

READINGS IN PSYCHOLOGY

In 1953, doctors performed brain surgery on a man named Henry, also known as H.M. The doctors hoped to alleviate Henry's severe epileptic seizures by removing his hippocampus, where they believed the seizures originated. Although the surgery relieved Henry's seizures, he suffered severe memory problems. For years after the operation he cited the year as 1953 and could not encode new long-term memories, even though his existing long-term memories remained intact. Philip F. Hiltz chronicled Henry's story in *Memory's Ghost*, published in 1995.



Reader's Dictionary

M.I.T.: Massachusetts Institute of Technology

hippocampus: a curved structure within the temporal lobe of the brain involved in transforming many kinds of short-term memories into permanent storage

MEMORY'S GHOST

BY PHILIP F. HILTS

We were out in the sun once, Henry in his wheelchair and I beside him, waiting for the taxi to take us for his brain scan. It was the usual changeable, disturbing weather of a Boston spring, but just now, it was bright and warm. "Great day!" I said. "And sunny!" As I said it, a shadow crossed the walk, and the sun dived into a cloud. Henry laughed. "Well, just as soon as you say it, it isn't!"

Across the street was a construction site. We watched at length; the crane—it must have been ten stories tall—swung out over the deep hole and back up to its bank, a huge bucket of gray muck gliding down. "I bet they are glad they don't have to haul

that all the way up," said Henry. I glanced up the street for the taxi, and quickly Henry's gaze followed. He wasn't sure why we were looking there, and he studied me. My head was turning back to the construction, and Henry's gaze settled there again, too. He watches and listens for clues, for the implications of a question, for hints at what the subject is, how he should feel, and how he should answer. How else could he be more than like a dog, waiting expectantly at the door? I imagine him walking, always a little uncertain, but compelled to press ahead while around him is a blank fog. "And I moved forward," said poet W.S. Merwin, "because you must live forward, which is away from whatever it was that you had, though you think when you have it that it will stay with you forever."

I recall one of my visits to Henry. As he talked with Dr. Corkin, who had come to get him for tests, I observed in silence. When she approached, he looked up, blank at first. I could almost put words to passing expressions on his face: Ah, a face that seems familiar. To talk to me? Yes—she takes up my eyes.

"How are you, Henry?"

He groped a little, feeling just behind him for something. "Fine, I guess," he said, and smiled a little. Again he watched, expectantly.

"Do you know what we're going to do today?"

I felt him turn metaphorically to search for an answer. Then he shrugged. "I don't remember."

But then she handed him his walker. He can grasp it, flip out the legs, set it just ahead of himself, and lean up into it.

"Why do you use a walker, Henry, do you know?"

A brief look into the fog. Nothing there. He looked down. “Well, it’s my legs,” he said. He quickly realized the humor in this too-obvious reply, and grinned.

Down the hall, he turned left, heading for the experiment room. How did his body know to go that way? Part of his brain has learned, though the other has not. The one that is supposed to keep track of what has been learned is missing.

At the plain gray table in the experiment room, Dr. Corkin asked, “Do you know where you are, Henry?”

Again, he looked out into a fog. But here! There is something! “Well, at M.I.T.!” He beamed; he gathered a scrap for his questioners; he always likes to please. It has taken decades of travel to M.I.T. and frequent talk of the place for him to know that if he’s being tested, this must be M.I.T.

Finally, as we stood out in the sun, the taxi arrived to take us across the Charles River. We bundled the awkward wheelchair in the trunk, him in the back seat, and we took the taxi over to Brigham and Women’s Hospital where the magnetic resonance scanner awaited him. It is more than a device, it is the size of a room, and it is not pressed against the patient like an X-ray scope, but surrounds the patient as he is inserted *within* the machine.

Henry was a bit dubious about this, especially as he had to remove all metal objects from his person. That meant his belt, and he was shy removing it in front of the women researchers in the room. He was more chagrined after he removed it and everyone could see that there was a paper clip holding his trousers together.

I sat in the room with him, while everyone else retreated to another room, behind a large observation window. They spoke

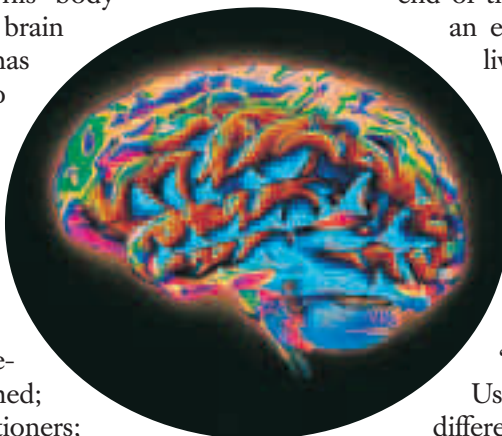
to Henry by microphone, trying to reassure him by tone of voice while they were in fact being distant and cold. And that noise! It was like being in a closet with a jackhammer operating in slow motion.

From all this crudeness issued, on the other end of the computing systems and wires, an elegant, flickering color image. A live image of his brain, slice by slice, as the imager moved backward through his brain taking images one plane at a time. When the imager reached Henry’s temporal lobes and the place where his middle brain should be, the researcher at the panel let out a low gasp. “Oh! That’s beautiful!” he said.

Used to peering at subtle shading differences denoting massive tumors, he was now confronted with a huge black hole in the center of the brain, the first thing of its kind he had ever seen.

The series of images lead to measurements, recalculations, new guesses. There is, Dr. Corkin has discovered, a little more of the hippocampus present than was thought. But the other bits of middle brain linked to it, the parahippocampal gyrus, the entorhinal cortex, and the perirhinal cortex are all destroyed: they must be an important part of the “hippocampal” system of memory consolidation.

The pictures from within the dome of Henry’s skull are a bit startling. Of course, we could have guessed what they might look like. But it is not the same to guess as to see the lovely textured images of the brain and then the black, ragged edges where tissue has been sucked out.



Analyzing the Reading

1. What types of things does Henry seem unable to recall?
2. Why does the researcher seem excited by Henry’s brain scan?
3. **Critical Thinking** Why does the author compare Henry to a dog?

