Chapter 11

Visual Imagery

Introspection and Images

- Sir Francis Galton – asked people to introspect & report on mental images
- Their responses suggested picture-like representation
  - Image viewed from particular angle & distance; colour and texture represented in image
- Large individual differences in quality of images reported.
  - People weren't actually seeing images
- How determine whether people really differed in image quality or just reported differences?

Chronometric Studies

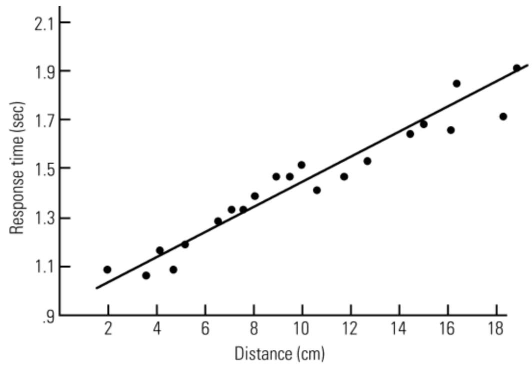
- Mental processes require finite & measurable amount of time
- Depiction vs. description (analogue vs. propositional)
  - Draw a cat vs. describe a cat
  - Different information salient in depictions and descriptions
  - Depictions include spatial relationships, size etc.

Chronometric Studies - 2

- Hypothesize different mental processes for depictions (images) & descriptions, and variables that would affect these processes
- Kosslyn: timed tasks involving mental imagery
  - Form mental image of object & answer yes-no questions about image
  - Answer questions without image → get different pattern of response times

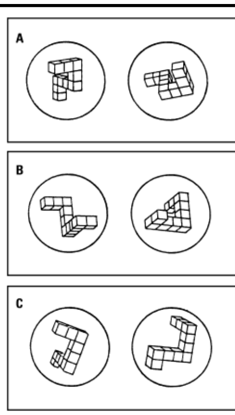
Chronometric Studies

- Kosslyn, Ball & Reiser (1978)
- Ss memorized fictional map) & drew it
- Ss imaged the map, focused on a landmark, & mentally moved a dot to another landmark.
- Time to move depended on distance between landmarks.
- Image preserves info about distances
- Image *depicts* map; is an analogue representation



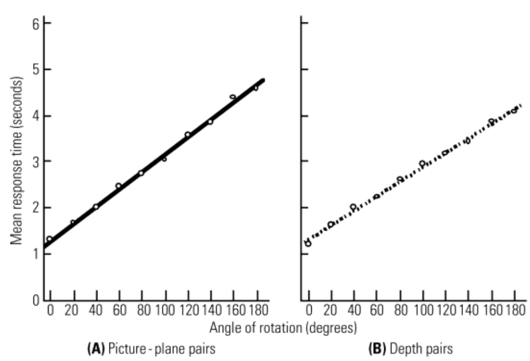
Zoom Experiment

- Ss asked to visualize mouse standing next to elephant or paper clip
- Then answered questions about the mouse by examining the image. e.g. Does the mouse have whiskers?
- Responses faster if mouse seen with paper clip than with elephant → more time needed to zoom in on mouse in 'elephant' condition
- Images preserve 2-D spatial relationships; propositional representations do not necessarily do so.
- Images more similar to pictures than to descriptions



Mental Rotation - 2

- Shepard, Cooper & Metzler (1971)
- Ss examined two diagrams of 3-D objects & decided whether the same objects were identical or mirror images.
- First pair: rotate in picture plane
- 2nd pair: rotate in depth
- 3rd pair: different objects
- Measure time to make decision
  - Prediction: more rotation → more time



Mental Rotation - 4

Results

- Time to make decision linear function of amount of rotation required
- No difference between rotation in page plane & rotation in depth
- 3-dimensional forms represented in images
- When Ss image rotation of letters, don't get linear function

Interactions between Imagery and Perception

- Segal & Fusella – dual task
  - Auditory or Visual signal detection (faint tones or lights)
  - Forming auditory or visual images.
- Predictions
  - If perception & imagery use overlapping mental processes → interference
- Results – as predicted
  - Visual imagery → reduced visual detection
  - Auditory imagery → reduced auditory det'n

Imagery & Perception - 2

Segal and Fusella: Results

	Percentage Detections	
	Vis. Signal	Aud. Signal
V image	61%	67%
A image	63%	61%

Imagery & Perception - 3

Segal and Fusella: Results

	Percentage False Alarms	
	Vis. Signal	Aud. Signal
V image	7.8%	3.7%
A image	3.6%	6.7%

Note: Crossover interactions

Imagery & Perception - 4

- Does priming from images exist?
- Farah (1985) had Ss visualize a capital letter. Then a faint letter was presented.
- Visualization (imagining) primed perception of same letter, but not a different letter.

