Module 41

Theories and Physiology of Emotion


Paul Simcock/Corbis

Module Learning Objectives

- **41-1** Describe how arousal and expressive behaviors interact in emotion.
- **41-2** Explain whether we can experience emotions without consciously interpreting and labeling them.
- **41-3** Describe the link between emotional arousal and the autonomic nervous system, and discuss the relationship between arousal and performance.
- **41-4** Discuss whether different emotions activate different physiological and brain-pattern responses.
- **41-5** Discuss the effectiveness of polygraphs in using body states to detect lies.

Motivated behavior often is driven by powerful emotions that color and sometimes disrupt our lives. I will never forget the day I went to a huge store to drop off film and brought along Peter, my toddler first-born child. As I set Peter down on his feet and prepared to complete the paperwork, a passerby warned, "You'd better be careful or you'll lose that boy!" Not more than a few breaths later, after dropping the film in the slot, I turned and found no Peter beside me.

With mild anxiety, I peered around one end of the counter. No Peter in sight. With slightly more anxiety, I peered around the other end. No Peter there, either. Now, with my heart accelerating, I circled the neighboring counters. Still no Peter anywhere. As anxiety turned to panic, I began racing up and down the store aisles. He was nowhere to be found. Apprised of my alarm, the store manager used the public-address system to ask customers to assist in looking for a missing child. Soon after, I passed the customer who had warned me. "I told you that you were going to lose him!" he now scorned. With visions of kidnapping (strangers routinely adored that beautiful child), I braced for the possibility that my negligence had caused me to lose what I loved above all else, and that I might have to return home and face my wife without our only child.


Courtesy of David G. Myers

But then, as I passed the customer service counter yet again, there he was, having been found and returned by some obliging customer. In an instant, the arousal of terror spilled into ecstasy. Clutching my son, with tears suddenly flowing, I found myself unable to speak my thanks and stumbled out of the store awash in grateful joy.

Where do such emotions come from? Why do we have them? What are they made of? Emotions don't exist just to give us interesting experiences. They are our body's adaptive response, increasing our chances of survival. When we face challenges, emotions focus our attention and energize our actions (Cyders & Smith, 2008). Our heart races. Our pace quickens. All our senses go on high alert. Receiving unexpected good news, we may find our eyes tearing up. We raise our hands triumphantly. We feel exuberance and a newfound confidence. Yet negative and prolonged emotions can harm our health.

Cognition and Emotion

41-1 How do arousal and expressive behaviors interact in emotion?

As my panicked search for Peter illustrates, **emotions** are a mix of *bodily arousal* (heart pounding); *expressive behaviors* (quickened pace); and *conscious experience,* including thoughts ("Is this a kidnapping?") and feelings (panic, fear, joy).

The puzzle for psychologists is figuring out how these three pieces fit together. To do that, we need answers to two big questions:

- A chicken-and-egg debate: Does your bodily arousal come *before*, *after,* or *at the same time as* your emotional feelings? (Did I first notice my racing heart and faster step, and then feel terror about losing Peter? Or did my sense of fear come first, stirring my heart and legs to respond?)
- How do *thinking* (cognition) and *feeling* interact? Does cognition always come before emotion? (Did I think about a kidnapping threat before I reacted emotionally?)

Historical emotion theories, as well as current research, have sought to answer these questions.

FYI

Not only emotion, but most psychological phenomena (vision, sleep, memory, sex, and so forth) can be approached these three ways—physiologically, behaviorally, and cognitively.

Historical Emotion Theories

JAMES-LANGE THEORY: AROUSAL COMES BEFORE EMOTION

Common sense tells most of us that we cry because we are sad, lash out because we are angry, tremble because we are afraid. First comes conscious awareness, then the feeling. But to pioneering psychologist William James, this commonsense view of emotion had things backwards. Rather, "We feel sorry because we cry, angry because we strike, afraid because we tremble" (1890, p. 1066). James' idea was also proposed by Danish physiologist Carl Lange, and so is called the **James-Lange theory.** James and Lange would guess that I noticed my racing heart and then, shaking with fright, felt the whoosh of emotion. My feeling of fear followed my body's response.

emotion a response of the whole organism, involving (1) physiological arousal, (2) expressive behaviors, and (3) conscious experience.

James-Lange theory the theory that our experience of emotion is our awareness of our physiological responses to emotion-arousing stimuli.

Steve Pope/AP Photo

Joy expressed According to the James-Lange theory, we don't just smile because we share our teammates' joy. We also share the joy because we are smiling with them.

CANNON-BARD THEORY: AROUSAL AND EMOTION OCCUR SIMULTANEOUSLY

Physiologist Walter Cannon (1871–1945) disagreed with James and Lange. Does a racing heart signal fear or anger or love? The body's responses—heart rate, perspiration, and body temperature—are too similar, and they change too slowly, to *cause* the different emotions, said Cannon. He, and later another physiologist, Philip Bard, concluded that our bodily responses and experienced emotions occur separately but simultaneously. So, according to the **Cannon-Bard theory,** my heart began pounding *as* I experienced fear. The emotion-triggering stimulus traveled to my sympathetic nervous system, causing my body's arousal. *At the same time,* it traveled to my brain's cortex, causing my awareness of my emotion. My pounding heart did not cause my feeling of fear, nor did my feeling of fear cause my pounding heart.

Cannon-Bard theory the theory that an emotion-arousing stimulus simultaneously triggers (1) physiological responses and (2) the subjective experience of emotion.

two-factor theory the Schachter-Singer theory that to experience emotion one must (1) be physically aroused and (2) cognitively label the arousal.

The Cannon-Bard theory has been challenged by studies of people with severed spinal cords, including a survey of 25 soldiers who suffered such injuries in World War II (Hohmann, 1966). Those with *lower-spine injuries,* who had lost sensation only in their legs, reported little change in their emotions' intensity. Those with *high spinal cord injury,* who could feel nothing below the neck, did report changes. Some reactions were much less intense than before the injuries. Anger, one man confessed, "just doesn't have the heat to it that it used to. It's a mental kind of anger." Other emotions, those expressed mostly in body areas above the neck, were felt *more* intensely. These men reported increases in weeping, lumps in the throat, and getting choked up when saying good-bye, worshipping, or watching a touching movie. Our bodily responses seemingly feed our experienced emotions.

But most researchers now agree that our emotions also involve cognition (Averill, 1993; Barrett, 2006). Whether we fear the man behind us on the dark street depends entirely on whether we interpret his actions as threatening or friendly.

AP® Exam Tip

Be prepared for at least a multiple-choice question that tests your ability to tell the difference between the James-Lange theory and the Cannon-Bard theory.

Cognition Can Define Emotion: Schachter and Singer

41-2 To experience emotions, must we consciously interpret and label them?

Stanley Schachter and Jerome Singer (1962) believed that an emotional experience requires a conscious interpretation of arousal: Our physical reactions and our thoughts (perceptions, memories, and interpretations) together create emotion. In their **two-factor theory,** emotions therefore have two ingredients: physical arousal and cognitive appraisal.

Consider how arousal spills over from one event to the next. Imagine arriving home after an invigorating run and finding a message that you got a longed-for job. With arousal lingering from the run, would you feel more elated than if you received this news after awakening from a nap?

The spillover effect Arousal from a soccer match can fuel anger, which can descend into rioting or other violent confrontations.

Reuters/CORBIS

To explore this *spillover effect,* Schachter and Singer injected college men with the hormone epinephrine, which triggers feelings of arousal. Picture yourself as a participant: After receiving the injection, you go to a waiting room, where you find yourself with another person (actually an accomplice of the experimenters) who is acting either euphoric or irritated. As you observe this person, you begin to feel your heart race, your body flush, and your breathing become more rapid. If you had been told to expect these effects from the injection, what would you feel? The actual volunteers felt little emotion—because they attributed their arousal to the drug. But if you had been told the injection would produce no effects, what would you feel? Perhaps you would react as another group of participants did. They "caught" the apparent emotion of the other person in the waiting room. They became happy if the accomplice was acting euphoric, and testy if the accomplice was acting irritated.

This discovery—that a stirred-up state can be experienced as one emotion or another, depending on how we interpret and label it—has been replicated in dozens of experiments (Reisenzein, 1983; Sinclair et al., 1994; Zillmann, 1986). As researcher Daniel Gilbert (2006) has noted, "Feelings that one interprets as fear in the presence of a sheer drop may be interpreted as lust in the presence of a sheer blouse." *The point to remember:* Arousal fuels emotion; cognition channels it.

Cognition May Not Precede Emotion: Zajonc, LeDoux, and Lazarus

But is the heart always subject to the mind? Must we *always* interpret our arousal before we can experience an emotion? Robert Zajonc [ZI-yence] (1980, 1984a) contended that we actually have many emotional reactions apart from, or even before, our interpretation of a situation. Perhaps you can recall liking something or someone immediately, without knowing why.

In earlier modules, we noted that when people repeatedly view stimuli flashed too briefly for them to interpret, they come to prefer those stimuli. Unaware of having previously seen them, they nevertheless rather like them. We have an acutely sensitive automatic radar for emotionally significant information, such that even a subliminally flashed stimulus can prime us to feel better or worse about a follow-up stimulus (Murphy et al., 1995; Zeelenberg et al., 2006). In experiments, thirsty people were given a fruit-flavored drink after viewing a subliminally flashed (thus unperceived) face. Those exposed to a happy face drank about 50 percent more than those exposed to a neutral face (Berridge & Winkielman, 2003). Those flashed an angry face drank substantially less.

Neuroscientists are charting the neural pathways of both "bottom-up" and "top-down" emotions (Ochsner et al., 2009). Our emotional responses can follow two different brain pathways. Some emotions (especially more complex feelings like hatred and love) travel a "high road." A stimulus following this path would travel (by way of the thalamus) to the brain's cortex (**FIGURE 41.1a**). There, it would be analyzed and labeled before the command is sent out, via the amygdala (an emotion-control center), to respond.

But sometimes our emotions (especially simple likes, dislikes, and fears) take what Joseph LeDoux (2002) has called the "low road," a neural shortcut that bypasses the cortex. Following the low-road pathway, a fear-provoking stimulus would travel from the eye or ear (again via the thalamus) directly to the amygdala (Figure 41.1b). This shortcut, bypassing the cortex, enables our greased-lightning emotional response before our intellect intervenes. Like speedy

AP® Exam Tip

Note the connections here to previous units. This paragraph relates to the nature of consciousness. The next paragraph relates to sensation and perception.

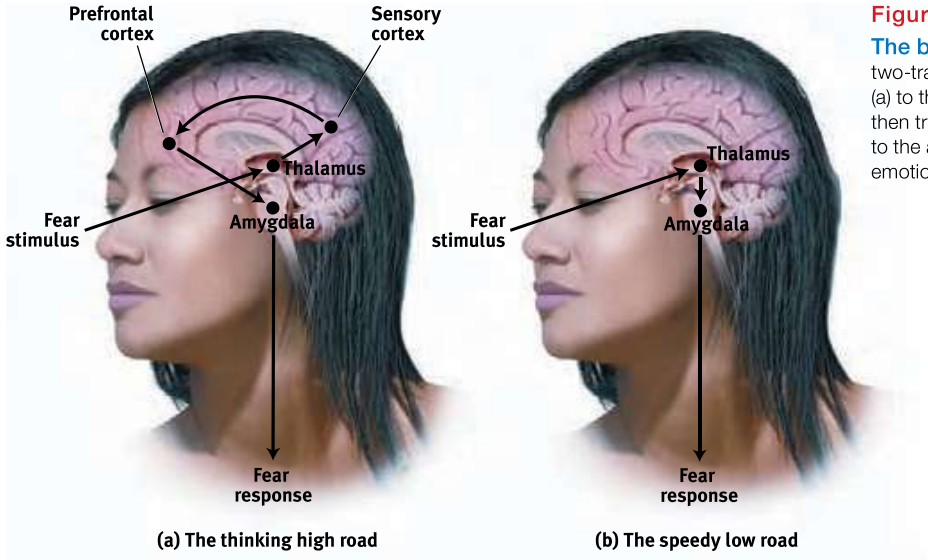
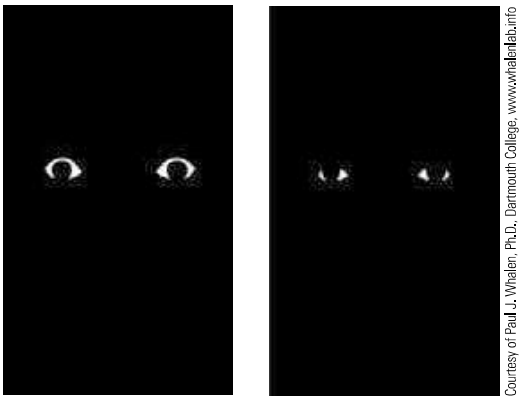


Figure 41.1

The brain's pathways for emotions In the two-track brain, sensory input may be routed (a) to the cortex (via the thalamus) for analysis and then transmission to the amygdala; or (b) directly to the amygdala (via the thalamus) for an instant emotional reaction.