CHAPTER
11

Thinking and Language



PSYCHOLOGY JOURNAL

In your journal, answer the following question: If you increase the size of your vocabulary, will you think better? Use past experiences to explain your answer. ■



CLICK HERE



PSYCHOLOGY
Online

Chapter Overview

Visit the *Understanding Psychology* Web site at psychology.glencoe.com and click on **Chapter 11—Chapter Overviews** to preview the chapter.

Thinking and Problem Solving

Reader's Guide

■ Main Idea

Thinking involves changing and reorganizing the information stored in memory to create new or transformed information, such as creative problem-solving strategies.

■ Vocabulary

- thinking
- image
- symbol
- concept
- prototype
- rule
- metacognition
- algorithm
- heuristic
- mental set
- functional fixedness
- creativity
- flexibility
- recombination
- insight

■ Objectives

- Identify the units of thought and the kinds of thinking.
- Explain strategies for and obstacles to problem solving.

EXPLORING PSYCHOLOGY

A Radical Assumption

Historians often refer to “the Copernican revolution” as a milestone in the history of science. Copernicus was a careful and creative scientist who eventually solved a problem that others before him had failed to solve: how to account for the movement of the planets in the heavens. . . . Copernicus finally created a theory that nicely predicted the movements of the planets. To do so, however, he had to make a radical assumption. Prior to Copernicus, everyone had taken it for granted that the sun and the other planets revolve around the Earth, and indeed, it looks that way to the naked eye. Copernicus argued that, if one made this assumption, it would be impossible to predict with accuracy the movement of the planets. His theory began with an alternate assumption, namely, that the Earth and the other planets in our solar system revolve around the sun.

—from *The Ideal Problem Solver* by John D. Bransford and Barry S. Stein, 1984

Going beyond memory, how do we think? How do we solve problems? How do we create ideas? How did Copernicus come up with his idea? If storage and retrieval were the only processes we used to handle information, human beings would be little more than glorified cameras and VCRs. Yet we are capable of doing things with information that make the most complex computers seem simple by comparison. These processes—thinking and problem solving—are most impressive when they show originality or creativity.

THINKING

thinking: changing and reorganizing the information stored in memory to create new information

You may view **thinking** as changing and reorganizing the information stored in memory to create new or transformed information. By thinking, for example, humans are able to put together any combination of words from memory and create sentences never devised before, such as this one.

Units of Thought

image: a visual, mental representation of an event or object

The processes of thought depend on several devices, or units of thought: images, symbols, concepts, prototypes, and rules. The most primitive unit of thought is an **image**, a visual, mental representation of a specific event or object. The representation is not usually an exact copy; rather, it contains only the highlights of the original. For example, if an adult tries to visualize a grandmother who died when he was seven, he would probably remember only a few details—perhaps the color of her hair or a piece of jewelry that she wore.

Imaging is an effective way to think about concepts. In 1971 two researchers (Shepard & Metzler) presented participants with 1,600 pairs of geometric images (see Figure 11.1). The researchers then asked the participants to determine if the objects in each pair were identical or different. The researchers discovered that the participants completed the task by rotating an image of one of the objects in their minds in an effort to see both patterns from the same perspective.

symbol: an abstract unit of thought that represents an object or quality

A more abstract unit of thought is a **symbol**, a sound, object, or design that represents an object or quality. The most common symbols in thinking are words; almost every word is a symbol that stands for something other than itself. An image represents a specific sight or sound, but a symbol may have a number of meanings. That symbols differ from the things they represent enables us to think about things that are not present, to consider the past and future, and to imagine things and situations that never will be or never were. Numbers, letters, punctuation marks, and icons are all familiar symbols of ideas that have no concrete existence.

concept: a label for a class of objects or events that have at least one attribute in common

When a symbol is used as a label for a class of objects or events with at least one common attribute—or for the attribute itself—it is called a **concept**. *Animals*, *music*, *liquid*, and *beautiful people* are examples of concepts based on the common attributes of the objects and experiences belonging to each category. Thus the concept *animal* separates a group of organisms from such things as automobiles, carrots, and Roquefort cheese. Concepts enable us to chunk large amounts of information. We do not have to treat every new piece of information as unique, since we already know something about the class of objects or experiences to which the new item belongs.

prototype: a representative example of a concept

When we think of a concept, we often think of a representative example of it. When you think of a vehicle, for example, you might picture a car or a truck. This representation is called a **prototype**. The prototype you picture may not be an example that you have actually experienced. Most often it simply is an example that has most of the characteristics of the particular concept.



A more complex unit of thought is a **rule**, a statement of a relation between concepts. The following are examples of rules: a person cannot be in two places at the same time; mass remains constant despite changes in appearance.

Images, symbols, concepts, prototypes, and rules are the building blocks of mental activity. They provide an economical and efficient way for people to represent reality, to manipulate and reorganize it, and to devise new ways of acting. For example, a person can think about pursuing several different careers, weigh their pros and cons, and decide which to pursue without having to try every one of them.

Kinds of Thinking

People think in several ways. *Directed thinking* is a systematic and logical attempt to reach a specific goal or answer, such as the solution to a math problem. This kind of thinking, also called *convergent thinking*, depends on symbols, concepts, and rules. Directed thinking is deliberate and purposeful. It is through directed thinking that we solve problems; formulate and follow rules; and set, work toward, and achieve goals.

In contrast, another type, called *nondirected* (or *divergent*) *thinking*, consists of a free flow of thoughts with no particular plan and depends more on images (see Figure 11.2).

Nondirected thinking is usually rich with imagery and feelings such as daydreams, fantasies, and reveries. People often engage in nondirected thought when they are relaxing or escaping from boredom or worry. This kind of thinking may provide unexpected insights into one's goals and beliefs. Scientists and artists say that some of their best ideas emerge from drifting thoughts that occur when they have set aside a problem for the moment.