→ Visual imagery & visual perception depend on overlapping mechanisms & resources.

Visual Imagery VS. Perception

- Perception (seeing cat)– activation of detectors by external stimuli
  - → activation of higher units (perception of cat)
- Imagery – activation of higher units without activation of detectors (visualize cat)

Imagery & Perception - 5

- Neuroimaging techniques show same areas active in occipital cortex during perception and imagery
  - Areas V1 & V2 sensitive to low-level features; active when Ss maintaining detailed, high-resolution images.
    - Larger objects or images activate larger areas
  - Area MT/MST sensitive to motion; also active when Ss asked to imagine something moving.
  - Area active in face perception also active in imagining faces

Imagery & Perception - 6

- Studies of brain damage: stroke patients have parallel damage to perception and imagery abilities
  - Can't perceive colour → can't image colours
  - One patient: Left-sided neglect → left-sided neglect in imagery as well
    - Visualize plaza – if image is from south side of plaza, no buildings imaged on east side;
    - If image is from north side, no buildings imaged on west side

Imagery & Perception - 7

Transcranial Magnetic Stimulation (TMS)

- Strong magnetic stimulation of scalp → temporary disruption of brain region below stimulated area.
- TMS to Area V1 (primary visual projection area) → disruptions in both perception & visual imagery

'Sensory' Effects in Imagery

- Visual acuity – ability to see fine detail
- 2-point acuity: How far apart must two dots be for Ss to see two rather than one?
- Acuity greatest in foveal vision (Ss looking directly at dots.)

Finke & Kosslyn, 1980

- Present two dots to foveal vision, then remove dots. Ask Ss to imagine dots.
- Then ask Ss to imaging moving eyes away from dots & judge whether dots still visible.

'Sensory' Effects in Imagery - 2

Finke & Kosslyn, 1980 cont'd

- Results show strong correlation between performance on 2-point acuity task (perception) and analogous imagery task.
  - Acuity decreased the farther S looked (or imagined looking) away from real or imagined dots
  - In both perception & imagery tasks, acuity decreases more rapidly with distance above or below focal point than to L or R.

Spatial vs. Visual Images

- People blind since birth can do mental rotation tasks → get data similar to sighted Ss.
- Blind people can't be using *visual* imagery.
- *Spatial* imagery – learned through movement, touch etc.
  - Not tied to any specific sensory modality ?

→ Need to distinguish btw. visual & spatial imagery

Spatial vs. Visual Images - 2

- Evidence for visual & spatial imagery being different
  - Can be situations in which brain-injured individuals cannot see or have agnosia (eg. bilateral occipital lobe damage, but can do tasks involving visual (or spatial?) imagery.
  - Some patients with neglect in visual have normal imagery & vice versa.

Neuropsychological Data

- Patient LH could not report colour of common objects. (10/20 compared to 19/20 for control Ss.)
- Could not report properties of animals (e.g. long or short tail) LH: 13/20; controls 19/20
- LH could do image scanning (Kosslyn's island), mental rotation.
- LH has specific impairment in visual tasks, but not spatial tasks.
- Memory for spatial positions & spatial manipulations ok

Individual Differences

- Some people have good spatial skills (sculptors? Organic chemists?), others have good visual skills (e.g. photographers, graphic artists)
- Different individuals may use different skills to do the same tasks, or people may use different skills depending on instructions.
- Image vividness: Some people report vivid images; others do not.
- Do people differ in conscious experience, or do they report same experiences differently?
  - 10% self report as not having "visual" images

Individual Differences - 2

- Prediction: Vivid imagers → do well on visual tasks
  - Often no correlation between vividness ratings & performance on various imagery tasks.
    - Spatial vs. visual tasks???
- Revised prediction: positive correlation between ratings of visual imagery and performance on visual imagery tasks, but not on spatial imagery tasks.
- Two-point acuity task (visual, not spatial task): performance correlated with vividness ratings.
- Conclusion: Vividness ratings related to richness of visual experience
  - Not related to spatial skills.

