Mental Imagery

What is Imagery?

- What is nature of the images?
  - Exact copy of original images?
  - Represented in terms of meaning?
    - If so, then how does the subjective sensation of an image arise?
- What is the nature of imagery for the other senses?

What We Can Imagine

- Things we have directly experienced
- Things never directly observed by our senses
- Things which could never actually exist

Difficulties Studying

- Subjective
- Difficult to verify accuracy of self report
- Introspection
- Functional equivalence

Functional Equivalence Hypothesis

- Visual imagery not identical to visual perception
- Visual imagery is functionally equivalent to visual perception
  - Can guide hypotheses

Functional Equivalence Hypotheses

- Mental transformations/movements
  - Longer to scan across large distances?
- Spatial relations
  - Easier to see details of large images?
- Generating information
  - Possible to answer questions unrelated to encoding?
- Construction of mental images
  - Longer to construct a complex mental image?
- Processing images
  - Same brain regions involved in both imagery and perception?

Mental Transformations

- Mental rotation tasks
- Shepard & Metzler (1971)
  - "Are they the same figure?"
- Decision time influenced by amount of time needed to rotate the figures
- Mental operations similar to physical operations

Mental Rotation

- Cooper & Shepard (1973)
  - Used familiar stimuli
  - Provided cue
  - Varied time prior to presenting rotated figures
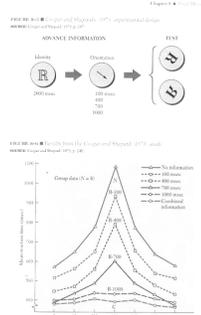
Image Scanning
(Kosslyn, Ball, & Reiser, 1978)

- Learn map of imaginary island
  - Objects on island (hut, tree, lake, etc.)
- Learn until accurately reproduced from memory
  - Objects placed < 1/2 inch from correct location

Image Scanning

- Testing
  - Imagine mentally traveling to named object
- Measured response times
- Linear relationship between distance and scan time
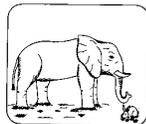- Suggests mental images are scanned similarly to physical images
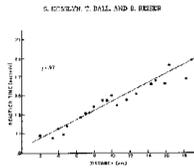
Functional Equivalence Hypotheses

- Mental transformations/movements
  - Longer to scan across large distances?
- Spatial relations
  - Easier to see details of large images?
- Generating information
  - Possible to answer questions unrelated to encoding?
- Construction of mental images
  - Longer to construct a complex mental image?
- Processing images
  - Same brain regions involved in both imagery and perception?
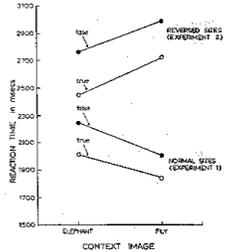
Spatial Relations (Image scaling)

- Imagine
  - Elephant – rabbit
  - Rabbit – fly
  - Rabbit – elephant sized fly
  - Rabbit – fly sized elephant
- Asked about specific features of image
- Reaction time measured

Spatial Relations (Image scaling)

- Slower to describe details of small objects
- Screen resolution for mental images
 - More detailed for images taking up more space

Functional Equivalence Hypotheses

- Mental transformations/movements
  - Longer to scan across large distances?
- Spatial relations
  - Easier to see details of large images?
- Generating information
  - Possible to answer questions unrelated to encoding?
- Construction of mental images
  - Longer to construct a complex mental image?
- Processing images
  - Same brain regions involved in both imagery and perception?

Generating Information

- Angle size comparisons
  - Paivio (1978)
- Imagine analog clocks
  - Could be imagined more precisely
  - Could be imagined more consistently
- Decision time related to difference between angles
  - Parallels research in psychophysics
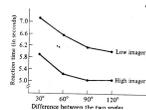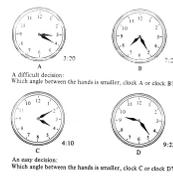
Analog Representation

- Information about a mental image stored in an analog code
  – Sheppard, Kosslyn, Finke
- Closely resembles physical referent

Analog Evidence

- Studies on visual imagery testing the functional equivalence hypothesis
  – Image scanning, mental rotation, angle size comparisons
- Suggest mental images are analogous to physical images
- Mental operations on mental images operate similarly to physical operations on physical objects

Analog Problems

- Selective maintenance in details of mental images
- Difficulty reinterpreting ambiguous figures
  – Chambers & Reisberg (1985, 1992)
- Difficult to form clear stable images of distorted objects
  – upside down, out-of-focus, mirror image