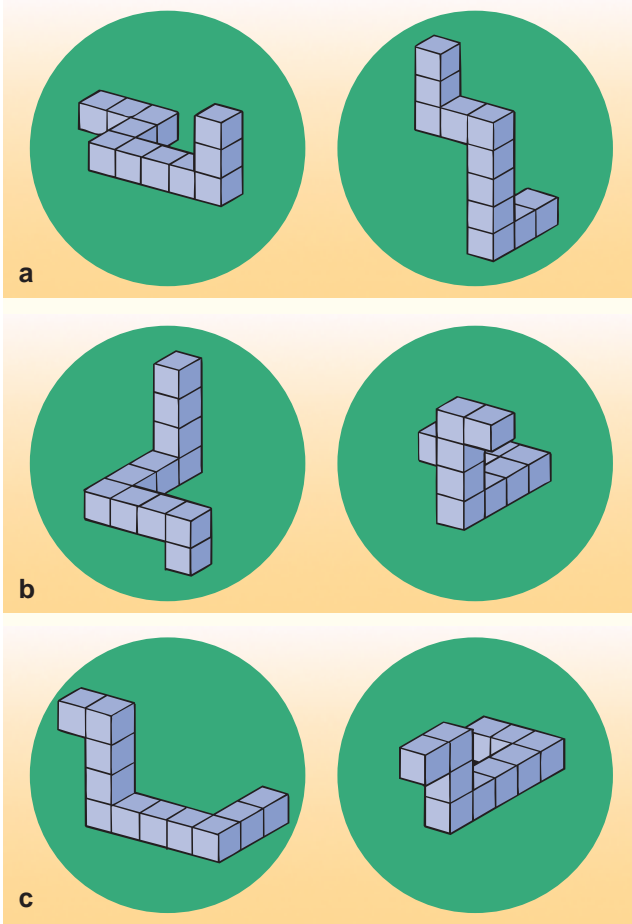
A third type of thinking is **metacognition**, or thinking about thinking. When you tackle an algebra problem and cannot solve it, thinking about your strategy may cause you to change to another strategy.

PROBLEM SOLVING

One of the main functions of directed thinking is to solve problems—to bridge the gap mentally between a present situation and a desired goal. The gap may be between hunger and food, a column of figures and a

Figure 11.1 Using Imagery

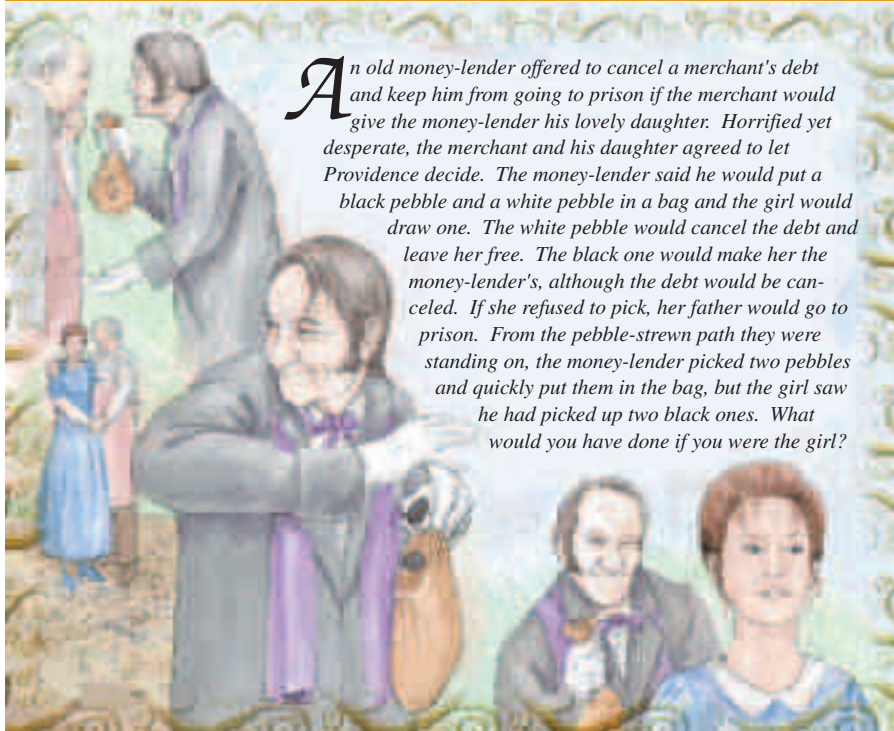
Rotate pairs of images of the patterns below in your mind to make them match. Do the drawings in each pair represent the same object, or are they different objects? (Check with your teacher to find out which pairs match.) *How do we use images when we are thinking about something?*



Reading Check
 What is the difference between a symbol and a concept? An image and a prototype?

rule: a statement of relation between concepts

metacognition: the awareness of one's own cognitive processes



An old money-lender offered to cancel a merchant's debt and keep him from going to prison if the merchant would give the money-lender his lovely daughter. Horrified yet desperate, the merchant and his daughter agreed to let Providence decide. The money-lender said he would put a black pebble and a white pebble in a bag and the girl would draw one. The white pebble would cancel the debt and leave her free. The black one would make her the money-lender's, although the debt would be canceled. If she refused to pick, her father would go to prison. From the pebble-strewn path they were standing on, the money-lender picked two pebbles and quickly put them in the bag, but the girl saw he had picked up two black ones. What would you have done if you were the girl?

This problem was devised by psychologist Edward De Bono, who believes that conventional directed thinking is insufficient for solving new and unusual problems. His approach to problem solving requires use of nondirected thinking to generate new ways of looking at the problem situation. (The answer to this problem is provided in Figure 11.7.) **When are people most likely to engage in nondirected thinking?**

total, a lack of money and bills to pay, or cancer and a cure. In all these examples, getting from the problem to the solution requires some directed thinking.

Strategies

Problem solving depends on the use of strategies, or specific methods for approaching problems. One strategy is to break down a complex problem into a number of smaller, more easily solved subgoals. *Subgoals* are intermediate steps toward a solution. For example, it is the end of the semester and your life is falling apart. You do not even have time to tie your shoelaces. You solve the problem by breaking it down into small pieces: studying for a science exam, finishing that overdue paper, canceling your dinner date, scheduling regular study breaks to maintain what is left of your sanity, and so forth.

For some problems, you may work backward from the goal you have set. Mystery writers often use this method: They decide how to end the story (“who did it”) and then devise a plot leading to this conclusion.

Another problem may require you to examine various ways of reaching a desired goal. Suppose a woman needs to be in Chicago by 11 A.M. on July 7 for a business conference. She checks train departures and arrivals, airline schedules, and car-rental companies. The only train to Chicago that morning arrives at 5 A.M. (too early), and the first plane arrives at 11:30 A.M. (too late). So she decides to rent a car and drive.

PSYCHOLOGY Online

Student Web Activity

Visit the *Understanding Psychology* Web site at psychology.glencoe.com and click on **Chapter 11—Student Web Activities** for an activity on thinking and problem solving.