Individual Differences - 3

- Vivid imagers show increased blood flow in occipital cortex when imaging;
  - ‘Sparse’ imagers do not
- Suggests that self reports (introspections) of imagery vividness may be valid.

Are Images Pictures?

- Necker cube, ambiguous figures – can be interpreted in 2 ways. Sensory information does not dictate perception.
  - *Picture* of Necker cube is neutral wrt interpretation, but perception is not. (We perceive one view or the other.)
- Percepts “go beyond the information given”.
- Percepts organized and unambiguous: specified figure/ground organiz’n, orientation etc.
- Like pictures, perceptions are depictions (not descriptions)
- Unlike pictures, perceptions not neutral wrt interpretation

Are Images Pictures? - 2

- Pictures: neutral depictions (Can be interpreted in more than one way.)
- Percepts: organized depictions (Have one interpretation.)
  - Percepts have *perceptual reference frame*.
    - Specifications that organize perception (e.g. orientation, figure-ground, near-far, front-back etc.)
- Are images like pictures or like percepts?

Are Images Pictures? - 3

- Chambers & Reisberg:
- Ss familiarized with some ambiguous pictures
- Showed Ss Duck-Rabbit picture. Ss asked to form mental image on basis of drawing.
- Ss biased towards one interpretation
- Ss imaged the figure & were asked to imagine image changing interpretation.

Are Images Pictures? - 3

Are Images Pictures? - 4

- Ss could not change perception of imagined figure, but could change perception of drawing they drew.
- → Images more like percepts than pictures.
  - Images are organized like percepts; have depiction plus perceptual reference frame

Learning from Images

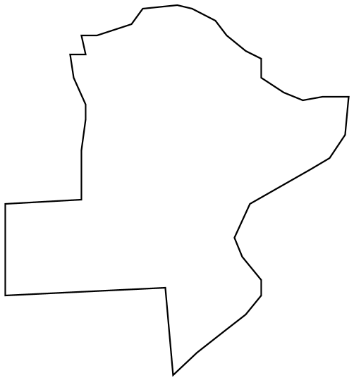
- People can sometimes make discoveries by manipulating mental images
  - Rita Anderson's work – take 3 simple figures (letters, triangles, circle etc) & create diagrams of objects.
- But Ss could not 'discover' duck perception in rabbit image
- Image = picture + reference frame
- Some discoveries consistent with reference frame of image; some not.
- → Prediction: discoveries more likely if consistent with reference frame

Learning from Images - 2

- Rabbit picture interpreted as child with pigtails.
  - New interpretation does not require change in reference frame (rabbit's ears at back of head → pigtails also at back of head; rabbit's face = child's face)
  - Change in perception of image occurs easily
  - Rabbit → duck requires left-right reversal (ears pointing backwards → beak pointing forwards)
    - Hint (e.g. see diagram as facing to the left) helps people make discoveries

<u>Reisberg & Chambers</u>

- Ss memorized nonsense shapes, 10th shape show in Figure 11.9



Learning from Images - 4

- Ss asked to image shape and rotate it 90° clockwise & identify familiar shape
- No Ss could identify the shape (Texas).
- Ss did not rotate reference frame.
- When Ss told during initial inspection that left side was top of figure, they could recognize the shape from the image.
- Changes in reference frame need instructions or training

Long-term Visual Memory

- Are visual images stored as whole "pictures" or stored in parts?
  - Imager first generates "image frame" (global shape) & then elaborates the details

<u>Evidence</u>

- Images with more parts take longer to generate
- Images with more details take longer to visualize
- Imagers control completeness & amount of detail in images
  - Can zoom in or out, can make imaged object move or rotate.

