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BLOOD, SWEAT, AND TEARS

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"My love was so hot as mighty nigh to burst my boilers."

Davy Crockett, *A Narrative of the Life of David Crockett*.¹

IN SPITE OF THE benign neglect of the topic of emotion by cognitive science, scientists who study emotion have by no means ignored cognition. In fact, psychologists interested in emotion, seduced by the intellectual excitement and appeal of cognitive science, have for some time been preoccupied with attempts to explain emotions in terms of cognitive processes. By this way of thinking, an emotion is not different from a cognition—emotions are just thoughts about situations we find ourselves in. Although this approach has had its share of successes, these have come at a high price. In trading in the passion of an emotion for thoughts about it, cognitive theories have turned emotions into cold, lifeless states of mind. Lacking sound and fury, emotions as cognitions signify nothing, or at least nothing very emotional. Our emotions are full of blood, sweat, and tears, but you wouldn't know this from examining modern cognitive research on emotion. Emotion research wasn't always this way, so let's see how and why the transformation occurred.

Body Heat

Why do we run away if we notice that we are in danger? Because we are afraid of what will happen if we don't. This obvious (and incor-

rect) answer to a seemingly trivial question has been the central concern of a century-old debate about the nature of our emotions.

It all began in 1884 when William James published an article titled "What Is an Emotion?"² The article appeared in a philosophy journal called *Mind*, as there were no psychology journals yet. It was important, not because it definitively answered the question it raised, but because of the way in which James phrased his response. He conceived of an emotion in terms of a sequence of events that starts with the occurrence of an arousing stimulus and ends with a passionate feeling, a conscious emotional experience. A major goal of emotion research is still to elucidate this stimulus-to-feeling sequence—to figure out what processes come between the stimulus and the feeling.

James set out to answer his question by asking another: do we run from a bear because we are afraid or are we afraid because we run? He proposed that the obvious answer, that we run because we are afraid, was wrong, and instead argued that we are afraid because we run:

Our natural way of thinking about . . . emotions is that the mental perception of some fact excites the mental affection called emotion, and that this latter state of mind gives rise to the bodily expression. My thesis on the contrary is that the bodily changes follow directly the PERCEPTION of the exciting fact, and that our feeling of the same changes as they occur IS the emotion.³

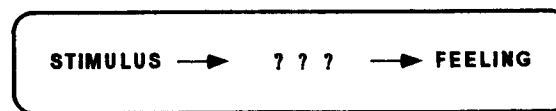


FIGURE 3-1
The Stimulus-to-Feeling Sequence.

Identification of the processes that intervene between the occurrence of an emotion-arousing stimulus and the conscious emotions (feelings) it elicits has been one of the major goals of emotion research. Unfortunately, this goal has often been pursued to the exclusion of some other equally important goals.

The essence of James' proposal was simple. It was premised on the fact that emotions are often accompanied by bodily responses (racing heart, tight stomach, sweaty palms, tense muscles, and so on) and that we can sense what is going on inside our body much the same as we can sense what is going on in the outside world. According to James, emotions feel different from other states of mind because they have these bodily responses that give rise to internal sensations, and different emotions feel different from one another because they are accompanied by different bodily responses and sensations. For example, when we see James' bear, we run away. During this act of escape, the body goes through a physiological upheaval: blood pressure rises, heart rate increases, pupils dilate, palms sweat, muscles contract in certain ways. Other kinds of emotional situations will result in different bodily upheavals. In each case, the physiological responses return to the brain in the form of bodily sensations, and the unique pattern of sensory feedback gives each emotion its unique quality. Fear feels different from anger or love because it has a different physiological signature. The mental aspect of emotion, the feeling, is a slave to its physiology, not vice versa: we do not tremble

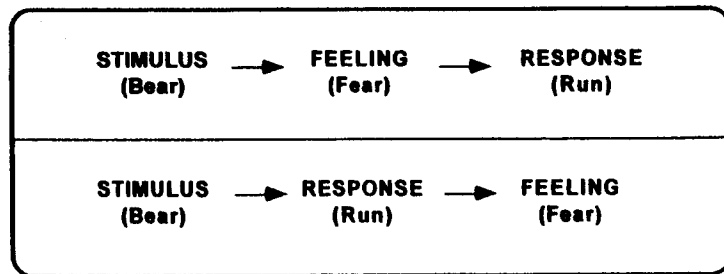


FIGURE 3-2
William James' Two Chains of Emotion.

The modern era in emotion research began when James asked whether feelings cause emotional responses or responses cause feelings. In answering that responses cause feelings, he started a century-old debate about where feelings come from. The question of what causes responses in the first place has, unfortunately, often been ignored.

STIMULUS → RESPONSE → FEEDBACK → FEELING

FIGURE 3-3
James' Feedback Theory.

James' solution to the stimulus-to-feeling sequence problem was that feedback from responses determine feelings. Since different emotions have different responses, the feedback to the brain will be different and will, according to James, account for how we feel in such situations.

because we are afraid or cry because we feel sad; we are afraid because we tremble and sad because we cry.

Fight or Flight

James' theory dominated the psychology of emotion until it was called into question in the 1920s by Walter Cannon, a prominent physiologist who had been researching the bodily responses that occur in states of hunger and intense emotion.⁴ Cannon's research led him to propose the concept of an "emergency reaction," a specific physiological response of the body that accompanies any state in which physical energy must be exerted. According to Cannon's hypothesis, the flow of blood is redistributed to the body areas that will be active during an emergency situation so that energy supplies, which are carried in the blood, will reach the critical muscles and organs. In fighting, for example, the muscles will need energy more than the internal organs (the energy used for digestion can be sacrificed for the sake of muscle energy during a fight). The emergency reaction, or "fight-or-flight response," is thus an adaptive response that occurs in anticipation of, and in the service of, energy expenditure, as is often the case in emotional states.

