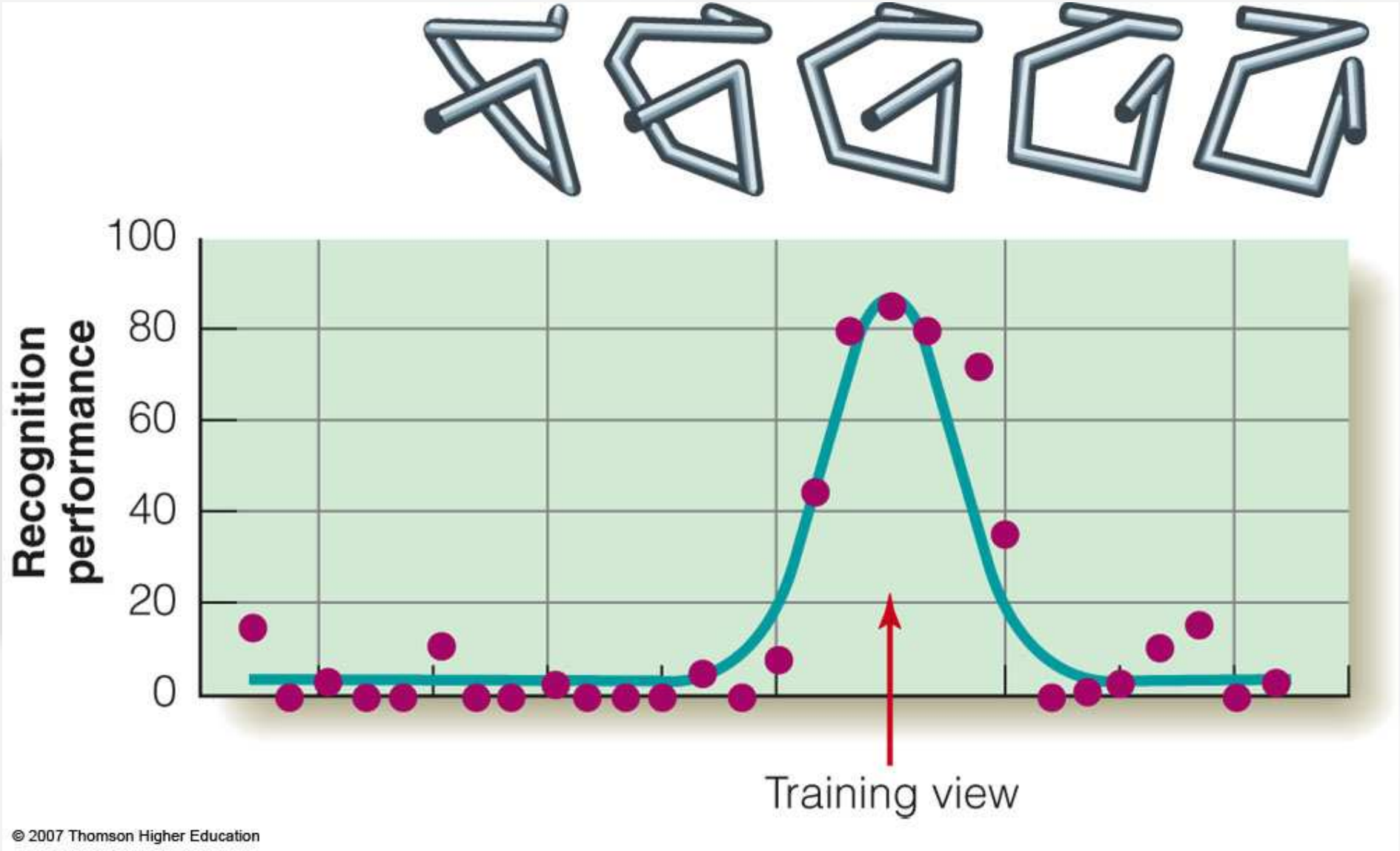
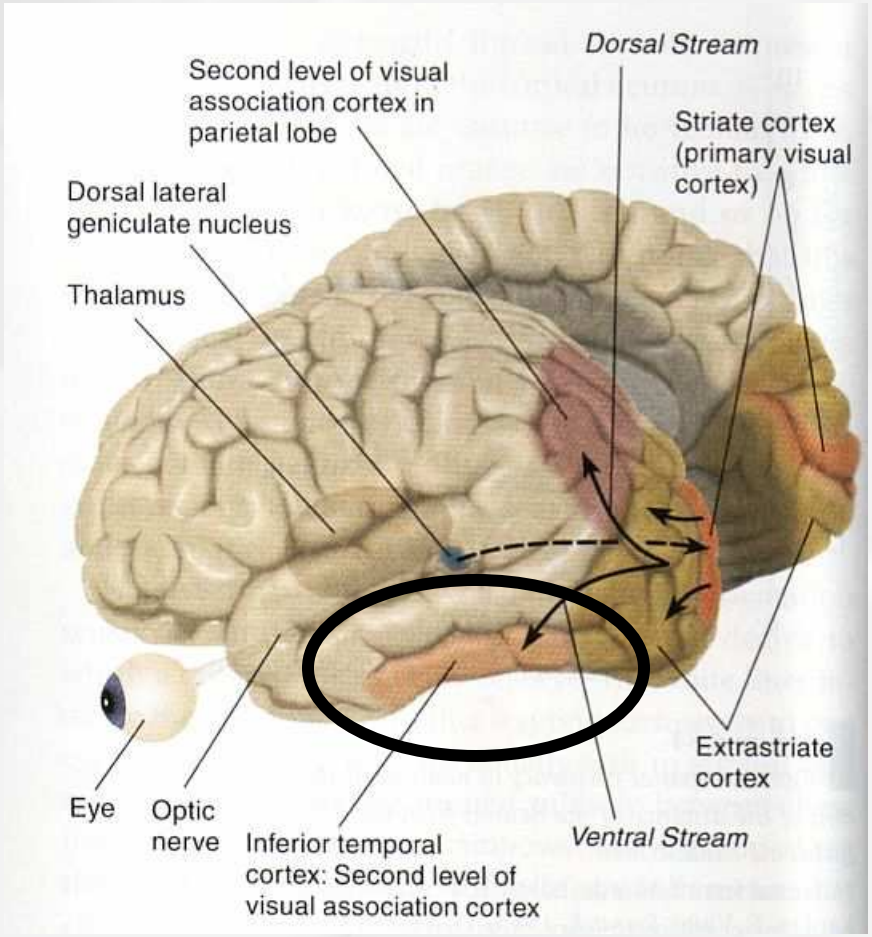