Long-term Visual Memory - 2

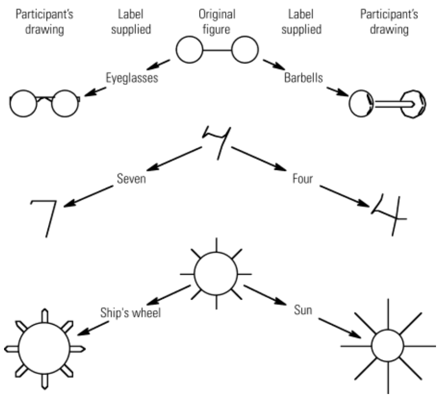
- Image File – "recipe" for construction of visual image in LTM
  - Contains descriptive information which may be propositional.
  - No special status; similar to other LTM files
- Active image – in working memory
  - Images require "special" processing operations; e.g. mental rotation, zoom, etc not used for other types of information
- Image file contains info not in active image

Verbal Coding of Visual Stimuli

- People with better colour vocabulary have better recall of colours (cross-cultural data)
  → Suggests people remember verbal descriptions of colours, not colours themselves
- Linguistic variation – no effect on perception of colour

Carmichael, Hogan, & Walters, 1932

- Ss saw simple drawings & heard one of two possible labels for each drawing.



Verbal Coding of Visual Stimuli - 3

- Ss asked to reproduce drawings from memory
- Distortions in reproductions reflected labels
  - O–O drawing looked like eyeglasses or dumbell depending on label given
  - →Label influenced visual image
- Some visual information stored propositionally (as descriptions)

Verbal Coding of Visual Stimuli - 4

- Which is further north, Detroit or Windsor, ON? How do you know?
- Answer is based on propositional or verbal information (Canada is north of US.), not map-like image.

Imagery and Memory

- Material that triggers visual imagery is easier to remember.
- Paivio, Yuille & Madigan (1968)
  - Ss rated words on image value. Different Ss learned lists of pairs of words
  - Highly imageable (concrete) words better recalled than words with low imagery value (abstract words).
  - CC pairs recalled > AC or CA pairs > AA pairs

Imagery and Memory - 2

- Mnemonics – use imagery
  - Must have two objects in image interacting, not just side by side. Why?
- Congenitally blind Ss benefit from "visual" imagery
- Bizarre images highly memorable (only in list of mixed bizarre & ordinary images)
  - Distinctiveness effect ???
  - List of bizarre images not better recalled than list of ordinary images.

Dual Coding

- Paivio & Colleagues
  - 2 different types of memory representations (visual & verbal)
  - Dual coding improves memory. Why?
  - Visual & verbal codes store different info.
    - Size & shape stored visually, abstract information (semantic information) stored verbally
  - Visual and verbal info. accessed in different ways (e.g. sentence verification vs. size comparisons)

Memory for Pictures

- Paivio: two memory codes, verbal and visual, which represent different info.
- One memory system
- Similarities btw. visual & verbal memory
  - Recall depends on associative links
  - Get priming effect with nonverbal stimuli
  - Get primacy & recency effects in memory for lists of pictures
  - Schemata, influence of generic knowledge on specific memories

Memory for Pictures - 2

Freidman (1979)

- Pictures of typical scenes (kitchen, barnyard) with some unexpected objects (fireplace in kitchen)
- Recognition test: familiar or unexpected objects changed.
- Ss rarely noticed changes in familiar objects (e.g. different type of stove, or toaster replaced by radio). Schema → object will be present. S recognizes object & pays no more attention

Memory for Pictures - 3

- Ss usually noticed changes to unexpected objects (e.g. fireplace missing or changed).
- Unexpected object attracts attention.
  - Ss looked longer at unexpected objects.
    - Stored kitchen + fireplace

Memory for Pictures - 4

Intraub et al. Boundary Extension

- People remember a picture as including more than it did
- See Figure 11.11, page 396 of text
- People show photograph of 2 garbage cans & lid against picket fence.
- Photo was cropped. Sides of garbage cans & top of fence not shown.

Memory for Pictures - 5

- People drew complete garbage cans & top of fence.
- Ss asked to reproduce picture drew objects as complete whereas they had been cut off at edge of photo.
- Ss know about real world (e.g. garbage cans usually symmetrical, fence doesn't stop at edge of photo) & knowledge intrudes in memory test.

Spatial vs. Visual Images - 2

- Baddeley & Lieberman (1980): matrix task
- 4 X 4 matrix, starting cell, 2nd row & 2nd column
- Ss instructed to put numbers in various cells beginning with starting cell, then cell to right or left (or above or below) etc.
- Then Ss reported contents of matrix.

Spatial vs. Visual Images -3

- Baddeley & Lieberman, cont'd
- Concurrent task
  - Visual task: press light for bright but not dim light
  - Spatial task: blindfolded & had to move hands in spatial pattern.
- Results
- No interference in matrix task from light detection.
- Did get interference from spatial task.