The bodily responses that make up the emergency reaction were believed by Cannon to be mediated by the sympathetic nervous system, a division of the autonomic nervous system (ANS). The ANS is a web of neural cells and fibers located in the body that controls the activity of the internal organs and glands, the so-called internal

milieu, in response to commands from the brain. The characteristic bodily signs of emotional arousal—like pounding hearts and sweaty palms—were known in Cannon's day to be the result of the activation of the sympathetic division of the ANS, which was believed to act in a uniform way, regardless of how or why it was activated. Given this supposed singularity of the sympathetic response mechanism, Cannon proposed that the physiological responses accompanying different emotions should be the same regardless of the particular emotional state that is experienced. As a result, James could not be right about why different emotions feel different, since all emotions, according to Cannon, have the same ANS signature.⁵ Cannon also noted that ANS responses are too slow to account for feelings—we're already feeling the emotion by the time these responses occur. So even if different emotions had different bodily signatures, these would be too slow to account for whether we feel love, hate, fear, joy, anger, or disgust in a particular situation. The answer to the riddle of emotion, according to Cannon, is found completely within the brain, and does not require that the brain "read" the bodily response, as James had said.⁶ We'll discuss the neural views espoused by James and Cannon in the next chapter, and we'll return to the issue of bodily feedback contributions to emotional experience in Chapter 9.

Cannon felt that while bodily feedback could not account for differences between emotions, it nevertheless played an important role, giving emotions their characteristic sense of urgency and intensity. Although James and Cannon disagreed about what distinguishes different emotions, they would seem to have agreed that emotions feel different from other (nonemotional) states of mind because of their bodily responses.

Passions as Reasons

During the behaviorists' reign in psychology, emotions, like other mental processes, were treated as ways of acting in certain situations.⁷ There was little or no effort to explain what gives rise to conscious emotional experiences, as these were not recognized as legitimate phenomena for scientific investigation. The stimulus-to-feeling sequence was simply not an issue. In fact, the concept of

emotion as a subjective state was often singled out by behaviorists as a prime example of the kind of fuzzy idea that needed to be dispensed with in a scientific psychology. It was one of the prime mental fictions, ghosts in the machine, created by psychologists to overcome their ineptness at explaining behavior.⁸

In the early 1960s, though, all this began to change. Stanley Schachter and Jerome Singer, social psychologists at Columbia University, revived the issue of where our feelings come from and proposed a new solution to the James-Cannon debate.⁹ Like James, Schachter and Singer suggested that bodily arousal or feedback was indeed crucial in the genesis of an emotional experience, but not quite in the way that James had proposed. And, like Cannon, they believed that physiological feedback lacked specificity. Riding the tide of the cognitive revolution, which had begun to penetrate deep into the heart and soul of most areas of psychology by this time, they argued that cognitions (thoughts) fill the gap between the nonspecificity of feedback and the specificity of felt experiences.

Schachter and Singer started with the assumption that physiological responses in emotion (sweaty palms, rapid heart beat, muscle tension) inform our brain that a state of heightened arousal exists. However, since these responses are similar in many different emotions they do not identify what kind of aroused state we are in. Schachter and Singer suggested that, on the basis of information about the physical and social context in which we find ourselves, as well as knowledge about what kinds of emotions occur in these particular kinds of situations, we label the aroused state as fear or love or sadness or anger or joy. According to Schachter and Singer, this labeling of the aroused state is what gives rise to and accounts for the specificity of felt emotion. In other words, emotional feelings result when we explain emotionally ambiguous bodily states to ourselves on the basis of cognitive interpretations (so-called attributions) about what the external and internal causes of the bodily states might be.

The major prediction from the Schachter-Singer theory was that if ambiguous physiological arousal was induced in human subjects it should be possible to bias the kind of emotion experienced by arranging the social context in which the arousal occurs. Schachter and Singer tested this hypothesis by giving subjects injections of adrenaline, a drug that induces physiological arousal by artificially

activating the sympathetic division of the ANS. The subjects were then exposed to either a pleasant, unpleasant, or emotionally neutral situation. As predicted, mood varied in accord with the context for the subjects given adrenaline but not for the control group that received placebo injections: adrenaline-treated subjects exposed to a joyful situation came out feeling happy, those exposed to an unpleasant situation came out feeling sad, and the neutral ones felt nothing in particular. Specific emotions were produced by the combination of artificial arousal and social cues. By inference, then, when emotionally ambiguous physiological arousal occurs naturally in the presence of real emotional stimuli, the aroused feeling is labeled on the basis of social cues. Emotions, in short, result from the cognitive interpretation of situations.

Stuart Valins, another social psychologist, performed a series of experiments to try to elucidate the nature of the cognition-arousal-emotion interaction.¹⁰ Subjects were given inaccurate information about how their body was responding to some situation. For example, Valins showed male subjects pictures of partially nude women. The subjects were at the same time listening to a sound that was supposed to be indicative of the rate at which their heart was beating. Valins manipulated the sounds independent of true heart beat so that some

STIMULUS → AROUSAL → COGNITION → FEELING

FIGURE 3-4

The Schachter-Singer Cognitive Arousal Theory.

Schachter and Singer, like Cannon, accepted that feedback is not specific enough to determine what emotion we feel in a given situation, but, like James they felt it was still important. Their idea was that feedback from bodily arousal is a good indicator that something significant is going on, even though it is not able to signal exactly what is happening. Once we detect bodily arousal (through feedback) we are then motivated to examine our circumstances. On the basis of our cognitive assessment of the situation, we then label the arousal. The labeling of arousal is what determines the emotion we feel. Cognitions thus fill the gap between the nonspecificity of bodily feedback and feelings for Schachter and Singer.

pictures were associated with high false heart rates and others with low rates. Later, the subjects judged as more attractive the pictures that had been associated with the high heart rate sounds, even though their actual heart rate was not high during exposure to these pictures. Valins concluded that in order for physiological activity to contribute to an emotional experience, the activity has to be represented cognitively. He argued that it is the cognitive representation of the physiological arousal, not the arousal itself, that interacts with thoughts about the situation in the generation of feelings.