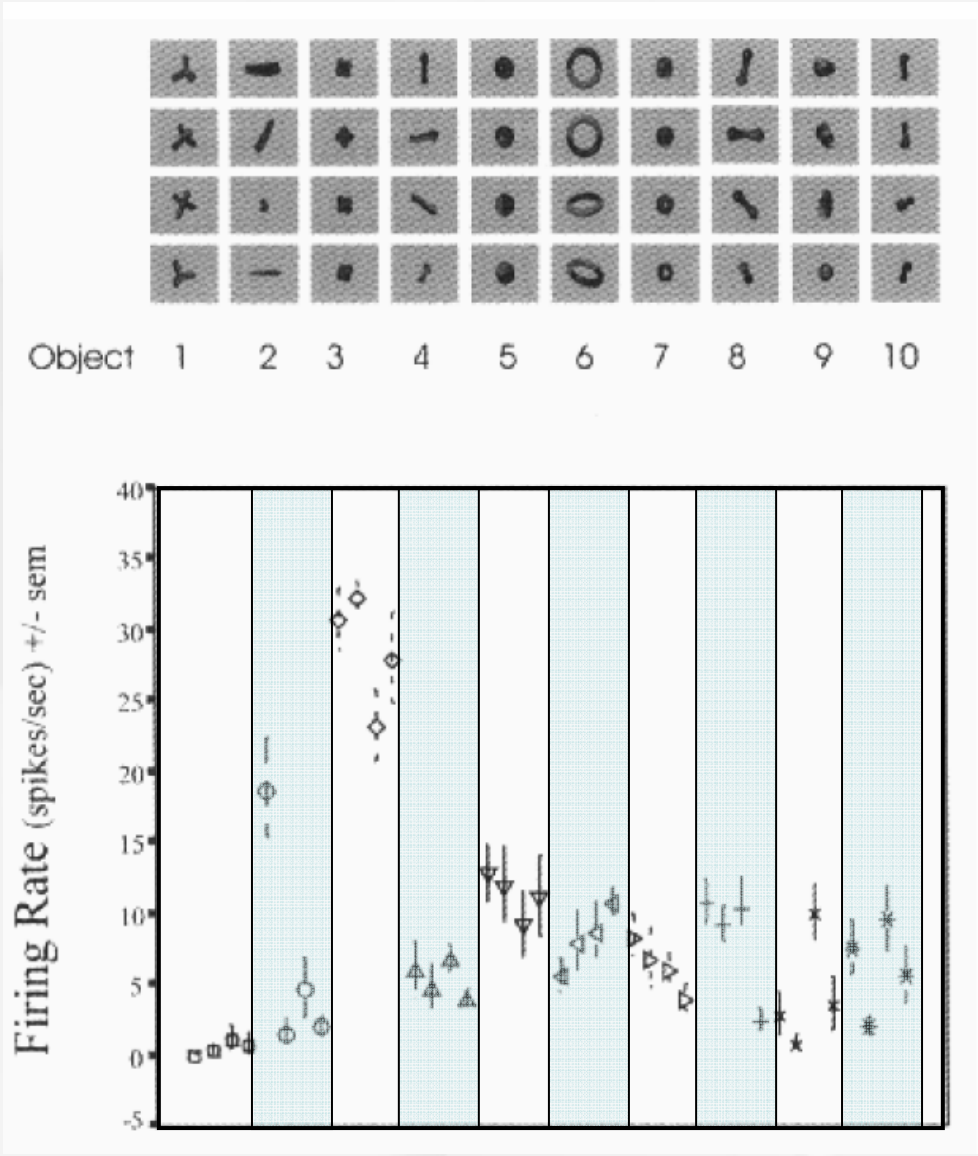


