Chapter 7: Imagery

Overview

Often when we talk about **imagery**, we're referring to visual imagery—it is inherent in the name: "image" implies visual. The text focuses on visual imagery in particular. We do, however, have images for all different sensory modalities: you can imagine not just what things look like, but what they sound like (the sound of a fire alarm), taste like (the taste of a lemon), and so on. In Chapter 3, we covered bottom-up versus top-down processing. Perception involves both, but imagery is completely top-down. There are no basic components to use so an image in your mind is formed using top-down processing.

Creating a mental image of to-be-remembered items can be a powerful memory strategy and therefore **mnemonic techniques** often involve the use of imagery. As mentioned below, demonstrating the use of a mnemonic in class can provide an impressive example of their value and ease of application. Memorization is something with which students have a lot of experience. Ask them what strategies they use and discuss *why* these strategies work. The best mnemonics work to tie things that are to-be-remembered (a word list, for example) to things that cannot be forgotten (rooms in your house, for example, as with the **method of loci**) and do it in a way that is easy to visualize.

Although the textbook discusses the **analog form of representation** and the **propositional knowledge hypothesis** separately, it is useful to point out that they represent two very distinct sides of the same issue. A mental representation can be thought of as an analog, a "stand-in" that closely resembles the physical object. Alternatively, it may be thought of as propositional (descriptive, abstract, language-like) in nature. Studying imagery is challenging because the images are not directly observable and so settling such a controversy is difficult.

An analog form seems to make intuitive sense. Most of us feel like we are forming a mental picture of objects but there is some truth to both explanations. If a mental image does resemble a physical object, and if it is represented spatially, then people should make judgments about mental images in a way that is similar to making judgments about physical objects. There is some evidence for this: for example, studies of **mental rotation** done by Shepard and Metzler indicate that the length of time participants took to make a same/different response to objects presented at different angles was directly related to the angle of rotation that was necessary to match up the two structures. This pattern of reaction times is like what you would see if subjects were comparing physical objects. Analogue form representation cannot, though, explain some other findings. Participants' inability to see a parallelogram in an image of the Star of David is one example (see Discussion/Debate idea 1 below).

Going beyond mental images of individual objects, we are also able to create larger and more complex mental representations. To get along in the world, you have to be able to navigate through geographical space and that involves having a cognitive map of where you are and where you are going. A **cognitive map** is a collection of mental images that incorporates relationships among objects. Using a cognitive map, we are able to make distance judgments, among other things. Not surprisingly, distance judgments made from cognitive maps are likely to be affected by things other than the **objective distance**. Thorndyke (1981) found that people's estimated distances varied great-

ly depending on the number of intervening cities between Point A and Point B. As well, if two locations seem to fit in the same category, they may be judged as closer than if they do not (Hirtle and Mascolo, 1986). Landmarks (or important places) can have a big effect on judgments of distance. McNamara and Diwadkar (1997) found that participants' estimated distance from a non-landmark to a landmark was significantly shorter than their estimated distance from the landmark to a non-landmark.

Shapes represented in cognitive maps can sometimes be distorted as well. People have a tendency to "regularize" angles (street angles, for example). They tend to mentally represent figures that are tilted as more horizontal or more vertical than they are and they tend to remember a series of geographical structures as more in line than they actually are. Showing students maps of areas that tend to be distorted in mental images can be helpful. For example, students may be interested to see that a map of the Canada–US border clearly shows Detroit farther north than Windsor. Applying the concept of **mental models** helps to make clear that cognitive maps are not simply blueprints of the world; they allow us to reason through situations and make inferences.

Finally, the chapter explores **auditory imagery**, detailing research that suggests the involvement of similar neural apparatus as in auditory perception. If you have had the experience of having a song "stuck in your head" in that it keeps playing over and over again in your mind, you have had the interesting experience of auditory imagery known as **earworms**.

Learning Objectives

In this chapter students will:

- Review experimental evidence for Paivio's dual-coding theory.
- Examine how synesthesia and eidetic imagery relate to ordinary imagery.
- Outline the role of distinctiveness in memory.
- Distinguish mental rotation, mental scanning, and egocentric perspectives.
- Identify the basic properties of cognitive maps.
- Explore auditory imagery and the brain areas involved in auditory imagery.