CLICK HERE

To determine which strategy to use, most of us analyze the problem to see if it resembles a situation we have experienced in the past. A strategy that worked in the past is likely to work again. We tend to do things the way we have done them before, and often, we shy away from new situations that call for new strategies. The more unusual the problem, the more difficult it is to devise a strategy for dealing with it.

Algorithms An **algorithm** is a fixed set of procedures that, if followed correctly, will lead to a solution. Mathematical and scientific formulas are algorithms. For example, to find the product of 345 and 23, we multiply the numbers according to the rules of multiplication to get a correct answer of 7,935. To play chess or checkers, we follow algorithms, or a fixed set of rules.

Heuristics While algorithms can be useful in finding solutions, they are a time-consuming method. People often use shortcuts to solve problems, and these shortcuts are called heuristics. **Heuristics** are experimental strategies, or rules of thumb, that simplify a problem, allowing one to solve problems quickly and easily (see Figure 11.3). For example, when watching the Wheel of Fortune game show, you might use what you already know about prefixes, suffixes, and roots of words to fill in the missing letters of a word or phrase. If a friend comes to you with a problem, your advice might include what has worked for you in the past.

Although heuristics allow us to make quick decisions, they can result in bad decisions because we make the decisions using shortcuts and sometimes ignore pertinent information.

Obstacles to Problem Solving

There are times when certain useful strategies become cemented into the problem-solving process. When a particular strategy becomes a habit, it is called a **mental set**—you are set to treat problems in a certain way. For example, a chess player may always attempt to control the four center squares of the chessboard. Whenever her opponent attacks, she responds by looking for ways to

algorithm: a step-by-step procedure for solving a problem

heuristic: a rule-of-thumb problem-solving strategy

mental set: a habitual strategy or pattern of problem solving

Figure 11.3 Types of Heuristics

Heuristics are mental shortcuts. Although they are not rules that always provide the correct answers, they are strategies that experience has taught us to apply. **What is the availability heuristic?**

1. Availability Heuristic: We rely on information that is more prominent or easily recalled and overlook information that is available but less prominent.

Example: In the news, we see people winning the lottery all the time and overestimate our chances at winning it also.

2. Representativeness Heuristic: We tend to assume that if an item is similar to members of a particular category, it is probably a member of that category, too.

Example: I have flipped a coin 10 times and it has landed on tails every time. The odds are it will land on heads this time. (The odds are 50–50, as they are for each coin toss.)

3. Anchoring Heuristic: We make decisions based on certain ideas, or standards, that are important to us.

Example: In my family, everyone gets up by 8:00 A.M. every day, including weekends.

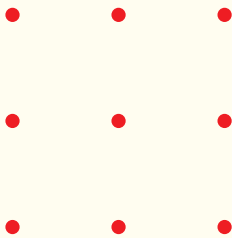
I believe that only lazy people sleep past 8:00 A.M. (I formed a judgment about other people based on a standard in my family.)



Figure 11.4 Connecting the Dots

Connect all nine dots shown by drawing four straight lines without lifting your pencil from the paper or retracing any lines. (The answer appears in Figure 11.7.)

How does following a mental set sometimes interfere with problem solving?



functional fixedness: the inability to imagine new functions for familiar objects

creativity: the capacity to use information and/or abilities in a new and original way

regain control of those four squares. She has a set for this strategy. If this set helps her win, fine. Sometimes, however, a set interferes with problem solving, and then it is called rigidity. You probably know the old riddle “What is black, white, and read all over? A newspaper.” When you say the riddle, the word *read* sounds like *red*, which is why some people cannot guess the answer. *Read* is heard as part of the black and white set—it is interpreted as being a color. If you asked, “What is black and white and read by people every day?” the correct answer would be obvious—and boring.

One form of set that can interfere with problem solving is **functional fixedness**—the inability to imagine new uses for familiar objects. In experiments on functional fixedness, people are asked to solve a problem that requires them to use a familiar object in an unfamiliar way (Duncker, 1945). Because they are set to use the object in the usual way, people tend to pay attention only to the features of the object that relate to its everyday use (see Figures 11.4 and 11.5). They respond in a rigid way.

Another type of rigidity occurs when a person makes a wrong assumption about a problem. In Figure 11.6, for example, the problem is to arrange the six matches into four equilateral triangles. Most people have trouble solving this puzzle because they falsely assume that they must stay within a two-dimensional figure.

People trying to solve the kind of problem described in the *Psychology and You* feature on page 301 experience a third kind of rigidity. Most people look for direct methods of solving problems and do not see solutions that require several intermediate steps.

Rigidity can be overcome if the person realizes that his or her strategy is not working and looks for other ways to approach the problem. The more familiar the situation, the more difficult this will be. Rigidity is less likely to occur with unusual problems. Many individuals are trained, through formal education, to think of only one way to do things. Rigidity can be overcome by thinking about—or being taught to think about—and analyzing situations from many perspectives.

CREATIVITY

The ability to use information in such a way that the result is somehow new, original, and meaningful is **creativity**. All problem solving requires some creativity. Certain ways of solving problems, however, are simply more brilliant or beautiful or efficient than others. Psychologists do not know exactly why some people are able to think more creatively than others, although they have identified some of the characteristics of creative thinking, including flexibility and the ability to recombine elements to achieve insight.

Figure 11.5

Overcoming Functional Fixedness

Given the materials pictured here, how would you go about mounting a candle vertically on a wooden wall in such a way that it can be lit? (The solution is presented in Figure 11.7.) **How might functional fixedness make it difficult to solve this problem?**



Flexibility

The ability to overcome rigidity is **flexibility**. Psychologists have devised a number of ingenious tests to measure flexibility. In one test, psychologists ask people how many uses they can imagine for a single object, such as a brick or a paper clip. The more uses a person can devise, the more flexible he or she is said to be. Whether such tests actually measure creativity is debatable. Nevertheless, it is obvious that inflexible, rigid thinking leads to unoriginal solutions or no solutions at all.