The Schachter-Singer theory and the research that followed were criticized on many points.¹¹ The real impact of this work, though, was not so much that it explained where our emotions come from but instead that it revitalized an old notion, one that was implicit in the philosophical writings of Aristotle, Descartes, and Spinoza—that emotions might be cognitive interpretations of situations.¹² Schachter and Singer put the idea into a package that fit nicely into the cognitive pandemonium that was everywhere in psychology. The success of their efforts is exemplified by the fact that the psychology of emotion, to this day, is mostly about the role of cognition in emotion.

The Big Chill

Something was missing in the cognitive theory espoused by Schachter and Singer. They tried to explain how we deal with emotional responses once they occur (when you notice your heart beating and your forehead sweating as you begin to run away from a bear in the woods, you label the experience fear) but did not give an account of what generates the responses in the first place. Obviously, the brain has to figure out that the bear is a source of danger and has to arrange for the responses that are appropriate to danger to occur. The brain's emotional business is thus well underway by the time Schachter and Singer's mechanism kicks in. So what happens first? What makes us run from danger? What comes between the stimulus and the response? Cognitive evaluations, according to appraisal theorists, fill this gap.

The concept of appraisal was crystallized by Magda Arnold in an influential book on emotion published at about the same time that

Schachter and Singer were doing their experiments.¹³ She defined appraisal as the mental assessment of the potential harm or benefit of a situation and argued that emotion is the "felt tendency" toward anything appraised as good or away from anything appraised as bad. Although the appraisal process itself occurs unconsciously, its effects are registered in consciousness as an emotional feeling.

Arnold's interpretation of James' bear-in-the-woods story would go like this: we perceive the bear and appraise it unconsciously, and our conscious experience of fear results from the tendency to run. In contrast to James, for Arnold the response does not need to occur in order to have the feeling—a feeling only requires an action tendency rather than an actual action. Emotions thus differ from nonemotional states of mind by the presence of appraisals in their causal sequence, and different emotions are distinguished from one another because different appraisals elicit different action tendencies, which give rise to different feelings.

In Arnold's view, once the appraisal outcome is registered in consciousness as a feeling, it becomes possible to reflect back on the experience and describe what went on during the appraisal process. This is possible because, according to Arnold, people have introspective access to (conscious awareness of) the inner workings of their mental life, and in particular access to the causes of their emotions. Arnold's approach assumes that we can, after an emotional experience, gain access to the unconscious processes that gave rise to the emotion. As we will see, this assumption is open to challenge.

The appraisal concept was adopted by other researchers in the 1960s. One of these was Richard Lazarus, a clinical psychologist who used the concept to understand the way people react to and cope with stressful situations.¹⁴ Studies by Lazarus clearly showed that interpretations of situations strongly influence the emotion experienced. For example, in a classic experiment, subjects watched a gruesome film clip of a circumcision ritual involving teenage members of an aboriginal Australian tribe. For some subjects, the soundtrack verbally played up the gory details, whereas for others the episode was either minimized or intellectualized by the voice overlay. The group that had the first soundtrack, in which the gruesome details were emphasized, had stronger ANS responses and their self-reports suggested that they felt worse afterward than the other two

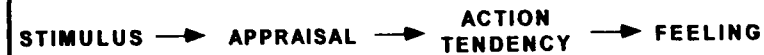


FIGURE 3-5
Arnold's Appraisal Theory.

Arnold argued that in order for a stimulus to produce an emotional response or an emotional feeling, the brain must first appraise the significance of the stimulus. Appraisals then lead to action tendencies. The felt tendency to move toward desirable objects and situations and away from undesirable ones is what accounts for conscious feelings in this model. Although appraisals can be either conscious or unconscious, we have conscious access to the appraisal processes after the fact.

groups, in spite of the fact that the arousing parts of the film were the same for all. Lazarus suggested that the different soundtracks caused the subjects to appraise the films in different ways and this led to different feelings about the situation. Lazarus argued that emotions can be initiated automatically (unconsciously) or consciously, but he emphasized the role of higher thought processes and consciousness, especially in coping with emotional reactions once they exist. Summarizing his position, he recently noted that "cognition is both a necessary and sufficient condition of emotion."¹⁵

Appraisal remains the cornerstone of contemporary cognitive approaches to emotion.¹⁶ In the tradition started by Arnold, most work in this field has proceeded under the assumption that the best way to find out about appraisals is the old-fashioned way—to ask the subjects to introspect and figure out what went through their minds when they had some past emotional experience. For example, in a seminal study of these *emotion-antecedent appraisal processes* by Craig Smith and Phoebe Ellsworth, people were asked to recall a past experience implied by emotion words (pride, anger, fear, disgust, happiness, etc.) and to rate the recalled experiences on different dimensions (pleasantness, effort involved, self-other involvement, attentional activity, controllability, etc.).¹⁷ They found that remembered experiences triggered by thoughts about emotion words could

be accounted for by the interplay of several different appraisals. For example, pride was characterized as occurring in situations involving pleasantness associated with little effort but much concentration of attention and personal responsibility, whereas anger involved unpleasantness associated with much effort, lack of control, and someone else being responsible. Smith and Ellsworth concluded that people's emotions are intimately related to their cognitive appraisals of their circumstances and that it is possible to gain insights into them by asking people to reflect back on what different emotions are like. These and other researchers assume that the kind of information that subjects use when they reflect back on an emotional experience is the same kind of information that the brain uses in creating the emotional experiences.¹⁸

To my mind, appraisal theories came very close to getting things right: the evaluation of a stimulus is clearly the first step in the initiation of an emotional episode; appraisals occur unconsciously; emotion involves action tendencies and bodily responses, as well as conscious experiences. But appraisal theories took two wrong turns on the road to understanding the emotional mind. First, they based their understanding of appraisal processes largely on self-reports—introspective verbal reflections. As we saw in the last chapter, introspection is often a blurry window into the workings of the mind. And if there is one thing about emotions that we know well from introspection, it is that we are often in the dark about why we feel the way we do. Second, appraisal theories overemphasized the contribution of cognitive processes in emotion, thereby diminishing the distinc-



FIGURE 3-6
General Purpose Appraisal Model.