Figure 41.2
The brain's sensitivity to threats
Even when fearful eyes (left) were flashed too briefly for people to consciously perceive them, fMRI scans revealed that their hypervigilant amygdala was alerted (Whalen et al., 2004). The eyes on the right did not have this effect.



reflexes that also operate apart from the brain's thinking cortex, the amygdala reactions are so fast that we may be unaware of what's transpired (Dimberg et al., 2000). In one fascinating experiment, researchers used fMRI scans to observe the amygdala's response to subliminally presented fearful eyes (**FIGURE 41.2**) (Whalen et al., 2004). Although they were flashed too quickly for people to consciously perceive them, the fearful eyes triggered increased amygdala activity. A control condition that presented happy eyes did not trigger this activity.

The amygdala sends more neural projections up to the cortex than it receives back, which makes it easier for our feelings to hijack our thinking than for our thinking to rule our feelings (LeDoux & Armony, 1999). Thus, in the forest, we can jump at the sound of rustling bushes nearby and leave it to our cortex to decide later whether the sound was made by a snake or by the wind. Such experiences support Zajonc's belief that *some* of our emotional reactions involve no deliberate thinking.

Emotion researcher Richard Lazarus (1991, 1998) conceded that our brain processes vast amounts of information without our conscious awareness, and that some emotional responses do not require *conscious* thinking. Much of our emotional life operates via the automatic, speedy low road. But, he asked, how would we *know* what we are reacting to if we did not in some way appraise the situation? The appraisal may be effortless and we may not be conscious of it, but it is still a mental function. To know whether a stimulus is good or bad, the brain must have some idea of what it is (Storbeck et al., 2006). Thus, said Lazarus, emotions arise when we *appraise* an event as harmless or dangerous, whether we truly *know* it is or not. We appraise the sound of the rustling bushes as the presence of a threat. Later, we realize that it was "just the wind."

So, as Zajonc and LeDoux have demonstrated, some emotional responses—especially simple likes, dislikes, and fears—involve no conscious thinking (**FIGURE 41.3**). We may fear a big spider, even if we "know" it is harmless. Such responses are difficult to alter by changing our thinking. We may automatically like one person more than another. This instant appeal can even influence our political decisions if we vote (as many people do) for a candidate we *like* over the candidate expressing positions closer to our own (Westen, 2007).

But as Lazarus, Schachter, and Singer predicted, our memories, expectations, and interpretations also influence our feelings about politics. Moreover, highly emotional people are intense partly because of their interpretations. They may *personalize* events as being somehow directed at them, and they may *generalize* their experiences by blowing single incidents out of proportion (Larsen et al., 1987). Thus, learning to *think* more positively can help people *feel* better. Although the emotional low road functions automatically, the thinking high road allows us to retake some control over our emotional life. Together, automatic emotion and conscious thinking weave the fabric of our emotional lives. (**TABLE 41.1** summarizes these emotion theories.)

Figure 41.3
Two pathways for emotions
Zajonc and LeDoux have emphasized that some emotional responses are immediate, before any conscious appraisal. Lazarus, Schachter, and Singer emphasized that our appraisal and labeling of events also determine our emotional responses.

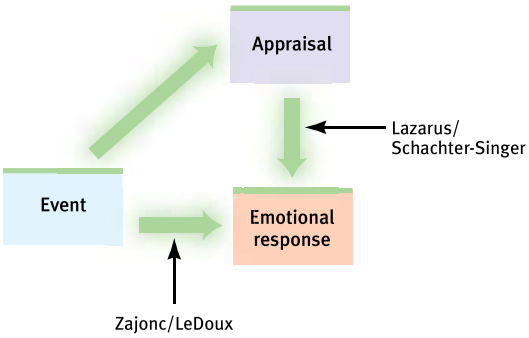


Table 41.1 Summary of Emotion Theories

Theory	Explanation of Emotions	Example
James-Lange	Emotions arise from our awareness of our specific bodily responses to emotion-arousing stimuli.	We observe our heart racing after a threat and then feel afraid.
Cannon-Bard	Emotion-arousing stimuli trigger our bodily responses and simultaneous subjective experience.	Our heart races at the same time that we feel afraid.
Schachter-Singer	Our experience of emotion depends on two factors: general arousal and a conscious cognitive label.	We may interpret our arousal as fear or excitement, depending on the context.
Zajonc; LeDoux	Some embodied responses happen instantly, without conscious appraisal.	We automatically feel startled by a sound in the forest before labeling it as a threat.
Lazarus	Cognitive appraisal ("Is it dangerous or not?")—sometimes without our awareness—defines emotion.	The sound is "just the wind."

AP® Exam Tip

Table 41.1 is an excellent summary of the theories of emotion. They are presented in the order of appearance historically. Notice that cognition, a hugely important factor in the modern theories, is not mentioned in the first two theories.

Before You Move On

► ASK YOURSELF

Can you remember a time when you began to feel upset or uneasy and only later labeled those feelings?

► TEST YOURSELF

Christine is holding her 8-month-old baby when a fierce dog appears out of nowhere and, with teeth bared, leaps for the baby's face. Christine immediately ducks for cover to protect the baby, screams at the dog, then notices that her heart is banging in her chest and she's broken out in a cold sweat. How would the James-Lange, Cannon-Bard, and two-factor theories explain Christine's emotional reaction?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Embodied Emotion

Whether you are falling in love or grieving a death, you need little convincing that emotions involve the body. Feeling without a body is like breathing without lungs. Some physical responses are easy to notice. Other emotional responses we experience without awareness.

Emotions and the Autonomic Nervous System

41-3 What is the link between emotional arousal and the autonomic nervous system? How does arousal affect performance?

As we saw in Module 10, in a crisis, the *sympathetic division* of your *autonomic nervous system (ANS)* mobilizes your body for action, directing your adrenal glands to release the stress hormones epinephrine (adrenaline) and norepinephrine (noradrenaline)

Autonomic Nervous System Controls Physiological Arousal

Sympathetic division (arousing)		Parasympathetic division (calming)
Pupils dilate	EYES	Pupils contract
Decreases	SALIVATION	Increases
Perspires	SKIN	Dries
Increases	RESPIRATION	Decreases
Accelerates	HEART	Slows
Inhibits	DIGESTION	Activates
Secrete stress hormones	ADRENAL GLANDS	Decrease secretion of stress hormones
Reduced	IMMUNE SYSTEM FUNCTIONING	Enhanced

Figure 41.4

Emotional arousal Like a crisis control center, the autonomic nervous system arouses the body in a crisis and calms it when danger passes.

(**FIGURE 41.4**). To provide energy, your liver pours extra sugar into your bloodstream. To help burn the sugar, your respiration increases to supply needed oxygen. Your heart rate and blood pressure increase. Your digestion slows, diverting blood from your internal organs to your muscles. With blood sugar driven into the large muscles, running becomes easier. Your pupils dilate, letting in more light. To cool your stirred-up body, you perspire. If wounded, your blood would clot more quickly.

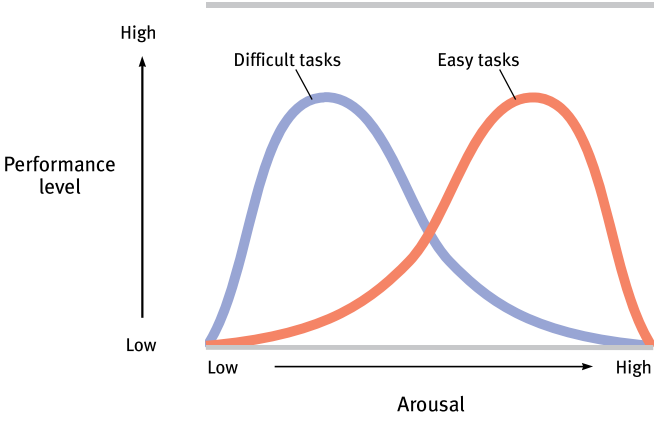
As we saw in Module 37, the *Yerkes-Dodson law* explains that arousal affects performance in different ways, depending on the task. When taking an exam, it pays to be moderately aroused—alert but not trembling with nervousness (**FIGURE 41.5**). But too little arousal (as when sleepy) can be disruptive, and, as we'll see later in this unit, prolonged high arousal can tax the body.

When the crisis passes, the *parasympathetic division* of your ANS gradually calms your body, as stress hormones slowly leave your bloodstream. After your next crisis, think of this: Without any conscious effort, your body's response to danger is wonderfully coordinated and adaptive—preparing you to *fight or flee*.

Figure 41.5

Arousal and performance Performance peaks at lower levels of arousal for difficult tasks, and at higher levels for easy or well-learned tasks. (1) How might this phenomenon affect runners? (2) How might this phenomenon affect anxious test-takers facing a difficult exam? (3) How might the performance of anxious students be affected by relaxation training?

ANSWERS: (1) Runners tend to excel when aroused by competition. (2) High anxiety in test-takers may disrupt their performance. (3) Teaching anxious students how to relax before an exam can enable them to perform better (Hembree, 1988).



The Physiology of Emotions

41-4 Do different emotions activate different physiological and brain-pattern responses?

Imagine conducting an experiment measuring the physiological responses of emotion. In each of four rooms, you have someone watching a movie: In the first, the person is viewing a horror show; in the second, an anger-provoking film; in the third, a sexually arousing film; in the fourth, a boring film. From the control center you monitor each person's perspiration, breathing, and heart rate. Could you tell who is frightened? Who is angry? Who is sexually aroused? Who is bored?

With training, you could probably pick out the bored viewer. But discerning physiological differences among fear, anger, and sexual arousal would be much more difficult (Barrett, 2006). Different emotions do not have sharply distinct biological signatures.

FotoStor.co.uk/Alamy

Emotional arousal
Elated excitement and panicky fear involve similar physiological arousal. That allows us to flip rapidly between the two emotions.

Nor do they engage sharply distinct brain regions. Consider the broad emotional portfolio of the *insula,* a neural center deep inside the brain. The insula is activated when we experience various social emotions, such as lust, pride, and disgust. In brain scans, it becomes active when people bite into some disgusting food, smell the same disgusting food, think about biting into a disgusting cockroach, or feel moral disgust over a sleazy business exploiting a saintly widow (Sapolsky, 2010).

Nevertheless, despite their similarities, sexual arousal, fear, anger, and disgust *feel* different to you and me, and they often *look* different to others. We may appear "paralyzed with fear" or "ready to explode." Research has pinpointed some real, though subtle, physiological distinctions and brain-pattern distinctions among the emotions. For example, the finger temperatures and hormone secretions that accompany fear and rage do sometimes differ (Ax, 1953; Levenson, 1992). Fear and joy, although they prompt similar increased heart rate, stimulate different facial muscles. During fear, your brow muscles tense. During joy, muscles in your cheeks and under your eyes pull into a smile (Witvliet & Vrana, 1995).

"No one ever told me that grief felt so much like fear. I am not afraid, but the sensation is like being afraid. The same fluttering in the stomach, the same restlessness, the yawning. I keep on swallowing." -C. S. Lewis, *A Grief Observed*, 1961

Some emotions also differ in their brain circuits (Panksepp, 2007). Compared with observers watching angry faces, those watching (and subtly mimicking) fearful faces show more activity in their amygdala (Whalen et al., 2001). Brain scans and EEG recordings show that emotions also activate different areas of the brain's cortex. When you experience negative emotions such as disgust, your right prefrontal cortex tends to be more active than the left. Depression-prone people, and those with generally negative personalities, also show more right frontal lobe activity (Harmon-Jones et al., 2002).

Positive moods tend to trigger more left frontal lobe activity. People with positive personalities—exuberant infants and alert, enthusiastic, energized, and persistently goal-directed adults—also show more activity in the left frontal lobe than in the right (Davidson, 2000, 2003; Urry et al., 2004). Indeed, the more a person's baseline frontal lobe activity tilts left—or is made to tilt left by perceptual activity—the more upbeat the person typically is (Drake & Myers, 2006).

To sum up, we can't easily see differences in emotions from tracking heart rate, breathing, and perspiration. But facial expressions and brain activity can vary with the emotion. So, do we, like Pinocchio, give off telltale signs when we lie? For more on that question, see Thinking Critically About: Lie Detection.

FYI

In 1966, a young man named Charles Whitman killed his wife and mother and then climbed to the top of a tower at the University of Texas and shot 38 people. An autopsy later revealed a tumor pressing against his amygdala, which may have contributed to his violence.

Thinking Critically About

Lie Detection

DreamPictures/Getty images

Can polygraph tests like this identify liars? To learn more, read on.

polygraph a machine, commonly used in attempts to detect lies, that measures several of the physiological responses (such as perspiration and cardiovascular and breathing changes) accompanying emotion.