Figure 5.37 Psychophysical curve showing that a monkey is better at identifying the view of the object that was presented during training (arrow). The drop-off in performance for other viewpoints is an example of a lack of view invariance.

How Does the Brain Process Information About Objects?



View invariant responses to familiar objects in monkey area IT



The neuron's responses are similar within each object across viewpoints.

Booth and Rolls, 1998

Neurons in monkey IT tend to reflect to what you consciously see.

Experiment by Sheinberg & Logothetis (1997)

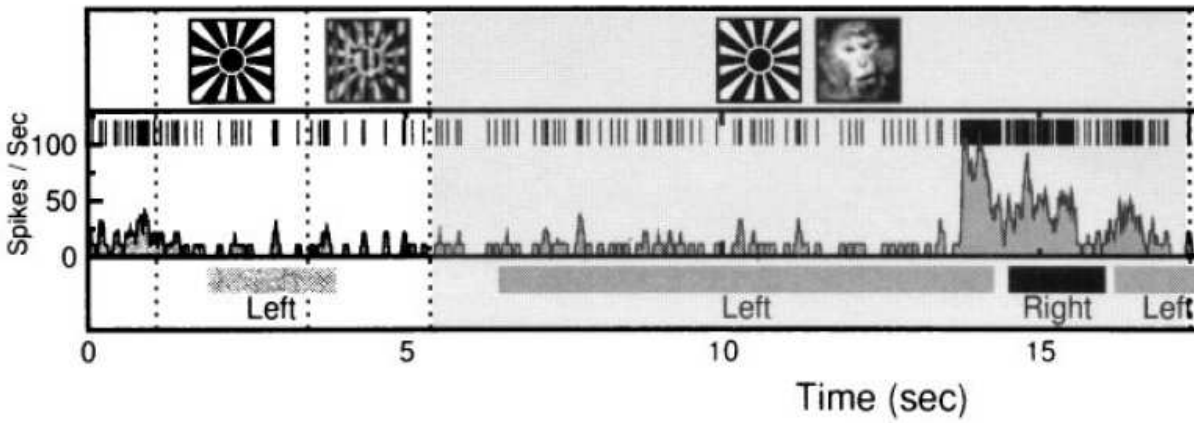
- *Binocular rivalry* was used - one picture shown to each eye
- Monkey was trained to pull a lever for a sunburst or an object
- Neuron in the IT cortex was monitored
- Firing was vigorous for only when the monkey saw the object

