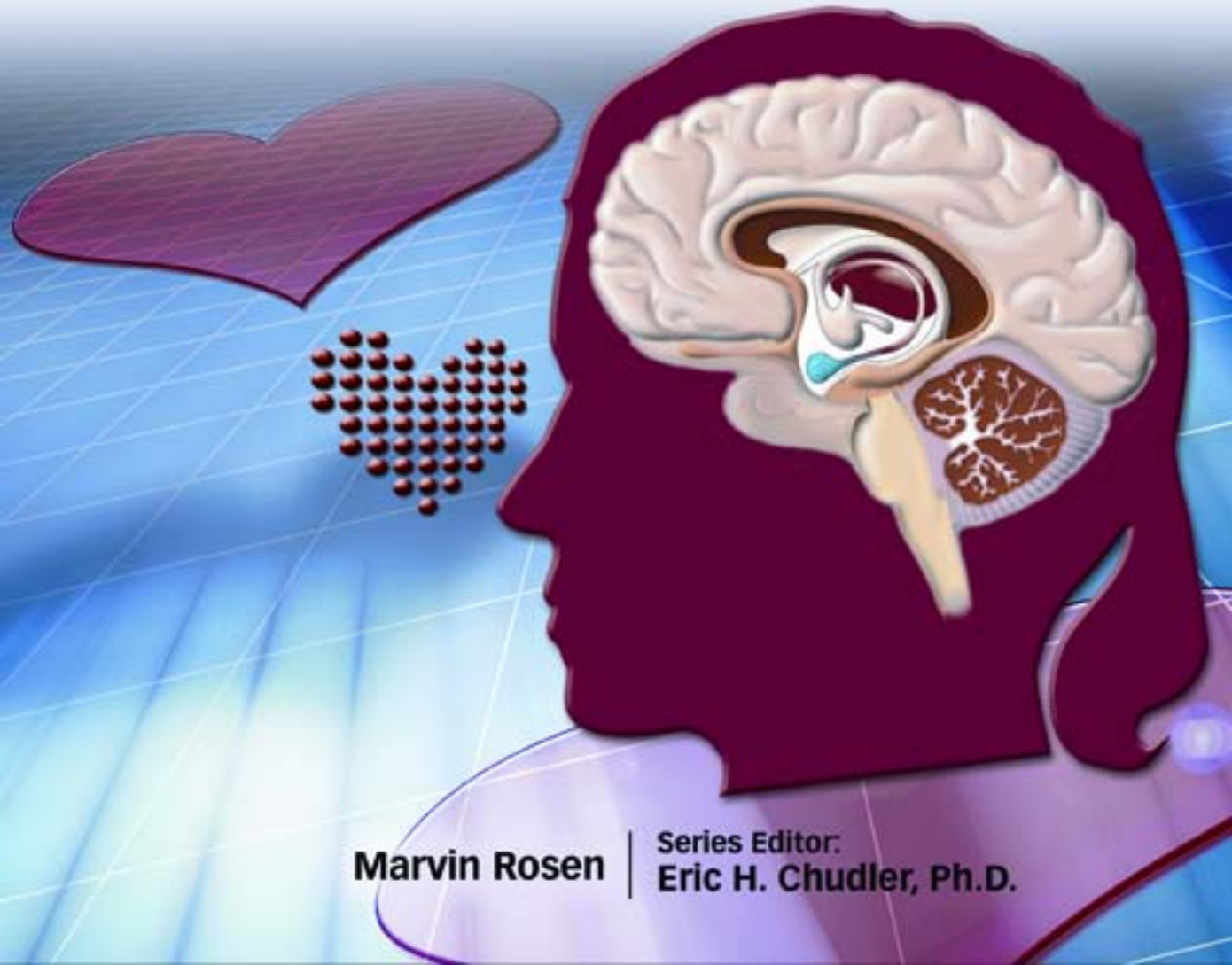
Brain Works

The Brain and Love



Marvin Rosen

Series Editor:
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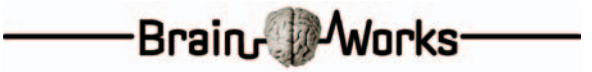

The Brain and Love

A Day in the Life of the Brain

How the Brain Grows

Inside Your Brain

Seeing, Hearing, and Smelling the World

Brain Works

The Brain and Love

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1

Love
Language and Concept

I'm not very smart but I know what love is.
—*Forrest Gump* (film, 1994)

More songs, poems, and novels are written about love than any other topic. Yet you may ask: "What is love? How will I recognize it?" You feel urged to find "true love." Yet, when you think you have found it, you are told: You're too young. It's only puppy love . . . an infatuation. Wait until you're older. Stay out of trouble. Love gets mixed up with sex and things you are told you should and should not do. Attitudes and codes of conduct change over time, however, and vary from culture to culture. What your parents tell you may differ from what you hear from your friends. How can you know the right way to behave?

Popular expressions reflect how we think about love. Consider these two expressions: “She was starved for affection”; “He thrives on love.” They express the idea that love fills a need and that, like food, love is essential to one’s well-being. The expressions “She is his better half” and “We are one” suggest that love is the union of two incomplete beings into a more perfect whole.

Like any emotion, love is complicated. It involves pleasant and unpleasant feelings, and sometimes painful ones. Besides the feelings, love is a set of attitudes, thoughts, and ideas. It leads to behaviors that can become silly, self-defeating, and embarrassing. Think of all the ways the word *love* is used in everyday conversation:

“I think I am in love.”
“I love to watch football.”
“She was his first love.”
“God is love.”
“He is lovesick.”
“I would love to go.”

The word has so many uses that it is difficult to find a general definition. Despite the complexity of the topic, it is essential to arrive at a reasonable definition. To do so, we might explore the abundance of written material is about love. We can read the love poems of Shakespeare, Shelley, Lord Byron, and Elizabeth Barrett Browning.

Too outdated? All right: We have popular song lyrics, novels, sitcoms, and numerous popular advice columns such as “Dear Abby” or the “Ask Jen” column in *Seventeen* magazine. We could also interview and observe people who say they are in love.

Not scientific enough? There is an increasing amount of scientific literature studying animals and humans to draw upon. The scientific approach will increase our understanding of love as a human feeling and condition, but it may not take into account the very different histories individuals might have.

This book takes both approaches: the scientific and the personal. It bases its understanding on scientific research, but it may also answer some of your questions about negotiating different aspects of relationships.

DEFINING LOVE

This book will explore the phenomenon of romantic love. Familial love, which is the love shared between family members, such as a mother and daughter, will not be discussed at length. In the discussions to follow, much of the research cited focuses upon adult relationships because similar studies of children and young adults have not been performed. The concept of love presented here distinguishes between attraction and mature, adult love, which involves intimacy and commitment, as well as passion. This depiction of love may not always describe the romantic relationships of most middle and high school students, but it represents a mature level of relationship of which readers should be made aware.

The best way to define something is to list its characteristics. One important aspect of romantic love is the desire to be in the presence of a particular person (Figure 1.1). One wishes to be approved by that person, to care for and be cared for by that person. One would make sacrifices for him or her. Love includes the desire to join physically with that person

Figure 1.1 **A young shepherd plays a tune for his love in this painting from the eighteenth century.**

and to be intimate. One wishes to know all about that person. If these characteristics are present but are not intense, this is probably a case of "like," not *love*.

To love someone means one is pleased by that person's physical appearance—and approves of his or her manner and way of talking. One cannot get enough of that person and wants to be constantly nearby. One thinks of future meetings and what might happen, and may fantasize about having sex with that person. Hormones are working overtime. If love is to mature, however, it must go beyond sex and passion. One learns to respect the person one loves and identify with his or her values. We are proud of our loved one's accomplish-

ments, saddened by his or her disappointments. We want our relationship to go on forever and trust that it will. In many instances, when passion lessens, the relationship ends. When love is real, it becomes a commitment. We give up ideas of the same type of relationship with someone else. Love brings continuous increases in the degree of caring. If love is not reciprocated, we suffer. Such are the joys and pains of love.

THE HISTORY OF LOVE

From the time that humans first began writing about their experiences, love has been a central theme in stories. In ancient myths, love was described as the work of gods and goddesses. It had positive and negative qualities. Lovers described themselves as trapped by love; they were "love-sick." People were seen as only half-finished until they met their "soul mate." Once true love occurred, lovers were united and they completed their growth process. This idea traces back to ancient Greek mythology. The Greek poets created two love deities, Aphrodite and Eros. (Eros also appears in Roman myths and is known as Cupid.) Aphrodite and Eros had the power to make mortals behave in ways beyond human control. In Homer's *Iliad*, love was one of the causes of the Trojan War, when Aphrodite aroused great feelings of passion between Paris and Helen. Eros struck his victims with an arrow, causing them to fall hopelessly in love (Figure 1.2). They did not know what hit them. The idea of being consumed by an uncontrollable passion remains with us today. It is part of the notion of love at first sight.

In epic tales of the Middle Ages, knights rescued damsels in distress, perpetuating romantic ideals of love. Love was noble, meeting the highest ethical and moral standards. It

Figure 1.2 **Eros is often depicted as a young child or an infant carrying a bow and arrow. In Greek mythology, Eros is the god of love. He is known as Cupid in Roman mythology.**

was the age of chivalry when a knight would gladly die for his true love. No other human activity could bring such happiness. Contemporary movies, such as *Robin Hood*, *Braveheart*, *King Arthur*, *Tristan & Isolde*, and *A Knight's Tale*, continue to enthrall audiences.

With the birth of Christianity, love acquired religious meaning. God was seen as the embodiment of love. Sex was to some a sin because it could occur in the absence of love.

King Arthur and Sir Lancelot du Lac

Nowhere is the romantic ideal better expressed than in the tales and legends of the knights of the Round Table. King Arthur was the central figure of these stories. He may or may not have been a real historical figure. There may or may not have been a king who was a great warrior fighting the Germanic invaders of Celtic Britain in the sixth century. If it is true, he was not a king with a band of knights in shining armor as the tales have said. What cannot be denied, though, is the influence of this figure in keeping strong the romantic ideal in art, literature, and popular thought.

Of all the mythical knights in the legend, Sir Lancelot was the most celebrated. He never failed in gentleness, courtesy, or courage. He is said to have been the greatest fighter and swordsman of all the knights of the Round Table. As a child, Lancelot was left by the shore of a lake, where he was found by Vivien, the Lady of the Lake, who raised him. When he was grown, Lancelot's true love was Queen Guinevere, Arthur's queen. He rescued her from certain death on two different occasions. During one of these rescues, Lancelot mistakenly killed Sir Gareth. This led to the breaking up of the Round Table. The queen hid in an abbey as a nun, and Lancelot lived the rest of his life as a hermit, doing penance.

Figure 1.3 **The title characters embrace during the famous balcony scene of William Shakespeare's *Romeo and Juliet*.**

Love was idealized by the British poets of the eighteenth and nineteenth centuries, and their poems live on as required reading in high school and college literature courses. ("She

walks in beauty like the night . . .” and “How do I love thee? Let me count the ways . . .”) Shakespeare’s sonnets remain classics and his play *Romeo and Juliet*, in which love endures beyond the grave, is perhaps the greatest love story of all time (Figure 1.3).

The romantic tradition of love was carried to the New World by the original British colonists, but during the three and a half centuries since the founding of the Plymouth Colony, there has been radical change in how social relationships are viewed. When America was young, most people lived on farms in rural areas. Children moved rapidly from school to the farm to become productive workers for their families. People married earlier; there was little time between the onset of sexual maturity and marriage. Celibacy before marriage was the accepted standard of behavior. Adolescence was not a major time of concern.

In the 1700s and 1800s, casual contact between boys and girls at unsupervised social gatherings was not allowed. If a boy wanted to court a girl, he had to meet her family and ask permission. Even then their meetings were chaperoned. However, a practice called bundling was sometimes permitted, in which a boy and a girl were allowed to share a bed, as long as they were wrapped in separate blankets. Sometimes, a board was placed between them to prevent inappropriate behavior. The couple was expected to talk through the night; sexual contact was prohibited.

With the Industrial Revolution in the nineteenth century, people moved to cities. Technological advances made labor less intensive, and people had more time to continue their education. Still, by the 1940s, the values of love, marriage, and virginity were largely accepted. They were expressed in movies, radio broadcasts, magazines, and even comic

Figure 1.4 **A teen gives his sweetheart a box of chocolates in this photograph from the 1930s.**

books. Adolescent males were depicted as pimply faced, bungling, sexually frustrated, awkward, and often socially inappropriate.

In 1937, sociologist Willard Waller described what he termed as the "rating and dating complex," a set of standards defining how young adults behaved toward each other. It described the rules your grandparents lived by. Under these standards, dating was an acceptable practice designed to lead to marriage (Figure 1.4). Initially there was a succession of dating partners. Eventually there were fewer and narrower

selections until two partners paired off and made a serious commitment to each other. There was a formal engagement and eventually marriage.

Walker studied this process at a small, rural college. Dating occurred largely on the basis of social status based upon appearance, clothing, wealth, and fraternity or sorority membership. High status students did not date those of lower status. Dating was limited mostly to fraternity and sorority members. A woman carefully guarded her reputation. A last-minute invitation for a date was not accepted. Women tried hard to avoid being exploited. Men did not want to date a "gold digger," who wanted them only for entrance to the best parties or the most expensive restaurants. Freshmen women were initially very popular because they were new faces on campus. Their popularity often diminished during their second year ("sophomore slump") as new freshmen arrived. Rules for men were less strict than those for women. During the last two years of college, relationships became more serious as students reverted back to older standards of courtship and marriage.

Changing Values About Love, Sex, and Romance

During the past 60 years, the United States has undergone what has been termed the sexual revolution. It has resulted in greater freedom for men and women to engage in sexual relationships. One factor was the development of contraceptives. Men and women could now engage in sex and know they were reasonably safe from pregnancy. After World War II, the idealization of love and marriage began to change. Teenaged boys had been subject to the draft and served in

the armed forces. Many served in foreign countries where attitudes toward sex were more liberal than at home. It became apparent that, if they were old enough to die for their country, they were old enough to be regarded as sexually active men.