41-5 How effective are polygraphs in using body states to detect lies?

Can a *lie detector*—a **polygraph**—reveal lies? Polygraphs don't literally detect lies. Instead, they measure emotion-linked changes in breathing, cardiovascular activity, and perspiration. If you were taking this test, an examiner would monitor these responses as you answered questions. She might ask, "In the last 20 years, have you ever taken something that didn't belong to you?" This item is a control question, aimed at making everyone a little nervous. If you lie and say *"No!"* (as many people do) the polygraph will detect arousal. This response will establish a baseline, a useful comparison for your responses to *critical questions ("Did you ever steal anything from your previous employer?")*. If your responses to critical questions are weaker than to control questions, the examiner will infer you are telling the truth.

Critics point out two problems: First, our physiological arousal is much the same from one emotion to another. Anxiety, irritation, and guilt all prompt similar physiological reactivity. Second, many innocent people do respond with heightened tension to the accusations implied by the critical questions (**FIGURE 41.6**). Many rape victims, for example, "fail" these tests when reacting emotionally but truthfully (Lykken, 1991).

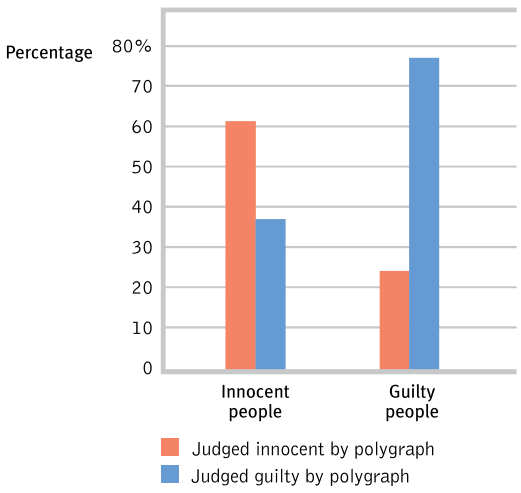
A 2002 U.S. National Academy of Sciences report noted that "no spy has ever been caught [by] using the polygraph." It is not for lack of trying. The FBI, CIA, and Departments of Defense and Energy in the United States have tested tens of thousands of employees, and polygraph use in Europe has also increased (Meijer & Verschuere, 2010). Meanwhile Aldrich Ames, a Russian spy within the CIA, went undetected. Ames took many "polygraph tests and passed them all," noted Robert Park (1999). "Nobody thought to investigate the source of his sudden wealth—after all, he was passing the lie detector tests."

A more effective approach to lie detection uses a *guilty knowledge test,* which also assesses a suspect's physiological responses to crime-scene details known only to the police and the guilty person (Ben-Shakhar & Elaad, 2003). If a camera and computer had been stolen, for example, only a guilty person should react strongly to the brand names of the stolen items. Given enough such specific probes, an innocent person will seldom be wrongly accused.

Research teams are now exploring new ways to nab liars. Psychologist Paul Ekman (2003) has done research (and has trained law enforcement officers) in detecting fleeting signals of deceit in facial expressions. Eyeblinks, for example, decrease during the cognitive demands of lying and increase afterward (Leal & Vrij, 2008). Other researchers are developing software that analyzes facial microexpressions (Adelson, 2004; Newman et al., 2003) or compares the language of truth-tellers and of liars (who use fewer first-person pronouns and more negative-emotion words).

"Forensic neuroscience" researchers are going straight to the seat of deceit—the brain. EEG recordings have revealed brain waves that indicate familiarity with crime information. fMRI scans have shown liars' brains activating in places that honest people's brains do not (Langleben et al., 2006, 2008; Lui & Rosenfeld, 2009). Pinocchio's giveaway signal of lying may be not the length of his nose, but rather the telltale activity in places such as his left frontal lobe and anterior cingulate cortex, which become active when the brain inhibits truth telling. A new U.S. $10 million Law and Neuroscience Project, led by psychologist Michael Gazzaniga, aims to assess appropriate uses of the new technology in identifying terrorists, convicting criminals, and protecting the

Thinking Critically About *(continued)*



innocent. In 2010, a U.S. federal court declared that fMRI lie detection is not yet ready for courtroom use (Miller, 2010). Many neuroscientists concur (Gazzaniga, 2011; Wagner, 2010). Others argue that jurors' and judges' seat-of-the-pants judgments "are worse than the science that is excluded" (Schauer, 2010).

Figure 41.6 How often do lie detection tests lie? In one study, polygraph experts interpreted the polygraph data of 100 people who had been suspects in theft crimes (Kleinmuntz & Szucko, 1984). Half the suspects were guilty and had confessed; the other half had been proven innocent. Had the polygraph experts been the judges, more than one-third of the innocent would have been declared guilty, and one-fourth of the guilty would have been declared innocent.

Before You Move On

▶ ASK YOURSELF

Can you think of a recent time when you noticed your body's reactions to an emotionally charged situation, such as a difficult social setting or perhaps even a test or game you were worrying about in advance? Did you perceive the situation as a challenge or a threat? How well did you do?

▶ TEST YOURSELF

How do the two divisions of the autonomic nervous system affect our emotional responses?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 41 Review

41-1 How do arousal and expressive behaviors interact in emotion?

- *Emotions* are psychological responses of the whole organism involving an interplay among physiological arousal, expressive behaviors, and conscious experience.
- Theories of emotion generally address two major questions: (1) Does physiological arousal come before, after, or at the same time as emotional feelings, and (2) how do cognition and feeling interact?
- The *James-Lange theory* maintains that emotional feelings follow our body's response to emotion-inducing stimuli.
- The *Cannon-Bard theory* proposes that our body responds to emotion at the same time that we experience the emotion (one does not cause the other).

41-2 To experience emotions, must we consciously interpret and label them?

- The Schachter-Singer *two-factor theory* holds that our emotions have two ingredients, physical arousal and a cognitive label, and the cognitive labels we put on our states of arousal are an essential ingredient of emotion.
- Lazarus agreed that many important emotions arise from our interpretations or inferences.
- Zajonc and LeDoux, however, believe that some simple emotional responses occur instantly, not only outside our conscious awareness, but before any cognitive processing occurs. This interplay between emotion and cognition illustrates our dual-track mind.

41-3 What is the link between emotional arousal and the autonomic nervous system? How does arousal affect performance?

- The arousal component of emotion is regulated by the autonomic nervous system's sympathetic (arousing) and parasympathetic (calming) divisions.
- Performance peaks at lower levels of arousal for difficult tasks, and at higher levels for easy or well-learned tasks.

41-4 Do different emotions activate different physiological and brain-pattern responses?

- Emotions may be similarly arousing, but some subtle physiological responses, such as facial muscle movements, distinguish them.
- More meaningful differences have been found in activity in some brain pathways and cortical areas and in the hormone secretions associated with different emotions.

41-5 How effective are polygraphs in using body states to detect lies?

- *Polygraphs,* which measure several physiological indicators of emotion, are not accurate enough to justify widespread use in business and law enforcement. The use of guilty knowledge questions and new forms of technology may produce better indications of lying.

Multiple-Choice Questions

1. One night Samar became frightened when she was startled by a noise while walking down the street alone. Which theory of emotion would say that her fear resulted from the startle response alone?

a. James-Lange
b. Cannon-Bard
c. Two-factor
d. Lazarus
e. Schachter-Singer

2. The Cannon-Bard theory of emotion states that

a. emotional response occurs before cognition.
b. physiological response occurs before emotional response.
c. emotional response occurs before physiological response.
d. cognition occurs before emotional response.
e. physiological response and emotion occur independently and simultaneously.

3. Which of the following is an example of cognitive appraisal?

a. Randal is happy all day because he is savoring the wonderful events of yesterday.
b. Charles is frightened in a dark alley because he remembers stories of others being attacked in dark alleys.
c. Sherika labels the arousal she is feeling as attraction because she is in the presence of a good-looking young man.
d. Dora is angry because she cannot figure out how to convince her husband to take her to Hawaii.
e. Ann is frustrated because traffic has made her late for an important meeting.

4. Which of the following characterizes the "low road" neural pathway to emotions?

a. Information travels directly from the thalamus to the amygdala.
b. The emotion results more slowly than it would via the "high road."
c. It is an example of top-down processing.
d. It is more likely to be utilized for complex feelings.
e. It passes through the brain's cortex.

Practice FRQs

1. Explain the role of conscious thinking in emotion according to the theory that some emotions take the high road while others take the low road.

Answer

1 point: The high-road theory argues that conscious thinking occurs before the emotion.

1 point: The low-road theory argues that conscious awareness does not occur until after the emotional response.

2. Lynn's boyfriend has not replied to her last three text messages. Lynn is experiencing anger, increased blood pressure, and rapid breathing. Analyze this situation using both the James-Lange and the Cannon-Bard theories of emotion.

(2 points)

Module 42

Expressed Emotion


Ocean/Corbis

Module Learning Objectives

42-1 Describe our ability to communicate nonverbally, and discuss gender differences in this capacity.

42-2 Discuss the culture-specific and culturally universal aspects of nonverbal expressions of emotion.

42-3 Describe how facial expressions influence our feelings.

Expressive behavior implies emotion. Dolphins, with smiles seemingly plastered on their faces, appear happy. To decipher people's emotions we read their bodies, listen to their voice tones, and study their faces. Does nonverbal language vary with culture—or is it universal? And do our expressions influence our experienced emotions?

"Your face, my thane, is a book where men may read strange matters." -Lady Macbeth to her husband, in William Shakespeare's *Macbeth*

Detecting Emotion in Others

42-1 How do we communicate nonverbally? How do the genders differ in this capacity?

FYI

To learn more about our experienced emotions of anger and happiness, see Module 83.

To Westerners, a firm handshake conveys an outgoing, expressive personality (Chaplin et al., 2000). A gaze, an averted glance, or a stare communicate intimacy, submission, or dominance (Kleinke, 1986). When two people are passionately in love, they typically spend time—quite a bit of time—gazing into each other's eyes (Rubin, 1970). Would such gazes stir these feelings between strangers? To find out, researchers asked unacquainted male-female pairs to gaze intently for two minutes either at each other's hands or into each other's eyes. After separating, the eye gazers reported feeling a tingle of attraction and affection (Kellerman et al., 1989).

Most of us read nonverbal cues well. Shown 10 seconds of video from the end of a speed-dating interaction, people can often detect whether one person is attracted to another (Place et al., 2009). We are especially good at detecting nonverbal threats. In a series of subliminally flashed words, we more often sense the presence of negative ones, such as *snake* or *bomb* (Dijksterhuis & Aarts, 2003). In a crowd of faces, a single angry face "pops out" faster than a single happy one (Hansen & Hansen, 1988; Pinkham et al., 2010). And even when hearing another language, most of us readily detect anger (Scherer et al., 2001).


Network Photographers/Alamy

A silent language of emotion Hindu classic dance uses the face and body to effectively convey 10 different emotions (Hejmadi et al., 2000).

Pollak, S.D., and Kistler, D.J. (2002). Proceedings of the National Academy of Sciences USA, 99: 13, 9072–9076.

Figure 42.1

Experience influences how we perceive emotions Viewing the morphed middle face, evenly mixing fear with anger, physically abused children were more likely than nonabused children to perceive the face as angry (Pollak & Kistler, 2002; Pollak & Tolley-Schell, 2003).

Experience can sensitize us to particular emotions, as shown by experiments using a series of faces (like those in **FIGURE 42.1**) that morph from fear (or sadness) to anger. Viewing such faces, physically abused children are much quicker than other children to spot the signals of anger. Shown a face that is 60 percent fear and 40 percent anger, they are as likely to perceive anger as fear. Their perceptions become sensitively attuned to glimmers of danger that nonabused children miss.

Hard-to-control facial muscles reveal signs of emotions you may be trying to conceal. Lifting just the inner part of your eyebrows, which few people do consciously, reveals distress or worry. Eyebrows raised and pulled together signal fear. Activated muscles under the eyes and raised cheeks suggest a natural smile, called a *Duchenne smile* in honor of the French physician who described it. A feigned smile, such as one we make for a photographer, often is frozen in place for several seconds, then suddenly switched off. Authentic smiles tend to be briefer and to fade less abruptly (Bugental, 1986).

Our brains are rather amazing detectors of subtle expressions. Just *how* amazing was clear when researchers filmed teachers talking to unseen schoolchildren (Babad et al., 1991). A mere 10-second clip of either the teacher's voice or face provided enough clues for both young and old viewers to determine whether the teacher liked and admired a child. In other experiments, even glimpsing a face for one-tenth of a second enabled people to judge people's attractiveness or trustworthiness or to rate politicians' competence and predict their voter support (Willis & Todorov, 2006). "First impressions . . . occur with astonishing speed," note Christopher Olivola and Alexander Todorov (2010).

