Visual Imagery

I. Introduction
II. Eidetic Imagery
III. Imagery and Working Memory
IV. Imagery and Long-Term Memory
V. Conclusions

I. Introduction

A. Food for Thought:
   What is the nature of visual images?
   Are they like pictures in the head?
   If they like pictures, how do you explain their inaccuracy or lack of detail?
   or
   Are they more abstract, like descriptions?
   If they are like descriptions, how do you explain the “sensation” of “seeing” that you have when you form an image.

Thinking about imagery

Draw a picture of a bicycle:
Lawson (2006)

Drawings demonstrate a failure to understand how everyday objects work.

(A) Male
(B) Female
(C) Female
(D) Male

How detailed are your images? Pick the accurate penny.
I. Introduction (cont)

B. Brief History
1) Structuralists: content of the mind
   used introspection to study images
2) Behaviorists: images could not be directly
   observed, so they were not a legitimate topic of
   study.
3) Cognitive Psychology:
   Paivio: Imagery as an aid to LTS
   Kosslyn: Imagery like visual perception

C. Views on the nature of mental images
1) Analogical representation
   Imagery is like (analogous to) perception, retaining
   some of the sensory qualities of perception and tied to a
   specific sensory modality (i.e. “visual”). The physical
   properties of the stored representation are similar to the
   physical properties of perception.
2) Propositional Representation
   Images are propositional (verbal/symbolic) descriptions,
   not tied to a sensory modality (amodal).
3) Dual Coding Hypothesis
   Memory stores both sensory images and verbal
   descriptions

II. Eidetic Imagery
A. Definition: Detailed, vivid recollections of a
   complex visual scene. Sometimes called
   photographic memory.

Webster’s definition:
Main Entry: eidetic
Pronunciation: ı′-de-ık
Function: adjective
Etymology: Greek eidoikes of a form, from eidos form — more at WISE
Date: circa 1924
me marked by or involving extraordinarily accurate and vivid recall especially of
visual images <can eidetic memory>
B. Haber & Haber (1964) One of the first systematic studies of eidetic imagery

Children were given 30 sec to view a picture
Then they were asked a series of questions

Criteria for eidetic images:
- Images lasted 40 sec or longer
- High accuracy in detail
- Children used present tense while describing the images
- Children scanned the blank screen while viewing their images

Incidence (see Haber & Haber, 1988)
- 2-15% of elementary school age children
- Equally likely in males and females
- Seems less frequent in adults
II. Eidetic Imagery (cont)

C. Strohmeyer & Psotka (1970)


Case study of an eidetic imager (Elizabeth)

1) She could reproduce a poem, written in a foreign language, from bottom to top, as fast as she could write.

2) She could fuse two part random dot patterns, each containing 1 million dots, presented four hours apart.

Random dot patterns from Julesz, used to test Elizabeth the eidetiker

Strohmeyer & Psotka (1970)

Conclusions?

1. Never replicated by anyone else.
2. Could be an example of something like Clever Hans – a horse that was thought to perform simple arithmetic.
3. Need for further research.
Another Example?

Stephen Wiltshire: Architectural Artist.
Draws city skylines from memory.
No documented scientific analysis.

Excerpt from NYC, Liberty Island


Random dots: Part A

Random Dots: Part B
D. Merritt (1979) (cont)

Millions took the test
30 wrote in with correct answer.
15 came to the lab to be tested.
None of them could do it in the lab.

Conclusion:
“none in a million”

E. Miller & Peacock (1982)

Compared eidetic 12-14 year old boys to a control group.
Used a simpler dot fusion test:
Miller & Peacock (1982) results

<table>
<thead>
<tr>
<th></th>
<th>Eidetic</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dot fusion (number correct out of 18)</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Recall of picture details: (out of 16)</td>
<td>6.3</td>
<td>4.9</td>
</tr>
</tbody>
</table>

Eidetic kids more susceptible to interference from a second stimulus than control kids.
Eidetic images lasted longer (25-180 sec) than images of the control group (0-13 sec).
F. Conclusions of Eidetic Imagery

1. Relative rare ability to maintain vivid images.
2. This ability is quantitatively and qualitatively different from non-eidetic imagery.
3. Not really "photographic memory" in that recall is far from perfect, the memories fade in a matter of a few minutes, and the images are easily disrupted by new visual stimulation.
4. The more fantastic claims of this ability have not been replicated.