Recombination

When the elements of a problem are familiar but the required solution is not, it may be achieved by **recombination**, a new mental arrangement of the elements. In football and basketball, for example, there are no new moves—only recombinations of old ones. Such recombination seems to be a vital part of creativity. Many creative people say that no truly great poem, no original invention, has ever been produced by someone who has not spent years studying his or her subject. The creative person is able to take the information that he or she and others have compiled and put it together in a totally new way. The brilliant philosopher and mathematician Sir Isaac Newton, who discovered the laws of motion, once said, “If I have seen further, it is by standing on the shoulders of giants.” In other words, he was able to recombine the discoveries of the great scientists who had preceded him to uncover new and more far-reaching truths.

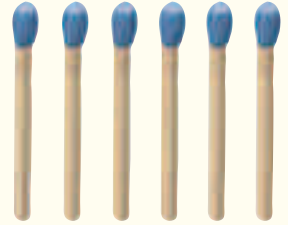
Insight

The sudden emergence of a solution by recombination of elements is called **insight**. Insight usually occurs when problems have proved resistant to all problem-solving efforts and strategies. The scientist or artist reaches a point of high frustration and temporarily abandons the task. Yet the recombination process seems to continue on an unconscious level. When the person is absorbed in some other activity, the answer seems to appear out of nowhere. This sudden insight has appropriately been called the “aha” experience.

Certain animals appear to experience this same cycle of frustration, temporary diversion (during which time the problem incubates), and then sudden insight. For example, Wolfgang Köhler (1976) placed a chimpanzee in a cage where a cluster of bananas was hung out of its reach. Also in the cage were several wooden boxes. At first the chimpanzee tried various unsuccessful ways of getting at the fruit. Finally it sat down, apparently giving up, and simply stared straight ahead for a while. Then suddenly it jumped up, piled three boxes on top of one another, climbed to the top of the pile, and grabbed the bananas.

Figure 11.6 Overcoming Wrong Assumptions

Arrange these six matches so that they form four equilateral triangles. (The solution appears in Figure 11.7.) **What are two characteristics of creative thinking?**



flexibility: the ability to overcome rigidity

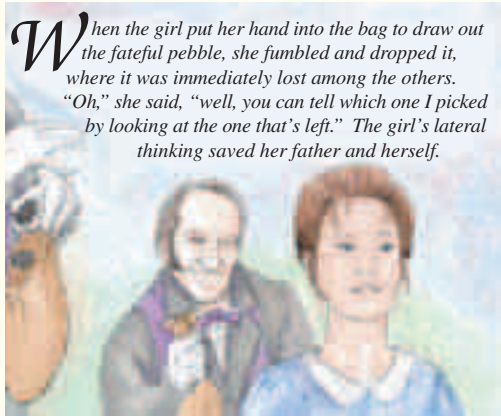
recombination: rearranging the elements of a problem to arrive at an original solution

insight: the apparent sudden realization of the solution to a problem

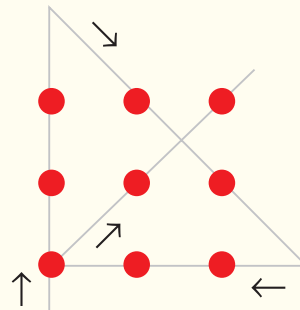


Solve This Problem

How would you go about solving this problem? A man and his two sons want to get across a river. The boat they have available can hold a maximum of only 200 pounds. The father weighs 200 pounds and the sons weigh 100 pounds each. How can all three people cross the river? (You'll find the answer in Figure 11.7.)



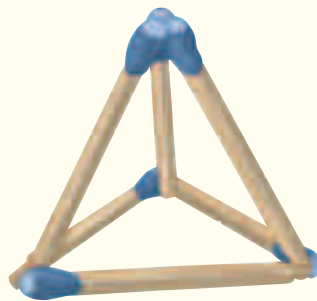
page 298



page 300

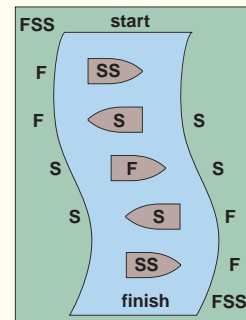


page 300



page 301

"F" represents "Father," and each "S" represents a "Son."



page 301

SECTION 1

Assessment

- 1. Review the Vocabulary** Describe two obstacles to problem solving.
- 2. Visualize the Main Idea** In a diagram similar to the one below, describe the characteristics of creative thinking.

Characteristics of Creative Thinking



- 3. Recall Information** What is the difference between convergent and divergent thinking? Give specific examples.
- 4. Think Critically** If you were a teacher, would you allow students to solve math problems using different approaches if they reached the same answer? Why?

5. Application Activity Focus on a favorite board game. Provide a written description of problem-solving techniques you would use to win the game. Compare your strategies with those of your classmates.



Case Studies

Checkmate

Period of Study: 1997

Introduction: On May 11, 1997, the final match of a rematch took place in the contemplative game of chess. The champion of the previous match, which had taken place a year earlier, was Garry Kasparov, a former scientist. Many consider Kasparov to be the best chess player to have ever lived. Kasparov's opponent was Deep Blue, a computer.

Hypothesis: The idea of a human versus a machine fascinated experts in a wide range of scientific studies. Most of them had the highest confidence in Kasparov's chances to defeat the computer for the second time. Psychologists believed that a computer pre-programmed with information of any kind would prove no match for the thought capacity and perceptions of the human mind. Even though Deep Blue was designed to play the game of chess with perfection, a nonfeeling and nonthinking machine could not defeat the ability of the human mind to think abstractly. A machine could also not match the human mind's feelings of determination and desire.

Method: As we know, computers are not thinkers—they can only do what they are programmed to do. Deep Blue, however, has amazing capacities. It can consider 300 million possible chess moves per second. With each of these 300 million possibilities, Deep Blue is programmed to assess the situation these moves will put it in. The human brain can evaluate only a very small fraction of moves compared to what Deep Blue can do. The Deep Blue defeated by Kasparov the previous year was an earlier version

of the 1997 model. A victory for Deep Blue could mean computers would not have to operate like a human brain to surpass it.

For his rematch with Deep Blue, Kasparov planned to copy his strategy from the previous year. This would involve using the early match (in a series of matches) to inspect the mighty computer for weaknesses and then to exploit those weaknesses (Anand, 1997).

Results: Deep Blue, the computer, defeated Kasparov. Experts explained that Kasparov's defeat was the result of comparing Deep Blue too much to the version he had played against the year before. The new and improved Deep Blue seemed to use moves that were very human-like.