Following Arnold, many psychologists today recognize the importance of appraisal processes in emotional phenomena, but they do not necessarily accept Arnold's equation of emotional feelings with action tendencies. The general-purpose appraisal model shown here thus simply suggests that appraisals fill the stimulus-to-feeling gap.

tion between emotion and cognition. Given that a major failing of cognitive science as a science of mind is its lack of concern with emotion (see Chapter 2), it is not too surprising that the cognitive approach to emotion suffers from the same problem—in emphasizing cognition as the explanation of emotion, the unique aspects of emotion that have traditionally distinguished it from cognition are left behind.

The Psychologist Who Came in from the Cold

By 1980, the cognitive approach to emotion was just about the only approach. But this began to change with the publication of a paper by social psychologist Robert Zajonc (pronounced, zy-unce).¹⁹ The paper was called "Feeling and Thinking: Preferences Need No Inferences." It very persuasively argued, on the basis of logic and clever experiments, that preferences (which are simple emotional reactions) could be formed without any conscious registration of the stimuli. This, he said, showed that emotion has primacy over (can exist before) and is independent of (can exist without) cognition. The net effect was a stall, rather than the demise, of the cognitive approach to emotion, as much appraisal research has occurred in the years following Zajonc's paper. Nevertheless, Zajonc had a major impact on the field, keeping alive the idea that an emotion is not just a cognition.

Zajonc summarized several experiments that he and his colleagues had performed using a psychological phenomenon, called the mere exposure effect, that he had discovered earlier. If subjects are exposed to some novel visual patterns (like Chinese ideograms) and then asked to choose whether they prefer the previously exposed or new patterns, they reliably tend to prefer the preexposed ones. Mere exposure to stimuli is enough to create preferences.

The twist to the new experiment was to present the stimuli subliminally—so briefly that the subjects were unable in subsequent tests to accurately state whether or not they had seen the stimulus before. Nevertheless, the mere exposure effect was there. The subjects judged the previously exposed items as preferable over the new (previously unseen) ones, in spite of the fact that they had little ability to consciously identify and distinguish the patterns that they had

seen from those that they had not. As Zajonc put it, these results go against common sense and against the widespread assumption in psychology that we must know what something is before we can determine whether we like it or not. If in some situations emotion could be present without recognition of the stimulus, then recognition could not be viewed as a necessary precursor to emotion.

The subliminal mere exposure effect has been confirmed by many different laboratories and the idea that preferences can be formed for stimuli that do not enter consciousness seems rock solid.²⁰ However, Zajonc's interpretation was controversial. He argued that the absence of conscious recognition meant that preferences (emotions) were forming without the aid of cognition—that emotion and cognition are separate functions of the mind. As we saw in Chapter 2, many information-processing functions that are considered prototypical examples of cognition also occur without conscious awareness. The absence of conscious recognition is not, strictly speaking, a useful basis for exclusion of cognition from emotional processing. At the same time, although Zajonc's studies did not prove that emotion and cognition are separable aspects of the mind, this does not mean that the opposite is correct, a point that we will return to at the end of the chapter.

Regardless of the relevance of Zajonc's subliminal mere exposure studies for understanding whether emotion depends on cognition, the experiments provided incontrovertible evidence that affective re-

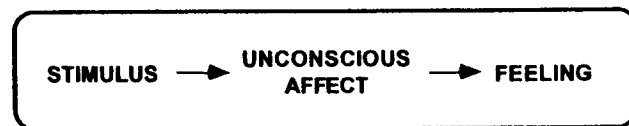


FIGURE 3-7
Zajonc's Affective Primacy Theory.

Contrary to much work in psychology, Zajonc has argued that affect precedes and occurs independent of cognition. This controversial hypothesis has been heatedly debated. What seems clear now is that emotional processing can occur in the absence of conscious awareness, but that this is a different issue from whether emotion and cognition are independent.

actions could take place in the absence of conscious awareness of the stimuli. Although some appraisal theories accept that appraisal is, or can be, unconscious, they have tended to also suggest that the individual has conscious access to the processes underlying appraisals (thus justifying the use of verbal reports to identify emotion-antecedent appraisal processes). If unconscious occurrences such as those found by Zajonc were commonplace, rather than esoteric outcomes of a clever experimental design, the conscious introspections that make up the database of appraisal theory would not be a very solid foundation for an understanding of the emotional mind.

The Emotional Unconscious

Zajonc was certainly not the first experimental psychologist to be interested in the emotional unconscious. There was a time, back around mid-century, when the emotional unconscious was quite the rage in psychology. It all began with the New Look movement,²¹ which challenged the stimulus-response view of perception espoused by the behaviorists. The New Look argued that perceptions are constructions that integrate sensory information about physical stimuli with internal factors, such as needs, goals, attitudes, and emotions. When New Look psychologists started doing experiments showing that subjects could have ANS responses to emotionally charged stimuli in the absence of conscious awareness of the stimuli (see below), it seemed as though the gap between two strange (if not estranged) bedfellows, psychology and psychoanalysis, might be closing.²² After all, the unconscious, and especially the emotional unconscious, is the linchpin of psychoanalytic theory.

After a brief period of enthusiastic reception, the unconscious perception studies of the New Look were extensively criticized and they were essentially dismissed. Unconscious perception just did not make sense to many psychologists, as there was no adequate framework for thinking about perception without awareness of the perceived stimulus. The cognitive movement and its emphasis on unconscious processing was knocking on the door, but psychology was still strongly behavioristic, and verbal responses were the primary behaviors of interest in research on humans. As one commentator,

Matthew Erdelyi of Brooklyn College, noted, there is a certain irony in this history.²³ Studies of unconscious processing were being buried at just the time that cognitive science was beginning to discredit the behaviorist preconceptions that made non-verbalizable perceptions seem impossible. But there is another irony here—that behaviorists, whose field was created to rid psychology of ghostly concepts like consciousness, should have befriended conscious introspections (verbal reports) as a method for validating psychological ideas.²⁴ Below, we will take a look at some early unconscious perception studies and the criticisms of them, and then turn to the new wave of research on this topic.