The changes in attitude also affected women. Women served in the armed forces or as factory workers performing jobs previously open only to men. The invention of television, the Korean and Vietnam wars, and the increased availability of contraceptive drugs also accelerated attitude change. Many women delayed marriage to pursue a career, but were no longer as willing to delay sex. Sex before marriage became acceptable for many women.

Of course, not every teen or young adult behaved according to the new standards. In many families, strong moral and religious values still prevailed and continue to do so today. To others, however, the old standards became outdated and no longer applicable. Although the values, attitudes, and behavior depicted on TV's *Sex and the City* may not hold universally, they are certainly part of the culture to which young people are exposed. Media products and advertising campaigns relentlessly promote sexuality and sexual behavior. Children and teens find role models in popular idols who dress, act, and talk in ways that promote sex.

In many circles, virginity has changed from a virtue to a stigma that some people do not want to admit about themselves. Teens and young adults no longer view their social relationships solely as courtship leading to marriage. A girl engaging in oral sex may believe it is not really sex since she is still technically a virgin. The distancing of teens from their parents is more dangerous today than it was a generation ago.[1] Like courtship, the ideal of love may also have a

different meaning to today's youth than it does to their parents and grandparents.

SUMMARY

In the following pages, you will explore love in all its forms and from many perspectives. The biological underpinnings of human feelings will be explored, including the involvement of the brain, nervous system, hormones, and body chemistry. We will consider love as a phenomenon with origins in animal behavior. The broader topic of emotions will be presented to provide a perspective and backdrop against which to view love. We will look at love as a process of give and take, involving costs and benefits.

The book will describe attempts to classify, categorize, and measure the various components of love, which will be distinguished from passion. Various theoretical approaches to love will be considered, involving philosophical and psychological insights of major personality systems and prominent therapists. These approaches will emphasize the importance of development, learning, and experience in our capacity for engaging in loving relationships. They will address the theory of love, and yet theory is not enough. We will end by dealing with the practice of love, focusing on you and your everyday relationships. We hope this book will make you a little wiser in dealing with people. You will not become an expert, but perhaps you will look at yourself and your relationships with some new insights. If you emerge somewhat more confident, more willing to engage in relationships, more aware of your specific needs from others, and more sensitive to what others need from you, then the effort has been worthwhile.

2

Biological Factors

Darwinian man, though well-behaved,
At best is only a monkey shaved.
—W.S. Gilbert (1836–1911), English lyricist

Love is a complex process, involving thoughts, feelings, and behavior. All of these have a biological as well as a psychological base. It is not an either-or relationship, but rather a joint effect of both factors. We begin here with a discussion of the biological underpinnings of love and the controlling influence they exert upon the processes we label as love.

The biological bases of love are more complicated than mere sexual urges, as the father of **psychoanalysis**, Sigmund Freud,

suggested. The bases of love actually begin well before puberty. Biological factors are present at birth and develop in sequence as we mature. Together with environmental inputs and learning, they determine our future as loving people.

CHEMISTRY

Increasingly, scientists have attributed significant roles to chemicals in the central nervous system, which consists of the brain and the spinal cord (Figure 2.1). Inside the brain is a vast network of nerve cells, which builds the route along which messages pass from the different sections of the brain to the body parts that each section of the brain controls. The messages are carried by electrical impulses that travel from nerve cell to nerve cell along the axon that runs between each (Figure 2.2). The whole network can be thought of like a system of telephone poles and connecting wires: The nerve cells are the poles, and the axons are the wires strung between individual poles. Like a system of telephone poles, electrical messages move along the cell axons at lightning speed. Unlike telephone wires and poles, nerve cells do not touch each other, although they come very close. The space where two nerve cells meet is a tiny gap called a **synapse**. The nerve impulse is carried cross this gap by brain chemicals called **neurotransmitters**, which attach to structures called dendrites on the receiving nerve cell.

Although their theories are not completely proven, researchers such as Helen Fisher,[2, 3] have suggested that the broad actions of some neurotransmitters are specifically involved in feelings and thoughts of love. One neurotransmitter called **dopamine** has a role in attention, motivation, and goal-directed behavior. In excess, dopamine can produce

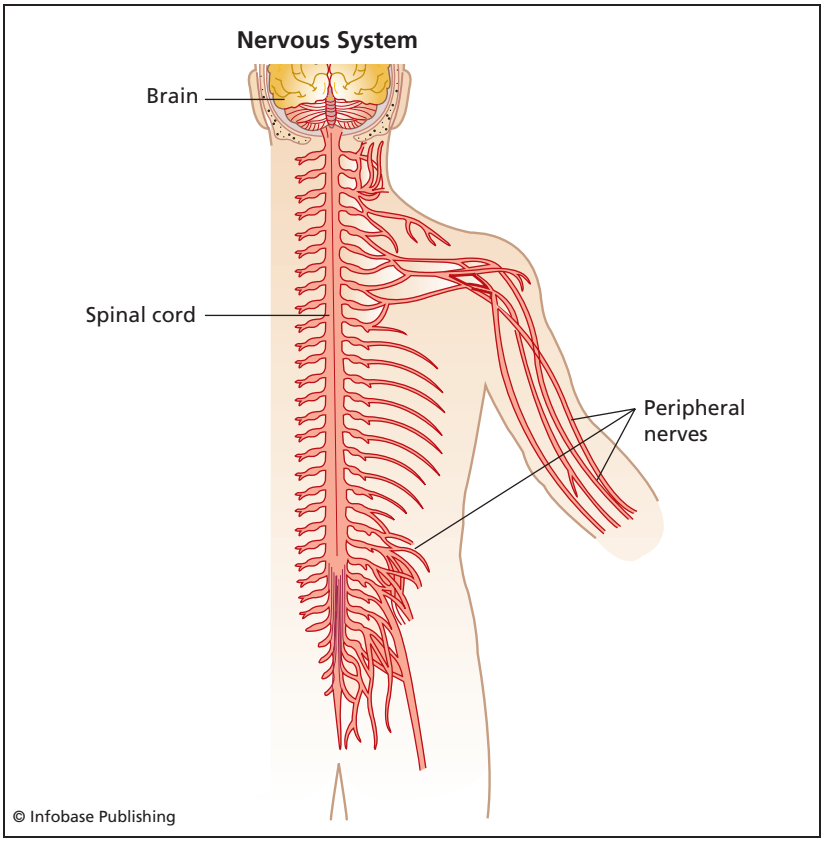

Figure 2.1 **The central nervous system consists of the brain and the spinal cord. The peripheral nervous system consists of nerves that connect to the central nervous system.**

feelings of exhilaration, increased energy, hyperactivity, sleeplessness, loss of appetite, symptoms of addiction, anxiety, and fear. Given that the ecstasy in romantic love involves these symptoms, it might be that feelings of love are determined, at least in part, by dopamine. Many writers have, after all, described love as an addiction.

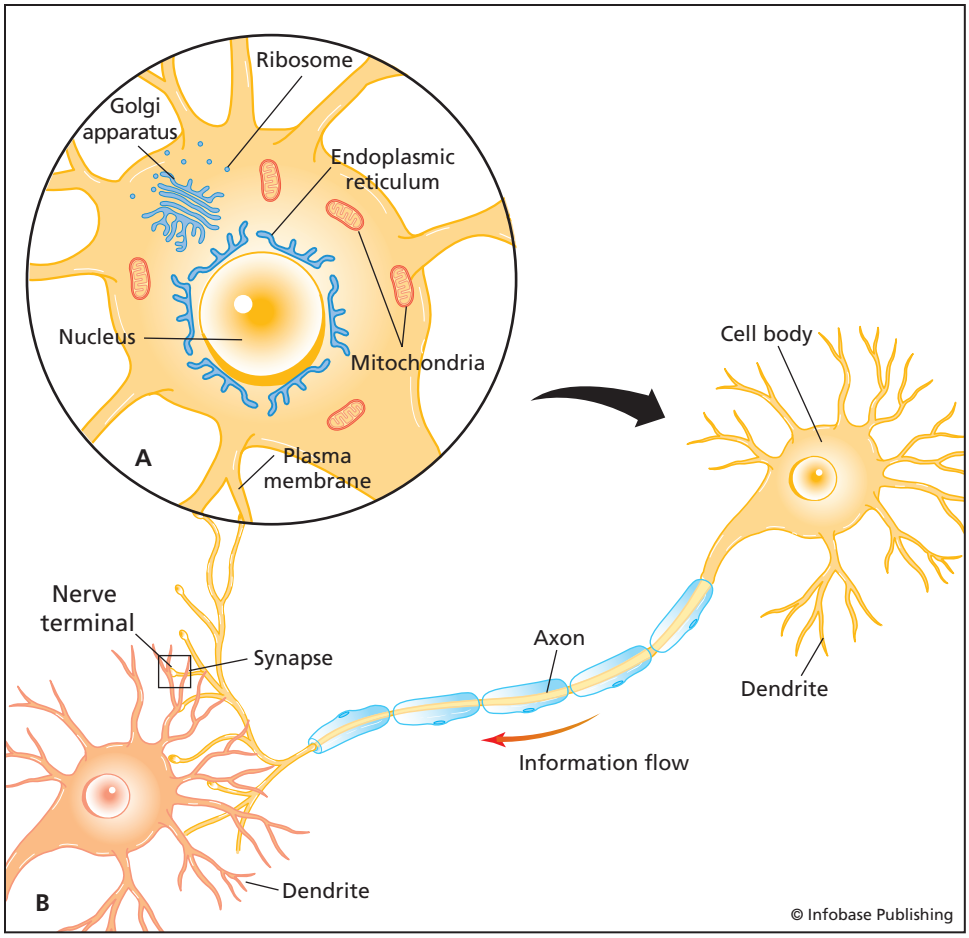

Figure 2.2 **(A) Neurons contain smaller internal cellular components called organelles. (B) Neurons have two different ends—a receiving end (dendrites) and a transmitting end (nerve terminal).**

Another neurotransmitter, **norepinephrine**, can also cause exhilaration, excessive energy, and loss of appetite. A third chemical, **serotonin**, has been associated with **depression** when levels at the synapse are too low. Some antidepression

medications work by increasing the levels of serotonin at synapses in the brain.

Depression, Anxiety, and Neurotransmitters

The feelings we experience in the course of a love relationship may range from extreme peaks of exhilaration to the depths of despair. To illustrate the impact of body chemistry upon love feelings, we start at the low end of the scale and explore the chemical building blocks of two negative states that may be triggered when love goes wrong.

Depression involves feelings of sadness; lowered self-esteem; and preoccupation with thoughts of rejection, failure, hopelessness, helplessness, and pessimism. The depressed person may show a combination of behaviors. He or she may withdraw from contact with others, avoid doing things that were previously enjoyable, stop eating (or eat excessively), turn to drugs or alcohol, and be unable to sleep. In serious cases, there may be ideas of suicide and suicidal acts.

It is believed that clinical depression is related to low levels of certain neurotransmitters in the brain and at the synapse between nerve cells. As was discussed previously, a nerve impulse travels from one nerve cell to another thanks to the release of a neurotransmitter into the synapse (Figure 2.3). The shape of the neurotransmitter matches the shape of a receptor in the receiving neuron (nerve cell) to fit like a key in a lock. This increases or decreases the likelihood that an impulse will be generated in the next neuron. Neurotransmitters that result in the generation of an impulse are known as excitatory neurotransmitters. Neurotransmitters that stop a neuron from firing a nerve impulse are known as inhibitory neurotransmitters.

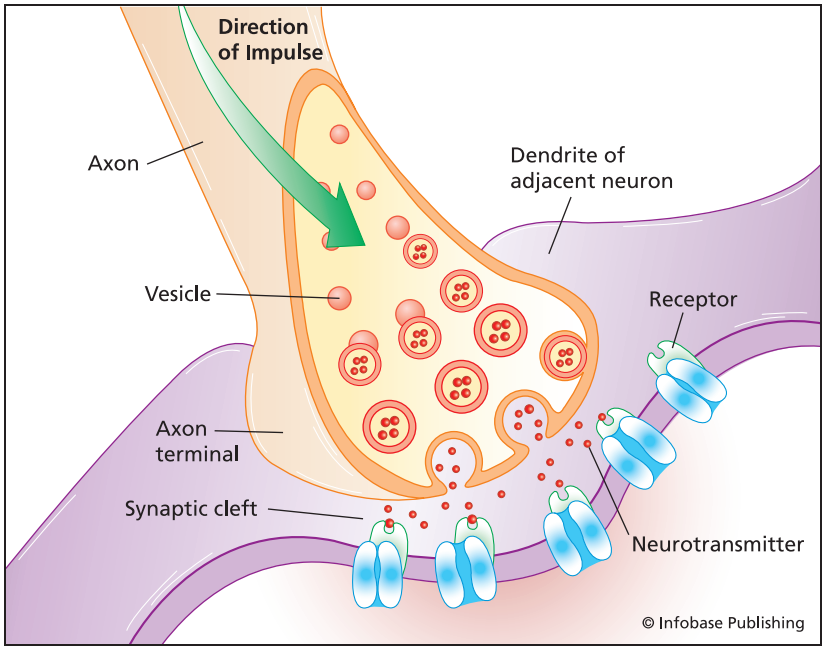

Figure 2.3 **Neurotransmitters move from the end of an axon to the dendrite of an adjacent neuron. The neurotransmitters attach to receptors on the surface of the dendrite, which may result in the firing of a nerve impulse.**

Many neurotransmitters are products of amino acids, which are chemicals that combine to build proteins. Neurotransmitters thought to be related to depression are called **monoamines**, particularly norepinephrine, dopamine, and serotonin. These three neurotransmitters originate in the central part of the brain and have different functions. Neurotransmitters, including the monoamines, are stored in small pouches, called synaptic vesicles, inside nerve cells. They are released from these pouches into the synapse after receiving an electric impulse from the axon of the nerve cell.