For every seemingly well-conceived move Kasparov made, the computer countered in devastating ways.

The time-consuming chess game robbed Kasparov of much of his concentration, whereas Deep Blue displayed no fatigue, frustration, or other human weaknesses. Now that psychologists know a human's mental capacity can be outmatched by a computer's programming, what assumptions can they make? Can a machine really prove to be more intelligent than the person who creates it? Do the physical limitations or the emotions of humans prevent us from using our full brain capacity? These questions and others like them may not be answered for years to come. This situation is new, and further testing in this area is needed to assess the issues accurately.



Analyzing the Case Study

1. Why was Kasparov favored to win the rematch?
2. What advantages did each opponent bring to the contest?
3. **Critical Thinking** Why were psychologists interested in the rematch between these two opponents?

Reader's Guide

■ Main Idea

Language and thought are closely related. Language requires the learning of a set of complex rules and symbols, yet most people have little difficulty learning their native language.

■ Vocabulary

- language
- phoneme
- morpheme
- syntax
- semantics

■ Objectives

- Explain the structure of language.
- Describe how children develop language.

EXPLORING PSYCHOLOGY

What Language Do You Understand?

Listen to someone speaking a language you do not know. You hear an unsung song, ever changing, rising and falling, occasionally illuminated by flashes of feeling. The sounds themselves are little more than vocal noises. If there are words, you cannot disentangle them; if there is a message, you cannot understand it. Interest evaporates. You might as well stare at a brick wall.

Now listen to a good friend. It is the same kind of vocalization, but you cannot hear it in the same way. The noises are there, but they are totally transparent. Your mind passes right through the sounds, through the words, through the sentences, and into the mind of your friend. Your experience is totally different.

—from *The Science of Words* by George A. Miller, 1991

Of all the things we do, nothing seems as complex and as important as understanding and speaking a language. We must learn thousands of words and a limited number of rules of grammar to make sense of those words to communicate and share ideas.

THE STRUCTURE OF LANGUAGE

Do you ever talk to yourself? Some people talk to themselves when they are thinking or solving a problem. When we are talking or thinking, we are using language. What is language? **Language** is a system of

language: the expression of ideas through symbols and sounds that are arranged according to rules

communication that involves using rules to make and combine symbols in ways that produce meaningful words and sentences. Language lets us communicate facts and ideas. It allows us to tell each other about the past, present, and future. We solve problems and make decisions based on learning that is transmitted through language. Language consists of three elements: phonemes (units of sound), morphemes (units of meaning), and syntax (units of organization). The study of meaning, or semantics, is the most complex aspect of language.

Phonemes

The smallest units of sound in human languages are **phonemes**. Phonemes can be represented by a single letter (such as consonants like *t* or vowels like *e*) or a combination of letters, such as *sh* (see Figure 11.8).

We can produce about 100 different recognizable sounds, but not all sounds are used in all languages. For instance, the English language uses about 43 sounds while some languages use as few as 15 sounds and others use as many as 85 sounds.

Morphemes

A **morpheme** is the smallest unit of meaning (see Figure 11.8). It is made up of one or more phonemes. Morphemes can be a word, a letter (*s*), a prefix (*un-* in *uncertain*), or a suffix (*-ly* in *slowly*). For example, the words *book*, *love*, and *reason* are single morphemes, while *loves*, *relearn*, and *walked* have two morphemes (*love* and *-s*, *re-* and *learn*, *walk* and *-ed*).

Syntax

Rules for combining words into meaningful phrases or sentences to express thoughts that can be understood by others is **syntax**. For example, the following string of words probably does not make sense: “Boy small bike large rode.” In English we follow grammatical rules, such as placing adjectives in front of nouns. If you applied these rules to the sentence above, it would read: “The small boy rode a large bike.” Every language has these rules, although the rules differ from language to language.

Semantics

The study of meaning or extracting meaning from morphemes, words, sentences, and context is **semantics**. The same word can have different meanings. Consider the following sentences: “A mind is a terrible thing to waste. Do you mind if I sit next to you?” The word *mind* is understood differently in the two sentences. How did you

phoneme: an individual sound that is a basic structural element of language

morpheme: the smallest unit of meaning in a given language

syntax: language rules that govern how words can be combined to form meaningful phrases and sentences

semantics: the study of meaning in language

Figure 11.8

Phonemes and Morphemes

The word *fearlessness* has nine phonemes and three morphemes. **What is the difference between phonemes and morphemes?**

Phonemes

(units of sound):



Morphemes

(units of meaning):



Profiles In Psychology

Noam Chomsky

1928–

“[A] human being is a biological organism like any other. It’s a biological organism with a very unique intellectual capacity that we are only barely beginning to understand. I think our intellectual capacities are very highly structured.”

Avram Noam Chomsky created the idea of *transformational grammar*. Transformational grammar is a system for describing the rules that determine all the sentences that can possibly be formed in any language. Chomsky claims that each of us is born with brain structures that make it relatively easy to learn the rules of language. Chomsky called those innate brain structures the *language-acquisition device*, or *LAD*. The LAD includes inborn mechanisms that guide a person’s learning of the unique rules of his or her native language.

know what the word *mind* meant in each sentence? From your knowledge of semantics, you knew that in the first sentence *mind* was a noun, while in the second sentence it was a verb. Your knowledge of a word’s meaning depends partly on context.

LANGUAGE DEVELOPMENT

For many years a debate over exactly how children learn language raged. B.F. Skinner believed that children learned language as a result of operant conditioning. When children utter sounds that are similar to adult speech patterns, their behavior is reinforced through smiles and extra attention; therefore, children repeat those sounds. Eventually children learn to produce speech. Critics state that

children understand language before they speak—and before they receive any reinforcement. They also believe that children learn the rules of language before they receive any feedback on speaking correctly.

Some psychologists argue that children learn language through observation, exploration, and imitation. These social learning advocates point out that children use language to get attention, ask for help, or to gain other forms of social contact. Parents can stimulate language acquisition by responding to and encouraging language development. These psychologists believe that both innate and environmental factors play a part in how a child learns language.

Although Noam Chomsky believed that reinforcement and imitation do contribute to language development, he did not believe that all the complex rules of language could be learned that way. Chomsky (1957) theorized that infants possess an innate capacity for language; that is, children inherit a mental program that enables them to learn grammar.

