Vision and Imagery

CSCI 5582, Fall 2007
What Phenomena Do Geons Not Explain?
"The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined.... The above mentioned elements are, in my case, of visual and some of muscular type. Conventional words or other signs have to be sought for laboriously only in a secondary stage, when the mentioned associative play is sufficiently established and can be reproduced at will."

-- Albert Einstein, in a letter to J. Hadamard
(in Hadamard, *The Psychology of Invention in the Mathematical Field* [1949])
"Despite the low academic status of visual thought, it is an intrinsic and inseparable part of engineering."

Some Immediate Questions About Imagery

- Indistinctness: the tiger example
- Difficulty of reinterpretation: the “ambiguous figure” example
- Difficulty of re-examination: the “Star of David” example
- The homunculus objection
Example 1:

Shepard-Metzler Visual Rotation Experiment
A. TWO-DIMENSIONAL ROTATION

Mean reaction time (seconds)
FIGURE 4.8: An example of a simple block diagram used by Brooks (1968) to study the scanning of mental images. The asterisk and arrow showed the subject the starting point and the direction for scanning the image. (Copyright 1968 by the Canadian Psychological Association. Reprinted by permission.)
FIGURE 4.9: A sample output sheet of the pointing condition in Brooks (1968) for mental image scanning. The letters are staggered to force careful visual monitoring of pointing. (Copyright 1968 by the Canadian Psychological Association. Reprinted by permission.)
Figure 12.2 CONSTRAINTS on visual resolution were measured by three patterns (bottom left). Subjects projected their mental images of each pattern onto the center of a large display (top left), then indicated how far they could look away from their images along each of the eight lines on the display before they could no longer tell the two halves of the imagined patterns apart. The fields of visual resolution decreased with increasing spatial frequency, or decreasing bar width (colored line, middle). These fields were elongated horizontally and larger below the direction of gaze than above it (colored shape, right). Similar results (black line, middle; black shape, right) were obtained when the patterns were actually projected on the display.
Ponzo Illusion
Summing Up the Experiments

- Certain types of operations may be performed on mental images:
  - Rotation (Shepard/Metzler)
  - Scanning (Kosslyn, Ball, and Reiser)
- Visual/Spatial cognition interferes with mental imagery
  - Brooks “moving-star” experiment
- Mental imagery seems to recreate some effects...
  - Ponzo illusion
  - McCollough effect
  - Resolution (Finke experiment)
- But not others
  - Ambiguous figures
  - Finding “parts” of figures
Arguments against “pictorial” model of mental imagery

- Introspection is an insufficient guide
- “Hidden” knowledge (e.g., direction to scan)
- Background knowledge (Pylyshyn’s “cognitive impenetrability”)
- The “parsimony” argument
- Mental imagery seems to do too much
- Mental imagery doesn’t do enough (Hinton’s example)
Figure 6.10 The division of the pattern activation subsystem into two more specialized subsystems, one that encodes categories (perhaps represented as prototypes) and one that encodes specific exemplars. The subsystems are illustrated in the context of the subsystems discussed previously.

Identifying Objects in Degraded Images
Fig. 1. Schematic of the structure of a trial in the imagery and perception conditions. In the imagery condition, participants kept their eyes closed throughout the scan. Each trial began with the name of a previously studied object, presented auditorily via headphones. In the imagery condition, participants had to generate a visual mental image of the object. In the perception condition, participants saw a faint picture of the named object. In both cases, participants had to wait for the auditory probe (4.5 s later, “W”, meaning “wider than tall” in this schematic) specifying the judgment to be performed. Upon hearing the probe, participants performed the judgment as quickly and accurately as they could, and response times (RT) and accuracy were recorded.
Where the research is...

- Relationship between 2D and 3D imagery
- Relationship between imagery and other sensory input (especially tactile)
- Role of mental imagery in “larger” representations (e.g., prototypes, scripts)
- Static vs. dynamic imagery