After the neurotransmitter molecules cross the synapse, they act on a receptor and then are inactivated and reabsorbed into the neuron from which they were released. The process is repeated with the arrival of the next nerve impulse.

For many years, the most widely believed **hypothesis** about the cause of depression has been a deficiency of norepinephrine or serotonin at the synaptic site. This is known as the monoamine hypothesis. There are many ways this deficiency could occur, including problems in the storage or release of the neurotransmitter, reabsorption problems with the receptors, or an **enzyme** called **monoamine oxidase** (MAO) that shuts off the neurotransmitters.

Two types of antidepressant medications are monoamine oxidase inhibitors (MAOIs) and selective serotonin reuptake inhibitors (SSRIs). Monoamine oxidase inhibitors prevent the MAO from shutting off the neurotransmitter. SSRIs stop the neurotransmitter serotonin from being pulled back into the synaptic vesicles after it carries the nerve impulse. Both approaches act to increase the concentration of the neurotransmitters that are thought to be depleted in people who are depressed.

These explanations of depression and the action of antidepressant medications have recently been challenged and are not definitive. Other explanations for depression have been suggested, too. For some people, depression may involve a hormone imbalance. In some people, there is an excess of cortisol, a hormone produced in the adrenal gland during times of stress.

Brain scanning procedures may prove helpful in diagnosing and treating depression. A technique known as positron emission topography (PET) measures glucose metabolism in various parts of the brain to study brain activity. This

technique may prove useful in linking activity of different regions of the brain with various types of depression. Studies of the electrical activity of the brain using electroencephalography (EEG) are used to measures different stages of sleep in people who are depressed. Rapid eye movement (REM) phases of sleep, during which most dreaming occurs, appear more rapidly after the onset of sleep in people who are depressed. Antidepressant medications appear to lengthen the time of onset of REM sleep.[4]

Anxiety is a vague, unpleasant feeling of fear and apprehension felt throughout the body. It is generally associated with a variety of symptoms, such as rapid heart rate, shortness of breath, diarrhea, dizziness, fainting, loss of appetite, sweating, frequent urination, tremors, and sleeplessness. These symptoms are also characteristic of fear. However, when people without anxiety problems are afraid, they usually know what is causing their fear. With anxiety, the source of the emotion is less clearly identified.

The biological components of anxiety lie in a division of the nervous system known as the autonomic nervous system. All of the nerve cells of our body fall into two major divisions, each with its own subdivisions. The central nervous system consists of the brain and spinal cord. The peripheral nervous system connects the central nervous system to the rest of the body. It consists of two parts. The somatic nervous system transmits sensation (touch, taste, temperature, vision, and hearing) from the outside world and sends messages to our skeletal muscles for voluntary movement. The autonomic nervous system transmits messages to the glands and involuntary muscles of our internal organs. It regulates bodily processes that are automatic, such as breathing and digestion. The autonomic nervous system is divided into two

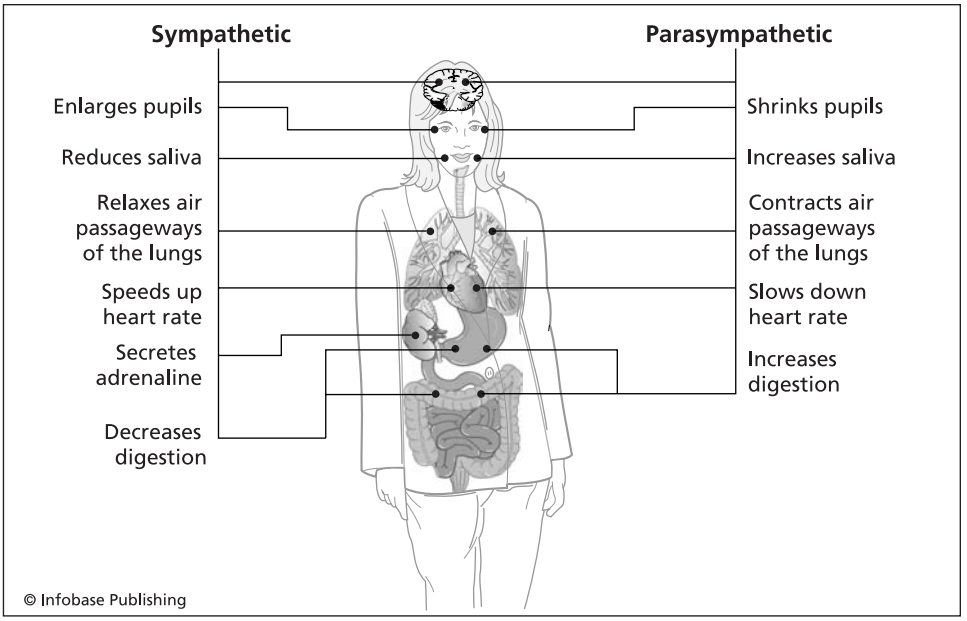

Figure 2.4 **The actions of the parasympathetic and sympathetic nervous systems often oppose each other. For example, the sympathetic nervous system acts to decrease the amount of saliva in the mouth, while the parasympathetic system increases the amount of saliva.**

parts, the sympathetic and parasympathetic nervous systems (Figure 2.4). The sympathetic system controls the processes that allow us to deal with emergencies. It can speed up the heart, slow digestion, cool the body through perspiration, pump blood to the muscles and brain, and raise blood sugar and energy levels. The parasympathetic system, on the other hand, regulates the calming processes that keep the body running. When the stressful events are over, it slows down the actions that sped up during the emergency.

The sympathetic system produces the symptoms of anxiety. Threatening or stressful situations result in the release of

epinephrine and norepinephrine to the bloodstream. These hormones, secreted by the adrenal glands, increase heart rate and respiration, force blood from digestive organs to the muscles and brain, and release fat from the body's stores. All of these sympathetic nervous system reactions prepare the organism for behaviors that will counter the source of stress, such as fighting or fleeing. These are known as **fight or flight** behaviors. Anxiety is related to the sympathetic system working overtime—there is no emergency, but the body reacts as if there were one.

THE BRAIN AND EMOTIONS

The anatomy of love rests in the brain within the **limbic system**, the area of the brain that controls motivation and emotion (Figure 2.5). Brain areas involved with pain and pleasure are also part of this complex system. Scientists believe that, as humans evolved from more primitive creatures, new brain layers developed, which gave humans the ability to experience emotions. As each layer formed, the organism was better able to **adapt** and learn.

Neurologist Paul MacLean has suggested a **triune theory** of the brain, based on an idea of how the brain developed during **evolution**. The theory suggests that the human brain is actually three brains in one. The three layers are the reptilian system (or R-complex), the limbic system, and the neocortex. According to the theory, each layer is responsible for separate functions of the brain, but all three layers interact.

The first layer of the brain, the reptilian system, controls basic functions, such as hunger, temperature control, and the fear response. The second layer of the brain, the limbic system, controls emotion, motivation, and memory. Pleasure

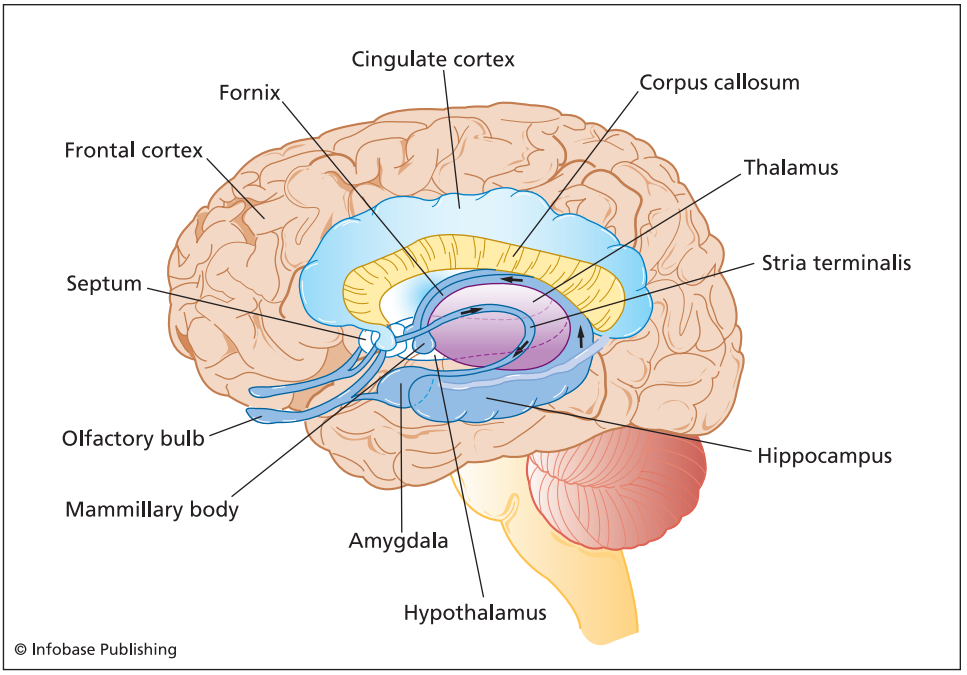

Figure 2.5 The limbic system contains a set of brain structures that control emotions.

and pain areas are also located in the limbic system. On each side of the limbic system is an almond-shaped area called the **amygdala**, which seems to play a major role in controlling feelings, especially fear and rage. If the amygdala of a normally peaceful cat is stimulated electrically, the animal prepares to attack—hissing and arching its back. The limbic system is also responsible for activities related to food, particularly the sense of smell. It also has an impact on sexual feelings and emotional bonding.

The outer layer of the brain, the layer that developed at the most recent point in human evolution, is the cerebral cortex

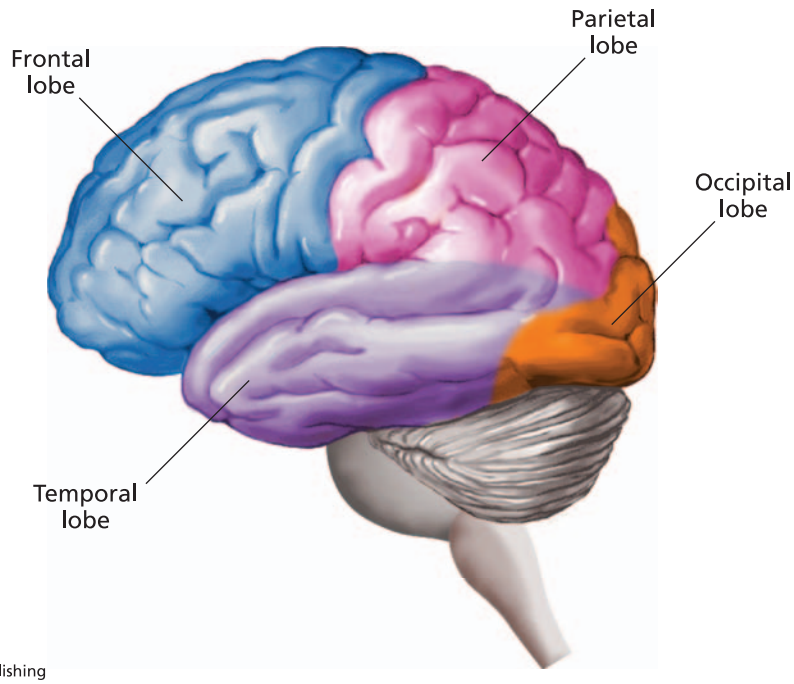

Figure 2.6 **The outer layer of the brain, known as the cerebral cortex, consists of four different lobes. Each lobe has different functions. For example, vision is primarily controlled by the occipital lobe.**

(Figure 2.6). This part of the brain is responsible for information processing and thinking. The cerebral cortex is the part of the brain that makes language, speech, writing, planning, and problem solving possible. It is divided into two halves, controlling opposite sides of the body. The right half handles creative tasks, such as playing an instrument or painting a picture. The left side of the brain takes charge of reasoning skills, such as doing a math problem, learning how to speak a language, or solving a Sudoku puzzle. Each half of the brain

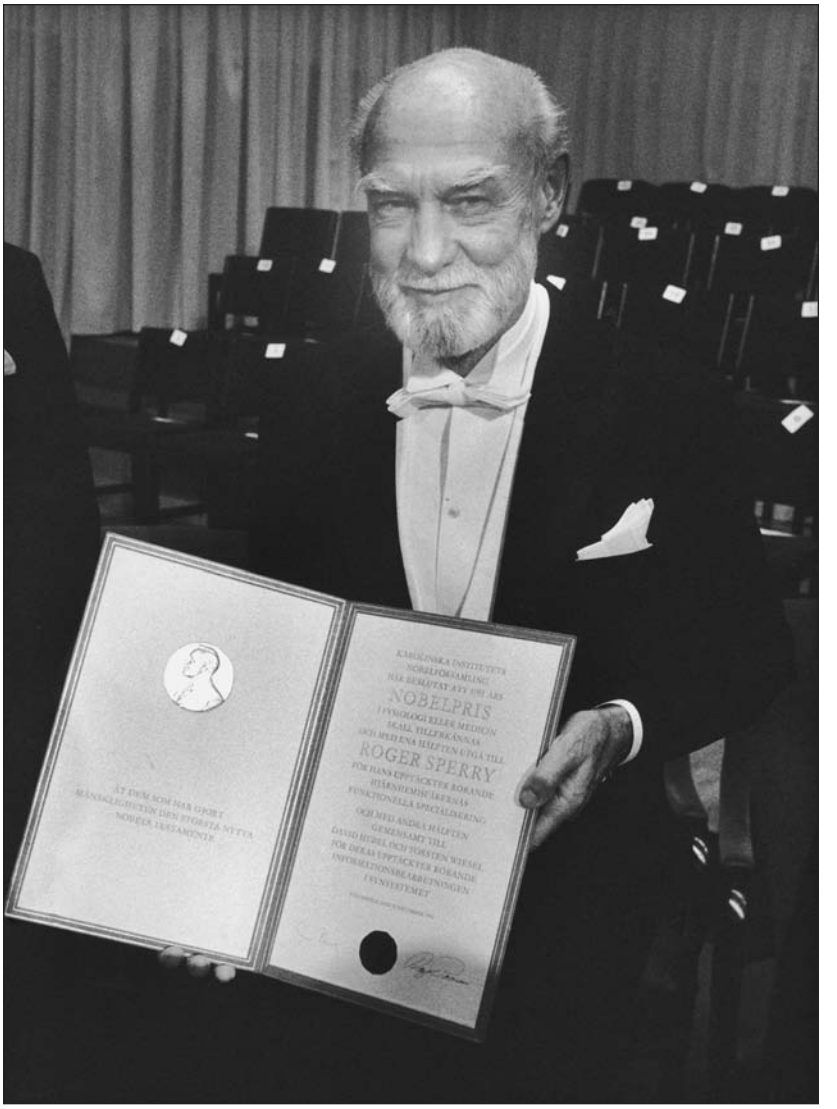

Figure 2.7 Roger Sperry displays the Nobel Prize that he won in 1981 for his work on split brains. With his experiments, Sperry was able to prove that the halves of the brain (hemispheres) serve different functions in the body.

controls one half of the body, too, but the signals cross: The right side of the brain controls the left side of the body, and the left side of the brain controls the right side of the body.