HOW LANGUAGE DEVELOPS

If Chomsky is right, then we would expect that all children go through similar stages of language development, no matter what culture or language group they belong to. Infants, in fact, do go through four stages of language development.

Beginning at birth, infants can cry and produce other sounds indicating distress. Around 2 months of age, infants begin to *coo*. Cooing refers to long, drawn-out sounds such as *oooh* or *eeeh*. At around 4 months of age, infants reach the first stage of language development and begin to *babble*. Babbling includes sounds found in all languages, such as *dadada* and *bababa*. When babbling, infants learn to control their vocal cords and to make, change, repeat, and imitate the sounds of their parents. At around 9 months of age, infants refine their babbling to increasingly include sounds that are part of their native language. Whereas in children who can hear, babbling is oral, deaf children babble by using hand signals. They repeat the same hand signals over and over again.

At around 12 months of age, infants begin to utter single words. They use these words to describe familiar objects and people, such as *da-da* or *doggie*. At this stage, children use single words to describe longer thoughts. For example, a child may say “da” to mean “Where is my father?” or “I want my father.”

Toward the end of their second year, children place two words together to express an idea. Children may say “Milk gone” to indicate that the milk has spilled or “Me play” to mean “I want to play.” This stage indicates that the child is beginning to learn the rules of grammar. The child’s vocabulary has expanded to about 50 to 100 words and continues to expand rapidly, as was discussed in Chapter 3.

By age 2–3, children form sentences of several words. These first sentences follow a pattern called *telegraphic speech*. This is a pattern of speaking in which the child leaves out articles such as *the*, prepositions such as *with*, and parts of verbs. For example, a child may say, “I go to park,” to mean, “I am going to the park.” By age 5, language development is largely complete, although vocabulary and sentence complexity continue to develop.




Bilingualism

Bilingualism is the ability to speak and understand two languages. How do bilingual people, though, keep the two languages separate? They do not. Try this experiment. Say the ink color of the following words aloud.

YELLOW GREEN RED BLUE VERDE AZUL AMARILLO ROJO

If you speak only English, you probably had a little trouble with the first four and had less trouble with the last four. If you speak Spanish, though, you knew that *verde*, *azul*, *amarillo*, and *rojo* are the Spanish words for *green*, *blue*, *yellow*, and *red*. You had difficulty with all the items.

Although it takes children longer to master two languages rather than just one, bilingual people can express their thoughts in a wide variety of ways. Bilingual children also learn early that there are different ways of expressing the same idea.

 **Reading Check**
What is the nature versus nurture debate concerning the development of language?

DO ANIMALS LEARN LANGUAGE?

Animals communicate with one another. We have all seen dogs bark or growl at each other. Do animals, though, learn language? Language involves more than just communicating—it involves rules of grammar. It involves combining words or phrases into meaningful sentences. Although animals do not possess the ability to use grammatical rules, they have been taught to communicate with humans. (Refer to Chapter 3 for an in-depth discussion.)

GENDER AND CULTURAL DIFFERENCES

People use language to communicate their culture and express their ideas. Do people who speak different languages actually think differently from one another? Benjamin Whorf (1956) argued that language affects our basic perceptions of the physical world. Whorf used the term *linguistic relativity* to refer to the idea that language influences thoughts. For instance, consider the word *snow*. Whorf estimated that the Inuit have many words for snow (including separate words for damp snow, falling snow, and melting snow) because their survival depends upon traveling and living in snow. According to Whorf's theory, different terms for snow help the Inuit see the different types of snow as different. On the other hand, Whorf claimed that Americans have one word for snow. Critics have pointed out that Americans actually have many words for snow. Whorf's theory of linguistic relativity still claims supporters, but it is difficult to separate culture from language when studying the use of language and the perceptions it influences.

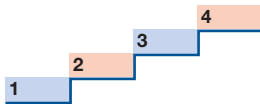
Does the English language express a particular value system? Some people argue that certain words in language create gender stereotypes. For example, a chairman may be a man or a woman. The use of pronouns also affects our thinking. Nurses, secretaries, and schoolteachers are often referred to as *she*, while doctors, engineers, and presidents are often referred to as *he*. Many organizations have instituted guidelines for the use of nonsexist language.

SECTION 2

Assessment

- 1. Review the Vocabulary** How many phonemes are in the word “thoughtfully”? How many morphemes?
- 2. Visualize the Main Idea** Using a flowchart similar to the one below, list the stages of language development.
- 3. Recall Information** How might we express gender values in our use of language?
- 4. Think Critically** You have taught your pet parrot to speak perfect English and understand several commands. Have you taught it language? Explain.

Stages of Language Development



- 5. Application Activity** In ordinary English, there is no resemblance between the written appearance of a word and the idea for which it stands. Write the following words in such a way that the word illustrates the idea: war, empty, fly, kick, Mommy.

Solving problems, creating ideas, and expressing our ideas through language are some of the most important skills that we acquire in our lives.

Section 1 Thinking and Problem Solving

Main Idea: Thinking involves changing, reorganizing, and recombining the information stored in memory to create new or transformed information, such as creative problem-solving strategies.

- Thought depends on several processes or components: images, symbols, concepts, prototypes, and rules.
- There are several kinds of thinking: directed, or convergent, thinking; nondirected, or divergent, thinking; and metacognition.
- Problem solving depends upon the use of strategies or specific methods for approaching problems.
- People use algorithms, or fixed sets of procedures, and heuristics, or mental shortcuts, to solve problems.
- At times certain useful strategies become so cemented into the problem-solving process that they actually interfere with problem solving. When a particular strategy becomes a habit, it is called a mental set.
- Functional fixedness, or the inability to imagine new functions for familiar objects, can interfere with problem solving.
- Some characteristics of creative thinking include flexibility and the ability to recombine elements to achieve insight.

Section 2 Language

Main Idea: Language and thought are closely related. Language requires the learning of a set of complex rules and symbols, yet most people have little difficulty learning their native language.

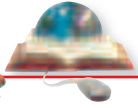
- Language consists of three parts: phonemes, morphemes, and syntax.
- According to B.F. Skinner, children learn language as a result of operant conditioning.
- Noam Chomsky theorized that children inherit a mental program that enables them to learn grammar.
- Infants go through four stages of language development—babbling at around 4 months of age, uttering single words at around 12 months of age, placing words together to express ideas at around 2 years of age, and forming complex, compound sentences by 4 years of age.
- People use language to communicate their culture and express their ideas.