Despite our brain's emotion-detecting skill, we find it difficult to detect deceiving expressions (Porter & ten Brinke, 2008). In one digest of 206 studies of discerning truth from lies, people were just 54 percent accurate—barely better than a coin toss (Bond & DePaulo, 2006). Moreover, contrary to claims that some experts can spot lies, the available research indicates that virtually no one—save perhaps police professionals in high-stakes situations—beats chance by much (Bond & DePaulo, 2008; O'Sullivan et al., 2009). The behavioral differences between liars and truth-tellers are too minute for most people to detect (Hartwig & Bond, 2011).

Paul Ekman

Which of researcher Paul Ekman's smiles is feigned, which natural? The smile on the right engages the facial muscles of a natural smile.

Some of us are, however, more sensitive than others to physical cues. In one study, hundreds of people were asked to name the emotion in brief film clips they watched. The clips showed portions of a person's emotionally expressive face or body, sometimes accompanied by a garbled voice (Rosenthal et al., 1979). For example, after a 2-second scene revealing only the face of an upset woman, the researchers would ask whether the woman was criticizing someone for being late or was talking about her divorce. Given such "thin slices," some people were much better emotion detectors than others. Introverts tend to excel at reading others' emotions, while extraverts are generally easier to read (Ambady et al., 1995).

Gestures, facial expressions, and voice tones, which are absent in written communication, convey important information. Those who listen to 30 seconds of people describing their marital separation can better predict their current and future adjustment than can those who read a script of the recording (Mason et al., 2010). Electronic communications provide impoverished nonverbal cues. To partly remedy that, we sometimes accompany our text messages, e-mails, and online posts with emotion cues (ROFL!). The absence of expressive e-motion

can make for ambiguous emotion. Without the vocal nuances that signal whether a statement is serious, kidding, or sarcastic, we are in danger of communicating our own egocentrism, as people misinterpret our "just kidding" message (Kruger et al., 2005).

Images.com/Corbis

Obvious emotions Graphic novel authors use facial expressions and other design elements to express emotion, reducing the need to explain how the characters are feeling.

Gender, Emotion, and Nonverbal Behavior

Is women's intuition, as so many believe, superior to men's? After analyzing 125 studies of sensitivity to nonverbal cues, Judith Hall (1984, 1987) concluded that women generally do surpass men at reading people's emotional cues when given "thin slices" of behavior. Women have also surpassed men in other assessments of emotional cues, such as deciding whether a male-female couple is a genuine romantic couple or a posed phony couple, and in discerning which of two people in a photo is the other's supervisor (Barnes & Sternberg, 1989).

Women's nonverbal sensitivity helps explain their greater emotional literacy. Invited by Lisa Feldman Barrett and her colleagues (2000) to describe how they would feel in certain situations, men described simpler emotional reactions. You might like to try this yourself: Ask some people how they might feel when saying good-bye to friends after graduation. Barrett's work suggests you are more likely to hear young men say, simply, "I'll feel bad," and to hear young women express more complex emotions: "It will be bittersweet; I'll feel both happy and sad."

Women's skill at decoding others' emotions may also contribute to their greater emotional responsiveness (Vigil, 2009). In studies of 23,000 people from 26 cultures around the world, women more than men reported themselves open to feelings (Costa et al., 2001). That helps explain the extremely strong perception that emotionality is "more true of women"—a perception expressed by nearly 100 percent of 18- to 29-year-old Americans (Newport, 2001). But the perception of women's emotionality also feeds—and is fed by—people's attributing women's emotionality to their disposition and men's to their circumstances: "She's emotional. He's having a bad day" (Barrett & Bliss-Moreau, 2009).

One exception: Anger strikes most people as a more masculine emotion. Quickly: Imagine an angry face. What gender is the person? If you're like 3 in 4 Arizona State University students, you imagined a male (Becker et al., 2007). The researchers also found that when a gender-neutral face was made to look angry, most people perceived it as male. If the face was smiling, they were more likely to perceive it as female (**FIGURE 42.2**).

When surveyed, women are also far more likely than men to describe themselves as empathic. If you have *empathy,* you identify with others and imagine what it must be like to walk in their shoes. You rejoice with those who rejoice and weep with those who weep. Children and adults who skillfully infer others' thoughts and feelings tend to enjoy positive peer relationships (Gleason et al., 2009).

Figure 42.2

Male or female? Researchers manipulated a gender-neutral face. People were more likely to see it as a male when it wore an angry expression, and as a female when it wore a smile (Becker et al., 2007).

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Physiological measures of empathy, such as one's heart rate while seeing another's distress, confirm a gender gap, though a smaller one than is indicated in survey self-reports (Eisenberg & Lennon, 1983; Rueckert et al., 2010). Females are also more likely to *express* empathy—to cry and to report distress when observing someone in distress. As **FIGURE 42.3** shows, this gender difference was clear in videotapes of male and female students watching film clips that were sad (children with a dying parent), happy (slapstick comedy), or frightening (a man nearly falling off the ledge of a tall building) (Kring & Gordon, 1998). Women also tend to experience emotional events, such as viewing pictures of mutilation, more deeply, with more brain activation in areas sensitive to emotion. And they are better at remembering the scenes three weeks later (Canli et al., 2002).

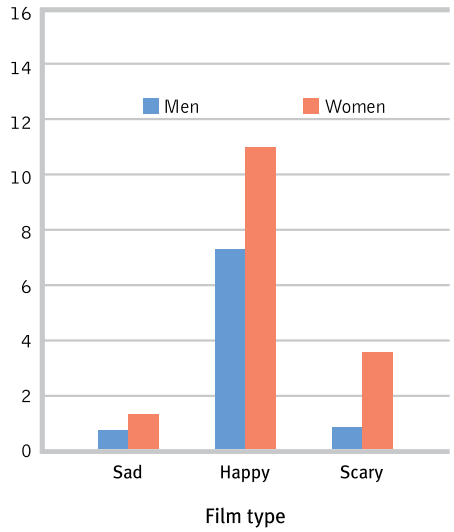


Figure 42.3
Gender and expressiveness
Male and female film viewers did not differ dramatically in self-reported emotions or physiological responses. But the women's faces *showed* much more emotion. (From Kring & Gordon, 1998.)

Culture and Emotional Expression

42-2 How are nonverbal expressions of emotion understood within and across cultures?

The meaning of *gestures* varies with the culture. Former U.S. President Richard Nixon learned this while traveling in Brazil; he made the North American "A-OK" sign, not realizing it was a crude insult to Brazilians. The importance of cultural definitions of gestures and other body language was again demonstrated in 1968, when North Korea publicized photos of supposedly happy officers from a captured U.S. Navy spy ship. In the photo, three men had raised their middle finger, telling their captors it was a "Hawaiian good luck sign" (Fleming & Scott, 1991).

Do facial expressions also have different meanings in different cultures? To find out, two investigative teams showed photographs of various facial expressions to people in different parts of the world and asked them to guess the emotion (Ekman et al., 1975, 1987, 1994; Izard, 1977, 1994). You can try this matching task yourself by pairing the six emotions with the six faces of **FIGURE 42.4**.

Figure 42.4
Culture-specific or culturally universal expressions?
As people of differing cultures and races, do our faces speak differing languages? Which face expresses disgust? Anger? Fear? Happiness? Sadness? Surprise? (From Matsumoto & Ekman, 1989.) See inverted answers below.

From left to right, top to bottom:
happiness, surprise, fear, sadness,
anger, disgust.

"For news of the heart, ask the face." -Guinean proverb

Regardless of your cultural background, you probably did pretty well. A smile's a smile the world around. Ditto for anger, and to a lesser extent the other basic expressions (Elfenbein & Ambady, 1999). (There is no culture where people frown when they are happy.)

Facial expressions do convey some nonverbal accents that provide clues to one's culture (Marsh et al., 2003). Thus data from 182 studies show slightly enhanced accuracy when people judge emotions from their own culture (Elfenbein & Ambady, 2002, 2003a,b). Still, the telltale signs of emotion generally cross cultures. The world over, children cry when distressed, shake their heads when defiant, and smile when they are happy. So, too, with blind children who have never seen a face (Eibl-Eibesfeldt, 1971). People blind from birth spontaneously exhibit the common facial expressions associated with such emotions as joy, sadness, fear, and anger (Galati et al., 1997).

Musical expressions also cross cultures. Happy and sad music feels happy and sad around the world. Whether you live in an African village or a European city, fast-paced music seems happy, and slow-paced music seems sadder (Fritz et al., 2009).

Do these shared emotional categories reflect shared cultural experiences, such as movies and TV broadcasts seen around the world? Apparently not. Paul Ekman and his team asked isolated people in New Guinea to respond to such statements as, "Pretend your child has died." When North American collegians viewed the taped responses, they easily read the New Guineans' facial reactions.

So we can say that facial muscles speak a universal language. This discovery would not have surprised Charles Darwin (1809–1882) who argued that in prehistoric times, before our ancestors communicated in words, they communicated threats, greetings, and submission with facial expressions. Their shared expressions helped them survive (Hess & Thibault, 2009). A sneer, for example, retains elements of an animal baring its teeth in a snarl. Emotional expressions may enhance our survival in other ways, too. Surprise raises the eyebrows and widens the eyes, enabling us to take in more information. Disgust wrinkles the nose, closing it from foul odors.

FYI

While weightless, astronauts' internal bodily fluids move toward their upper body and their faces become puffy. This makes nonverbal communication more difficult, especially among multinational crews (Gelman, 1989).

Smiles are social as well as emotional events. Bowlers seldom smile when they score a strike; they smile when they turn to face their companions (Jones et al., 1991; Kraut & Johnston, 1979). Euphoric Olympic gold-medal winners typically don't smile when they are awaiting their ceremony. But they wear broad grins when interacting with officials and facing the crowd and cameras (Fernández-Dols & Ruiz-Belda, 1995). Thus, a glimpse at competitors' spontaneous expressions following an Olympic judo competition gives a very good clue to who won, no matter their country (Matsumoto et al., 2006). Even natively blind athletes, who have never observed smiles, display the same social smiles in such situations (Matsumoto & Willingham, 2009).

Although we share a universal facial language, it has been adaptive for us to interpret faces in particular contexts (**FIGURE 42.5**). People judge an angry face set in a frightening situation as afraid. They judge a fearful face set in a painful situation as pained (Carroll & Russell, 1996). Movie directors harness this phenomenon by creating contexts and soundtracks that amplify our perceptions of particular emotions.

Although cultures share a universal facial language for basic emotions, they differ in how *much* emotion they express. Those that encourage individuality, as in Western Europe, Australia, New Zealand, and North America, display mostly visible emotions (van Hemert et al., 2007). Those that encourage people to adjust to others, as in China, tend to have less visible displays of personal emotions (Matsumoto et al., 2009; Tsai et al., 2007). In Japan, people infer emotion more from the surrounding context. Moreover, the mouth, which is so expressive in North Americans, conveys less emotion than do the telltale eyes (Masuda et al., 2008; Yuki et al., 2007).

Cultural differences also exist *within* nations. The Irish and their Irish-American descendants tend to be more expressive than Scandinavians and their Scandinavian-

Angry, Disgusted, or Afraid?: Studies on the Malleability of Emotion Perception, Hillel Aviezer, Ran R. Hassin, Jennifer Ryan, Cheryl Grady, Josh Susskind, Adam Anderson, Morris Moscovitch, Shlomo Bentin

R.R. Provine. Emotional tears and NGF: A biographical appreciation and research beginning. *Archives Italiennes de Biologie*, 149, 271–276.

Figure 42.5
We read faces in context
Whether we perceive the man in the top row as disgusted or angry depends on which body his face appears on (Aviezer et al., 2008). In the second row, tears on a face make its expression seem sadder (Provine et al., 2009).

American descendants (Tsai & Chentsova-Dutton, 2003). And that reminds us of a familiar lesson: Like most psychological events, emotion is best understood not only as a biological and cognitive phenomenon, but also as a social-cultural phenomenon.

The Effects of Facial Expressions

42-3 How do our facial expressions influence our feelings?

As William James (1890) struggled with feelings of depression and grief, he came to believe that we can control emotions by going "through the outward movements" of any emotion we want to experience. "To feel cheerful," he advised, "sit up cheerfully, look around cheerfully, and act as if cheerfulness were already there."

"Whenever I feel afraid
I hold my head erect
And whistle a happy tune."
-Richard Rodgers and Oscar Hammerstein, *The King and I*, 1958

Studies of the emotional effects of facial expressions reveal precisely what James might have predicted. Expressions not only communicate emotion, they also amplify and regulate it. In *The Expression of the Emotions in Man and Animals,* Charles Darwin (1872) contended that "the free expression by outward signs of an emotion intensifies it. . . . He who gives way to violent gestures will increase his rage."