Key Concepts with Illustrative Examples

cognitive map (see page 229)

> One day as you are getting out of your car, somebody stops you and asks you for directions to the same coffee shop that you go to every day. You find you have no trouble giving the individual detailed directions, as it is almost like you can see the route in your head. It is clear that you have developed a cognitive map—information from the environment that is worked over and

elaborated into a tentative, cognitive-like map, indicating routes and paths and environmental relationships.

distinctiveness hypothesis (see page 207)

More distinctive items tend to be easier to recall. Consider this list of 10 random items to be memorized: apple, newspaper, tree, guitar, bicycle, pencil, Justin Bieber, lake, baseball, toothpaste. Which item do you think would be most likely to be remembered later on?

dual-coding theory (see page 203)

Items or events may be represented verbally or non-verbally. A line of poetry may be valued for the intricate wording or for the imagery it calls to mind.

earworm (see page 233)

If you have ever had the experience in which a catchy song from an advertisement pops into your head and, hours later, you are still "replaying" it in your mind over and over, you have experienced an auditory image known as an earworm. An earworm is a conscious experience of sound—typically a short phrase of catchy music that seems to get stuck on replay in your head.

eidetic imagery (see page 214)

Eidetic imagery (sometimes referred to as "photographic memory") refers to the creation of a lasting perception of a visually complex image. An individual capable of eidetic imagery may be able to draw a very detailed picture of a complicated landscape after a very brief presentation (for example, see http://www.youtube.com/watch?v=jVqRT_kCOLI).

left and right hemispheres theory (see page 206)

There is evidence to support the theory that the left hemisphere of the brain controls speech and is better at processing verbal material than the right hemisphere, which is better at non-verbal tasks. This lateralization of function is related to handedness in that it is estimated that between 70 to 95% of persons process language in the left hemisphere, including 95% of right-handers and 70% of left-handers. Approximately 17% of left-handers process language in their right hemisphere, while the rest process language bilaterally (in both hemispheres).

mental rotation (see page 218)

Mental rotation is the process whereby people imagine the rotation of an object. For example, mall maps are often displayed in a vertical orientation. Some degree of mental rotation is necessary in navigating such a map.

mnemonic technique (see page 206)

Mnemonic techniques are procedures used to aid memory. The text discusses the method of loci, which is based on places and images. For example, you are making a grocery list which includes milk, eggs, butter, and sugar. Picture yourself walking through your house. As you go

from room to room, place each item from your list somewhere in your house. The more bizarre the image is, the easier it is to remember. Perhaps you imagine a cow sitting on your sofa drinking a glass of milk. As you "move" into the dining room, you see a giant rabbit carrying a colourful egg. You continue in this way until you have developed an image for every item on the list. Then, when you get to the grocery store, replay the virtual walk through your house complete with the images. You should be able to remember everything on your list.

special places strategy (see page 209)

At some point, most of us have stored something valuable in a place where we thought nobody else would look, and that we knew we would remember. Unfortunately, when we later need to find the item, we discover that the hiding spot was so good that we also do not remember it. This phenomenon is called the special places strategy and it occurs because there is usually no imaginative relationship between the item and the location to serve as a memory cue.

synesthesia (see page 210)

Synesthesia refers to the phenomenon of sensory stimulation in one modality creating an experience in another modality. Grapheme-colour synesthesia, a relatively common type, involves a link between letters or numbers and colours. Lexical-gustatory synesthesia, a much rarer variety, melds sounds with taste sensations.

Discussion and Debate Ideas

1. Encourage students to consider not only the power of mental images but also their limitations. In some cases, imagery can easily be used to answer questions about objects. For example, you can answer the question "Which is redder, a cherry or a tomato?" by creating mental images of those two objects and comparing them. If asked how many left turns you make on your way home from work, you might imagine yourself driving home, counting turns. Mental images can be very useful, but their potential is limited in some situations. Ask students to think about instances in which imagery is not enough to answer a question. One way of demonstrating the limits of visual imagery is with reference to an experiment by Reed (1974). Have students picture a Star of David. Ask the question "Is there a parallelogram embedded in the figure?" It seems that when we scan our mental image for the parallelogram we are unable to "see" it, and most of us answer no. Once shown the actual figure, the parallelogram is apparent. Although it seemed that we had a clear image in mind, it was not sufficient for dissecting the object.

2. What if imagery is completely epiphenomenal? That is, what if it serves no function and is simply a by-product of other cognitive processes? Is it still worth investigating? Where do students stand on knowledge for the sake of knowledge?