Chapter Vocabulary

thinking (p. 296)
 image (p. 296)
 symbol (p. 296)
 concept (p. 296)
 prototype (p. 296)
 rule (p. 297)
 metacognition (p. 297)
 algorithm (p. 299)
 heuristic (p. 299)
 mental set (p. 299)
 functional fixedness (p. 300)
 creativity (p. 300)
 flexibility (p. 301)
 recombination (p. 301)
 insight (p. 301)
 language (p. 304)
 phoneme (p. 305)
 morpheme (p. 305)
 syntax (p. 305)
 semantics (p. 305)

CLICK HERE

PSYCHOLOGY
Online



Self-Check Quiz

Visit the *Understanding Psychology* Web site at psychology.glencoe.com and click on **Chapter 11—Self-Check Quizzes** to prepare for the Chapter Test.

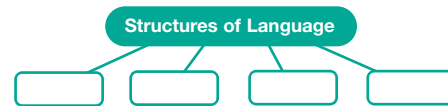
Reviewing Vocabulary

Choose the letter of the correct term or concept below to complete the sentence.

- | | |
|-------------------------|------------------|
| a. prototype | f. syntax |
| b. algorithm | g. semantics |
| c. functional fixedness | h. mental set |
| d. insight | i. thinking |
| e. phonemes | j. metacognition |
- A(n) _____ is a fixed set of procedures that, if followed correctly, will lead to a solution.
 - _____ indicates the meaning of words or phrases when they appear in certain sentences or contexts.
 - Changing or reorganizing the information stored in memory to create new or transformed information is _____.
 - A person experiences _____ when he or she comes upon a solution to a problem by creating a new mental arrangement of the elements of the problem.
 - The strategy of problem solving that you use over and over again is your _____.
 - _____ is a set of rules for combining words, phrases, and sentences to express thoughts that can be understood by others.
 - Thinking about thinking is called _____.
 - When you think of a car as an example of a vehicle, you are thinking of a(n) _____.
 - The smallest units of sound in the human language are called _____.
 - The inability to imagine new functions for familiar objects is called _____.

Recalling Facts

- Define the five units of thought. Then list the five units of thought in order of increasing complexity.
- What is creativity? What are the three characteristics of creative thinking? Give an example of one of the three characteristics.
- Using a graphic organizer similar to the one below, identify and explain the structures of language.



- What are three strategies people often use to solve problems? Explain how you have used one of these strategies to solve a problem.
- How did B.F. Skinner and Noam Chomsky differ in their ideas about how children learn language?

Critical Thinking

- Applying Concepts** Do you think using algorithms rather than heuristics is always the best way to solve problems? Why or why not?
- Making Inferences** What kind of thinking—directed or nondirected—do you think is required for creativity? Why do you think so?
- Analyzing Concepts** Based on what you have learned about language development, do you think all students in elementary school should be taught a foreign language? Why or why not?
- Synthesizing Information** According to the theory of linguistic relativity, a person's language influences his or her thoughts. Do you believe that bilingual people have more complex thought processes than people who speak only one language? Explain your answer.
- Demonstrating Reasoned Judgment** What theory of language development do you agree with the most? Why?

Psychology Projects

- 1. Problem Solving** Suppose you wanted to put together a jigsaw puzzle. What are the problem-solving strategies you might use? Which one do you think would work best? Present your strategies in an illustrated “how-to” pamphlet for others to refer to.
- 2. Language** Listen to the speech of a child between the ages of 2 and 4. Pay special attention to the child’s language skills. Then write a report explaining what parts of language structure the child is exhibiting.
- 3. Thinking** Ask 15 to 20 people to give you directions to a specific location, such as the school gym. Notice how they describe the directions (by using only words, creating a map, or using their hands). After they have finished, ask them to describe the mental imagery they used. In a brief report, summarize your findings.



Technology Activity

The Internet has several sites designed for parents of preschool children. Locate some of these sites to find out what suggestions parents can obtain to improve language development in their young children. Report and evaluate the suggestions in light of the information about language development you have learned in this chapter.



Psychology Journal

Consider how language shapes your thinking and how language and thought are integrated processes. Recall an episode in your life in which you used language (your communication skills) to solve an important problem. Describe the event and analyze why you were equipped to resolve this particular issue.

Building Skills

Interpreting a Graph Many factors contribute to a child’s language development. Review the graph, then answer the questions that follow.

1. What does the graph illustrate?
2. What conclusion can you draw about the relationship of the number of words that a parent says to a child and the size of the child’s vocabulary?
3. What theory of language development does the information in this graph best support?

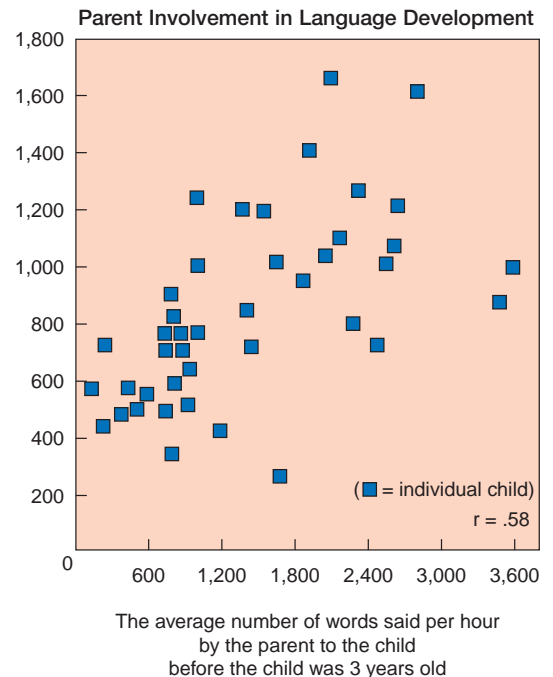


Practice and assess key social studies skills with **Glencoe Skillbuilder Interactive Workbook CD-ROM, Level 2.**



See the **Skills Handbook**, page 628, for an explanation of interpreting graphs.

The number of words in the child’s recorded vocabulary at age 3



Source: Robert S. Feldman, *Understanding Psychology*, 1999.