Psychologist Roger Sperry[5, 6] was one of the first to explain the idea of a left brain and right brain and their role in how the brain works (Figure 2.7). Medical examinations of certain patients—such as war and accident victims and people suffering from tumors and strokes—showed that the two sides of the brain are associated with different functions. Injuries to the left side of the brain usually impair reading, writing, and speaking. Injuries to the right side of the brain have less effect on these functions.

In the 1980s, two brain surgeons found that they could use what is known about the right and left brain to help patients with epilepsy. This disorder affects the nervous system and causes the patient to have seizures, which are sudden attacks on the brain that might include violent shaking, blacking out, and losing control of body functions. If no other treatments were working, doctors discovered that they could help a patient with epilepsy by cutting his **corpus callosum**, which connects the two brain hemispheres. At first, the operation did not appear to affect the patient negatively. However, it later became apparent that the operation had an unusual side effect. The patients reacted differently to images flashed in their right or left visual fields. (A visual field is the area you can see when looking straight ahead. If you focus on a coin held at arm's length, the right visual field is everything you can see to the right of the coin without moving your eyes or head. The left visual field is everything you can see to the left of the coin without moving your eyes or head.) When an

image was put in a patient's right field of vision, the patient could say what the picture was. When the image was shown to the patient's left field of vision, the patient could not say what the picture was. If the patient was given a way of responding without speaking, such as identifying the objects by touch, they could pick out what they had seen but could

Love, Evolution, and Controversy

Some scientists believe that love serves a purpose in evolution. Love is seen as leading to sex, which results in reproduction and the ability of a species to continue to exist. Charles Darwin (1809–1882), a British scientist, laid the foundations of the modern theory of evolution. At age 22, he served as a naturalist (a scientist who studies nature) on a ship going on a scientific expedition around the world. The ship stopped at various islands in the Pacific Ocean. Darwin studied geological formations, fossils, and living organisms on the islands. He observed that certain remains of extinct species closely resembled living organisms in the same area. He developed a theory that he called natural selection to account for why this was so. The members of every species, he reasoned, must compete with other species to survive. The survivors tend to be those organisms that possess certain characteristics that are favorable to their survival. They pass on these characteristics to their children. This gradual and continuing process is the way species evolve.

Darwin's theory of natural selection is one of the best-supported ideas in science for explaining the diversity of life forms on Earth. Despite the evidence, there have been numerous recent attacks on the theory. Many states and towns have ruled that science teachers must give equal time in class to alternative theories.

not actually say the word. It was as if they had two separate and different visual worlds and two separate minds. This phenomenon is explained by the fact that speech is primarily formed in the left hemisphere of the brain. An image appearing in the left field of vision crosses over for processing in the right hemisphere, which lacks the ability to form speech.

A group of scientists, philosophers, and religious leaders have argued that living organisms are too complex to have evolved by means of natural selection. Mechanisms involved in vision and the clotting of blood, they argue, involve large numbers of proteins whose interactions cannot be explained by the theory of natural selection. Other arguments point to large gaps in the available record of fossils, especially during the period when many new species seemed to suddenly appear. The existence of a supreme designer creating these new species is suggested. Two theories that often counter evolution are creationism and intelligent design.

Supporters of evolution point out that creationism and intelligent design are not scientific theories supported by evidence from experiments, and should not, therefore, be taught as science. Evidence of DNA in all species follows a pattern consistent with a slow evolutionary history. Archeologists have recently unearthed a fish with the beginnings of a simple wrist and fingers, which provides evidence of an evolutionary link from fish to human. The discovery of more "transitional" fossils in the future would provide further support for the theory of evolution.

Other studies have shown the left side of the brain to be more logical, rational, and able to deal with things in sequence. The right brain responds more on instinct, in a nonverbal way, and is able to deal with things all at once. Despite these differences, though, this does not mean that art abilities are located only in the right side of the brain and math abilities are located only in the left. Complex activities require the teamwork of both halves of the brain.

Mood, Memory, and Love

Love is a complex process involving thoughts, feelings, and behavior. It is an excellent example of how psychology and biology work together in determining every aspect of one's life. Learning, thinking, memory, emotion, and motivation are all undoubtedly involved in love. All of these activities are controlled by the brain. This section will discuss the connections between memory processes and feelings.

Since the 1970s, new technologies have provided a better understanding of how the setup of the brain affects memory. There are two kinds of memory: declarative memory (for events, images, names) and procedural memory (how to do things). The amygdala and another part of the brain, called the hippocampus, work on storing conscious memories. Different processes store the two types of memories.

Learning and experience can change the way the brain's neurons are put together. Studies with snails in the 1980s revealed that as snails learn their brains release greater amounts of serotonin at certain synapses that make the nerve cells better at sending signals. These changes to the snails' brains are permanent.

Neurotransmitters play a key role in memory, and they may also provide a link between memory and feelings. For example, if a boy goes on a first date with a girl, and the restaurant they choose has terrible food, the movie they go to is boring, and then they get into a car accident on the way home, those two people might have a negative memory of each other because the date went so poorly. Being upset sours memories. Being happy makes people recall happy memories.

Similarly, moods influence the interpretation of present experiences. For example, if a friend teases you when you are in a good mood, you might laugh; but if you are in a bad mood, you might snap back and say something mean. If people are in a happy mood, they often see themselves as skilled and successful. They see others as loving and giving. Yet, in a bad mood, those same people may see themselves and others more negatively.

3

Brain Imaging

Without a doubt, the brain is the most complex of human organs. It provides the biological basis of everything that makes us human—speaking, thinking, learning, problem solving, planning for the future, and, most important to our topic here, forming attachments to other people. Abnormal brain functioning plays a major role in many symptoms of mental illness. Early attempts to identify how the brain works in a person with mental illness were not productive in understanding thoughts and feelings. Until the 1960s and 1970s, technology was unavailable for studying the relationships between how the brain is set up and how it works. The development of brain imaging techniques changed all that.

WHAT IS BRAIN IMAGING?

Brain imaging refers to techniques that doctors and researchers use for studying the structure and function of the brain in living people. Brain imaging does not involve surgery, and it provides clear pictures and even allows doctors to watch what happens in the brain when a patient is thinking or solving a problem. The various brain imaging techniques can be divided into two broad categories: structural techniques such as computed tomography (CT) and **magnetic resonance imaging** (MRI) are used to study the structure of the brain. Dynamic or functional techniques, such as positron emission tomography (PET), allow doctors to watch the brain in action, observing changes in blood flow and electrical activity. Three kinds of brain imaging tools are reviewed briefly here.

CT Scans

CT (computed tomography) imaging systems measure X-ray beams passing through an area of tissue (Figure 3.1). CT scans create three-dimensional images, unlike traditional X rays, which result in two-dimensional images. CT scans provide a wide range of useful information for physicians to help them treat disease and injuries. CT scans have revealed much about the structure of the brain in mental disorders. CT scanning traces its origins to the work of a South African scientist, Allan Cormack, who was studying the effect of radiation in patients receiving radiation therapy. Cormack later shared the 1979 Nobel Prize in **Physiology** with Godfrey Hounsfield for this discovery. The first CT scanner for studying the human brain was installed at a hospital in Wimbledon, England, in 1971.

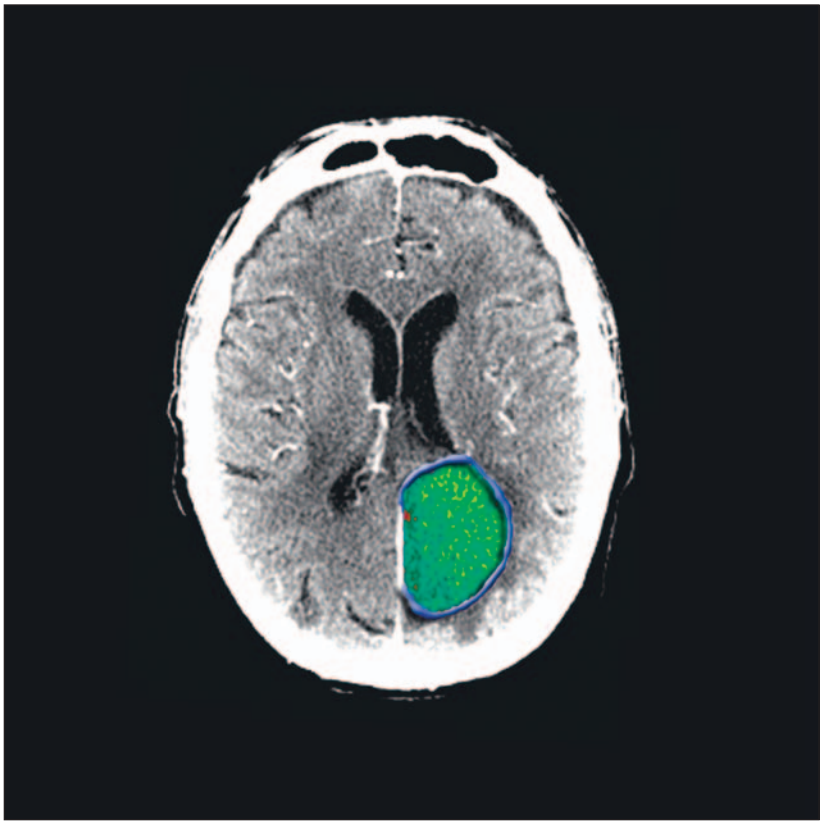

Figure 3.1 **This CT scan of the brain shows a cancerous tumor (green). CT scans, also known as CAT scans, help physicians to detect brain abnormalities and injuries.**

MRI Scans

Nuclear magnetic resonance imaging (NMR or MRI) allows observation of the brain by measuring changes that occur when atoms are placed in a magnetic field. MRI produces an image that differentiates various types of tissues. The images appear as shades of grey, white, and black produced by the spinning charged particles. The images allow the physician

Figure 3.2 **A patient is inserted into a functional magnetic resonance imaging machine (fMRI).**

to distinguish between gray and white matter of the brain and to visualize relatively small structures, such as cranial nerves, nuclei of the basal ganglia, and structures of the limbic system, including the hypothalamus. Like the CT scan, MRIs have been used to study brain anatomy in mental disorders.

One criticism of the MRI is that it provides information about where brain activity takes place, but not how the brain actually functions. A newer technique called functional MRI (fMRI) provides a little more information by studying brain activity while the brain is performing certain mental tasks, such as hearing, seeing, learning, and memorizing (Figure 3.2). A combination of fMRI and other approaches

has provided important information to help researchers understand differences between normal and diseased brains. These methods have also provided information about normal cognitive processes, such as a person's ability to memorize information, recognize faces and objects, and experience pain.

PET Scans

Positron emission tomography (PET) was invented in 1979. In a PET scan, a radioactive substance is ingested by or injected into a patient. The radioactive substance is detected by the PET scan machine as it moves through the body and is broken down by cells in the body. PET scans allow physicians to create maps of activity in specific brain regions (Figure 3.3). Different colors or degrees of brightness on a PET scan indicate different levels of tissue or organ function. PET scans are not generally used in diagnosing central nervous system illnesses but may be useful in understanding certain psychiatric disorders and the effect of certain treatments. For example, a PET scan might reveal whether a 60-year-old man exhibiting forgetfulness and personality changes is depressed or suffering from Alzheimer's disease by identifying the part of his brain that is operating abnormally.

BRAIN IMAGING AND LOVE

The brain is most likely involved in all three areas of loving—**cognition**, feeling, and behavior. The use of brain imaging in studies of love is extremely rare. However, there have been discoveries about differences in brain structure in people with some mental disorders. These discoveries sug-

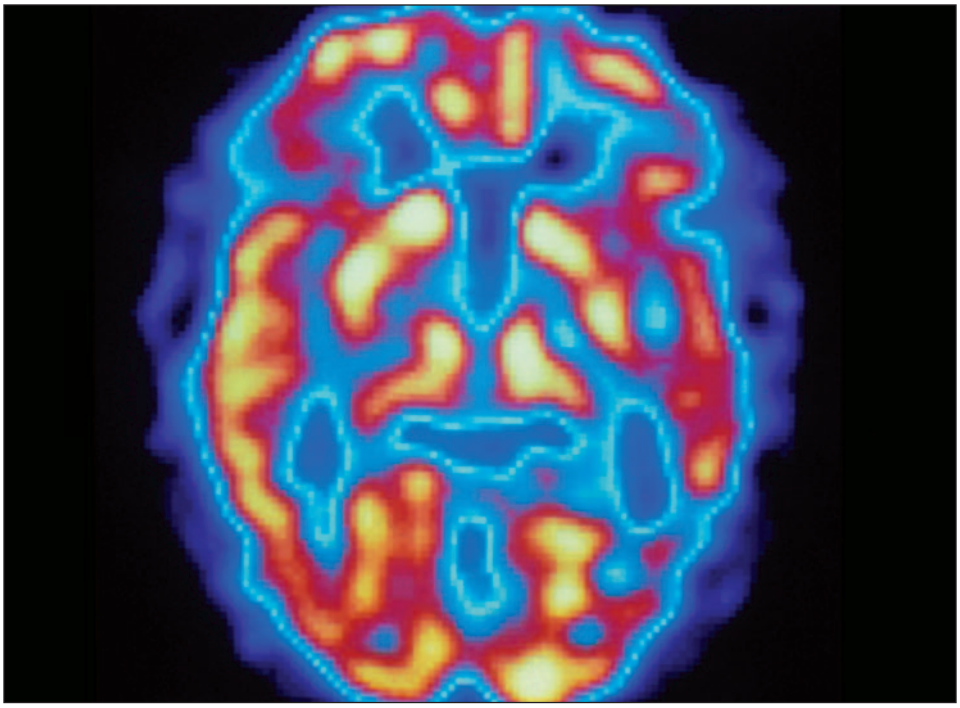

Figure 3.3 **This PET scan shows the brain activity of a healthy patient. Low brain activity is colored blue, while high activity is colored yellow.**

gest that future research will show differences among people with varying abilities to form relationships.