One of the major areas of research on unconscious processing to come out of the New Look involved *perceptual defense*, the demonstration that “dirty” words have a higher threshold for stimulus recognition than comparable words that lack sexual, scatological, or other taboo connotations. In a typical experiment, subjects were shown words on a screen. By varying the amount of time that the words were shown, it was possible to determine the amount of time a particular subject needed to recognize a given word. It was discovered that the exposure time required for “taboo” words (e.g., bitch, fuck, Kotex, cancer) was longer than for words lacking taboo connotations.²⁵ The results were interpreted in terms of Freudian defense mechanisms, particularly repression: the taboo words were perceived subconsciously and censored (prevented from entering consciousness) because their appearance in consciousness would have elicited anxiety.

A related line of work involved *subliminal perception*. One of the classic studies was performed by Richard Lazarus, before his appraisal theory days.²⁶ In that experiment, patterns of letters were briefly flashed on a screen using exposure durations that were determined to be too short to allow verbal identification. Some of the patterns had been previously paired with an electric shock in order to transform the meaningless letters into emotionally charged stimuli capable of eliciting ANS responses. When these conditioned emotional stimuli were presented subconsciously, but not when emotionally neutral stimuli occurred, the ANS responded, indicating that the emotional meaning of the conditioned stimuli had been registered, in

spite of the fact that the subjects reported no awareness of the stimuli (ANS responses have been a favorite in this kind of work since they do not depend on verbal processes and can thus be used to track emotions that occur in the absence of the ability to verbally describe the stimulus).

Marketing experts seized upon the implications of subliminal perception research, hoping to surreptitiously influence consumers to buy products. A theater in New Jersey, for example, gave audiences quick flashes of the phrase “Drink Coke” or “Eat popcorn” in order to promote visits to the concession stand.²⁷ Whether the tactic actually worked or not is not clear, but the public was outraged over this unethical act of manipulation and the invasion of privacy.²⁸ In point of fact, though, the advertising industry uses emotional cues (implicitly and explicitly) to persuade consumers to buy products all the time. Persuasion is, after all, their business, as Vance Packard noted in a famous book, *The Hidden Persuaders*.²⁹ Persuasion always works better when the persuadee is not aware that he or she is being influenced.³⁰ Implicit messages are the bread and butter of many advertising campaigns.

In spite of a great deal of initial interest in the theoretical implications of the perceptual defense and subliminal perception experiments, the interpretation of the results in terms of unconscious perception of emotional meaning was called into question by Charles Eriksen in the early 1960s.³¹ Eriksen believed that unconscious perception was a logical impossibility³² and he challenged this interpretation of the findings. He argued that the failure of the subjects in perceptual defense studies to verbally identify the taboo stimuli was due, not to the failure of the stimulus to enter consciousness, but to an unwillingness of the subjects to say these embarrassing words in public. And the inability of subjects in the subliminal perception experiments to verbally identify the secret stimuli was due, not to a failure to consciously perceive the stimuli, but to imperfections of verbal processes when it comes to accurately characterizing perceptual experiences.

Widespread acceptance of Eriksen's critique sealed research on the emotional unconscious into what seemed to be a coffin, but turned out to be a time capsule. After somewhat of a hiatus in the 1960s and 1970s, a new surge of interest in unconscious emotional

processes emerged, spurred on by Zajonc's studies and by Matthew Erdelyi's reinterpretation of the perceptual defense and subliminal perception work in terms of the principles of cognitive science.³³ Nevertheless, within the psychology of emotion, especially amongst the cognitively minded appraisal theorists, the emphasis has remained on the conscious, verbally accessible aspects of emotion. The evidence for the existence of unconscious aspects of emotion is often ignored or denied, or when accepted is given second billing to the conscious aspects. As several researchers who work on unconscious processes have stated, they are so busy trying to prove that unconscious processing exists that there is little time to actually explore how it works.³⁴ But due to the creation of new and improved techniques for studying unconscious processing,³⁵ the existence proofs now seem clear. Below I will review some of the evidence showing that emotional processing can take place outside of conscious awareness. Some of the work involves subliminal stimulation, whereas other studies utilize stimuli that are consciously perceived but their emotional implications are implicit and not noticed at the time the stimulus is seen or heard.

Zajonc's subliminal mere exposure studies were some of first to use the new techniques that made unconscious processing seem undeniable. In the wake of this research, many similar experiments were performed. In one particularly interesting variation by Robert Bornstein, subjects were brought into the laboratory and given very brief exposures to pictures of faces.³⁶ As expected, they were unable to identify which ones they had seen before, but when asked to rate how much they liked the pictures, the preexposed ones received more positive ratings. Mere exposure works for faces. In a second part of the study, the subjects were given brief (subliminal/unconscious) exposures to pictures of person A or of person B. Then, the subject, together with persons A and B, was asked to try to decide on the gender of the author of several poems. By a prearrangement unknown to the subject, A and B disagreed and the subject had to break the tie. As predicted by the mere exposure hypothesis, the subjects tended to side with the person whose face they had been unconsciously ex-

posed to. Familiarity does not necessarily breed contempt. Bornstein later performed what is called a "meta-analysis" of subliminal mere exposure research, which means he analyzed the published data from many different studies.³⁷ This led him to conclude that the mere exposure effect is much stronger when the stimuli are subliminally presented than when the stimuli are freely available for conscious inspection. This turns out to be a common finding in a number of different kinds of studies of unconscious emotional processing, and it emphasizes a point that we will see time and again—our emotions are more easily influenced when we are not aware that the influence is occurring.