Left eye: “sunbursts”

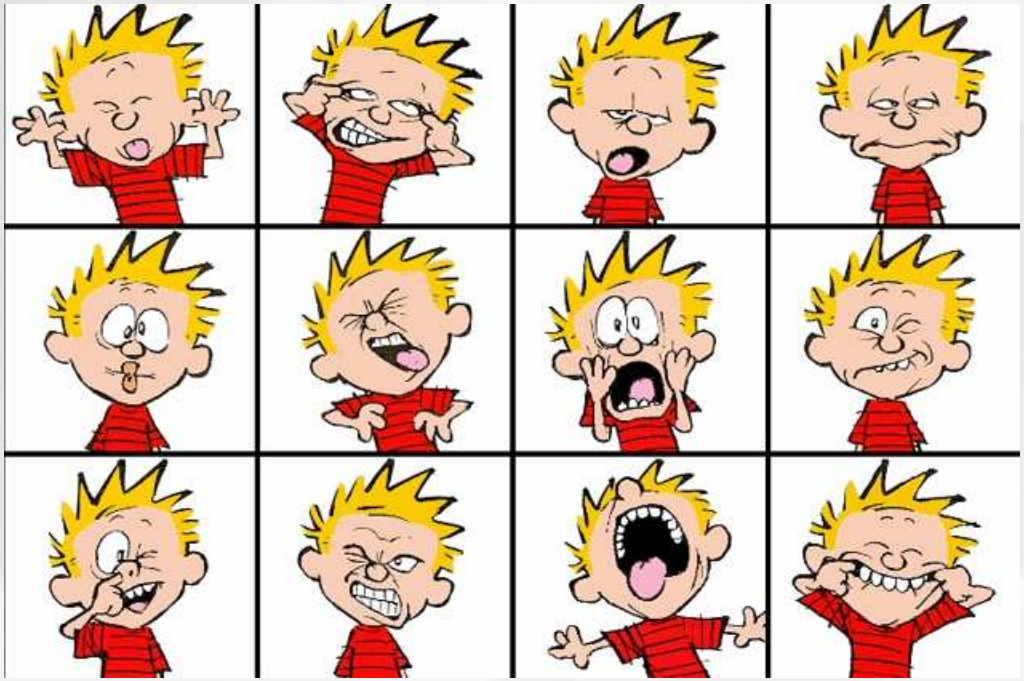
Right eye: “objects”

Left eye only

Both eyes (rivalry)



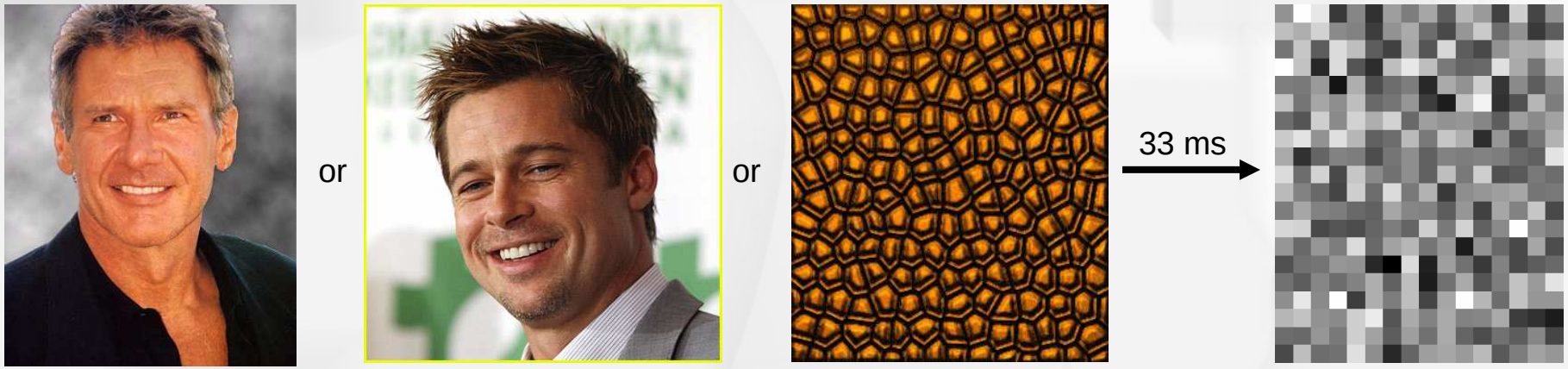
Face Perception



Neurons in FFA also reflects to what you consciously see.