Researcher Helen Fisher is one person who has used brain imaging to study love. Fisher advertised in the campus newspaper at Stony Brook University for students who had just fallen madly in love. She tried to select subjects who were so intensely in love that they could not eat or sleep. Fisher and her team of researchers used various methods to ensure the subjects were being honest. They were shown photographs of their loved ones. They were also shown love letters from

their loved ones, music tapes that reminded them of the person, and perfumes or colognes their loved ones wore. The subjects completed questionnaires and turned a dial to indicate the strength of their romantic feelings. The reactions the subjects had when reminded of their loved ones were compared with their reactions to photographs of other persons and objects that had no meaning to them. Their reactions confirmed that photos and other objects could elicit feelings of passion. Objects unrelated to their love partner did not arouse such feelings.

When the investigators were certain that they had identified subjects who were passionately and obsessively in love, they placed these subjects in an fMRI brain scanning machine. While blood flow to various areas of the brain was being measured, subjects switched between looking at photos of their loved ones and pictures of large numerals (a task meant to distract them from thinking of their loved ones). The researchers obtained pictures of the brain under the different testing conditions. Many brain areas became active as the subjects viewed photographs of their loved ones.

Two brain regions in particular stood out in the scans. The first was the **caudate nucleus**, a C-shaped area near the center of the brain. This area has recently been found to be part of the reward mechanism of the brain. It is necessary for detecting and telling the difference among rewards, and providing sensations of pleasure. It produces motivation and movements to obtain preferred rewards. The more passionate the subject felt, the greater the activity of the caudate nucleus. A second active area is called the **ventral tegmental area** (VTA). It is also an important part of the reward center of the brain. More important, it is a major area for cells that produce the neurotransmitter dopamine. From this area,

nerves distribute dopamine to many other brain areas. As we learned earlier, dopamine is responsible for feelings of euphoria, although it has many other functions. Other areas may also be active in feelings of love, but Fisher's findings highlight the importance of brain networks and brain chemistry in generating feelings of romantic love.

4

Understanding Emotion

The heart has its reasons, whereof reason knows nothing.
Blaise Pascal (1623–1662), French mathematician and physicist

Humans are emotional creatures. People feel things intensely, and these feelings provide richness and color to their lives. Language expresses these feelings. Even if people fail to use words to communicate, their bodies often convey what they are feeling. Someone smiles or laughs when he is happy. A person's shoulders slump and she moves slowly when she feels sadness. People may clench their fists when tense or angry. It is easy to read some people's feelings and more difficult with others.

Likewise, people differ in their sensitivity to the emotional cues given by others. People with strong social skills have the ability to sense the feelings of others and are able to respond appropriately to their needs. There is still some controversy about whether humans are the only animals capable of emotion, but surely no other animal is able to experience the wide variety and the tiny differences in the range of feelings humans have. Just think of the many different words we have to describe varying shades of the feeling of happiness: blissful, cheerful, delighted, overjoyed, content, pleased, satisfied, thrilled, upbeat, ecstatic.

Emotion is also closely linked to motivation. People desire to approach and possess things that make them feel positive, and they avoid what frightens or angers them. Thus, feelings affect what objects people own and the experiences they have. This fact is not lost on advertisers, who lure us into buying their products by arousing positive feelings. We are often unaware that we are being manipulated. People's need to be loved and accepted, to be admired for their wealth and good taste, and to be attractive to others, are routinely used to sell everything from cars to chewing gum.

For example, for many years the Marlboro Man, a macho cowboy riding a stallion, promoted the sale of Marlboro cigarettes (Figure 4.1). In the previous chapter we described how neurotransmitters might connect emotion and memory. The Marlboro Man ads provide an example of how this process involves brain mechanisms. The Marlboro ads brought together a person's ideas about horses, the freedom of the outdoors, attractive cowboys, and even the calming sensations associated with smoking. The links between these images and the brain mechanisms for positive emotions may

Figure 4.1 **For many years, the Marlboro advertisers used the Marlboro Man as a symbol of freedom and masculinity. This ad appeared in an American magazine in 1969.**

make both the body and the mind want a Marlboro cigarette. This in turn might motivate someone to buy a pack. Examine today's ads and see if you can identify what feelings the

advertiser is trying to arouse. What makes you choose between two identically-flavored sodas? What about your choice in clothing?

The following sections will explore what happens in your body when you feel love, what exactly you might feel, and how you express these feelings.

PHYSIOLOGICAL CHANGES

Physiology is the study of how the bodies of living things work. Emotions involve the interaction of many bodily reactions. There may be physical arousal, such as the heart pounding in fear and anger. There may be expressive behaviors, such as facial expression or clenching of fists. Our brains may also interpret the source of the experience, bringing forth different feelings that vary in strength. The autonomic nervous system plays a role, as do hormones such as epinephrine, testosterone, and estrogen, neurotransmitters such as serotonin, and previous learning and memories. Which of these parts comes first and how they interact is difficult to determine.

Our autonomic nervous system controls the activity of our internal organs, including the heart, stomach, and intestines. It also controls the smooth muscles of blood vessels and the activity of sweat glands. These are the parts of the body that are active during emotional states. When our hands become cold and clammy in fear or when we blush in embarrassment, it is due to the action of the autonomic nervous system. Methods of measuring the physiological changes allow us to identify the biological components of emotion. The **polygraph** test (commonly known as a lie-detector test) is used to gather information all at once from many channels of electrical activity in the body. The polygraph measures brain wave activity,

heartbeat, respiration, finger pulse volume, and electrical conductance of the skin. One application of the polygraph is in police investigations as a lie detector, although this use is controversial. Our interest here, however, is in identifying the biological changes during states of emotional arousal and possible physiological differences among the various emotions.

Lie Detection

The lie detector, or polygraph, uses measures of physiological responses to tell whether people are lying. Before the 1980s, it was widely used in law enforcement work. It was also used by private corporations to detect employee theft. In 1983, President Ronald Reagan signed a bill authorizing its use in government investigations.

The polygraph works by measuring physiological responses, such as changes in respiration, pulse rate, blood pressure, and skin resistance, in response to certain questions. Physiological responses to questions such as "Did you steal from your employer?" are compared to those obtained under relaxed conditions or less emotionally loaded questions. It is assumed that the guilty person will show physiological changes related to anxiety in response to critical questions.

In more recent years, the polygraph test has come under serious criticism. Hardened criminals may be able to control their anxiety during the test, while some innocent people may show anxiety in response to critical questions. Furthermore, because physiological arousal happens with many emotions, the polygraph cannot tell the differences among specific emotions, such as guilt, anger, and anxiety. Therefore, error is often introduced into the process. Although the test will do better than tossing a coin in identifying guilt, it will also falsely identify many innocent people. Available

Studies investigating physiological change with emotions may, for example, have subjects watch films designed to produce fear, sadness, anger, sexual arousal, or even boredom. Those viewers would be wired to a polygraph to measure heart rate, respiration, and perspiration. From the results of the polygraph, researchers try to tell who was frightened,

research does not support the scientific reliability of the test for security screening. In 1988, the U.S. Congress passed the Employee Polygraph Protection Act, prohibiting most polygraph testing in jobs outside the government.

A woman undergoes a polygraph test.

who was angry, who was sexually aroused, and who was merely bored. In such studies it is easy to identify a bored person, but not so easy to tell the difference between other emotions, such as those experienced by someone watching a funny movie versus someone watching a sad one. Fear and anger also tend to produce the same physiological response. The fact that similar physiological arousal is associated with different subjective feelings is significant. It supports one theory of emotion that stresses the importance of thoughts and interpretations combining with biological events to determine emotions.

Another important role in the love process may involve **endorphins**, which are chemicals produced by the brain that increase feelings of pleasure and reduce pain. They are thought to control the high we experience when we are in love and the crash that comes when love fails. They are released in response to pain and bring about a good mood. These natural opiates may also account for a "runner's high," the happiness felt by many people during and after exercise. These processes also occur in animals, but there is an important difference. Animals lack the highly developed cerebral cortex of humans. The cerebral cortex is the seat of thought processes that exert control over feelings of love. It is by these processes that personal preferences, learning, and past experience influence whom we judge as attractive and acceptable as a partner in love.

ATTACHMENT

The process of attachment refers to the close bonding between child and caregiver that begins at birth. Attachment is not

Figure 4.2 **After birth, ducks instinctively follow the first living creature they see. This instinct is known as imprinting. Baby ducks usually imprint on their mother, although chicks hatched in an incubator may imprint on their human caretakers.**

limited to the human species. It is observed when a baby bird attaches itself to the first organism it sees after birth, usually its mother. The baby will follow the mother everywhere. This phenomenon, called **imprinting**, is not something the chick learns (Figure 4.2). A chick's brain is actually programmed for this response. A story of geese imprinting on a young girl was depicted in the 1996 movie *Fly Away Home*. A more complex give-and-take relationship develops among mother mammals and their children, in which the mother and child become attached to each other.

Harry Harlow, a psychologist who studied how behaviors change as humans and animals get older, made an accidental discovery while observing monkeys. Baby monkeys who had been separated from their mothers attached themselves to a small blanket that had been placed in each cage. Later, when the blanket was removed for cleaning, the monkeys became visibly distressed. Previously it had been assumed that attachment to the mother occurred because of her breast-feeding. Attachment to the blankets, even though there was no food being presented, suggested that warmth and touch were the basis for attachment in the monkeys. Monkeys even attached to artificial mothers made of wire and covered with cloth. They preferred these mother substitutes to wire mothers that provided milk but were not covered by cloth.

It is unclear how much Harlow's findings with monkeys have to do with what human infants feel. While biological factors may continue to have an influence, learning and environment play a significant role, too. Many psychologists believe that human love begins with the earliest attachment of the newborn infant to its mother. The infant is born with the mouth reflex to suck, which begins the process of attachment. The initial response is unlearned but the infant soon learns to associate milk, warmth, closeness, touching, and comfort with the sucking.

If a mother is having problems during this bonding period—if her milk is sparse or absent, or if she is depressed or anxious—there may be problems with the attachment process. A tense mother communicates this tension to her baby, who may then develop an insecure attachment. The baby may develop stomach cramps. It may become agitated and

difficult to feed, even with a bottle. This serves to increase the mother's tension. In more serious situations, the mother may be emotionally disturbed, addicted to alcohol or drugs, or actually reject the baby. There might be neglect, abuse, or abandonment. If there is no substitute caregiver in the home, the baby may be placed in a shelter or foster home. Loss of the primary caregiver at an early age can have a serious impact later in the child's life. Children may have difficulty learning to trust others or to form relationships. They may lack the ability to love others.

Psychologists have identified three types of attachments in infants by observing how they behave in the absence of their mothers, and what happens when she returns. An infant with secure attachments actively explores his or her surroundings when the mother is there, separating from her but returning every once in a while to use her as a secure base before continuing to explore. The infant becomes upset at long separations. Infants with less secure, anxious attachments also seek closeness with their mothers. If the mother returns after an absence, the infant shows anger and is not comforted by her presence. A third type of reaction is called avoidant attachment. When the mother returns after an absence, the infant completely avoids her.

The type of attachment pattern of an infant appears to be related to the mother's behavior. Mothers of infants with secure attachments are sensitive to the infants' feelings and respond appropriately to their needs. Mothers of infants with anxious attachments seem to be anxious themselves and respond inconsistently to the infants' feelings. Mothers of infants with avoidant attachments tend to ignore their children and may brush off the babies' needs for comfort.

Attachment styles during infancy may be related to later patterns of behavior. Some people have no trouble becoming close to another person and feel secure in their relationships. They do not worry about being abandoned. They are able to trust and are less lonely in the absence of a loved one. When they feel stress they can approach others for comfort. They can offer support when someone else is stressed. They can communicate their feelings to others. People with anxious attachments are often confused about their relationships. They want to be close to another person, but believe that their feelings are not returned. They worry about rejection. They engage in love-hate relationships. They continually form and break relationships. They have low self-esteem. Finally, people with avoidant attachment styles are less likely to enter into relationships at all. They do not feel comfortable approaching people or allowing others to get close to them. They may have casual relationships, but that is as far as they allow it to go. They are unable to communicate their feelings. They describe their parents as rejecting.

EMPATHY AND ITS ORIGINS

Empathy is the ability to understand and feel as another person does—to put oneself into another's shoes. Some scientists have suggested that the ability to empathize with others is critical to our survival as a species. It seems to originate from birth and, like attachment, may be one of the earliest ways we show love. When a newborn baby hears the cries of another baby, he also begins to cry. The baby's response to the distress of another human being is not merely a response to loud noise. David Hoffman, a psychologist at

New York University, believes that this unlearned response is the beginning of empathy, the ability to observe the emotions of another human being and to take it on as one's own. This emotional response allows us to move beyond our own survival and to help others. Empathy involves both feelings and thoughts, because an empathic person must feel as another person feels and must also understand what the person is feeling and why.