The emotional unconscious has also been studied with a procedure called subliminal emotional priming that has been used extensively by Zajonc and several of his associates in recent years.³⁸ In this kind of experiment, a priming stimulus with some emotional connotation, such as a picture of a frowning or smiling face, is presented very briefly (5 milliseconds, or 1/200th of a second) and is immediately followed by a masking stimulus, which eliminates the subject's ability to consciously recall the prime—the mask displaces the prime from consciousness, essentially blanking it out. Following a delay, a target stimulus pattern is presented. It remains on a comfortable amount of time (seconds) and is consciously perceived. After seeing many patterns in this way, the subject is asked to rate how much they liked the target stimuli. Zajonc found that whether the subjects liked or disliked a stimulus (for example, a Chinese ideogram) was related to whether the stimulus was primed by an unconscious smile or frown. The target stimulus acquired emotional significance by virtue of its relationship with an emotional meaning activated subliminally by the unconsciously processed smile or frown. And, as in the mere exposure work, the emotional priming was much more effective for subliminal (masked, thus unconscious) presentations than for presentations that were not masked and where conscious awareness of the stimulus was possible.

And then there is the Pöetzl effect.³⁹ Otto Pöetzl, a Viennese psychiatrist, performed studies in 1917 in which a complex visual picture, like a landscape, was shown to subjects subliminally. He then asked the subjects to draw as much of the picture as possible. After-

ward, the subjects were instructed to go home and have a dream that night, and then come back the next day. When they returned to the laboratory, they were asked to report on the dream and draw pictures related to the dream. Pöetzl claimed that features of the original picture that were not included in the first drawing emerged in the drawing of the dream.

Matthew Erdelyi has profitably exploited the Pöetzl effect to explore the nature of unconscious processes.⁴⁰ In one study Erdelyi presented subjects with a complex visual scene for 500 milliseconds. This is not a subliminal presentation, as there is plenty time for parts of the stimulus to enter into awareness. The purpose of using this duration was to allow some but not all of the scene to be consciously perceived. In fact, though, you can get the same result by allowing the subject to just look at the picture freely since in any complex scene there will always be stimulus elements that are noticed and others that are not,⁴¹ and of those that are noticed some will be recalled and some not. In Erdelyi's study, after the flash, the subjects were then asked to draw as much of the scene as possible. Some then engaged in a period of free association and fantasy while others played a game of darts. They then made drawings of the picture again. Erdelyi found that the second drawings often reflected previously unremembered aspects of the stimulus for the subjects allowed to fantasize and free associate but not for the dart game group. Erdelyi calls this effect "hypermnnesia," by which he means an improvement in memory—the recovery of a previously inaccessible memory. Hypermnnesia has been shown by Erdelyi using his modified Pöetzl procedure and several other kinds of techniques, and he believes that the recovery of memory, by dreaming, and by fantasy and free association while awake, represents the release of memories from suppression by other factors.

Through therapeutic sessions with patients, psychoanalyst Howard Shevrin identified words related to their conscious experience of a symptom or to the unconscious conflict underlying the symptom.⁴² For example, a patient may come to the analyst complaining of being extremely uncomfortable in social situations. The patient is thus fully conscious of this social phobia, but does not consciously know the cause of the problem. After the analytic sessions, Shevrin came up



FIGURE 3-8
Hypermnnesia Stimulus:

*Complex visual scene used by Erdelyi to study the effects of fantasy and dreaming on memory recall. Subjects examined the picture briefly. The next day they were asked to recall as much as they could about the picture. See text for details. (From *Psychoanalysis: Freud's Cognitive Psychology* by Erdelyi. Copyright © 1985 by Mathew Hugh Erdelyi. Used with permission of W.H. Freeman and Company.)*

with a set of individually tailored words that he felt captured aspects of either the unconscious conflict or the conscious symptoms. He then presented them subliminally or openly to the patients while "brain waves" were recorded from their scalps. For the words related to the unconscious conflict (the underlying cause of the social phobia), the brain waves were more strongly elicited by subliminal presentations, whereas for the words related to the conscious symptom (fear of social situations), the brain waves were more strongly elicited when the stimuli were consciously perceived. Again, the emotional mind seems to be particularly susceptible to stimuli that its conscious counterpart does not have access to.

Finally, social psychologist John Bargh has performed many experiments showing that emotions, attitudes, goals, and intentions

can be activated without awareness, and that these can influence the way people think about and act in social situations.⁴³ For example, physical features (like skin color or hair length) are enough to activate racial or gender stereotypes, regardless of whether the person possessing the feature expresses any of the behavioral characteristics of the stereotype. This kind of automatic activation of attitudes occurs in a variety of different situations and appears to constitute our first reaction to a person. And once activated, these attitudes can influence the way we then treat the person, and can even have influences over our behavior in other situations. In one dramatic example, Bargh had subjects participate in what they thought was a language test. They were given words on cards and had to make sentences out of them. For some subjects, the sentences were about elderly people, whereas other subjects received sentences about other topics. After completing the task, the subjects left the room. Unbeknownst to them, the amount of time taken to walk down the hall to a designated location was timed by the experimenters. Remarkably, the subjects that had unscrambled sentences about elderly people took longer to cover the distance than the other subjects. The sentences did not include any specific statements about old people being slow or weak, but simply thinking (and pretty indirect thinking at that) about old people was enough to activate this stereotype and influence their behavior. In other studies subjects unscrambled sentences having to do with either "assertiveness" or "politeness." They were then told to walk down the hall and find the experimenter, who, by prearrangement, was involved in a conversation with someone. The amount of time the subjects waited before interrupting was recorded. Those primed with assertiveness interrupted sooner than those primed with politeness. Bargh notes that this automatic activation of unconscious processes has an upside and a downside. If we are nice to someone they may indeed be nice to us in return. On the other hand, if seeing someone from another racial group activates a negative attitude (e.g., that persons of that group are hostile and aggressive), we may act negatively toward them, prompting them in return to act negatively toward us, creating a vicious circle that further perpetuates the stereotype.