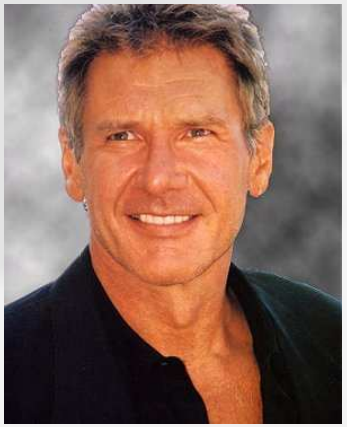
Grill-Spector et al. (2004)

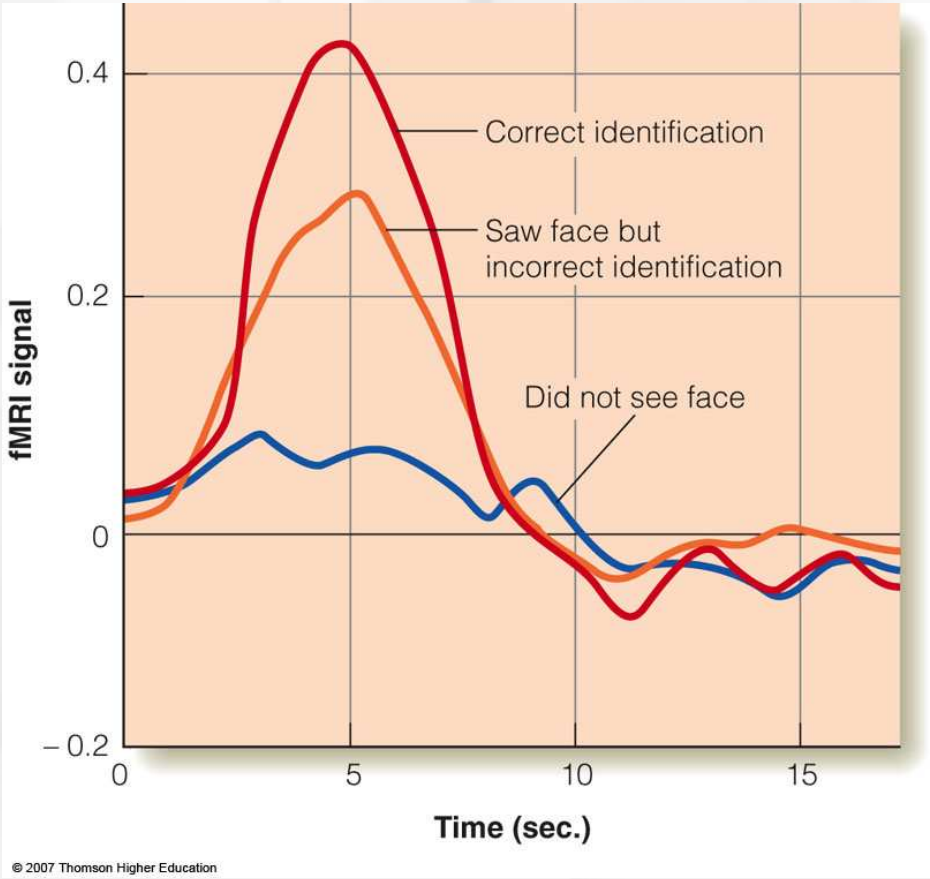
- Fusiform Face Area (FFA) in each participant was identified with fMRI.
- On each trial, participants were shown either:
  - A picture of Harrison Ford's face
  - A picture of another person's face
  - A random texture
  - All stimuli were shown for 50 ms followed by a random-pattern mask
  - Participants were to indicate what they saw (Harrison Ford, another face, or a texture pattern).



Grill-Spector Experiment - continued

- For trials that only included Harrison Ford's face, results showed that FFA activation:
  - Was greatest when picture was correctly identified as Ford
  - Was less when picture was identified as other object
  - Showed little response when there was no identification of a face





The hollow face illusion

http://www.richardgregory.org/experiments/index.htm