Was Darwin right? You can test his hypothesis: Fake a big grin. Now scowl. Can you feel the "smile therapy" difference? Participants in dozens of experiments have felt a difference. For example, James Laird and his colleagues (1974, 1984, 1989) subtly induced students to make a frowning expression by asking them to "contract these muscles" and "pull your brows together" (supposedly to help the researchers attach facial electrodes). The results? The students reported feeling a little angry. So, too, for other basic emotions. For example, people reported feeling more fear than anger, disgust, or sadness when made to construct a fearful expression: "Raise your eyebrows. And open your eyes wide. Move your whole head back, so that your chin is tucked in a little bit, and let your mouth relax and hang open a little" (Duclos et al., 1989).

facial feedback effect
the tendency of facial muscle states to trigger corresponding feelings such as fear, anger, or happiness.

This **facial feedback effect** has been repeated many times, in many places, for many basic emotions (**FIGURE 42.6**). Just activating one of the smiling muscles by holding a pen in the teeth (rather than with the lips, which activates a frowning muscle) is enough to make cartoons seem more amusing (Strack et al., 1988). A heartier smile—made not just with the mouth but with raised cheeks that crinkle the eyes—enhances positive feelings even more when you are reacting to something pleasant or funny (Soussignan, 2001). Smile warmly on the outside and you feel better on the inside. When smiling, you will even more quickly understand sentences that describe pleasant events (Havas et al., 2007). Scowl and the whole world seems to scowl back.

So your face is more than a billboard that displays your feelings; it also feeds your feelings. No wonder depressed patients reportedly feel better after between-the-eyebrows Botox injections that paralyze the frowning muscles (Finzi & Wasserman, 2006). Two months after the treatment, 9 of the 10 nonfrowning patients given this treatment were no longer depressed. Follow-up studies have found that Botox paralysis of the frowning muscles slows people's reading of sadness or anger-related sentences, and it slows activity in emotion-related brain circuits (Havas et al., 2010; Hennenlotter et al., 2008). In such ways, Botox smooths life's emotional wrinkles.

Other researchers have observed a similar *behavior feedback* phenomenon (Snodgrass et al., 1986). You can duplicate the participants' experience: Walk for a few minutes with short, shuffling steps, keeping your eyes downcast. Now walk around taking long strides, with your arms swinging and your eyes looking straight ahead. Can you feel your mood shift? Going through the motions awakens the emotions.

Likewise, people perceive ambiguous behaviors differently depending on which finger they move up and down while reading a story. (This was said to be a study of the effect of using finger muscles "located near the reading muscles on the motor cortex.") If participants read the story while moving an extended middle finger, the story behaviors seemed more hostile. If read with a thumb up, they seemed more positive. Hostile gestures prime hostile perceptions (Chandler & Schwarz, 2009; Goldin-Meadow & Beilock, 2010).

You can use your understanding of feedback effects to become more empathic: Let your own face mimic another person's expression. Acting as another acts helps us feel what another feels (Vaughn & Lanzetta, 1981). Indeed, natural mimicry of others' emotions helps explain why emotions are contagious (Dimberg et al., 2000; Neumann & Strack, 2000). Primates also ape one another, and such synchronized expressions help bond them (and us) together (de Waal, 2009). One social worker with Moebius syndrome, a rare facial paralysis disorder, struggled to make emotional connections with Hurricane Katrina refugees. When people made a sad expression, "I wasn't able to return it. I tried to do so with words and tone of voice, but it was no use. Stripped of the facial expression, the emotion just dies there, unshared" (Carey, 2010).

Figure 42.6
How to make people smile without telling them to smile
Do as Kazuo Mori and Hideko Mori (2009) did with students in Japan: Attach rubber bands to the sides of the face with adhesive bandages, and then run them either over the head or under the chin. (1) Based on the facial feedback effect, how might students report feeling when the rubber bands raise their cheeks as though in a smile? (2) How might students report feeling when the rubber bands pull their cheeks downward?

ANSWERS: (1) Most students report feeling more happy than sad when their cheeks are raised upward. (2) Most students report feeling more sad than happy when their cheeks are pulled downward.

* * *

How do our emotions, personality, attitudes, and behaviors influence our risk of disease? What can we do to prevent illness and promote health? To study how stress and healthy and unhealthy behaviors influence health and illness, psychologists and physicians created the interdisciplinary field of *behavioral medicine,* integrating behavioral and medical knowledge. **Health psychology** provides psychology's contribution to behavioral medicine. Let's consider some of psychology's findings on stress and ways of coping with it.

health psychology a subfield of psychology that provides psychology's contribution to behavioral medicine.

Before You Move On

▶ ASK YOURSELF

Can you think of one situation in which you would like to change the way you feel, and create a simple plan for doing so? For instance, if you would like to feel more cheerful on your way to class tomorrow morning rather than dragging yourself there, you might try walking briskly—with head held high and a pleasant expression on your face.

▶ TEST YOURSELF

Who tends to express more emotion—men or women? How do we know the answer to that question?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 42 Review

42-1 How do we communicate nonverbally? How do the genders differ in this capacity?

- Much of our communication is through body movements, facial expressions, and voice tones. Even seconds-long filmed slices of behavior can reveal feelings.
- Women tend to read emotional cues more easily and to be more empathic.

42-2 How are nonverbal expressions of emotion understood within and across cultures?

- The meaning of gestures varies with culture, but facial expressions, such as those of happiness and fear, are common the world over.
- Cultures also differ in the amount of emotion they express.

42-3 How do our facial expressions influence our feelings?

- Research on the *facial feedback effect* shows that our facial expressions can trigger emotional feelings and signal our body to respond accordingly.
- We also mimic others' expressions, which helps us empathize.

Multiple-Choice Questions

1. What do we call the tendency of facial muscle states to trigger corresponding feelings such as fear, anger, or happiness?

a. Culture-specific expression
b. Moebius syndrome
c. Botox
d. Facial feedback effect
e. Culturally universal expression

2. Which of the following statements is most accurate regarding emotion?

a. Smiles are neither social nor emotional events.
b. Inhabitants of individualist countries are more likely to display nonverbal emotions than inhabitants of collectivist countries.
c. Mouths convey more emotion than eyes.
d. Natively blind people who have never seen a smile will never generate a smile.
e. Cultures share a universal facial language for basic emotions.

3. Which subfield of psychology provides psychology's contribution to behavioral medicine?

a. Cognitive
b. Health
c. Clinical
d. Educational
e. Community

Practice FRQs

1. Name the phenomenon describing the impact facial expressions can have on our disposition, and give an example.

Answer

1 point: The facial feedback effect.

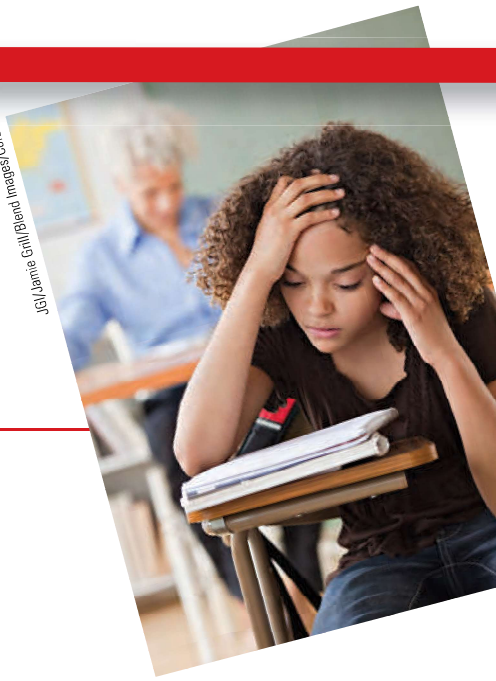
1 point: For example, smiling makes you feel happy and frowning makes you feel a little angry.

2. Name four pieces of evidence that suggest women are more empathic than men.

(4 points)

Module 43

Stress and Health



Jgi/Jamie Grill/Blend Images/Corbis

Module Learning Objective

43-1 Identify events that provoke stress responses, and describe how we respond and adapt to stress.

How often do you experience stress in your daily life? Never? Rarely? Sometimes? Or frequently? When pollsters put a similar question to college students, some 85 percent recalled experiencing stress during the last three months—and most said it had disrupted their schoolwork at least once (AP, 2009). On entering college or university, 18 percent of men and 41 percent of women reported having been "frequently overwhelmed" by all they had to do during the past year (Pryor et al., 2012).

For many students, the high school years, with their new relationships and more demanding challenges, prove stressful. Deadlines become relentless and intense at the end of each term. The time demands of volunteering, sports, music and theater, work, college prep courses, and college applications combine with occasional family tensions and success pressures. Sometimes it's enough to give you a headache or disrupt sleep.

Stress often strikes without warning. Imagine being 21-year-old Ben Carpenter on the world's wildest and fastest wheelchair ride. As he crossed an intersection on a sunny summer afternoon in 2007, the light changed. A large truck, whose driver didn't see him, started moving into the intersection. As they bumped, Ben's wheelchair turned to face forward, and its handles got stuck in the truck's grille. Off they went, the driver unable to hear Ben's cries for help. As they sped down the highway about an hour from my home, passing motorists caught the bizarre sight of a truck pushing a wheelchair at 50 miles per hour and started calling 911. (The first caller: "You are not going to believe this. There is a semi truck pushing a guy in a wheelchair on Red Arrow highway!") Lucky for Ben, one passerby was an undercover police officer. Pulling a quick U-turn, he followed the truck to its destination a couple of miles from where the wild ride had started, and informed the disbelieving driver that he had a passenger hooked in his grille. "It was very scary," said Ben, who has muscular dystrophy. In this section, we explore stress—what it is and how it affects us.

AP Photo/Michigan State Police

Extreme stress Ben Carpenter experienced the wildest of rides after his wheelchair got stuck in a truck's grille.

FYI

In Module 84, we take a close look at some ways we can reduce the stress in our lives, so that we can flourish in both body and mind.

Stress: Some Basic Concepts

43-1 What events provoke stress responses, and how do we respond and adapt to stress?

stress the process by which we perceive and respond to certain events, called *stressors,* that we appraise as threatening or challenging.

Stress is a slippery concept. We sometimes use the word informally to describe threats or challenges ("Ben was under a lot of stress"), and at other times our responses ("Ben experienced acute stress"). To a psychologist, the dangerous truck ride was a *stressor.* Ben's physical and emotional responses were a *stress reaction.* And the process by which he related to the threat was *stress.* Thus, **stress** is the process of appraising and responding to a threatening or challenging event (**FIGURE 43.1**). Stress arises less from events themselves than from how we appraise them (Lazarus, 1998). One person, alone in a house, ignores its creaking sounds and experiences no stress; someone else suspects an intruder and becomes alarmed. One person regards a new job as a welcome challenge; someone else appraises it as risking failure.

When short-lived, or when perceived as challenges, stressors can have positive effects. A momentary stress can mobilize the immune system for fending off infections and healing wounds (Segerstrom, 2007). Stress also arouses and motivates us to conquer problems. In a Gallup World Poll, those who were stressed but not depressed reported being energized and satisfied with their lives—the opposite of the lethargy of those depressed but not stressed (Ng et al., 2009). Championship athletes, successful entertainers, and great teachers and leaders all thrive and excel when aroused by a challenge (Blascovich et al., 2004). Having conquered cancer or rebounded from a lost job, some people emerge with stronger self-esteem and a deepened spirituality and sense of purpose. Indeed, some stress early in life is conducive to later emotional resilience (Landauer & Whiting, 1979). Adversity can beget growth.

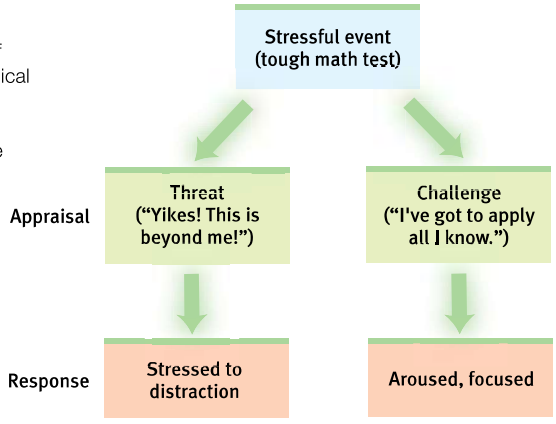
Extreme or prolonged stress can harm us. Children who suffer severe or prolonged abuse are later at risk of chronic disease (Repetti et al., 2002). Troops who had posttraumatic stress reactions to heavy combat in the Vietnam war later suffered greatly elevated rates of circulatory, digestive, respiratory, and infectious diseases (Boscarino, 1997). People who lose their jobs, especially later in their working life, are at increased risk of heart problems and death (Gallo et al., 2006; Sullivan & von Wachter, 2009).

So there is an interplay between our heads and our health. Before exploring that interplay, let's look more closely at stressors and stress reactions.

Stressors—Things That Push Our Buttons

Stressors fall into three main types: catastrophes, significant life changes, and daily hassles. All can be toxic.