In the two studies described above, the priming stimuli were consciously available but their meanings were implicit. Nevertheless,

other studies show similar effects when the social primes are presented subliminally. Bargh argues that whether the subjects are aware of the priming stimulus is less critical than whether they are aware of the ways in which the stimuli are implicitly (without awareness) categorized and interpreted. The fact that emotions, attitudes, goals, and the like are activated automatically (without any conscious effort) means that their presence in the mind and their influence on thoughts and behavior are not questioned. They are trusted the way we would trust any other kind of perception. In other words, the perception in oneself of an attitude (disguised as fact) about a racial group can seem to be as valid as the perception of the color of their skin. When one is aware of biases and possesses values against having these, he or she can exercise control over them. However, the ability to do this depends on being aware of the unconscious influences, which is quite another matter. As cognitive psychologist Larry Jacoby asks and answers: "When are unconscious influences expected to have their largest effects? . . . When you least expect them."⁴⁴ According to Bargh, a goal of social psychology should be to make people aware of these nonintuitive, scientifically discovered unconscious factors that affect thought and behavior. But he admits that this is an uphill battle: "Inasmuch as people check such a proposition against their own phenomenal experience to test its validity, we will never be persuasive, because by definition one can never have any phenomenal experience of perception without awareness."⁴⁵

As we look back on almost a half a century of research on unconscious processing, it is fair to say that some of the early studies may indeed not have used techniques that allow one to completely rule out the possibility of some awareness of the stimuli. But science is progressive, and the mistakes of the past are part of the wisdom of the present. We have learned a great deal about how subliminal perception research should be conducted and interpreted, and research today has higher standards of what counts as an unconscious perception.⁴⁶ When we apply the new, clever, and strict ways of evaluating whether information processing takes place unconsciously, we still reach the conclusion that emotional meanings can be processed at subconscious levels. Just because the research methods of the past

may have lacked perfection does not mean that the results were wrong. It now seems undeniable that the emotional meanings of stimuli can be processed unconsciously. The emotional unconscious is where much of the emotional action is in the brain.⁴⁷

A Reappraisal

From James onward an important gap was left in the causal chain leading to emotional responses and emotional experiences, and something like appraisal was needed. The gap occurs between the arrival of the emotion-provoking stimulus and the resulting physiological responses and/or feelings. In James' theory, the perception of the stimulus automatically (without conscious participation) produces the responses that provide the feedback that defines the feeling. But not all stimuli that are perceived do this. Something else has to happen. The physical features of the stimulus have to be evaluated—appraised; their significance to the individual has to be determined. It is this computed significance that starts the emotion ball rolling. This is the case for all of the theories that have been described. The brain has to evaluate a stimulus and decide whether that stimulus should be ignored or should lead to some reaction. Appraisal, in other words, fills the gap between stimuli and responses and between stimuli and feelings. But, in my view, appraisal theories did not quite get it right, as they required that the appraisal mechanism get all involved in introspectively accessible levels of higher cognition from the start.

The inadequacy of any approach to emotion based solely or mainly on introspectively accessible aspects of the mind is apparent from the experimental studies described above showing that much of emotional processing occurs (or can occur) unconsciously, as well as by the fact that people often find their emotions puzzling. Consciously accessible appraisal processes cannot be the way, or at least not the only way, the emotional brain works. Even when we are conscious of the outcome of some emotional appraisal (for example, knowing that you dislike someone), this does not mean that you consciously understand the basis of the appraisal (knowing why you dislike the person). The conscious outcome might be based on

nonverbalizable intuitions, so-called gut feelings,⁴⁸ rather than on some verbalizable set of propositions.

Proponents of folk psychology (a kind of introspective psychology), argue that people know what is in their minds and they use this information all the time.⁴⁹ They point out that people are very good at accounting for their mental life and behavior on the basis of self-knowledge and their general understanding of the way other people's minds work. For example, if I say I will pick up my son at school at a certain time, chances are I will do it. If I see you arguing with your spouse, chances are I'll be correct if I assume you are mad. The folk psychologist says that examples like this add proof to the idea that age-old wisdom constitutes a scientifically correct theory of mind that we all have in our heads. But even though I am consciously aware of my decision to pick my son up and may even consciously remember to carry out the plan, this does not mean that I know how I remembered to do it. And even though I may be correct when I decide you are angry, that does not mean that I know how I made my decision or that I know what it is in your brain that accounts for your anger. The biologist Stephen J. Gould makes a good point: "Science is not 'organized common sense'; at its most exciting, it reformulates our view of the world by imposing powerful theories against the ancient, anthropocentric prejudices that we call intuition."⁵⁰ When I say I'm angry, I may be, but I might also be wrong. I might really be afraid or jealous or some combination of all of these. Donald Hebb pointed out long ago that outside observers are far more accurate at judging a person's true emotional state than is the person himself.⁵¹ I'm not denying that people are consciously aware of certain things and that they can consciously do things. All I'm saying is that some, perhaps many, of the things we do, including the appraisal of the emotional significance of events in our lives and the expression of emotional behaviors in response to those appraisals, do not depend on consciousness, or even on processes that we necessarily have conscious access to.

Noting that emotions can sometimes be puzzling, the philosopher Amelie Rorty makes a distinction between the apparent cause of an emotion (the stimuli immediately available and consciously perceived) and the actual cause.⁵² The real cause of an emotion is not

necessarily some immediately present stimuli, but instead may involve the interaction of these with a causal history stored in memory. As we have seen, unnoticed events can activate memories, including emotional memories, implicitly (without awareness), and implicit and undetected meanings of consciously perceived stimuli can do the same. A father who yells at his children may rationalize his outburst by saying that the children were misbehaving. But the outburst may also be due in part to the fact that he had a bad day at the office, or even to the way his parents treated him as a child, and at the time he may not be consciously aware of these influences at all. The cause of an emotion can, in other words, be very different from the reasons we use to explain the emotion to ourselves or others after the fact. Appraisal theories have dealt with reasons rather than causes.