Psychologist Carolyn Zahn-Waxler at the National Institute of Mental Health studies empathy as a developmental process in infants. At first, infants cannot distinguish themselves from others. However, by the end of their first year, babies begin to recognize a difference between themselves and others. When a baby hears another baby crying, he realizes it is not himself in distress. The baby continues to express distress, but, he now has better strategies for coping. He may use the same strategies to comfort the other child, such as bringing a teddy bear to her. By the end of the second year, a toddler realizes that all people have their own internal feelings. By age five, the child understands that social situations can cause people to be distressed.

While there are undoubtedly characteristics that people are born with to cause them to have empathy, how people are raised also plays a role. There are wide individual differences. Maternal warmth seems to enhance empathy. Also, children are more empathetic when their mothers provide them with clear messages about the consequences of hurting others. As you will learn in Chapter 5, people are more empathic with and attracted to persons whom they view as similar to themselves. People tend to empathize more with others from similar economic and social backgrounds.

Empathy continues to develop throughout one's life and is surely a necessary component of falling in love.

FEELINGS

It is difficult to describe a feeling. Feelings are personal and subjective. One can only assume that when two people indicate that they are angry, they are experiencing at least roughly the same feeling. This would also hold true for other emotions. Feelings vary in intensity, but it is safe to conclude that if someone says he is angry, he does not mean that he feels anything similar to happiness. Despite that, however, it is still difficult to determine exactly what someone means when he says, "I am angry." This is because our language is not able to provide enough words to show the differences between small shades of emotions.

Because of the richness and shades of emotional experience, it is difficult to provide an exact list of every possible feeling. Psychologist Carroll Izard has tried to identify the basic emotions that form the starting point for all the different emotional shades. Izard's list of 10 emotions are different in how they affect people physically, what a person's facial expression is during the emotion, and the reports of people experiencing those feelings. The 10 emotions identified are interest-excitement, joy, surprise, distress, anger, disgust, contempt, fear, shame, and guilt. Studies of the facial expressions of infants suggest that most of these distinct feelings are present in infancy. The lifting of the inner part of the eyebrows reveals distress or worry, for example, while raising the eyebrows and pulling them together signals fear. The ways people express these emotions are even the same across

different cultures. Some emotions appear to be combinations of two or more fundamental feelings. Love, for example, may be a combination of interest-excitement and joy.

FACIAL EXPRESSIONS

People often express to others what they feel by their actions, speech, or writing. These communications are essential for social interactions. They provide cues to others about how to behave—whether to offer sympathy or support if someone is upset, to back off or to challenge if a person is angry, to clarify or explain if a person is confused. Even when people fail to put their feelings into words, their bodies may do the job for them. Facial expression and body language convey what words often do not (Figure 4.3). People who are emotionally sensitive detect these signals and become skilled at responding to them in appropriate ways.

Facial expressions can be considered our silent language, because each expression usually means the same thing—for example, a person will most likely smile when she is happy, not when she is afraid. Nineteenth-century English biologist Charles Darwin stressed the importance of facial expressions, suggesting that they play an important role in helping organisms adapt to their environment. He believed facial expressions are a survival mechanism—a trait that animals have that helps them survive. He thought fear, for example, was an important part of how animals responded to danger. If a dog was about to attack a rabbit, and the rabbit was not afraid, the dog would certainly kill it. Rabbits with the ability to feel fear would be more likely to run away, and more likely to survive. Facial expressions are seen as an important part

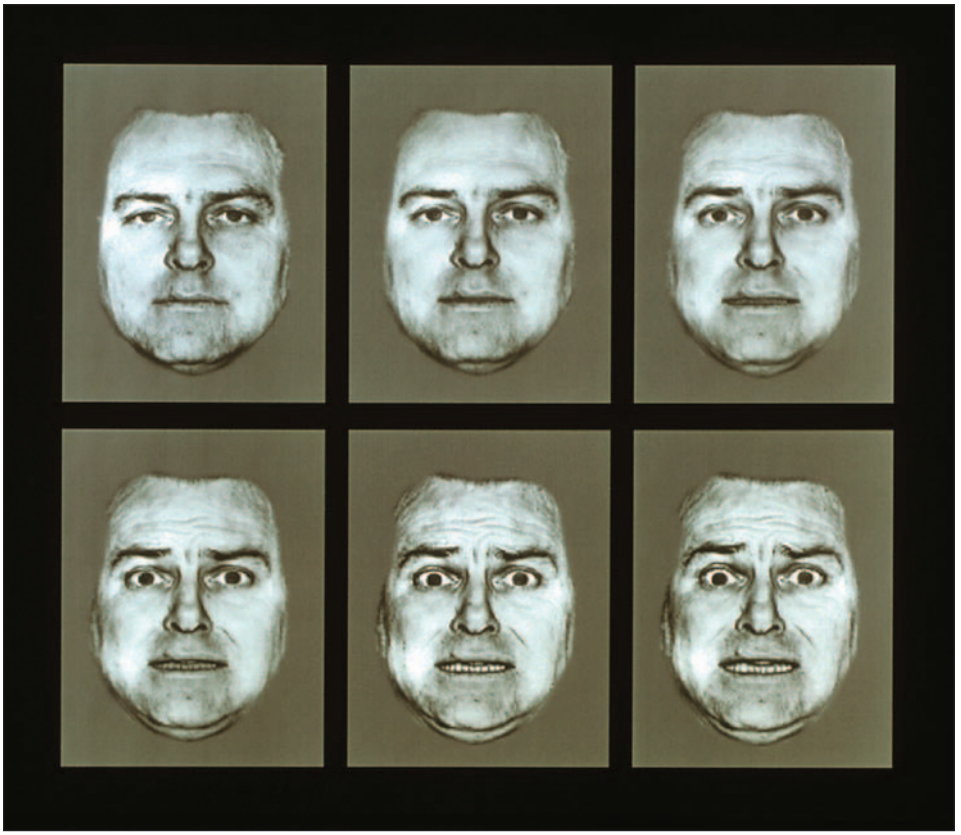

Figure 4.3 **Different stages of fear are illustrated in the above series of photographs. In the upper left, the man is at ease. At bottom right, he shows the greatest amount of fear.**

of emotions because they signal to others what someone or some animal is feeling, and what will likely occur next. For example, a dog may use facial expressions of anger to warn another dog that it has come too close to its favorite bone.

For many years, psychologists rejected Darwin's ideas because those ideas suggested that emotions were already part of a person at birth and were not influenced by learning. More

recently, though, Darwin's hypothesis about facial expressions has received research support. If expressions are, indeed, genetic, they should be the same from culture to culture. Two research psychologists, Paul Ekman and Wallace Friesen, put Darwin's hypothesis to the test. They gathered university students of different backgrounds in five different countries, and showed them facial photographs of people exhibiting six basic emotions. In each country, the students were asked to judge what emotion was being expressed. The high degree of agreement among the students suggested that facial expressions are consistent regardless of culture or language.

In 1987, Ekman went to an isolated tribe in New Guinea and asked the tribe members to depict various emotions while being videotaped. One situation was "Pretend your child has died." American college students viewing the tapes later could easily identify the emotions the tribe members displayed. Regardless of culture, a person cries when he is distressed, smiles when he is happy, and shakes his head when he is opposed to something. Subtle changes in facial muscles, such as a slight lifting of the eyebrows that reveals worry or distress, are difficult to suppress, yet may be very revealing.

Darwin also suggested that facial expressions actually enhance an emotion as a person feels it. Test subjects asked to make a frowning expression reported actually feeling a little angry[7] and those asked to smile rated cartoons as funnier than did the people who were not smiling.[8]

DO ANIMALS HAVE FEELINGS?

There are stories of animals showing empathy for humans, such as a dog running for help, saving children, or detecting

danger. The idea that certain animals, especially dogs, demonstrate love is popularly accepted. To **anthropomorphize** means to attribute human characteristics to animals. The concept of animals that talk and feel is something many people are familiar with from childhood. Fairy tales, Disney films and cartoons, movies such as *The March of the Penguins* and *Shrek*, comic strips, and television all make the idea familiar and acceptable. Is there, however, any real evidence that animals experience emotion?

Marc Bekoff works at the University of Colorado as an **ethologist**, or a scientist who studies animal behavior. He is especially interested in dog behavior. Bekoff's studies of videotapes of dogs lead him to believe that certain gestures are used by many animals to signal their intentions. Bekoff and other scientists are convinced that these gestures are more than just behaviors—they reveal underlying emotions. Many scientists believe that other social animals, such as chimpanzees, monkeys, dolphins, and birds, are capable of emotions and other mental states, such as envy, empathy, and a sense of fairness.

Frans de Waal, a researcher at the Yerkes Regional Primate Research Center at Emory University in Atlanta, has demonstrated just this. De Waal has shown that if two monkeys work on a task in order to get a food reward and only one monkey receives the reward, that monkey will share with the other. This behavior suggests a sense of fairness. Another study suggested that monkeys can feel envy: If one monkey receives a desirable reward, such as grapes, while the second gets one less desirable, like cucumbers, the second monkey will stop working. Yet, both monkeys will work for cucumbers if that is the only reward presented. De Waal has also observed empathetic behavior in chimps. If a

Figure 4.4 **It is widely accepted that animals are capable of expressing emotions. This is especially true of social animals, such as the chimpanzee.**

chimp loses a fight and sits on the floor screaming, another chimp will embrace, groom, and comfort it (Figure 4.4). De Waal and other ethologists believe, as Darwin did, that many animals are capable of complex emotions. Animals do appear to have the brain structures to support such feelings. Researchers argue that complex feelings would not have developed in humans without some earlier signs of them in animals. Animal equivalents of feelings of fairness, kindness, and empathy may be primitive forms of morality that have evolved to improve their odds of survival.

THEORIES OF EMOTION

Now that the basic parts of emotions have been presented, it is time to consider an overall explanation about how these processes work together. Various theories have been proposed and tested.

The earliest explanation was offered in 1890 by a pioneer in psychology, William James, a psychologist at Harvard University. James believed that our feelings are a response to our external behavior. You walk into the woods and encounter a bear. Your immediate reaction is to run in the opposite direction as fast as you can. The sensation of running leads to the feeling of fear. James's idea goes against the popular view that we run from the bear because we are afraid, not that we become afraid because we start to run. Carl Lange, a Danish physiologist, came up with the same theory on his own, which came to be known as the James-Lange Theory.

Despite such anecdotal evidence, some psychologists and physiologists believed the James-Lange Theory was too simple to explain the complexity of our emotions. A racing heart, for example, is associated with both fear and anger, so how could the body tell the difference between the two feelings? Two American physiologists, Walter Cannon and Philip Bard, believed that feelings and bodily reactions occur together, and that one does not cause the other. When a person encounters a situation that arouses emotion, two systems are started up together: the sympathetic division of the autonomic nervous system, which causes the bodily response, and the cerebral cortex of the brain, which interprets the feeling. Their theory is referred to as the Cannon-Bard Theory. Both the James-Lange and Cannon-Bard theories have support among researchers.

SUMMARY

We have presented current thinking about emotions in general. We now return to the focus of this book, the specific emotion of love. Like all emotions, love involves feelings, physiology, thoughts, and expressions. There are theories and there are day-to-day experiences. In the following chapter, we will shed light upon both perspectives. We will present research findings and concepts as well as common experience, to bring both theory and practice together.

5

The Psychology of Love

Love cures people—both the ones who give it and the ones who receive it.
—Dr. Karl Menninger (1893–1990), American psychiatrist

When you realize you want to spend the rest of your life with somebody, you want the rest of your life to start as soon as possible.
—*When Harry Met Sally* (film, 1989)

A popular view suggests that all social interactions are based upon self-interest. According to this concept, we are motivated to seek pleasure and avoid pain. As we evaluate a potential

relationship, we analyze what it will take to engage in the relationship and what we will get out of it. Economists call this a cost-benefit analysis. Social psychologists label it as **social exchange theory**.

Giving and getting are the currency of business and all negotiations. You decide to go to college because you anticipate that a college degree will bring certain benefits. You expect to become better educated, to be eligible for a higher paying job, to meet new friends and engage in new experiences, to gain respect and social status. College will also cost you, however, in terms of money, time, effort, and perhaps having to forgo other things you would like to do. If you desire to pay this price, it is because you believe that the advantages and outcomes outweigh, or at least are worth, the cost. Some psychologists study how people make such decisions on the basis of the value of the outcome and the individual's expectation of achieving that outcome. Such decisions, however, are not always easy. People may misread the value of the outcome, positively or negatively—they may overestimate or underestimate their chances of achieving it. Emotions enter into these perceptions.

Love, involving both feelings and behavior, can be analyzed on the basis of economic principles. Decisions are often made on the basis of fuzzy perceptions of value, inadequate information, intense physiological inputs, unrealistic expectations, and poor judgment. Gains and losses in love typically do not involve money, but rather an exchange of emotions, rewarding experiences, and satisfying communications.

Relationships that provide greater rewards will last longer. In intimate relationships, rewards consist of companionship, emotional support, and comfort in times of stress (Figure 5.1). There is a sense of consistency. Your boyfriend or

Figure 5.1 **In a healthy relationship, each partner provides companionship, emotional support, and comfort in times of stress.**

girlfriend is someone you have learned you can count on when you have had a bad day at school or a fight with a friend. Costs are judged in terms of the time it takes to maintain the relationship, conflicts that may occur, and compromises and sacrifices that may be necessary to maintain the relationship. While consistency—one of the rewards of a relationship—is

initially satisfying, it also brings a certain loss of freedom. It is assumed that you will not initiate another relationship with someone else. Maintaining the relationship may mean giving up some time spent in the company of friends. The most satisfying relationships, though, achieve a healthy balance. The benefits and cost to one person in the relationship should roughly equal the benefits and costs to the other.