Propositional Representation

- Image code is in the form of an abstract language-like representation
  – Anderson & Bower, Pylyshyn
- Storage is neither visual or spatial
- Image does not resemble original stimulus

Propositional Representation

- Images and verbal statements represented in terms of deep meanings
  – As propositions
- Mental images are generated from this propositional representation

TYPE OF RELATIONSHIP	REPRESENTATION IN WORDS	PROPOSITIONAL REPRESENTATION*	IMAGINAL REPRESENTATION
Actions	A mouse bit a cat.	Bite [action] (mouse [agent of action], cat [object])	
Attributes	Mice are furry.	[external surface characteristic] (furry [attribute], mouse [object])	
Spatial positions	A cat is under the table.	[vertically higher position] (table, cat)	
Class membership	A cat is an animal.	[categorical membership] (animal [category], cat [member])	

Dual-Code Hypothesis

- Information can be represented by both/ either propositions and analog images
  - Paivio (1969,1971)
  - Kosslyn (1994)

Kosslyn (1994)

- Images have two components
  - Surface representation
    - Quasi-pictoral
  - Deep representation
    - Stored in LTM
    - Literal information
      - How something looks
    - Propositional information
      - Describes in verbal terms

Road-Route Knowledge

- Road-route knowledge
  - Knowledge of specific pathways for moving from one location to another
    - May be based on procedural knowledge and declarative knowledge
  - Learned from navigating through the environment
  - Takes longer to learn than survey knowledge
  - More flexible and orientation free than survey knowledge

Landmark & Survey Knowledge

- Landmark knowledge: knowledge about specific features at a location
- Survey knowledge: involves estimated distances between landmarks much as they might appear on survey maps
  - May be represented imaginally or propositionally
  - Bird's eye view often learned from maps

Cognitive Maps

- Similar to actual maps
  - Do not actually resemble mapped area
  - Symbolic representation of area
- Preserve crucial spatial information
  - Functionally relevant information preserved
- Subject to distortions and inaccuracies

Distortions in Cognitive Maps

- Thorndike (1981)
  - Learn map of hypothetical region
  - Cities distributed at various distances from each other
    - 100, 200, 300, 400 miles
  - Intervening cities
    - 0, 1, 2, 3
  - Given 64 city pairs - estimate distances between them
    - The more intervening cities, the greater the estimated distance

Distortions

- Road-route distance
  - Estimate shorter distances if road route is a straight line
- Semantic categories
  - Shift landmarks closer to other in the same semantic category
- Right-angle bias
  - Assume two roads cross at a 90 degree angle

Heuristics

- Symmetry
  - Represent shapes and countries as symmetrical
- Rotation
  - Images represented as vertical or horizontal
- Alignment
  - Assume alignment
- Relative position
  - Effect of semantic knowledge

Memory for Pictures

- Humans have excellent visual memory
- Shepard (1967)
  - Ss shown 612 pictures or 612 words
  - 2 hour delay
  - Recognition test
    - Pictures - almost perfect recognition
      - One week delay - 87%
    - Words - 88%

Memory for Pictures

- Standing (1973)
  - Determine limits of visual memory
- 10,000 pictures over 5 days
- Tested immediately after session on 5th day
- Ss remembered ~6600 pictures

Images and Advertising

- Selling product
  - Requires memory for the name of the product
- People typically have poor memory for advertised products
 - Even after only a 30 minute delay

Pairing Product with Brand Name

- Essentially a paired associates task
- Advertisers capitalize on visual memory
- Combine product and brand name
  - Single interactive picture
  - Facilitates recall of brand name

Lutz & Lutz (1977)

- Searched yellow pages for ads
  - Interactive Illustration
    - Picture Interaction
    - Letter accentuation
  - Noninteractive Illustration
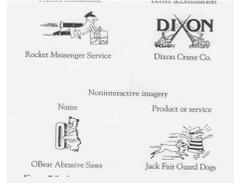
Lutz & Lutz (1977) Procedure

- Ss studied 24 brand-product pairs
  - 10 sec each
- Control group studied brand-product pairs
  - No images
- Recall
  - Given 24 products and asked to recall brand name

Lutz & Lutz (1977) Results

- Performance highest for interactive illustrations
  - Almost entirely driven by picture interaction
  - Letter accentuation performance much worse
- Noninteractive illustration
  - Performed equivalently to control group