III. Imagery and Working Memory

A. STS vs. LTS imagery
B. Kosslyn’s model
C. Evidence for analogical representation in STS

A. STS vs. LTS imagery

1. Computer metaphor:
   LTS Imagery: information on a computer disk used to create images.
1. Computer metaphor:

STS Imagery: a perceptual like representation (e.g., analogical) constructed on the computer screen from the information on disk.

B. Kosslyn’s model
C. Analogical Representation in STS

1. Mental Rotation: Shepard’s task

Shepard & Metzler (1971) results

Rotation time related to distance rotated
Demonstrates perceptual quality of STS imagery

C. Analogical Representation in STS

2. Scanning Mental Images; SIZE
   (Kosslyn, 1975)

Participants were asked “to construct a visual image of two animals standing next to each other . . . kept in the proper relative sizes . . . To be in view simultaneously.”
Imagine an elephant, next to it is a goose. Does a goose have legs?

On average, animals pictured next to an elephant took 211 msec slower than animals paired with a fly.

Imagine a fly, next to it is a goose. Does a goose have legs?

C. Analogical Representation in STS

Scanning Mental Images
(distance):
(Kosslyn, Ball, & Geiser, 1978)
"imagine a black spec moving"

a) hut to the well
b) hut to the rock

C. Analogical Representation in STS

Scanning Distance Results (Kosslyn, Ball, & Geiser, 1978)

Reaction time was a linear function of scanning distance.
C. Analogical Representation in STS (cont)

2. Modality Specific Interference
   a) Definition:
   - Imagery in a given modality causes interference with perceptual activities in that modality.
   - Perceptual activities in a given modality causes interference with imagery in that modality.

2. Modality Specific Interference
   b) Segal & Fusella (1970)
      - Task #1: image either “a tree” or “a telephone ringing”
      - Task #2: detection tonal detection
      - light detection

c) Segal & Fusella (1970)
   Results

![Graph showing detection results for auditory and visual images.](attachment:image.png)
3. Matching Stimuli (parallel processing)

Nielsen & Smith (1973)

Face matching task:

Condition 1: given a description, have to decide if a face matches the description

Condition 2: look at a face, have to decide if a second face matches the first face.

Independent Variable: Number of relevant features (3, 4, or 5)

Dependent Variable: Reaction Time

Nielsen & Smith (1973)

Sample materials

Large eyes, small ears, broad nose:

Nielsen & Smith (1973)

Sample materials

Small eyes, large ears, broad nose:
Nielsen & Smith (1973) sample materials

small eyes, large ears, broad nose:

Nielsen & Smith (1973) sample materials

Do the following faces match?

Nielsen & Smith (1973) results

Description-Face
Face-Face

RT

Number of Features

5 6 7 8 9 10 11 12 13 14 15

500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300
4. Physiological Evidence
Ishai, Haxby, & Ungerleider (2002)
Visual Imagery of Famous Faces
(Bruce Willis, Jennifer Aniston, Tom Cruise, etc.)

fMRI’s comparing images of faces:
1) while viewing the faces
2) based on immediate memory for the faces
3) based on recall of the faces from LTM
Focused on the “core” systems “comprised of regions in the visual cortex, the inferior occipital, fusiform gyri, and superior temporal sulcus (STS), which mediate the visual analysis of faces.”

III. Imagery and STS: Conclusion
A. STS vs. LTS imagery
B. Kosslyn’s model
C. Evidence for analogical representation in STS
   Mental Rotation & Scanning: perceptual qualities
   Modality Specific Interference: images modality bound
   Matching Task: demonstrates parallel representation
   Physiological evidence: visual imagery activates the visual cortex
IV. Imagery and LTS:

A. Imagery as a mnemonic device
B. Paivio’s Dual Code Hypothesis
C. Representation of images in LTS

A. Imagery as a mnemonic device
1) demonstration: method of loci

2) Bower & Winzenz (1970)
   Participants studied 15 unrelated word pairs
   (5sec/item)
   e.g., salad - prairie
   teacher - windmill
   cannon - farm.
   