In all relationships, success is based on the recognition of one's own needs and sensitivity in relation to what the other person genuinely is able and willing to provide. The willingness to engage in a love relationship highlights a sense of priorities. These must be balanced with the priorities of the partner. There must be a willingness to give as well as receive, and to make compromises. One must believe that rewards exceed those that may be found elsewhere. As relationships mature, incentives for each partner may change. New balances must be worked out or the relationship becomes strained to the point of rupture.

WHAT IS ATTRACTIVE?

One aspect of romantic relationships that has been investigated concerns the manner in which we select a partner. To whom are we most attracted? Who do we avoid? Social psychologists have explored the process of attraction to identify the characteristics that make one person like and admire someone else.

It seems logical that we are drawn to people when our relationships with them are rewarding. We like those who pay attention to us and provide support or status. Yet, there must first be something that brings a person close to someone else before he or she is able to find the experience

rewarding. Initial attraction depends primarily upon physical characteristics. Although differences exist among different cultures about what is considered attractive, there are also similarities. As young people go through puberty, they often begin to be attracted to others who show signs of physical maturity. In many cultures, slimness and physical fitness are valued characteristics. For both boys and girls, those seen as attractive do not vary greatly from the norm for their particular culture.

Two well-known proverbs about attraction are contradictory: "Opposites attract" and "Birds of a feather flock together." The second is more in keeping with research results. People tend to value things, people, and ideas with which they are most familiar. They tend to associate with people who are similar to themselves and to avoid those who are dissimilar. Characteristics such as age, education, religion, social status, education, race, and intelligence are significant predictors of choices for dating, friendships, and marriage partners.

THOUGHTS OF LOVE

Many writers have reduced passion to acts of imagination. We do not fall in love with a person, they say, but with our image of that person—an image enhanced by imagination. Our mind becomes filled with our perception of attributes, not always realistic. We daydream of the delights of being loved by that person and the pain of being rejected.

Once we encounter a person who possesses attributes we admire, a sequence of biological arousal, thoughts, feelings, and behavior may follow. This sequence may result in a feeling of "love at first sight." Later, experience or the opinions

of others may allow for a reassessment of the original feeling. The love-struck person may continue to entertain thoughts that support or justify the original impression, even if there is evidence that the impression was inaccurate. Feelings may intensify and lead to changes in behavior.

Thoughts of love may differ with age. Younger people may love more intensely than adults, with more abandon and less judgment. Psychologist Stanton Peel described the love of teens as "addictive love," total absorption with another person. It is an idealization of that person, seeing only the positive characteristics and not the negative. There is a sense of dependence upon the other person, an exaggerated need for attention and affection from that person. It can be a painful experience if the desired response does not occur. It can interfere with everyday tasks and productivity at home and in school. It feels like an overwhelming and uncontrollable urge. Popular songs, friends, and the media may support this feeling. Parents and other adults may insist that it is just an infatuation, but often a teen's thoughts lead to a different conclusion.

ACTS OF LOVE

Both males and females use tactics to make themselves more attractive to the opposite sex. Girls and women wear make-up, groom their hair in popular styles, wear sexy clothing and jewelry, and act coy. Boys and men display their possessions, their strength, and their athletic ability. They brag about their abilities and tend to show off.

In 1988, psychologist David Buss asked 100 male and female subjects to list the five most important acts that expressed love. Their responses fell into broad categories,

such as exchanging gifts or providing financial support, faithfulness, marriage, sex, making sacrifices, arranging an introduction to parents, and having children. There were differences between genders. Males were more likely to name gift-giving as a love act. Females were more likely to view faithfulness and having children as love acts.

CLASSIFYING LOVE

Part of a psychologist's goal in his or her work is to explain complex human behavior in a simple, orderly way. As you already are aware, love involves many subtleties and variations. Is it possible to simplify relationships enough to enhance understanding, and yet also do justice to the complexities? Two attempts to do so are presented below.

Just as any color is a combination of the three primary colors—red, yellow, and blue—psychologist John Allen Lee classifies love behaviors on the basis of the interactions of three primary dimensions. The first dimension he named *eros*, based on ancient Greek mythology. It is based on physical attraction, involves intense feelings of passion, and may be called love at first sight. The second dimension he called *storge*, the Greek word for affection. It refers to a slow-growing friendship and the sharing of mutually enjoyable activities. The third dimension he named *ludus*, the Latin word for play or games. Ludus lovers avoid limiting themselves to one partner, preferring multiple relationships. They are rovers. Styles of love may change with time and experience, and may involve various combinations of eros, storge, and ludus.

Psychologist Robert Sternberg has also developed a three-factor **model** of love, which he depicts graphically as the

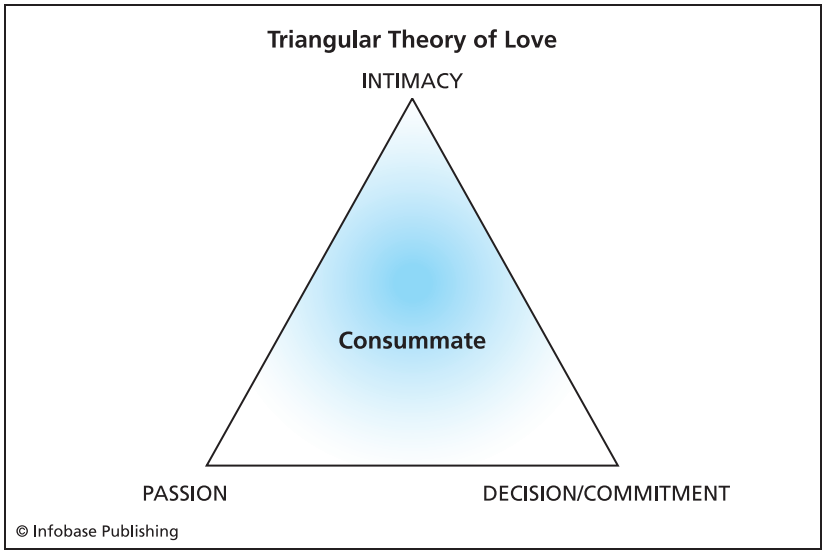

Figure 5.2 **Psychologist Robert Sternberg's theory of love consists of three factors: intimacy, passion, and decision/commitment. All three factors come together to create complete, or consummate, love.**

corners of a triangle (Figure 5.2). The various combinations of these factors, occurring singly, in pairs, or all together, are seen as accounting for eight types of love. A ninth type, the absence of love, occurs when none of the three factors are present. The three points of Sternberg's love triangle are intimacy, passion, and decision/commitment.

Intimacy refers to a close feeling of connection with another in a loving relationship. It includes concern about the welfare of that person, a high regard or respect for that person, trust in being able to depend upon that person, mutual understanding, the sharing of possessions, and the feeling of emotional support from that person. Passion is a driving force that leads to romance. It consists of a strong physical attraction.

Passion may be intense at the beginning of a relationship, but less so as the relationship matures. Decision/commitment is the conscious decision that one loves a person. It may be short- or long-term, but in either case will involve a decision to maintain the relationship and to build upon it.

When the relationship involves intimacy alone, it is labeled as friendship. There is no passion and no commitment. Passion alone, without intimacy or commitment, is called infatuation. It can be used to refer to love at first sight. The target of the feeling is seen in ideal terms and may become an obsession. When there is decision/commitment without intimacy or passion it is an empty love, without the fuel to sustain it.

Intimacy with passion is the basis for romantic love. The partners are unwilling to commit to each other, although that may occur in the future. This may be the case with young people who do not want to commit to each other exclusively. Sternberg labels intimacy occurring with commitment as companionate love. There is a strong feeling of friendship and decision to maintain the relationship. Passion with commitment, but without intimacy, is when, for example, two partners profess love without really knowing each other. There may be a whirlwind romance and even a quick marriage. Unfortunately, it may also lead to a quick separation. All three factors occurring together—called consummate love—is a complete love.

According to Sternberg's model, each person in a relationship has a "love triangle" of feelings for his or her partner. Love relationships involve the interactions between the two triangles, one for each partner. The three factors may vary in intensity. In the best instances, a workable balance can be reached. Living happily together will depend upon each

person understanding the nature of the relationship and how it affects interactions.

INITIATING RELATIONSHIPS

Relationships have to start somewhere. Before people can bond, there has to be attraction. Next comes some initial interaction. It can be a look, a gesture, or a manner of talking, identified by both parties as flirting. Accurate awareness of such signs can lead to increased frequency of interactions until one party initiates a more formal arrangement, called dating.

Irenaus Eibl-Eibesfeldt, a German scientist, secretly filmed facial expressions and gestures of people in many different cultures. From these films, he studied flirting and courting behaviors. A pattern of female gestures emerged that was so similar across different cultures that Eibl-Eibesfeldt believed the gestures were unlearned and universal. Whether it was in the highlands of New Guinea or the large cities of Japan, women exhibited the same behaviors.

Each woman in the films first smiled, then lifted her eyebrows in a swift, jerky movement as she opened her eyes wide to look at the object of her attention. Then she dropped her eyelids and tilted her head down and to the side, withdrawing her glance. Sometimes she covered one hand with her other hand, nervously giggling. Women may arch their backs, raise their shoulders, and toss their hair back to attract attention. Some of these gestures observed in women are also seen in animals, such as tilting the head and looking up.

Men also use courting behaviors, such as thrusting their chest out to assert their dominance. Eye contact and body language convey interest. When a man encounters female

Figure 5.3 **Boys and girls express their feelings of attraction in different ways. Girls are more likely to casually touch someone they like. Boys are more likely to show off with feats of strength or athletic skill.**

courting behavior, he may at first use some meaningless gesture, such as adjusting his eyeglasses or tugging at his ear lobe. This allows him to process what is going on and to decide how to respond—whether to withdraw or stay and encourage the flirtation.

Teens are often influenced by the flirtatious behaviors they observe in the media. Girls might wear makeup and provocative clothing, and become loud and boisterous around boys in order to be noticed. Girls are more likely than boys to use touch to communicate (Figure 5.3). Boys often show off with athletic stunts and rowdy behavior. Younger boys generally

approach girls only within the safety of a group. Sexually provocative behavior among younger people today appears to occur earlier than in previous generations, yet, as always, some teens remain shy, withdrawn, and inhibited with members of the opposite sex.

Although the telephone was an essential tool for flirting and dating in previous generations, the advent of computers and the Internet makes the telephone less necessary today. The courting ritual now includes e-mails, text messages, and instant messages. Talking online is often less intimidating than personal contact and can satisfy growing needs of teens, even when no more than "virtual courting" occurs. Teens might assume false identities in encounters with unknown people. Unfortunately, adults often have been reported to pose as teens, presenting a serious danger to teens who respond to solicitations by strangers.

AFRAID TO LOVE

Flirting and dating can be fun. Jumping in and out of relationships can become a way of life for some young people. Entering into a serious relationship is a conscious choice that involves the risk of the break-up of that relationship and the pain that may follow. While some people long for love, others shy away from it. Love involves risk. There is always the chance of loss. A love, once gained, may not be permanent. Relationships are broken as often as they are made. Even the beginnings of love may not be completely positive. Bonding emotionally with another person means giving up some freedom and individuality.

For some people, the fear of loving may go deeper. When attachment with the primary caregiver is interrupted or

Social Phobia

The primary characteristic of social phobia is a fear of social situations. The individual may anticipate embarrassment and likely experiences an immediate anxiety response. Adolescents and adults usually realize that this reaction is inappropriate, but younger children may not. People troubled by social phobia report that it interferes with school, work, and social life. Typically they fear that they will be judged as "crazy" or "stupid." They may fear public speaking because others will notice their trembling hands or because they will stumble over their words. They experience all the possible symptoms of anxiety, such as rapid heartbeat, tremors, sweating, digestion problems, muscle tension, a shaky voice, blushing, and confusion.

Other features sometimes associated with social phobia are hypersensitivity to criticism, evaluation, or rejection; difficulty in being assertive; difficulty in taking tests; avoidance of eye contact; and low self-esteem. Young children will appear excessively timid in unfamiliar social situations. They will shrink from contact with others, refuse to participate in group-play, and even refuse to talk. Adolescents may drop out of school. Adults may be unemployed because of fear of being interviewed. They may have no friends or cling to unfulfilling relationships.

Estimates of how much of the U.S. population experiences social phobia range from 3 percent to 13 percent. Typically social phobia comes out during the mid-teenage years after a shy childhood. It may follow a stressful or humiliating experience. It can be continuous during the course of a lifetime. In some cases, it may lessen in adulthood or disappear altogether. It may also re-emerge, such as when a person begins dating or after the death of a loved one. People with social phobia can be helped by psychotherapy designed to treat their anxiety.

disturbed in some way, serious emotional problems may develop—problems that interfere with the forming of relationships throughout one's life. Some children experience or are witnesses to violence. Exposure to violence may result in children having difficulties telling the difference among emotional states and being able to express feelings. They might also have early relationship problems.

Neglect or abuse can also affect attachment style. Physical and sexual abuse may lead to heightened fear and anxiety, aggression, withdrawal, intrusive thoughts, and relationship problems. The government has ways to remove a child from an abusive home situation. That child may be placed in a foster home, shelter, residential treatment facility, or other out-of-home placements. These situations, unfortunately, sometimes place the child at risk for continued physical or emotional damage. Such children may require a long relearning process before they have the emotional resources to engage in trusting relationships.

LOVE AT FIRST SIGHT

We have learned that love involves more than physiological urges. It involves more than physical attraction. It requires time and effort and learning to know and trust. That type of love does not occur in one moment. What does sometimes occur rapidly is passion. All the qualities that make someone attractive and all the biological urges can erupt like a lightning bolt. Love may or may not follow. The ancient Greeks regarded passionate love as madness. Religions have taught that passionate love needs to be controlled, not expressed. Many great writers have described passionate love in less critical terms. The French writer known by the pen name Stendhal (Henri-Marie Beyle, 1743–1842) suggested that

passionate love occurs in stages. First there is admiration, based on physical appearance, charm, and wit. The second stage, anticipation, is based upon imagination. The individual imagines all the wonderful pleasures that may come from an association with the object of attraction. This is followed by hope that love will be returned. During these stages, the person may reevaluate original perceptions and may find new qualities to admire.