Figure 43.1
Stress appraisal The events of our lives flow through a psychological filter. How we appraise an event influences how much stress we experience and how effectively we respond.




Roy Mehta/Getty Images

CATASTROPHES

Catastrophes are unpredictable large-scale events, such as wars, earthquakes, floods, wildfires, and famines. Nearly everyone appraises catastrophes as threatening. We often give aid and comfort to one another after such events, but damage to emotional and physical health can be significant. In surveys taken in the three weeks after the 9/11 terrorist attacks, for example, two-thirds of Americans said they were having some trouble concentrating and sleeping (Wahlberg, 2001). In the New York area, people were especially likely to report such symptoms, and sleeping pill prescriptions rose by a reported 28 percent (HMHL, 2002a; NSF, 2001). In the four months after Hurricane Katrina, New Orleans' suicide rate reportedly tripled (Saulny, 2006).


AFP/Getty Images

Toxic stress Unpredictable large-scale events, such as the severe earthquake that devastated Haiti in 2010, trigger significant levels of stress-related ills. When an earthquake struck Los Angeles in 1994, sudden-death heart attacks increased fivefold. Most occurred in the first two hours after the quake and near its center and were unrelated to physical exertion (Muller & Verrier, 1996).

For those who respond to catastrophes by relocating to another country, the stress is twofold. The trauma of uprooting and family separation combine with the challenges of adjusting to the new culture's language, ethnicity, climate, and social norms (Pipher, 2002; Williams & Berry, 1991). In the first half-year, before their morale begins to rebound, newcomers often experience culture shock and deteriorating well-being (Markovizky & Samid, 2008). Such relocations may become increasingly common because of climate change in years to come.

SIGNIFICANT LIFE CHANGES

Life transitions are often keenly felt. Even happy events, such as getting married, can be stressful. Other changes—graduating from high school, leaving home for college, losing a job, having a loved one die—often happen during young adulthood. The stress of those years was clear in a survey in which 15,000 Canadian adults were asked whether "You are trying to take on too many things at once." Responses indicated highest stress levels among young adults (Statistics Canada, 1999). Young adult stress appeared again when 650,000 Americans were asked if they had experienced a lot of stress "yesterday" (**FIGURE 43.2**).

Some psychologists study the health effects of life changes by following people over time. Others compare the life changes recalled by those who have or have not suffered a specific health problem, such as a heart attack. These studies indicate that people recently widowed, fired, or divorced are more vulnerable to disease (Dohrenwend et al., 1982; Strully, 2009). In one Finnish study of 96,000 widowed people, their risk of death doubled in the week following their partner's death (Kaprio et al., 1987). Experiencing a cluster of crises—losing a job, home, and partner, for example—puts one even more at risk.

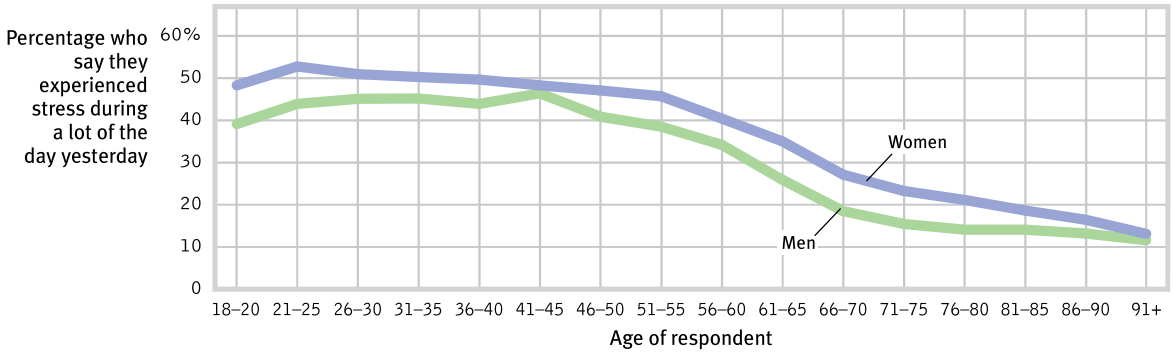


Figure 43.2
Age and stress
A Gallup-Healthways survey of more than 650,000 Americans during 2008 and 2009 found daily stress highest among younger adults (Newport & Pelham, 2009).

DAILY HASSLES

Events don't have to remake our lives to cause stress. Stress also comes from *daily hassles*—rush-hour traffic, aggravating siblings, long lunch lines, too many things to do, family frustrations, and friends who don't respond to calls or texts (Kohn & Macdonald, 1992; Repetti et al., 2009; Ruffin, 1993). Some people can simply shrug off such hassles. For others, however, the everyday annoyances add up and take a toll on health and well-being.

Many people face more significant daily hassles. As the Great Recession of 2008–2009 bottomed out, Americans' most oft-cited stressors related to money (76 percent), work (70 percent), and the economy (65 percent) (APA, 2010). Such stressors are well-known to residents of impoverished areas, where many people routinely face inadequate income, unemployment, solo parenting, and overcrowding.

Prolonged stress takes a toll on our cardiovascular system. Daily pressures may be compounded by anti-gay prejudice or racism, which—like other stressors—can have both psychological and physical consequences (Pascoe & Richman, 2009; Rostosky et al., 2010; Swim et al., 2009). Thinking that some of the people you encounter each day will dislike you, distrust you, or doubt your abilities makes daily life stressful. Such stress takes a toll on the health of many African-Americans, driving up blood pressure levels (Ong et al., 2009; Mays et al., 2007).

The Stress Response System

Medical interest in stress dates back to Hippocrates (460–377 B.C.E.). In the 1920s, Walter Cannon (1929) confirmed that the stress response is part of a unified mind-body system. He observed that extreme cold, lack of oxygen, and emotion-arousing events all trigger an outpouring of the stress hormones epinephrine and norepinephrine from the core of the adrenal glands. When alerted by any of a number of brain pathways, the sympathetic nervous system (see Figure 41.4) increases heart rate and respiration, diverts blood from digestion to the skeletal muscles, dulls feelings of pain, and releases sugar and fat from the body's stores. All this prepares the body for the wonderfully adaptive response that Cannon called *fight or flight.*

"You've got to know when to hold 'em; know when to fold 'em. Know when to walk away, and know when to run." -Kenny Rogers, "The Gambler," 1978

Since Cannon's time, physiologists have identified an additional stress response system. On orders from the cerebral cortex (via the hypothalamus and pituitary gland), the outer part of the adrenal glands secretes *glucocorticoid* stress hormones such as *cortisol.* The two systems work at different speeds, explains biologist Robert Sapolsky (2003): "In a fight-or-flight scenario, epinephrine is the one handing out guns; glucocorticoids are the ones drawing up blueprints for new aircraft carriers needed for the war effort." The epinephrine guns were firing at high speed during an experiment inadvertently conducted on a British Airways San Francisco to London flight. Three hours after takeoff, a mistakenly played message told passengers the plane was about to crash into the sea. Although the flight crew immediately recognized the error and tried to calm the terrified passengers, several required medical assistance (Associated Press, 1999).

Canadian scientist Hans Selye's (1936, 1976) 40 years of research on stress extended Cannon's findings. His studies of animals' reactions to various stressors, such as electric shock and surgery, helped make stress a major concept in both psychology and medicine. Selye proposed that the body's adaptive response to stress is so general that, like a single burglar alarm, it sounds, no matter what intrudes. He named this response the **general adaptation syndrome (GAS),** and he saw it as a three-phase process (**FIGURE 43.3**). Let's say you suffer a physical or an emotional trauma. In Phase 1, you have an *alarm reaction,* as your sympathetic nervous system is suddenly activated. Your heart rate zooms. Blood is diverted to your skeletal muscles. You feel the faintness of shock.

general adaptation syndrome (GAS) Selye's concept of the body's adaptive response to stress in three phases—alarm, resistance, exhaustion.

With your resources mobilized, you are now ready to fight back. During Phase 2, *resistance,* your temperature, blood pressure, and respiration remain high. Your adrenal glands

AP Photo/Luis Hidalgo

AP Photo/Chile's Presidency

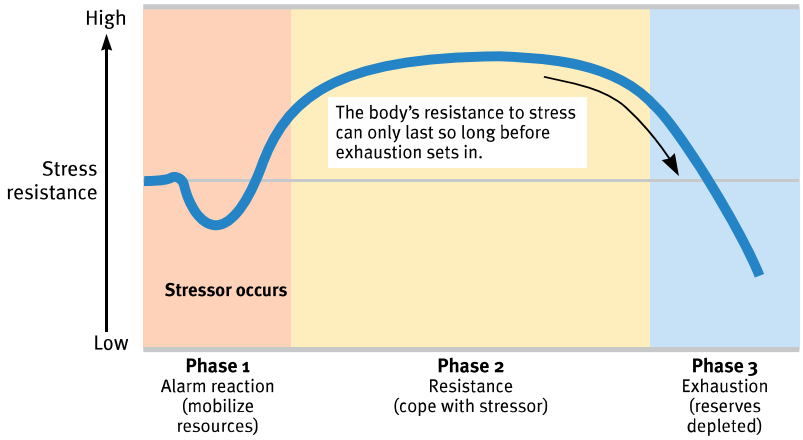


Figure 43.3

Selye's general adaptation syndrome When a gold and copper mine in Chile collapsed in 2010, family and friends rushed to the scene, fearing the worst. Many of those holding vigil outside the mine were nearly exhausted with the stress of waiting and worrying when, after 18 days, they received news that all 33 of the miners inside were alive and well.

pump hormones into your bloodstream. You are fully engaged, summoning all your resources to meet the challenge.

As time passes, with no relief from stress, your body's reserves begin to run out. You have reached Phase 3, *exhaustion.* With exhaustion, you become more vulnerable to illness or even, in extreme cases, collapse and death.

Selye's basic point: Although the human body copes well with temporary stress, prolonged stress can damage it. The brain's production of new neurons slows and some neural circuits degenerate (Dias-Ferreira et al., 2009; Mirescu & Gould, 2006). One study found shortening of *telomeres,* pieces of DNA at the ends of chromosomes, in women who suffered enduring stress as caregivers for children with serious disorders (Epel et al., 2004). Telomere shortening is a normal part of the aging process; when telomeres get too short, the cell can no longer divide and it ultimately dies. The most stressed women had cells that looked a decade older than their chronological age, which may help explain why severe stress seems to age people. Even fearful, easily stressed rats have been found to die sooner (after about 600 days) than their more confident siblings, which average 700-day life spans (Cavigelli & McClintock, 2003).

"You may be suffering from what's known as full-nest syndrome."

Fortunately, there are other options for dealing with stress. One is a common response to a loved one's death: Withdraw. Pull back. Conserve energy. Faced with an extreme disaster, such as a ship sinking, some people become paralyzed by fear. Another stress response, found especially among women, is to seek and give support (Taylor et al., 2000, 2006). This **tend-and-befriend** response is demonstrated in the outpouring of help after natural disasters.

Facing stress, men more often than women tend to socially withdraw, turn to alcohol, or become aggressive. Women more often respond to stress by nurturing and banding together. This may in part be due to *oxytocin,* a stress-moderating hormone associated with pair bonding in animals and released by cuddling, massage, and breast feeding in humans

tend-and-befriend response under stress, people (especially women) often provide support to others (tend) and bond with and seek support from others (befriend).

(Campbell, 2010; Taylor, 2006). Gender differences in stress responses are reflected in brain scans: Women's brains become more active in areas important for face processing and empathy; men's become less active (Mather et al., 2010).

It often pays to spend our resources in fighting or fleeing an external threat. But we do so at a cost. When stress is momentary, the cost is small. When stress persists, we may pay a much higher price, with lowered resistance to infections and other threats to mental and physical well-being.

Before You Move On

▶ ASK YOURSELF

How often is your stress response system activated? What are some of the things that have triggered a fight-or-flight response for you?

▶ TEST YOURSELF

What two processes happen simultaneously when our stress response system is activated? What happens if the stress is continuous?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 43 Review

43-1 What events provoke stress responses, and how do we respond and adapt to stress?

- *Stress* is the process by which we appraise and respond to stressors (catastrophic events, significant life changes, and daily hassles) that challenge or threaten us.
- Walter Cannon viewed the stress response as a "fight-or-flight" system.
- Later researchers identified an additional stress-response system in which the adrenal glands secrete glucocorticoid stress hormones.
- Hans Selye proposed a general three-phrase (alarm-resistance-exhaustion) *general adaptation syndrome (GAS).*
- Prolonged stress can damage neurons, hastening cell death.
- Facing stress, women may have a *tend-and-befriend* response; men may withdraw socially, turn to alcohol, or become aggressive.

