

"The nature of memory and its process has now been explained as the persistent possession of an image, in the sense of a copy of the thing to which the image refers..."

— Aristotle, *On Memory and Recollection*

"... after the object is removed or the eye shut, we still retain an image of the thing seen, though more obscure than when we see it."

— Thomas Hobbes, *Leviathan*

"... The ideas of the nurse and mother are well framed in their [children's] minds; and, like pictures of them, represent only those individuals."

— Locke,
Essay Concerning Human Understanding

Hamlet: My father... Methinks I see my father.

Horatio: Where, my lord?

Hamlet: In my mind's eye, Horatio.

— Shakespeare, *Hamlet*, Act I

Problems with the "Image-As-Picture" Notion

- Indistinct details: the "tiger" example
- Difficulty of reinterpretation: the "ambiguous figure" example
- Difficulty of re-examination: the "Star of David" example
- The homunculus objection

What is Imagery?

A Collection of Experiments

- Mental Rotation
- Mental Scanning
- Interference with Visual Imagery
- Reproduction of Some Types of Visual Effects
- "Imagery Overflow" Experiments
- "Imagery Grain" Experiments

What is Imagery? A Collection of Experiments

- **Mental Rotation**
Shepard and Metzler blocks rotation experiment
- **Mental Scanning**
Kosslyn et al. Island experiment
Finke and Pinker "arrow-pointing" experiment
- **Interference with Visual Imagery**
Brooks "follow-the-star" experiment
- **Reproduction of Some Types of Visual Effects**
Ponzo Illusion
McCollough effect (Finke and Schmidt)
Spatial Resolution (Finke)
- **"Imagery Overflow" Experiments**
Kosslyn "walk-toward-the-ruler" experiment
- **"Imagery Grain" Experiments**
Kosslyn "rabbit-whisker" experiment

Experiments in Mental Imagery: A Summary

- Certain types of operations may be performed on mental images
 - Rotation (Shepard and Metzler)
 - Scanning (Kosslyn, Ball, and Reiser)
- Visual/Spatial Cognition Interferes with mental imagery
 - "Moving-Star" experiment (Brooks)
- Mental Imagery seems to recreate some visual effects...
 - McCullough effect (orientation-specific color aftereffects)
 - Resolution (Finke's experiments on stripe patterns)
 - Ponzo illusion (Wallace)
- ... But not others
 - Ambiguous figures
 - (Chambers and Reisberg)
 - Finding "parts" of figures (Reed)

Sources of Controversy: Arguments Against a Straightforward 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)

Kosslyn's Model of Mental Imagery

- **Neurological Evidence**

 - PET Results**

 - Studies of Brain-Lesioned Patients**

- **What this model might explain**

 - Weak or fleeting nature of imagery**

 - Need for transformations (e.g., rotation)**

 - Interference with other visual effects**

Open Questions

- Relation between 2D and 3D imagery
- Relation between visual imagery and other types of sensory input (especially tactile)
- Static vs. Dynamic Imagery
- Role of mental imagery in other representations (prototypes, scripts)

Trainability/Development (Imagery as a Skill)

- **Visualizing Polyhedra: Using Propositional Knowledge to Guide Imagery**
- **The need for better models (the agenda for AI)**