Lecture Notes

# Chapter 9: Visual Imagery and Spatial Cognition

## Learning Objectives

* Identify examples of visual images
* Distinguish between the dual-coding hypothesis and the relational-organizational hypothesis
* Summarize empirical studies related to imagery
* Review principles of visual imagery and examine critiques of the research
* Describe the neuropsychological studies conducted for visual imagery
* Explain the concept of spatial cognition and the kinds of spaces to be distinguished

## Outline

**I.** Setting the Stage

**A.** People sometimes answer memory questions by mentally picturing a familiar scene and scanning it.

**1.** But what is the nature of these **visual images?**

**2.** How do we construct and use visual images?

**B.** Although we confine ourselves to a discussion of visual imagery in this chapter, other kinds of mental images exist, such as auditory and olfactory images.

**C.** The study of visual images has had a controversial history in the science of psychology, but interest in visual imagery has never completely vanished.

**D.** Practically, imagery can be used to help athletes perform better and to help people cope with negative emotional events.

**II.** Codes in Long-Term Memory

**A.** According to the **dual-coding hypothesis**, long-term memory contains two distinct codes for representing information: one verbal and one involving imagery.

**1.** Because concrete words can give rise to both verbal and visual codes, they are easier to remember than abstract words.

**2.** In one study, participants learned pairs of two concrete nouns (CC) better than concrete-abstract (CA) pairs, which were in turn remembered better than AC and AA noun pairs.

**a)** Paivio explained this by noting that, whenever possible, participants formed visual images of the noun pairs to aid in recall.

**b)** This was easiest with two concrete nouns.

**c)** The first noun in the pair serves as a *conceptual peg* on which the representation of the second noun is hooked; thus, the imaginability of the first noun is most important.

**B.** An alternative to the dual-coding hypothesis, the **relational-organizational hypothesis,** holds that imagery improves memory because it produces more associations between the items to be recalled.

**1.** Forming an image forces a person to create a number of links between the information to be remembered and other information in memory.

**2.** Bower’s research showed that recall was best when participants created interacting images of paired associates, rather than simply repeating the word pairs or creating images that were “separated in imaginal space.”

**3.** If imagery leads to more elaborate encoding, as the dual-coding hypothesis predicts, then both imagery groups should have outperformed the rote repetition group.

**III.** Empirical Investigations of Imagery

**A.** Lee Brooks asked participants to imagine an outlined letter, move clockwise mentally from a particular corner and indicate whether each corner was at the extreme top or extreme bottom of the letter.

**1.** Participants were asked to respond either verbally or by pointing to a “Y” for yes and “N” for no.

**2.** Participants took longer to respond by pointing, indicating that the spatial pointing task interfered with the mental imagery task.

**B.** Moyer asked questions about the relative size of objects such as a pineapple and a coconut and found that people were faster to respond when the two objects differed greatly than when they differed by a small amount.

**1.** The same pattern of responding is found when people look at actual objects rather than mental images.

**2.** This phenomenon is called the *symbolic distance effect.*

**C. Mental rotation** studies have established that people who are asked to mentally rotate drawings of three-dimensional objects show behaviors that are similar to people who rotate actual objects.

**1.** Reaction times were longer when the required angle of rotation was larger.

**2.** Participants could mentally rotate their images either clockwise or counterclockwise, depending on which direction led to a lesser angle.

**3.** Some studies, however, suggest that people can recognize rotated objects without performing mental rotations, as long as the distinctive geons of the object remain visible.

**D.** Evidence from scanning studies also suggests that images are like pictures in many ways.

**1.** The task of **imaginal scanning** requires participants to form a visual image and then move from one location to another in their image.

**2.** When people “look for” parts of the image, their reaction time depends upon the distance between the previous part and the current part.

**E.** Barbara Tversky, however, showed that mental maps are systematically distorted because of the **heuristics** (rules of thumb) that people use in forming map images.

**F.** Chambers and Resiberg asked research participants to form a mental image of a drawing that was actually an ambiguous figure.

**1.** When looking at such drawings on paper, most people can “see” both interpretations of the figure.

**2.** However, participants who formed mental images after a quick look at the drawings could rarely reverse their interpretation of the mental image.

**G.** Further, research by Knauff and Johnson-Laird suggests that, when presented with *three-term series problems,* visual relationship problems actually slowed down performance relative to control problems or visuospatial problems.

**IV.** The Nature of Mental Imagery

**A.** Finke has proposed five principles of visual imagery to describe the fundamental nature of images.

**1.** Imagery can be used to retrieve information about the physical properties of objects that was not explicitly encoded previously.

**2.** Imagery is functionally equivalent to perception to the extent that similar mechanisms in the visual system are activated when objects are imagined as when those objects are perceived.

**3.** The spatial arrangement of the elements of a mental image corresponds to the way objects are arranged in actual physical space.

**4.** Imagined transformations and physical transformations exhibit corresponding dynamic characteristics and are governed by the same laws of motion.

**5.** The structure of mental images corresponds to that of actual perceived objects.

**B.** Imagery research, however, has been controversial in psychology.

**1.** The results of many imagery studies can be explained through reference to participants’ **tacit knowledge** about the task; the results of image scanning experiments, for example, may simply be due to **demand characteristics** of the task.

**2.** Sometimes experimenters can give subtle cues to participants, resulting in **experimenter expectancy effects.**

**3.** The view of images as “mental pictures” is contradicted by some studies.

**a)** Unlike real pictures, you cannot “look” at a mental image without first knowing what it is.

**b)** Pictures and images are disrupted in different ways.

**c)** Images are more easily distorted by the viewers’ interpretations than real pictures are.

**C.** *Propositional theory* rejects the idea that images serve as distinct mental codes and instead argue for a single code, neither visual nor verbal but propositional in nature.

**V.** Neuropsychological Findings

**A.** Patterns of cerebral blood flow are similar in visual processing and in the use of visual images.

**B.** The creation of visual images activates areas of the brain involved in visual processing, such as the occipital lobe.

**1.** Imaging faces activates the *fusiform face area,* which is also activated when subjects view photographs of faces.

**2.** Imagining places activates the *parohippocampal place area* of the brain, which is also active when people view photographs of complex scenes.

**C.** Similarly, imagining a song leads to activation of areas in the secondary auditory cortex.

**D.** These findings argue against a propositional interpretation of imagery and against the interpretation of imagery studies as resulting solely from demand characteristics.

**VI.** Spatial Cognition

**A.** The term **spatial cognition** refers to how people represent and navigate in and through space; visual imagery is one part of this broader concept.

**B.** Barbara Tversky distinguishes between several types of space in spatial cognition.

**1.** The **space of the body** includes knowing where different parts of one’s body are located at a given moment and what other objects they may be interacting with.

**2.** The **space around the body** refers to the area immediately around you, localized in terms of the front-back, up-down, and left-right axes with relation to your body.

**3.** The **space of navigation** refers to larger spaces that we may walk through and explore; when we give directions to someone, we are dealing with the space of navigation.

**a)** These representations are not always accurate or complete.

**b)** Thus, Tversky prefers the term *cognitive collage* to *cognitive map,* because they are subject to systematic errors and distortions.

**C.** Recent work on **spatial updating** suggests that we revise our mental representations as we move through space—or even as we move through “virtual” space in playing a video game.