

Visual Imagery

Chapter 10

Imagery Demonstration

- Answer these questions...
 - How many windows are there in your house/ apartment?
 - Which is bigger, a carpenter ant or a ladybug?
 - How do you get from here to the UMC?
- How did you answer these questions?
 - Mental imagery

What is Imagery?

- Visual imagery = perceiving in the absence of a physical stimulus
- Motor imagery = mental movement in the absence of overt action
- There is also imagery for audition, taste, smell, and touch
 - Listen to the “Happy Birthday” song in your head
 - Think about what a lemon tastes like
 - Think about what peppermint smells like
 - Think about touching sandpaper

Today's Plan

- Classic research
- What is the imagery debate?
 - Pictures versus propositions
 - Tacit knowledge explanation
- Behavioral evidence linking vision to visual imagery
- Neuroscientific evidence linking imagery and vision

Imagery and the Cognitive Revolution

- Developed ways to measure behavior that could be used to infer cognitive processes
 - Paired-associate learning
- Paivio (1963, 1965)
 - Memory for words that evoke **concrete mental images** (usually nouns) is better than those that do not (Chapter 7)
 - Conceptual-peg hypothesis
 - e.g., boat-hat; monkey-bicycle

Imagery and the Cognitive Revolution

- Shepard and Meltzer (1971)
 - Mental rotation / mental chronometry
 - Participants mentally rotated one object to see if it matched another object

Imagery and Perception

- Spatial correspondence between imagery and perception
 - Mental scanning (Kosslyn)
- We act as if our mental images are physical entities
 - Scanning
 - Acuity

Image Scanning (Kosslyn, 1973)

- Memorize a picture
- Then imagine it and focus on one part. Answer true/false:
 - Where is the motor?
 - Where is the flag?
 - Where is the anchor?

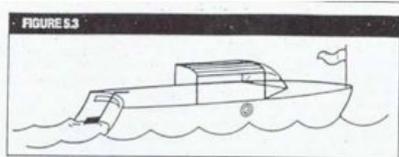
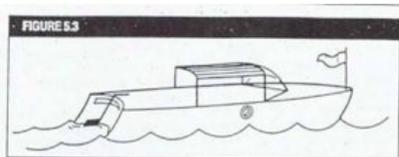


Image Scanning (Kosslyn, 1973)

- Takes longer to “find” parts farther away from from start location
- What’s another explanation for longer times?
 - Experimenter expectancy



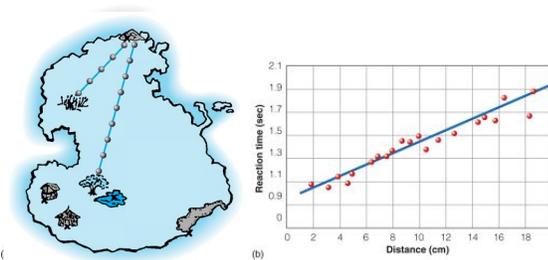
Imagery and Perception

- Kosslyn (1973)
 - Memorize picture, create an image of it
 - In image, move from one part of the picture to another
 - It took longer for participants to mentally move long distances than shorter distances
 - Took this as evidence showing that like perception, imagery is spatial

Imagery and Perception

- Kosslyn et al. (1978)
 - Island with 7 locations, 21 trips
 - It took longer to scan between greater distances
 - Visual imagery is spatial

Kosslyn (1978)



Propositional vs Spatial

"The cat is under the table"

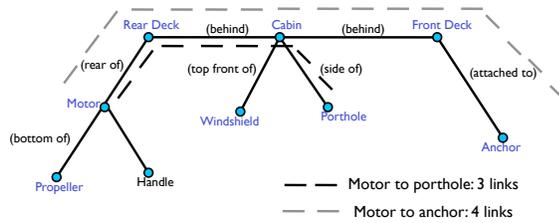
Propositional representation
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Spatial, or depictive, representation

Propositional Representations (Pylyshyn)

How to apply propositional representations to the boat example?



Is Imagery Spatial or Propositional?

- Pylyshyn (2003)
- Kosslyn's results can be explained by using real-world knowledge unconsciously
 - Tacit-knowledge explanation
 - e.g.: People know that in the real world it takes longer to move from the back of the boat to the front vs to the middle.

Finke & Pinker (1982) Results

- Participants took longer to respond when the arrow was farther away from the dot
- In their mental image, they were scanning from the arrow to the dot
- Couldn't use tacit knowledge: no time to memorize dot and arrow distance
 - supports spatial representations

Finke & Pinker (1982) Results

- Pylyshyn's Response
- The tacit knowledge claim is simply the claim that when subjects are asked to "imagine x" they use their knowledge of what "seeing x" would be like and they simulate as many of these effects as they can.
- Whether a subject has this sort of tacit knowledge cannot always be determined by asking them
 - When the arrow is further from the dot, the task is more difficult. Longer times could reflect difficulty retrieving tacit knowledge

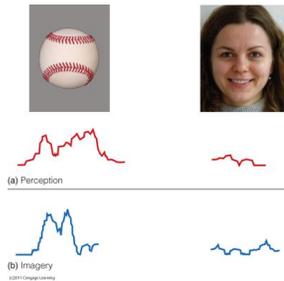
Imagery so far

- Classic research
 - Imageless thought debate
 - Wundt
 - Behaviorism
 - Shepard & Meltzer
- What is the imagery debate?
 - Pictures versus propositions
 - Tacit knowledge explanation
 - Kosslyn
 - Pylyshyn

