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.

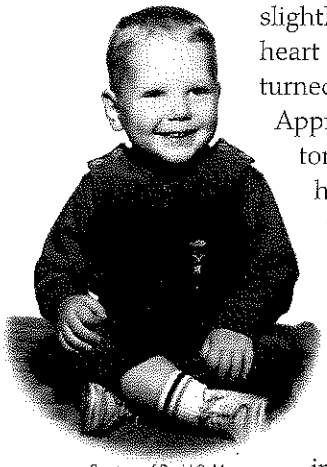
41-3 Describe the link between emotional arousal and the autonomic nervous system, and discuss the relationship between arousal and performance.

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.

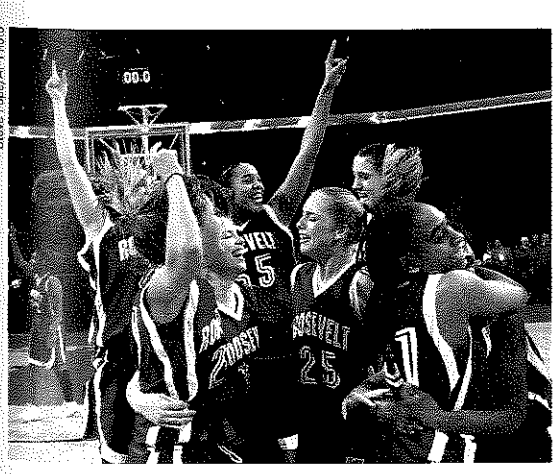
Historical Emotion Theories

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

4-12 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.

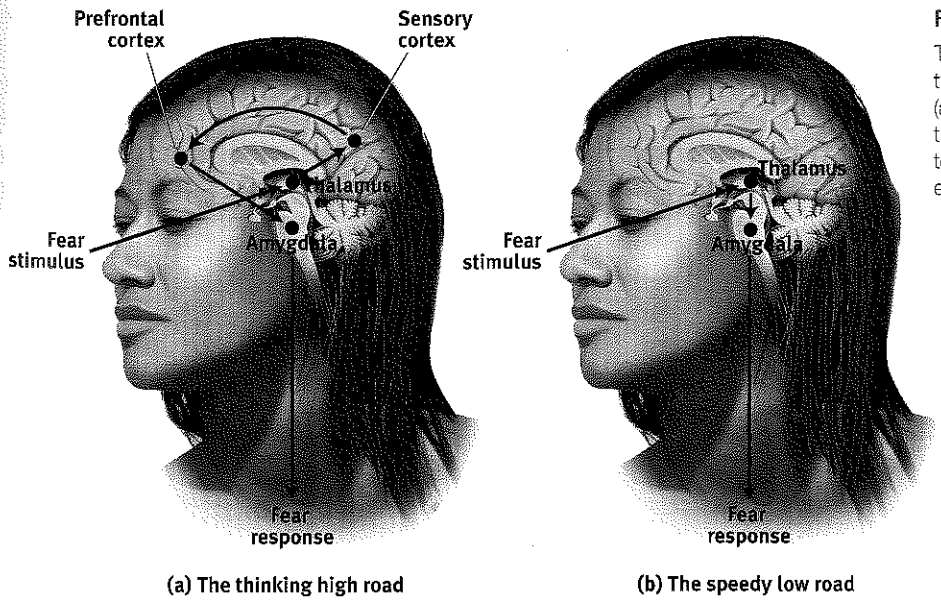


Figure 41.1

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.

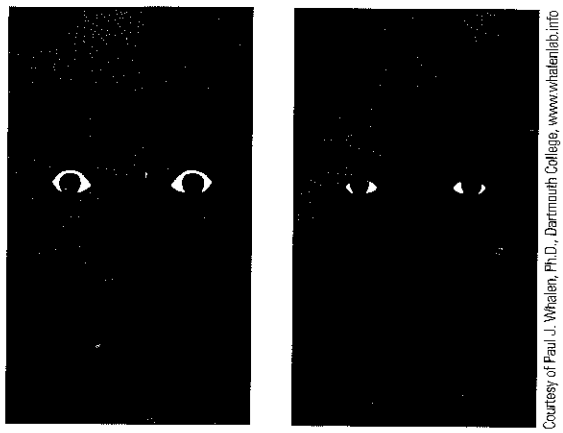


Figure 41.2
The brain's sensitivity to threats
Even when fearful eyes (left) were flashed too briefly for people to consciously perceive them, fMRI scans revealed that their hypervigilant amygdala was alerted (Whalen et al., 2004). The eyes on the right did not have this effect.

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.)

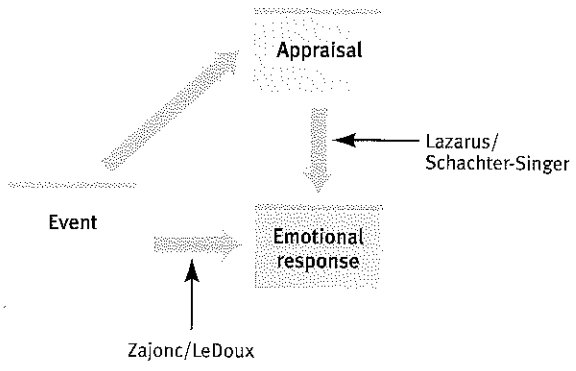


Figure 41.3
Two pathways for emotions
Zajonc and LeDoux have emphasized that some emotional responses are immediate, before any conscious appraisal. Lazarus, Schachter, and Singer emphasized that our appraisal and labeling of events also determine our emotional responses.