3. Demonstrate for the students how the Peg-Word mnemonic works. Using this mnemonic, a set of words (see the rhyme list below) can serve as "pegs" on which words to be memorized may be "hung."

- one is a bun
- two is a shoe
- three is a tree
- four is a door
- five is a hive
- six is bricks
- seven is heaven
- eight is a gate
- nine is a line
- ten is a hen

Have students call out ten random words and watch as you memorize them on the spot and report the list a few minutes later. This memorization should not be difficult—just be sure to create a rich mental image for each (for example, if word 10 is "skateboard," you might picture a hen riding a skateboard).

Have the students discuss why this technique works. Point out that a rich mental image is easy to create and quite lasting. Student suggestions for the list of ten may include bizarre words, which can lead to a discussion of the von Restorff effect.

4. Cognitive psychology textbooks always go into detail about various mnemonic strategies. The method of loci, for example, has probably been mentioned in almost every single introductory cognition or memory textbook ever written. There is evidence that these strategies work to improve memory performance and they make an important point about the relationship between imagery and memory. However, these techniques are pretty much *only* mentioned in cognition textbooks. They are not techniques that people are likely to use very much in everyday life. Have students consider why that is. The method of loci, for example, is a fairly involved technique; it requires creating a very involved set of images. Furthermore, it is really only useful for memorizing a list of items. How often do you have to do that? Why not just write the list down? The mnemonic techniques can be effective and students would benefit from incorporating them into their studying, but it seems a valid criticism to say that they aren't great solutions for improving memory performance in general.

5. To demonstrate the subjective nature of visual imagery, have students form a mental image of an everyday object and then, without naming the object provide a verbal description of the object. Tell other students to form a visual image based on the description and then identify the object. Ask the student who provided the description to identify when the object has been correctly identified.

6. Have students make suggestions for mnemonic techniques for remembering various types of information related to the course (examples could include parts of the eye from Chapter 3, types of memory from Chapter 5, etc.). What are some of the problems that can occur with the use of mnemonics?

7. Discuss what types of careers would require strong visual imagery and spatial skills. Some examples would be architect, graphic designer, astronomer, pilot, photographer, engineer, interior designer, etc.

8. Have students sketch the layout of the kitchen in their house or apartment, detailing the location of the furniture and appliances. Have them take the sketches home to compare them to the actual layout of the room. Discuss the types of errors they made and come up with explanations as to why the errors were made.

9. Discuss how life would be different if a person did not experience mental imagery (aphantasia). What challenges would this present? Would some things become easier to do?

Further Reading, Media Suggestions, and Teaching Aids

1. **Synaesthesia: www.synaesthesia.com**

   This website provides an introduction to synesthesia. Included are links to university laboratories conducting research on the topic as well as interactive tests for synesthesia.

2. **When Senses Collide. 2008. (BBC Documentary can be found at: https://www.youtube.com/watch?v=KGYrBaK-JYI)**

   This is a fascinating BBC documentary about synesthesia. It includes interviews with several synesthetes, a demonstration of testing for the condition, and a description of findings from studies of brain activation.

3. **Visual Spatial Intelligence Test: http://www.queendom.com/tests/access_page/index.htm?idRegTest=1118**

   This site allows students to test their ability to rotate objects using mental imagery.

4. **Beaman, C. P., Powell. K., & Rapley, E. 2015. Want to block earworms from conscious awareness? *The Quarterly Journal of Experimental Psychology*, 68, 1049-1057.**

   This article will assist instructors in answering some of the questions students might have on this interesting and ecological topic. The authors outline some basic information about this phenomenon beyond what is found in the text book and discusses the effectiveness in chewing gum to stop the earworms.

5. **Matt, F. W., & Kosslyn, S. M. 2002. Visual mental images can be ambiguous: Insights from individual differences in spatial transformation abilities. *Cognition*, 86, 57-70.**

   This article expands upon the discussion in the textbook on the ability of participants to reverse an ambiguous image during mental imagery. Results of the study suggest that the ability to mentally rotate an object was highly correlated with the ability to reverse the ambiguous figure.