Multiple-Choice Questions

1. Which of the following is an example of stress?

a. Ray is tense and anxious as he has to decide which college to attend.
b. Sunga is assigned an extra shift at work.
c. Joe's parents are allowing him to stay home alone while they go away for a weekend.
d. Linda remembers to repay a friend the $10 she owes her.
e. Enrico learns of a traffic accident on the Interstate.

2. The general adaptation syndrome (GAS) begins with

a. resistance.
b. appraisal.
c. exhaustion.
d. alarm.
e. challenge.

3. Which of the following is likely to result from the release of oxytocin?

a. A fight-or-flight response
b. A tend-and-befriend response
c. Social isolation
d. Elevated hunger
e. Exhaustion

Practice FRQs

1. Xavier has a huge math test coming up next Tuesday. Explain two ways appraisal can determine how stress will influence his test performance.

Answer

1 point: If Xavier interprets the test as a challenge he will be aroused and focused in a way that could improve his test performance.

1 point: If Xavier interprets the test as a threat he will be distracted by stress in a way that is likely to harm his test performance.

2. Name and briefly describe the three phases of Hans Selye's general adaptation syndrome (GAS).

(3 points)

Module 44

Stress and Illness


Aaron Haupt/Getty Images

Module Learning Objectives

44-1 Describe how stress makes us more vulnerable to disease.

44-2 Explain why some of us are more prone than others to coronary heart disease.

44-1 How does stress make us more vulnerable to disease?

Not so long ago, the term *psychosomatic* described psychologically caused physical symptoms. In common usage, the term came to mean that the symptoms were unreal—"merely" psychosomatic. To avoid such connotations and to better describe the genuine physiological effects of psychological states, most experts today refer instead to stress-related **psychophysiological illnesses,** such as hypertension and some headaches. Stress also leaves us less able to fight off disease. The field of **psychoneuroimmunology** studies these mind-body interactions (Kiecolt-Glaser, 2009). This awkward name makes sense when said slowly: Your thoughts and feelings *(psycho)* influence your brain *(neuro),* which influences the endocrine hormones that affect your disease-fighting *immune* system. And this field is the study of *(ology)* those interactions.

psychophysiological illness literally, "mind-body" illness; any stress-related physical illness, such as hypertension and some headaches.

psychoneuroimmunology the study of how psychological, neural, and endocrine processes together affect the immune system and resulting health.

lymphocytes the two types of white blood cells that are part of the body's immune system: *B lymphocytes* form in the *b*one marrow and release antibodies that fight bacterial infections; *T lymphocytes* form in the *t*hymus and other lymphatic tissue and attack cancer cells, viruses, and foreign substances.

Hundreds of experiments reveal the nervous and endocrine systems' influence on the immune system (Sternberg, 2009). You can think of the immune system as a complex surveillance system. When it functions properly, it keeps you healthy by isolating and destroying bacteria, viruses, and other invaders. Four types of cells are active in these search-and-destroy missions (**FIGURE 44.1**). Two are types of white blood cells, called **lymphocytes.** *B lymphocytes* mature in the *b*one marrow and release antibodies that fight bacterial infections. *T lymphocytes* form in the *t*hymus and other lymphatic tissue and attack cancer cells, viruses, and foreign substances—even "good" ones, such as transplanted organs. The third agent is the *macrophage* ("big eater"), which identifies, pursues, and ingests harmful invaders and worn-out cells. And, finally, the *natural killer cells* (NK cells) pursue diseased cells (such as those infected by viruses or cancer). Your age, nutrition, genetics, body temperature, and stress all influence your immune system's activity.

When your immune system doesn't function properly, it can err in two directions. Responding too strongly, it may attack the body's own tissues, causing some forms of arthritis or an allergic reaction. Underreacting, it may allow a dormant herpes virus to erupt or cancer cells to multiply. Women are immunologically stronger than men, making them less susceptible to infections, but this very strength also makes them more susceptible to self-attacking diseases, such as lupus and multiple sclerosis (Morell, 1995; Pido-Lopez et al., 2001).

Your immune system is not a headless horseman. The brain regulates the secretion of stress hormones, which suppresses the disease-fighting lymphocytes. Immune suppression appears when animals are stressed by physical restraints, unavoidable electric shocks, noise, crowding, cold water, social defeat, or separation from their mothers (Maier et al., 1994). One six-month study monitored immune responses in 43 monkeys (Cohen et al., 1992).

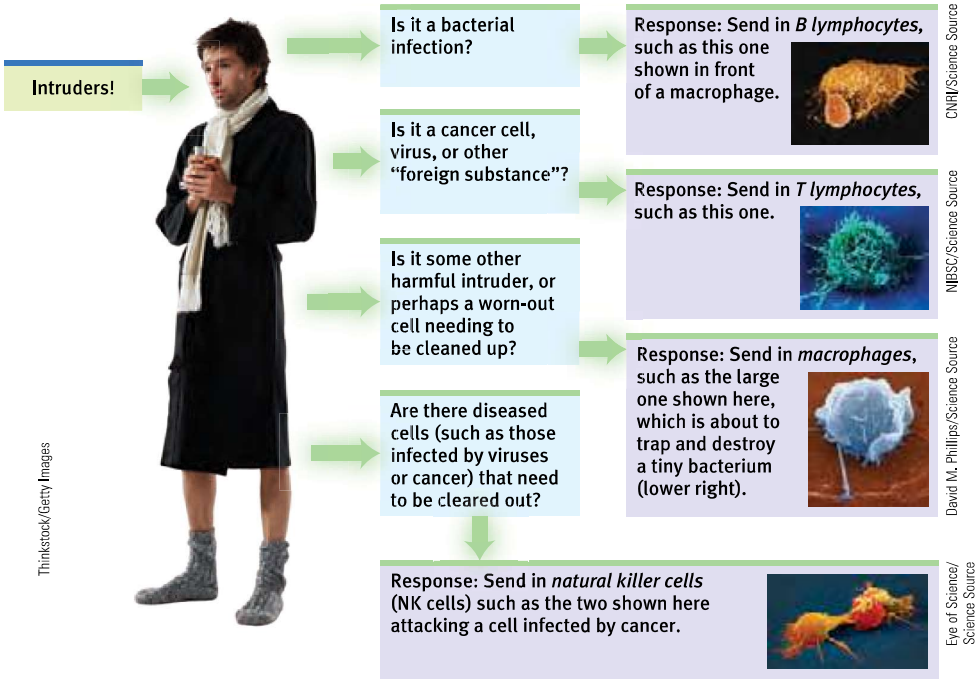


Figure 44.1
A simplified view of immune responses

Twenty-one were stressed by being housed with new roommates—three or four new monkeys—each month. By the end of the experiment, the socially disrupted monkeys' immune systems were weaker than those of monkeys left in stable groups. Human immune systems react similarly. Two examples:

- *Surgical wounds heal more slowly in stressed people.* In one experiment, dental students received punch wounds (precise small holes punched in the skin). Compared with wounds placed during summer vacation, those placed three days before a major exam healed 40 percent more slowly (Kiecolt-Glaser et al., 1998). Marriage conflict also slows punch-wound healing (Kiecolt-Glaser et al., 2005).
- *Stressed people are more vulnerable to colds.* Researchers dropped a cold virus into the noses of stressed and relatively unstressed people (**FIGURE 44.2**). Among those living stress-filled lives, 47 percent developed colds. Among those living relatively free of stress, only 27 percent did. In follow-up research, the happiest and most relaxed people were likewise markedly less vulnerable to an experimentally delivered cold virus (Cohen et al., 2003, 2006). Other studies reveal that major life stress increases the risk of a respiratory infection (Pedersen et al., 2010).

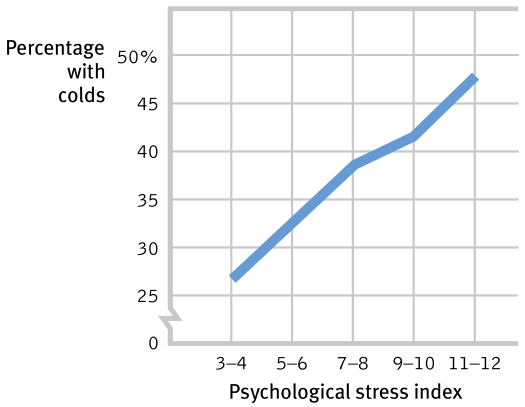


Figure 44.2
Stress and colds In an experiment by Sheldon Cohen and colleagues (1991), people with the highest life stress scores were also most vulnerable when exposed to an experimentally delivered cold virus.

The stress effect on immunity makes physiological sense. It takes energy to track down invaders, produce swelling, and maintain fevers. Thus, when diseased, your body reduces muscular energy output by inactivity and increased sleep. Stress does the opposite. It creates a competing energy need. During an aroused fight-or-flight reaction, your stress responses divert energy from your disease-fighting immune system and send it to your muscles and brain (see Figure 41.4). This renders you more vulnerable to illness. *The bottom line:* Stress does not make us sick, but it does alter our immune functioning, which leaves us less able to resist infection.

Let's consider some ways that stress might affect AIDS, cancer, and heart disease.

Photofusion/ UIG via Getty Images

Africa is ground zero for AIDS In Ghana, the Ministry of Health uses these informative billboards as part of prevention efforts.

Stress and Susceptibility to Disease

Stress and AIDS

We know that stress suppresses immune functioning. What does this mean for people with AIDS *(acquired immune deficiency syndrome)*? As its name tells us, AIDS is an immune disorder, caused by the *human immunodeficiency virus (HIV)*. AIDS has become the world's fourth leading cause of death and Africa's number one killer.

Ironically, if a disease is spread by human contact (as AIDS is, through the exchange of bodily fluids, primarily semen and blood), and if it kills slowly (as AIDS does), it can be lethal to more people. Those who acquire HIV often spread it in the highly contagious first few weeks before they know they are infected. Worldwide, some 2.6 million people—slightly more than half of them women—became infected with HIV in 2009, often without their awareness (UNAIDS, 2010). Years after the initial infection, when AIDS appears, people have difficulty fighting off other diseases, such as pneumonia. More than 25 million people worldwide have died of AIDS (UNAIDS, 2010). (In the United States, where "only" a half-million of these fatalities have occurred, AIDS has killed more people than did combat in all the twentieth-century wars.)

FYI

In North America and Western Europe, 74 percent of people with AIDS are men. In Sub-Saharan Africa, 60 percent of people with AIDS are women (UNAIDS, 2010).

Stress cannot give people AIDS. But could stress and negative emotions speed the transition from HIV infection to AIDS in someone already infected? Might stress predict a faster decline in those with AIDS? The answer to both questions seems to be *Yes* (Bower et al., 1998; Kiecolt-Glaser & Glaser, 1995; Leserman et al., 1999). HIV-infected men who experience stressful events, such as the loss of a partner, exhibit somewhat greater immune suppression and travel a faster course in this disease.

Would efforts to reduce stress help control the disease? Again, the answer appears to be *Yes.* Educational initiatives, bereavement support groups, cognitive therapy, relaxation training, and exercise programs that reduce stress have all had positive consequences for HIV-positive people (Baum & Posluszny, 1999; McCain et al., 2008; Schneiderman, 1999). But the benefits are small, compared with available drug treatments.

Although AIDS is now more treatable than ever before, preventing HIV infection is a far better option. This is the focus of many educational programs, such as the ABC (*a*bstinence, *b*eing faithful, *c*ondom use) program that has been used with seeming success in Uganda (Altman, 2004; USAID, 2004). In addition to such programs that seek to influence sexual norms and behaviors, today's "combination prevention" programs also include medical strategies (such as drugs and male circumcision that reduce HIV transmission) and efforts to reduce social inequalities that increase HIV risk (UNAIDS, 2010).

Stress and Cancer

Stress does not create cancer cells. But in a healthy, functioning immune system, lymphocytes, macrophages, and NK cells search out and destroy cancer cells and cancer-damaged cells. If stress weakens the immune system, might this weaken a person's ability to fight off cancer? To explore a possible connection between stress and cancer, experimenters have implanted tumor cells in rodents or given them *carcinogens* (cancer-producing substances). They then exposed some rodents to uncontrollable stress, such as inescapable shocks, which weakened their immune systems. Those rodents were indeed more prone to developing cancer (Sklar & Anisman, 1981). Their tumors developed sooner and grew larger than in nonstressed rodents.

Does this stress-cancer link also hold with humans? The results are mixed. Some studies find that people are at increased risk for cancer within a year after experiencing depression, helplessness, or bereavement (Chida et al., 2008; Steptoe et al., 2010). In one large Swedish study, the risk of colon cancer was 5.5 times greater among people with a history of workplace stress than among those who reported no such problems. This difference was not attributable to group differences in age, smoking, drinking, or physical characteristics (Courtney et al., 1993). Other studies, however, have found no link between stress and human cancer (Coyne et al., 2010; Petticrew et al., 1999, 2002). Concentration camp survivors and former prisoners of war, for example, do not have elevated cancer rates.