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.

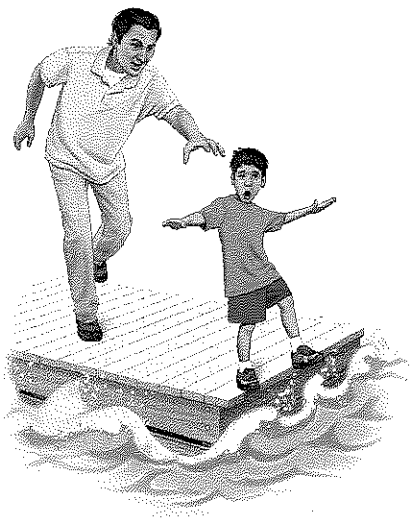
Embodied Emotion

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

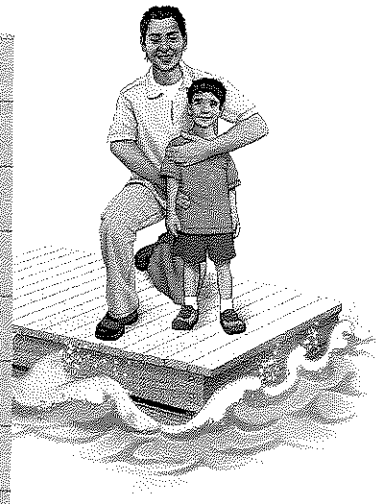


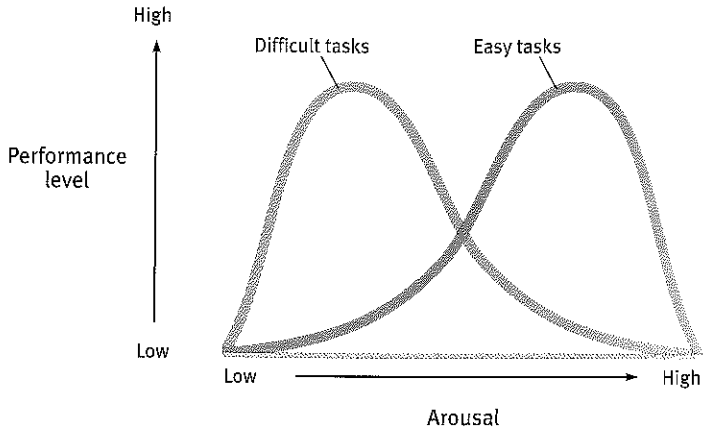
Figure 41.4
Emotional arousal Like a crisis control center, the autonomic nervous system arouses the body in a crisis and calms it when danger passes.

(**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?

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.

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.

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).

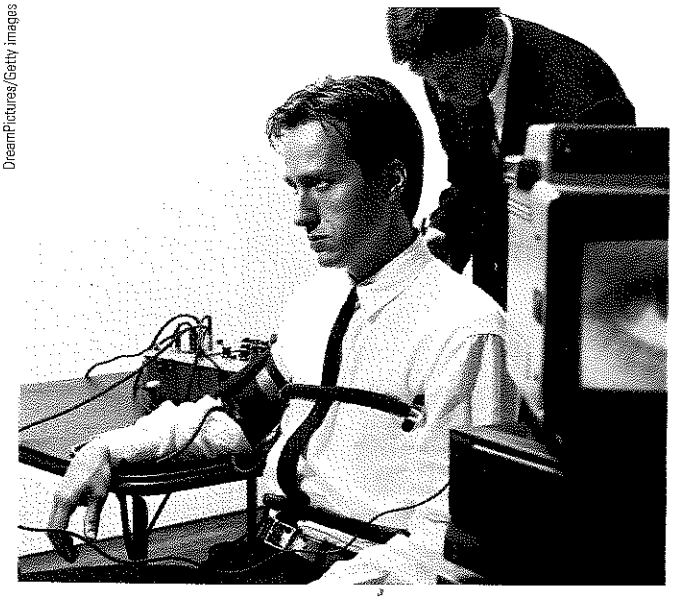
To sum up, we can't easily see differences in emotions from tracking heart rate, breathing, and perspiration. But facial expressions and brain activity can vary with the emotion. So, do we, like Pinocchio, give off telltale signs when we lie? For more on that question, see Thinking Critically About: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

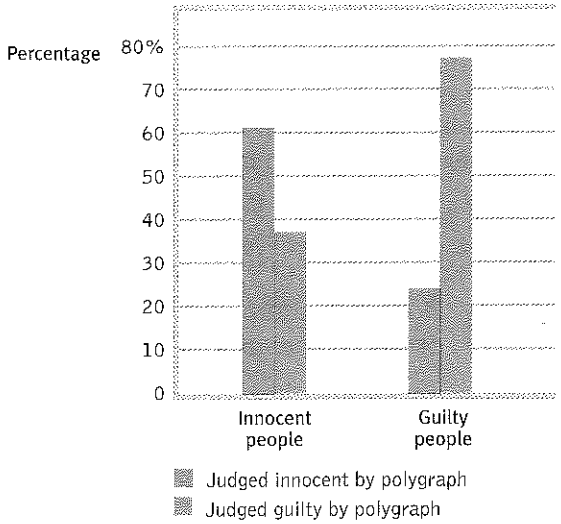
A 2002 U.S. National Academy of Sciences report noted that "no spy has ever been caught [by] using the polygraph." It is not for lack of trying. The FBI, CIA, and Departments of Defense and Energy in the United States have tested tens of thousands of employees, and polygraph use in Europe has also increased (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)