Homework or Study Questions

1. **How does dual-coding theory account for the findings of Paivio (1965)?**

Paivio (1965) found that, when participants were asked to respond with the second member of a studied word pair, memory performance was best when both words were concrete and worst when both words were abstract. As well, memory performance was better when the "stimulus" (the first member of the pair, provided at test) was concrete than when it was abstract. Concrete words were rated as higher in imagery. According to the dual-coding theory, a concrete word can be encoded in two ways: verbally and non-verbally. An abstract word may only be encoded verbally. Concrete words, then, have the advantage of two possible codes. A concrete stimulus is more likely to reinstate a visual image and is therefore a better cue for response.

2. **What does it mean to say that images are "epiphenomenal"?**

A strong proponent of the hypothesis that knowledge is stored propositionally might argue that images are epiphenomenal. According to this view, images are by-products of cognitive processes and serve no function in and of themselves.

Whether or not images are epiphenomenal should matter a great deal to imagery researchers. If mental images are simply tacked-on to cognitive functioning like window dressing, the importance of imagery research is minimized.

3. **How are synesthesia and eidetic imagery similar?**

Both synesthesia and eidetic imagery are examples of cognitive dedifferentiation. Cognitive dedifferentiation occurs when functions that are typically independent from one another are combined. Synesthesia is a fusing of the sense modalities and eidetic imagery is a fusing of imagery and perception.

4. **Outline the evidence linking the hippocampus to the construction of cognitive maps.**

There is evidence for a relationship between the relative size of the hippocampus and the amount of knowledge required for complex navigation. An intriguing example of this is a study of London taxi drivers. These drivers must devote a large amount to learning thousands of routes all over London. This results in a very complex cognitive map of the city. Maguire et al. (2000) found that the posterior part of the hippocampus was larger in taxi drivers than non-taxi drivers. More tellingly, years of experience predicted hippocampal size. This suggests that taxi-driving experience leads to enlargement of the hippocampus (it's not simply that a large hippocampus is a prerequisite for becoming a taxi driver).

5. **Explain the special places strategy. Why does it typically not work?**

The special places strategy is the act of choosing a storage location that other people will not think of; however, when the time comes to retrieve the item, you may not remember the location either. When we try to find an object we have stored, we typically have to come up with an association between the object and the location. If we have stored the object in a place where

other people would not think to look, there is no association between the object and the location, making it difficult to remember.

6. **What is the difference between mental rotation and egocentric perspective transformations?**

   Mental rotation requires you to rotate the object, whereas egocentric perspective transformations require you to imagine yourself moving while objects in the environment remain still.

7. **Identify the features of eidetic imagery according to Haber (1979).**

   The image is perceived as being "out there" instead of inside the head.
   The image can be scanned and its parts described.
   Descriptions of an eidetic image are faster than memory reports.
   Eidetic imagery is more common in children than in adults.

8. **Explain the role of objective and categorical distances in mental scanning.**

   Objective distances, the true distances between objects, are preserved in mental scanning in that the further apart objects are in the real world, the longer it takes to mentally scan between the objects. Categorical distances are the number of units traversed during mental scanning. It appears that images may be structured hierarchically, with objective distances nested within categorical distances.

9. **What did Neisser mean when he defined an image as a "readiness to perceive something"?**

   Neisser meant that imagery causes us to anticipate what we will actually perceive. Therefore, we respond more quickly to a target.

Suggestions for Research Paper Topics

1. Examine the link between the brain processes involved in visual perception and those involved in visual imagery. Do they rely on similar brain regions? What are the differences?

2. This chapter focuses on visual imagery. Review the literature and find out what is known about imagery in another modality (hearing, smell, taste, or touch).

3. Maurer (1997) suggested that newborns are synesthetes. With reference to the literature, do you believe this to be true or not?

4. Based on research that has been conducted on the benefits of video gaming on imagery abilities, design a video game that would be maximally beneficial.

5. Design a research study to test the effectiveness of different mnemonic techniques.

6. The subject of mathematics is often described as a spatial skill. Review the literature connecting spatial ability and proficiency in math. Is it possible to improve math skills by improving spatial ability?

7. Research the connection between athletic ability and spatial skills. Are there some sports where spatial ability is more important than others?

8. Aphantasia is a neurological condition first identified in 2015 to refer to individuals who are unable to experience mental imagery. People who report this condition still seem to be able to solve mental rotation problems. How might they compensate for the lack of mental imagery to solve these problems?

9. It has long been reported in the media that males perform better than females on spatial tasks such as the mental rotation task. Investigate if there is scientific evidence to support this. If so, other than cognitive differences, what other explanations are offered for the differences?