"I didn't give myself cancer."
-Mayor Barbara Boggs Sigmund (1939–1990), Princeton, New Jersey

One danger in hyping reports on emotions and cancer is that some patients may then blame themselves for their illness: "If only I had been more expressive, relaxed, and hopeful." A corollary danger is a "wellness macho" among the healthy, who take credit for their "healthy character" and lay a guilt trip on the ill: "She has cancer? That's what you get for holding your feelings in and being so nice." Dying thus becomes the ultimate failure.

It's important enough to repeat: *Stress does not create cancer cells.* At worst, it may affect their growth by weakening the body's natural defenses against multiplying malignant cells (Antoni & Lutgendorf, 2007). Although a relaxed, hopeful state may enhance these defenses, we should be aware of the thin line that divides science from wishful thinking. The powerful biological processes at work in advanced cancer or AIDS are not likely to be completely derailed by avoiding stress or maintaining a relaxed but determined spirit (Anderson, 2002; Kessler et al., 1991). And that explains why research consistently indicates that psychotherapy does not extend cancer patients' survival (Coyne et al., 2007, 2009; Coyne & Tennen, 2010).

FYI

When organic causes of illness are unknown, it is tempting to invent psychological explanations. Before the germ that causes tuberculosis (TB) was discovered, personality explanations of TB were popular (Sontag, 1978).

Stress and Heart Disease

44-2 Why are some of us more prone than others to coronary heart disease?

Stress is much more closely linked to **coronary heart disease,** North America's leading cause of death. In this disease, the blood vessels that nourish the heart muscle gradually close. Hypertension and a family history of the disease increase the risk of coronary heart disease. So do many behavioral factors (smoking, obesity, a high-fat diet, physical inactivity), physiological factors (an elevated cholesterol level), and psychological factors (stress responses and personality traits).

coronary heart disease
the clogging of the vessels that nourish the heart muscle; the leading cause of death in many developed countries.

In some classic studies, Meyer Friedman, Ray Rosenman, and their colleagues tested the idea that stress increases vulnerability to heart disease by measuring the blood cholesterol level and clotting speed of 40 U.S. male tax accountants at different times of year (Friedman & Rosenman, 1974; Friedman & Ulmer, 1984). From January through March, the test results were completely normal. Then, as the accountants began scrambling to finish their clients' tax returns before the April 15 filing deadline, their cholesterol and clotting measures rose to dangerous levels. In May and June, with the deadline past, the measures returned to normal. Stress predicted heart attack risk for these men. The researchers' hunch had paid off, launching a classic nine-year study of more than 3000 healthy men, aged 35 to 59.

FYI

In both India and America, Type A bus drivers are literally hard-driving: They brake, pass, and honk their horns more often than their more easygoing Type B colleagues (Evans et al., 1987).

Tony Freeman/Photo Edit

"The fire you kindle for your enemy often burns you more than him." -Chinese proverb

Type A Friedman and Rosenman's term for competitive, hard-driving, impatient, verbally aggressive, and anger-prone people.

Type B Friedman and Rosenman's term for easygoing, relaxed people.

At the start of the study, the researchers interviewed each man for 15 minutes, noting his work and eating habits, manner of talking, and other behavioral patterns. Those who seemed the most reactive, competitive, hard-driving, impatient, time-conscious, supermotivated, verbally aggressive, and easily angered they called **Type A.** The roughly equal number who were more easygoing they called **Type B.** Which group do you suppose turned out to be the most coronary-prone?

Nine years later, 257 men had suffered heart attacks, and 69 percent of them were Type A. Moreover, not one of the "pure" Type Bs—the most mellow and laid back of their group—had suffered a heart attack.

As often happens in science, this exciting discovery provoked enormous public interest. But after that initial honeymoon period, researchers wanted to know more. Was the finding reliable? If so, what is the toxic component of the Type A profile: Time-consciousness? Competitiveness? Anger?

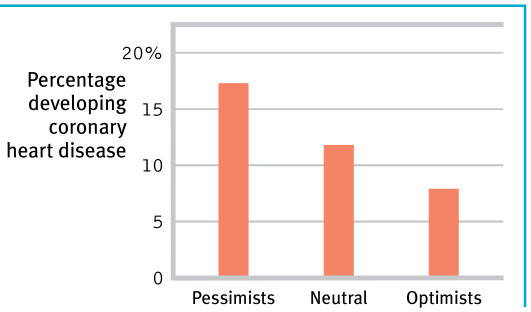
More than 700 studies have now explored possible psychological correlates or predictors of cardiovascular health (Chida & Hamer, 2008; Chida & Steptoe, 2009). These reveal that Type A's toxic core is negative emotions—especially the anger associated with an aggressively reactive temperament. As we will see in Module 83's discussion of anger, when we are harassed or challenged, our active sympathetic nervous system redistributes bloodflow to our muscles, pulling it away from our internal organs. One of those organs, the liver, which normally removes cholesterol and fat from the blood, can't do its job. Type A individuals are more often "combat ready." Thus, excess cholesterol and fat may continue to circulate in their blood and later get deposited around the heart. Further stress—sometimes conflicts brought on by their own abrasiveness—may trigger altered heart rhythms. In people with weakened hearts, this altered pattern can cause sudden death (Kamarck & Jennings, 1991). Hostility also correlates with other risk factors, such as smoking, drinking, and obesity (Bunde & Suls, 2006). In important ways, people's minds and hearts interact.

Hundreds of other studies of young and middle-aged men and women have confirmed the finding that people who react with anger over little things are the most coronary-prone. Suppressing negative emotions only heightens the risk (Kupper & Denollet, 2007). One study followed 13,000 middle-aged people for 5 years. Among those with normal blood pressure, people who had scored high on anger were three times more likely to have had heart attacks, even after researchers controlled for smoking and weight (Williams et al., 2000). Another study followed 1055 male medical students over an average of 36 years. Those who had reported being hot tempered were five times more likely to have had a heart attack by age 55 (Chang et al., 2002). As others have noted, rage "seems to lash back and strike us in the heart muscle" (Spielberger & London, 1982).

Pessimism seems to be similarly toxic. One study followed 1306 initially healthy men who a decade earlier had scored as optimists, pessimists, or neither. Even after other risk factors such as smoking had been ruled out, pessimists were more than twice as likely as optimists to develop heart disease (**FIGURE 44.3**) (Kubzansky et al., 2001).

Figure 44.3

Pessimism and heart disease A Harvard School of Public Health team found pessimistic men at doubled risk of developing heart disease over a 10-year period. (From Kubzansky et al., 2001.)



Depression, too, can be lethal. Happy people tend to be healthier and to outlive their unhappy peers (Diener & Chan, 2011; Siahpush et al., 2008). Even a big, happy smile predicts longevity, as Ernest Abel and Michael Kruger (2010) discovered when they examined the photographs of 150 Major League Baseball players who had appeared in the 1952 *Baseball Register* and had died by 2009. On average, the nonsmilers had died at 73, compared with an average 80 years for those with a broad, genuine smile.

Photo File/Getty Images

"A cheerful heart is a good medicine, but a downcast spirit dries up the bones." -PROVERBS 17:22

The accumulated evidence from 57 studies suggests that "depression substantially increases the risk of death, especially death by unnatural causes and cardiovascular disease" (Wulsin et al., 1999). After following 63,469 women over a dozen years, researchers found more than a doubled rate of heart attack death among those who initially scored as depressed (Whang et al., 2009). In the years following a heart attack, people with high scores for depression are four times more likely than their low-scoring counterparts to develop further heart problems (Frasure-Smith & Lesperance, 2005). Depression is disheartening.

Depressed people tend to smoke more and exercise less (Whooley et al., 2008), but stress itself is also disheartening:

- When following 17,415 middle-aged American women, researchers found an 88 percent increased risk of heart attacks among those facing significant work stress (Slopen et al., 2010).
- In Denmark, a study of 12,116 female nurses found that those reporting "much too high" work pressures had a 40 percent increased risk of heart disease (Allesøe et al., 2010).
- In the United States, a 10-year study of middle-aged workers found that involuntary job loss more than doubled their risk of a heart attack (Gallo et al., 2006). A 14-year study of 1059 women found that those with five or more trauma-related stress symptoms had three times the normal risk of heart disease (Kubzansky et al., 2009).

Research suggests that heart disease and depression may both result when chronic stress triggers persistent inflammation (Matthews, 2005; Miller & Blackwell, 2006). After a heart attack, stress and anxiety increase the risk of death or of another attack (Roest et al., 2010). As we have seen, stress disrupts the body's disease-fighting immune system, enabling the body to focus its energies on fleeing or fighting the threat. Yet stress hormones enhance one immune response, the production of proteins that contribute to inflammation. Thus, people who experience social threats, including children raised in harsh families, are more prone to inflammation responses (Dickerson et al., 2009; Miller & Chen, 2010). Inflammation fights infections; if you cut yourself, inflammation recruits infection-fighting cells. But persistent inflammation can produce problems such as asthma or clogged arteries, and worsen depression (see **FIGURE 44.4**). Researchers are now uncovering the molecular mechanisms by which stress, in some people, activates genes that control inflammation (Cole et al., 2010).

* * *

We can view the stress effect on our disease resistance as a price we pay for the benefits of stress (**FIGURE 44.5** on the next page). Stress invigorates our lives by arousing and motivating us. An unstressed life would hardly be challenging or productive.

Figure 44.4

Stress→inflammation→heart disease and depression

Gregory Miller and Ekin Blackwell (2006) report that chronic stress leads to persistent inflammation, which heightens the risk of both depression and clogged arteries.

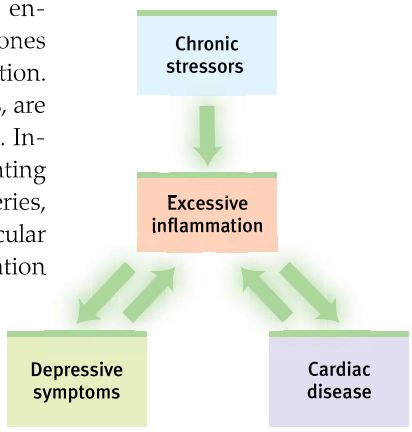


Figure 44.5

Stress can have a variety of health-related consequences This is especially so when stress is experienced by angry, depressed, or anxious people. Job and income loss caused by the recent economic recession has created stress for many people, such as this jobless Japanese man living in a Tokyo "capsule hotel."

Behavioral medicine research provides a reminder of one of contemporary psychology's overriding themes: *Mind and body interact; everything psychological is simultaneously physiological.* Psychological states are physiological events that influence other parts of our physiological system. Just pausing to *think* about biting into an orange section—the sweet, tangy juice from the pulpy fruit flooding across your tongue—can trigger salivation. As the Indian sage Santi Parva recognized more than 4000 years ago, "Mental disorders arise from physical causes, and likewise physical disorders arise from mental causes." There is an interplay between our heads and our health. We are biopsychosocial systems.

Before You Move On

▶ ASK YOURSELF

Are there changes you could make to avoid the persistent stressors in your life?

▶ TEST YOURSELF

Which component of the Type A personality has been linked most closely to coronary heart disease?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 44 Review

44-1 How does stress make us more vulnerable to disease?

- *Psychoneuroimmunologists* study mind-body interactions, including *psychophysiological* illnesses, such as hypertension and some headaches.
- Stress diverts energy from the immune system, inhibiting the activities of its *B* and *T lymphocytes,* macrophages, and NK cells.
- Stress does not cause diseases such as AIDS and cancer, but by altering our immune functioning it may make us more vulnerable to them and influence their progression.

44-2 Why are some of us more prone than others to coronary heart disease?

- *Coronary heart disease,* North America's number one cause of death, has been linked with the reactive, anger-prone *Type A* personality.
- Compared with relaxed, easygoing *Type B* personalities, Type A people secrete more of the hormones that accelerate the buildup of plaque on the heart's artery walls.
- Chronic stress also contributes to persistent inflammation, which heightens the risk of clogged arteries and depression.

Multiple-Choice Questions

1. Which of the following best identifies any stress-related physical illness, such as hypertension and some headaches?

a. Bacterial infection
b. Psychoneuroimmunology
c. Allergic reaction
d. Psychophysiological illness
e. Viral infection

2. What is North America's leading cause of death?

a. Psychosomatic disorders
b. Coronary heart disease
c. Cancer
d. Depression
e. Stroke

3. What did a famous Harvard University public health study identify as a factor that doubles the risk of heart disease?

a. Optimism
b. Apathy
c. Pessimism
d. Competitiveness
e. AIDS

Practice FRQs

1. Explain the two types of people identified by Friedman and Rosenman in their study on stress responses and personality traits.

Answer

1 point: Type A people are competitive, hard-driving, impatient, verbally aggressive, and anger prone.

1 point: Type B people are easygoing and relaxed.

2. Explain the difference between *B* lymphocytes and *T* lymphocytes.

(2 points)