JEALOUSY

Some writers have described "addictive love" as intense love relationships in which the lover becomes obsessed with his or her partner. Initially, such relationships are intensely pleasurable. Over time, though, the "addicted" person becomes preoccupied with the potential to lose that love. Addictive lovers may feel deficient in some way, as if they cannot attract a lover who will be good to them. This insecurity, similar to what has been labeled as anxious attachment in children, makes the addictive lover intensely jealous. The lover is dependent upon the relationship and threatened by any possible other suitors. The relationship becomes destructive, restrictive, unhealthy, and negative. Love and hate can occur at the same time.

Males and females generally differ in what makes them jealous. Males may become jealous if a socially dominant person flirts with their partner. Females might become jealous if the person flirting with their partner is physically attractive. The threat to the relationship does not have to be real. A less secure person will be more easily threatened, even by innocent behaviors of his or her partner. When the relationship is relatively new and when the individual is

highly dependent upon it, jealous feelings are more easily aroused and are more intense.

Jealous reactions also depend upon the type of attachment style of the individual. A group of scientists analyzed 1,400 responses to a quiz about love that appeared in the *Rocky Mountain News*.[9] One question tried to identify three types of attachments—secure, avoidant, and anxious/ambivalent. One question was "Which of the following best describes your feelings?" Fifty-six percent of the readers picked the choice representing secure attachment: "I find it relatively easy to get close to others and am comfortable depending on them and having them depend on me. I don't often worry about being abandoned or about someone getting too close to me." Twenty-five percent picked the choice reflecting avoidant attachment: "I am somewhat uncomfortable being too close to others. I find it difficult to trust them completely, difficult to allow myself to depend upon them. I am nervous when anyone gets too close, and often, love partners want me to be more intimate than I feel comfortable being." Nineteen percent of respondents picked the choice that indicated anxious-ambivalent attachment: "I find that others are reluctant to get as close as I would like. I often worry that my partner doesn't really love me or won't want to stay with me. I want to merge completely with another person, and this desire sometimes scares people away."

LOVE MAINTENANCE

Psychoanalyst Theodor Reik has said, "No one falls out of love . . . One climbs out of it. We give up the hopeless task of making over someone into our ideal. We end the relationship." [10] Yet relationships do survive. As love matures,

blemishes may be more apparent but other positive qualities emerge that allow the love relationship to endure.

The maintenance of a relationship involves more than the qualities of initial attraction or the absence of disliked qualities. Initial qualities that influence partner selection, such as physical attractiveness, become less important over time. Other factors now enter into decision-making processes, leading to maintenance of the relationship. These include such things as the person's acceptability to friends, special skills that the partner demonstrates, and common interests in leisure-time activities. However, in mature love relationships, including marriage, the emotional reactions of both partners toward each other need to remain positive overall. The process for long-term relationships requires sufficient time for both partners to get to know each other. Findings from interviews of couples support the need of most respondents for intimacy, beyond passion.

Perhaps the most positive factor in the maintenance of a loving relationship is that each person continues to evaluate the other positively and to communicate this knowledge. At the beginning of a relationship, both partners initiate physical closeness; they make frequent eye contact, give each other gifts, say kind things, hold hands, are thoughtful of each other, and avoid criticism. As the relationship continues, these things tend to occur less frequently. Partners might take each other for granted. If this type of thoughtlessness is constant, it jeopardizes the relationship.

SEX AND LOVE

Sigmund Freud, the originator of psychoanalysis, believed that sexual impulses are a major force in human motivation

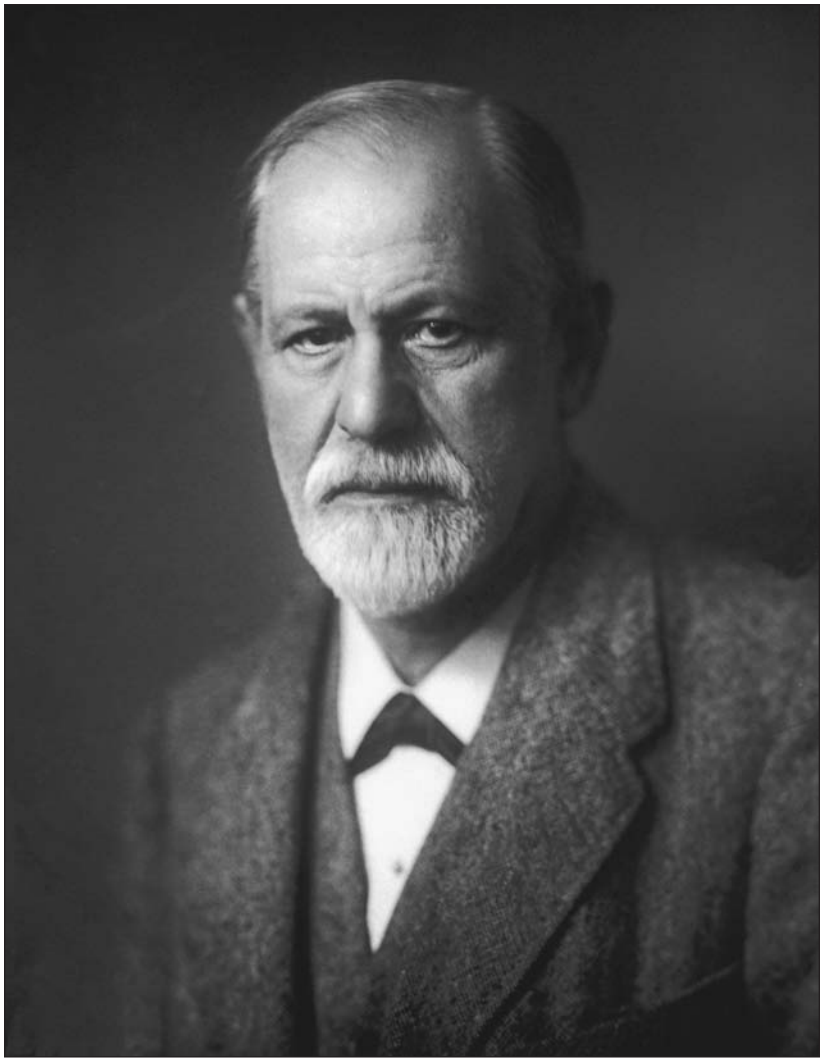

Figure 5.4 **Sigmund Freud is the founder of the branch of psychology called psychoanalysis.**

(Figure 5.4). Not everyone endorses this idea, but it is impossible to deny that our society is highly sexualized. Advertisers use sexual images to sell cars, cigarettes, clothing, and

thousands of other items. Television soap operas and dramas exploit sexual themes.

Studies show that preteens and teens are having sex at younger ages than was the case in previous generations. In a recent survey conducted by the Centers for Disease Control and Prevention, 34 percent of high school freshman have had sexual intercourse.[11] Twelve percent of high school sophomores have had four or more sexual partners. This does not come without consequences, however, as one in four sexually active teens will contract a sexually transmitted disease. Twenty percent of sexually active females aged 15 to 19 will get pregnant each year. Early sexual activity also takes it toll on mental health, including depression over cheating and the break-up of relationships—and the toll is not limited to sexual intercourse. Many girls believe that if it is not sexual intercourse, it is not real sex and "does not count." But sex is also an emotional issue.

Parents are often reluctant to talk about sex with their children. Children may be afraid to reveal what they are already doing. Some experts see the solution in more sex education in schools; others want sex education kept out of schools and left to parents or religious leaders. What is certain is that students need guidelines for conducting social relationships with peers, because pressure from friends can lead to risky, self-defeating, unhealthy, and even dangerous behavior. Social pressure for sexual activity is very strong. Anyone considering having sex needs to be made aware of the risks, which include sexually transmitted diseases and unwanted pregnancy. In the end, every individual must make a sensible and responsible choice.

6

Biology and Psychology
A Unified Whole

Doubt thou the stars are fire,
Doubt the sun doth move.
Doubt truth to be a liar,
But never doubt thy love.
—*Hamlet*, by William Shakespeare (1564–1616)

In recent years, psychologists have become critical of research that focuses exclusively upon weaknesses, impairments, and illness. Instead, more research emphasis has been placed upon positive attributes of people. Psychologists have studied factors related to optimism, positive feelings, happiness, strengths, and health.

This book has explored the most positive of human traits—the capacity to relate, attach, care for, and love. The topic transcends the field of psychology to encompass areas of concern for biologists, philosophers, and religious thinkers. We have explored romantic love from many perspectives. Our understanding of the workings of the human brain, particularly through the use of brain imaging techniques, offers promise for uncovering the biology behind the emotion known as love.

YOUR WHOLE SELF

This book separated the various ingredients of a complex topic. Brain processes, chemical events, and bodily reactions have been given special attention. Theory has been separated from everyday situations. Such splitting is necessary to provide some order to what can appear chaotic, to organize, categorize, abstract, generalize, clarify, simplify, explain, and hypothesize. Yet, the separation is artificial and bound to be insufficient to deal with all the complexities of love. Narrow or one-sided explanations cannot provide an adequate picture of any individual situation or a valid prescription for any one problem. The act of abstracting or generalizing requires a loss of information and a certain loss of accuracy. Exactly how the components of love interact, and in what proportions, varies with the individual situation. The author can only hope to have woven some thread of mutual understanding with the reader so that he or she can say, "Yes, that is my condition, my experience."

Each individual is a whole person, not a sum of independently operating biological and psychological parts. We all need to find that individual, to recognize the biology in

our drives and urges, the history and experience determining what we find attractive, our preferences, habits, quirks, prejudices, inhibitions, and fears. We need to recognize these pushes and pulls, but not be trapped by them.

Today's youth have many more options available to them than their ancestors. When our country was young, marriages were seen as being more permanent than they are today. Marriages were often arranged and represented alliances between families. Divorce was frowned upon. Sex outside of marriage was considered a sin. With the Industrial Revolution and the entrance of women into the labor force, women achieved greater independence. Single-parent homes became commonplace. Alternative living arrangements became available. More choices also bring the need for greater responsibility and increased uncertainty. While casual relationships are now accepted, there is also the likelihood of greater risk, insecurity, anxiety, and pain. No relationship should be taken for granted or entered into lightly.

Working at relationships can become a habit. Once learned, it does not stop when you fall in love. It does not stop when you decide to marry. You need to stay in tune with your emotional life and to give it the same degree of importance you invest in thoughts, ideas, attitudes, and interests.

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Glossary

Adapt To develop skills and traits that will allow survival in a new environment.

Amygdala The almond-shaped nerve cluster in the limbic system that is linked to emotion.

Anthropomorphize To attribute human characteristics to animals.

Caudate nucleus The structure near the center of the brain involved in movement, feelings of pleasure, and motivation.

Cognition The mental activities associated with thinking, knowing, and remembering.

Corpus callosum A broad band of axon fibers connecting the two sides of the brain.

Depression An extreme mood of sadness, hopelessness, and lowered self-esteem; the worst cases are diagnosed by doctors as emotional disorders.

Dopamine A neurotransmitter believed to be related to certain mental disorders.

Empathy The ability to feel as others feel; to place oneself in another's shoes.

Endorphin Neurotransmitters linked to feelings of pleasure and the control of pain.

Enzyme A protein in living organisms that helps chemical reactions take place.

Epinephrine A hormone produced in the adrenal glands that stimulates the autonomic nervous system; also called adrenaline; linked to the "fight or flight" mechanism in animals and humans.

Ethologist A scientist who studies animal behavior.

Evolution The process by which a species changes over time to adapt to its environment.

Fight or flight The sympathetic nervous system reaction of the body to stress, controlled by the release of epinephrine and norepinephrine to the bloodstream.

Hypothesis A possible scientific explanation for something that happens.

Imprinting The process by which certain birds and mammals form attachments during a critical period early in life.

Limbic system A group of brain structures associated with emotions, such as fear and anger, and drives for food and sex.

Magnetic resonance imagery (MRI) A technique that uses magnetic fields and radio waves to produce computer-generated images of internal organs; used to see structures within the brain.

Model A system of understanding based on logical, mathematic, or physical examples showing some similarity. For example, a piano keyboard may be a model for the workings of certain parts of the ear.

Monoamine A type of neurotransmitter.

Monoamine Oxidase (MAO) An enzyme at the synapse that inactivates monoamines.

Natural selection The process by which nature favors those members of a species best equipped to survive and reproduce ("survival of the fittest").

Neurologist A scientist who studies the brain and how it works.

Neurotransmitters Chemical messengers between nerve endings (synapses) that help along the transmission of impulses from one nerve cell to another.

Norepinephrine A chemical found in the nervous system, responsible for the tightening of blood vessels; also called noradrenaline.

Physiology The study of the body and how it works.

Polygraph A tool used in lie detection that measures physiological responses, such as respiration, blood pressure, heart rate, and skin resistance.

Psychoanalysis A theory and technique based on the idea that we have unconscious reasons for certain behaviors. Psychologists use the theory often in "talk therapy" with patients to recover unconscious memories and thoughts to explain behavior.

Psychologist A scientist who specializes in the study of human behavior; some psychologists treat people with mental disorders, while others conduct research.

Serotonin A neurotransmitter thought to be linked to anxiety disorders and depression. Decreased serotonin at synapses is linked to depression.

Social exchange theory The theory that our social behavior is an exchange process; the object of social relationships according to this theory is to maximize benefits and minimize costs.

Synapse The area between nerve cells where the fibers of one cell are in close proximity to those of another. Neurotransmitters help the transmission of the nerve impulse.

Triune theory The theory that the brain evolved in three layers—reptilian, limbic, and neocortex—each one more complex that the one before it.

Ventral tegmental area (VTA) A part of the neural reward circuitry of the brain; dopamine is produced here and distributed to many brain areas.

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