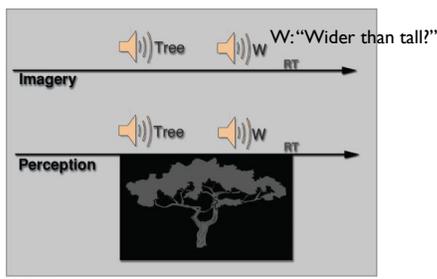
Imagery and the Brain

- Category-specific neurons
- *Imagery neurons* (Kreiman et al., 2000) respond to both **perceiving** and **imagining** an object
 - Overlap in brain activation
 - Visual cortex

Imagery neurons



Kreiman et al. (2000)



Ganis et al. (2004)

Imagery and the Brain

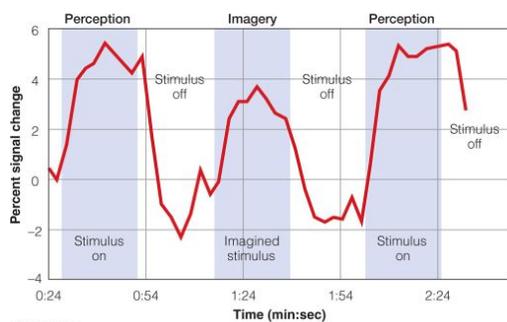
- Ganis and coworkers (2004)
 - Complete overlap of activation by perception and imagery in front of the brain
 - Differences near back of the brain
 - Perception > Imagery
 - Bottom-up vs top-down difference

Imagery and the Brain

- Amedi and coworkers (2005)
 - Again, overlap
 - Also deactivation of non-visual areas of brain during imagery
 - Hearing
 - Touch
 - Mental images more fragile, less activation keeps other things from interfering

Imagery and the Brain

fMRI



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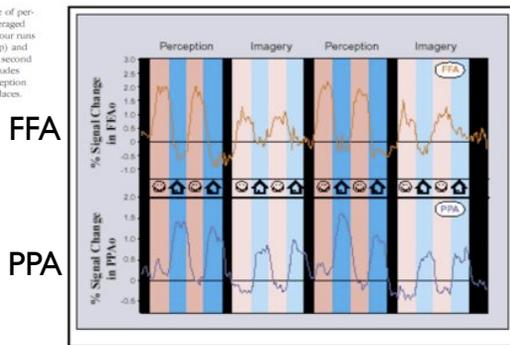
Imagery and the Brain



Nancy Kanwisher, M.I.T.

Imagery and the Brain

Figure 3. Time course of percent signal change (averaged over subjects 1 and 3; four runs each) for the FFAo (top) and PPAo (bottom) for the second experiment, which includes both imagery and perception epochs for faces and places.

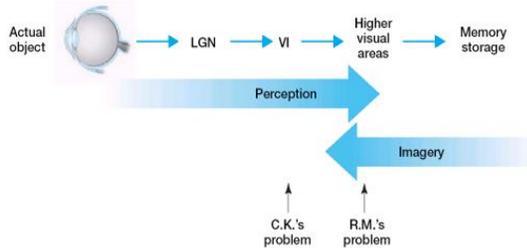


O'Craven & Kanwisher (2000)

Correlation vs. Causation

- Brain activity can also be an epiphenomenon. Just correlated with behavior in fMRI, etc.
- Using TMS, can (temporarily) disrupt a brain region. Impaired function means that region was important.
 - Kosslyn et al. (1999)
 - TMS to visual areas caused slower response for both perception and imagery
 - Visual areas are important for both.

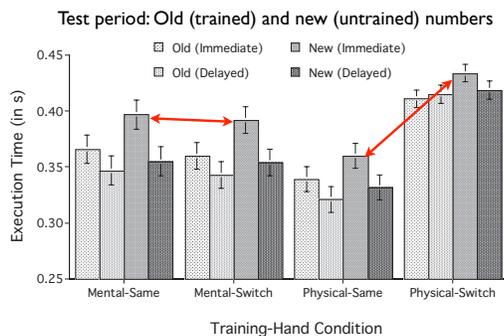
- Earlier we said perception and imagery are related, but what about the double dissociation?
- Mechanisms only partially overlap
 - Perception: bottom-up and top-down
 - Imagery: top-down only



Motor Imagery versus Action

- Imagery alone can be used to learn a new motor task
- Imagery can be used to maintain performance in the absence of physical practice for at least 3 months
- The same brain regions active during physical practice are also active during motor imagery
 - Supplementary motor areas, premotor areas, primary motor cortex
- Research at CU: Alice Healy

Motor Imagery



Generalization via mental practice!

Wohldmann et al. (2008)

Improving Memory with Imagery

- The pegword method
- The method of loci
- The keyword method

The Pegword Method

- One is “bun”
- Two is “shoe”
- Three is “tree”
- Four is “door”
- Five is “hive”
- Six is “sticks”
- Seven is “heaven”
- Eight is “gate”
- Nine is “wine”
- Ten is “hen”

Item number	Peg word	Peg image	Item to be recalled	Connecting image
1	Bun			
2	Shoe			
3	Tree			
4	Door			
5	Hive			

Set of Loci

- Driveway
- Garage door
- Front door of house
- Coat closet
- Fireplace
- Easy chair
- Television
- Dining-room table

More Imagery Mnemonics

- For imagery-based mnemonics to work, the images you create have to be **integrated**

- Evidence: Bower & Winzenz (1970)

- Three mnemonic conditions

- **Overt rote rehearsal**

- 30% recall

“piano, cigar, piano, cigar...”

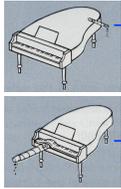


- **Noninteracting imagery**

- 27% recall

- **Interacting imagery**

- 53% recall



They are equally effective

- Interacting images do NOT have to be bizarre to be effective