   Four types of instructions:
   rehearsal, read a sentence, make-up a sentence,
   make-up a vivid interacting image
## 2) Bower & Winzenz (cont)

### Results:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehearsal</td>
<td>37%</td>
</tr>
<tr>
<td>Sentence Reading</td>
<td>54%</td>
</tr>
<tr>
<td>Sentence Generation</td>
<td>77%</td>
</tr>
<tr>
<td>Imagery</td>
<td>87%</td>
</tr>
</tbody>
</table>

## Imagery and Key Terms?

- **Recency effect:** better recall of words at the end of the list than words in the middle of the list.
- **Orthographic distinctiveness:** lowercase words that have an unusual shape.
- **Reality monitoring:** Discriminating between actual and imagined events.
- **Global coherence:** integrations of major ideas that occur throughout a text.

## B. Paivio’s Dual Code Hypothesis

1) Two independent but interacting systems:
- **Imagery system:** stores images (analogical representation). Associated with right hemisphere processing.
- **Verbal system:** stores linguistic information, or verbal descriptions. Associated with left hemisphere processing.
B. Paivio’s Dual Code Hypothesis (cont)

2) Material can be processed in one or both systems:
   - **picture**: image processing, but you may elect to label the picture (verbal processing).
   - **concrete words**: verbal processing, but you may elect to form an image.
   - **abstract words**: verbal processing only?

3) Two codes increase the likelihood of later retrieval.

B. Paivio’s Dual Code Hypothesis (cont)

4. Imagery and other forms of processing:
   - Imagery may aid associative processing
     interactive images
   - Imagery may aid discriminative processing
     images may be more distinctive than words

vs. “cow”

B. Paivio’s Dual Code Hypothesis (cont)

Experimental Support: Paivio & Csapo (1969)

- Materials: pictures, concrete words, or abstract words
- Varied rate of presentation:
  - **Fast**: 5.3 items per sec (limits participants to one code)
  - **Slow**: 2 items per sec (opportunity for dual codes)
Paivio & Csapo (1969) (cont)

Results

<table>
<thead>
<tr>
<th>Rate of Presentation</th>
<th>Figures</th>
<th>Concrete Words</th>
<th>Abstract Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slow</td>
<td></td>
<td></td>
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</tbody>
</table>

C. Representation of images in LTS

Are images stored in LTS analogical (picture like)?

Neisser & Kerr (1973) Concealed Object Experiment

Subjects asked to rate a group of sentences on the vividness of the imagery, (scale from 1 to 7)

Followed by a surprise recall test

Concealed Object Experiment (cont)

Three types of sentences:

- **Concealed**: “A harp is hidden inside the torch held by the Statue of Liberty.”
- **Pictorial**: “A harp is sitting on top of the torch held by the Statue of Liberty.”
- **Separate**: “Looking from one window you see the Statue of Liberty; from a window on another wall you see a harp.”
Neisser & Kerr (1973) Concealed Object Experiment (cont)

Results:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Vividness</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>concealed</td>
<td>3.38</td>
<td>4.83</td>
</tr>
<tr>
<td>pictorial</td>
<td>2.82</td>
<td>5.21</td>
</tr>
<tr>
<td>separate</td>
<td>3.17</td>
<td>3.96</td>
</tr>
</tbody>
</table>

Conclusions:
1) vividness and recall were not related
2) images are not stored analogically in LTS

V. Conclusions on Visual Imagery

A. Debate: are images analogical or propositional?
The answer depends on what type of imagery
B. Eidetic Imagery: analogical, but short in duration.
C. STS Imagery: we use it to perform a number of tasks, its seems analogical
D. LTS Imagery: imagery helps long-term retention, one explanation of this is Paivio’s Dual code hypothesis (image and verbal codes)

But: no strong evidence for analogical storage in LTS.