Two of the leading appraisal theorists, Nico Frijda and Klaus Scherer, have both recently acknowledged significant limitations of the research foundation of much of cognitive appraisal. Frijda says: "investigating the relationships between appraisals and emotion labels is research into emotion word meanings or into the structures of experience, as distinct from research that qualifies as investigation of emotion antecedents. . . . Emotions may well result from appraisal processes, but these need not be those suggested by the self reports."⁵³ Along similar lines, Scherer says that the emphasis of appraisal research on mapping emotion words onto emotion experiences has left the field concentrating on the content of experiences and the way experiences are verbally labeled to the exclusion of the true processes that give rise to appraisals.⁵⁴ And in an insightful discussion of unconscious processes, Kenneth Bowers makes the interesting point that if our understanding of the causation of thought and action were directly available to introspection, we would not need the field of psychology.⁵⁵ Indeed, it was the inadequacy of introspection that led to behaviorism, and the success of cognitive science as an alternative to behaviorism is due in large measure to its ability to investigate the mind without relying exclusively or mainly on introspection.

Some appraisals lead to conscious awareness of the appraisal outcome, whereas others do not. Introspections are often going to be a poor window into how processing that gives rise to conscious content

works and are no window at all into processing that does not give rise to immediate conscious content. Although cognitive appraisal theorist Richard Lazarus has emphasized conscious appraisal processes in emotions, he has always accepted that unconscious appraisals occur and recently he argued: "although it is a daunting task, I believe we must . . . find effective ways of exploring what lies below the surface, how it relates to what is in awareness, and how it influences the entire emotion process."⁵⁶ Similarly, Klaus Scherer recently challenged his colleagues who study human appraisal processes to rely more on techniques that do not depend on verbal reports. Scherer also suggests that appraisal researchers turn to brain science to try to validate mechanisms that psychologists uncover.⁵⁷ I go one step further and argue that we might turn to brain research to find novel mechanisms that psychologists have not thought of or to find novel interpretations of existing mechanisms.

Introspective understanding of the causes of emotion states can be weak, especially when people are asked to reflect back on an episode after it is over.⁵⁸ And even if they are asked right away they may still not know the actual cause. There is much more to explain about an emotion than what one can get at from retrospective consciously accessible thoughts about the situation. But this does not mean that introspection is useless. There are some kinds of mental events that we have introspective access to and others that we do not. The trick, obviously, is to figure out where the dividing line is. However, the line is both thin and fuzzy—it may not be in the same place in different people and in a given individual it may move from moment to moment.⁵⁹ There is much to be learned about conscious experience by studying introspections. But if emotions reflect processes that also occur unconsciously, as it seems they do, then we need to take these into consideration as well.

Emotion and Cognition: Two Sides of the Same Coin, or Different Currency?

So far I have tried to present a strong case for the argument that much emotional processing occurs unconsciously and therefore that

there is more to an emotion than what we can glean from our introspections about it. But the same argument was made about cognition in the previous chapter—that not all aspects of thinking, reasoning, problem solving, and intelligence can be understood on the basis of introspections. Given that emotional and cognitive processing both largely occur unconsciously, it is possible that emotional and cognitive processing are the same, or, as it is usually said, that emotion is just a kind of cognition.

There is a benign and a not-so-benign version of the idea that emotion is a kind of cognition. In both versions, the terms “cognitive” and “mental” are used interchangeably. This is clearly a departure from the approach of early cognitive scientists, who saw cognition as the part of the mind having to do with thinking and reasoning, but not with emotion and some other mental processes like motivation and personality (see Chapter 2).

In the benign version, the boundaries of cognition are moved so that, in addition to including thinking, reasoning, and intelligence, it also includes emotion. In this scheme, nothing fundamental changes in the way emotion is conceived—cognition and emotion are given equal billing in a field that studies both. This is simply a semantic issue about what the mind, and its science, should be called. I prefer the term “mind science” over “cognitive science” for this all-encompassing approach to the mind. Although this is somewhat a matter of preference, it is not an idle one. It is an attempt to prevent one from sliding from the benign to the not-so-benign version, in which emotion is perversely reconceived as thinking and reasoning.

In the not-so-benign version, then, “cognitive” and “mental” are equated by squeezing emotion into the traditional view of cognition—cognition as thinking and reasoning. This, as we have seen, is the unfortunate way the study of emotion has gone since the early 1960s—the essence of an emotion has been altered in order that emotions could be conceived as reasoned thoughts about situations. It is this trend that Zajonc was reacting to when he proposed that emotion and cognition should be kept separate. But the heated debate over the relation of emotion to cognition got caught up in a variety of technical issues and this broader concern was lost.⁶⁰

My desire to protect emotion from being consumed by the cog-

nitive monster comes from my understanding of how emotion is organized in the brain. Although the brain organization of emotion is the subject of other chapters, I will summarize several key points that justify my belief that emotion and cognition are best thought of as separate but interacting mental functions mediated by separate but interacting brain systems.

- When a certain region of the brain is damaged, animals or humans lose the capacity to appraise the emotional significance of certain stimuli without any loss in the capacity to perceive the same stimuli as objects. The perceptual representation of an object and the evaluation of the significance of an object are separately processed by the brain.
- The emotional meaning of a stimulus can begin to be appraised by the brain before the perceptual systems have fully processed the stimulus. It is, indeed, possible for your brain to know that something is good or bad before it knows exactly what it is.
- The brain mechanisms through which memories of the emotional significance of stimuli are registered, stored, and retrieved are different from the mechanisms through which cognitive memories of the same stimuli are processed. Damage to the former mechanisms prevents a stimulus with a learned emotional meaning from eliciting emotional reactions in us, whereas damage to the latter mechanism interferes with our ability to remember where we saw the stimulus, why we were there, and who we were with at the time.
- The systems that perform emotional appraisals are directly connected with systems involved in the control of emotional responses. Once an appraisal is made by these systems, responses occur automatically. In contrast, systems involved in cognitive processing are not so tightly coupled with response control systems. The hallmark of cognitive processing is flexibility of responses on the basis of processing. Cognition gives us choices. In contrast, activation of appraisal mechanisms narrows the response options available to a few choices that evolution has had the wisdom to connect up with the particu-

lar appraisal mechanism. This linkage between appraisal process and response mechanisms constitutes the fundamental mechanism of specific emotions.

- The linkage of appraisal mechanisms with response control systems means that when the appraisal mechanism detects a significant event, the programming and often the execution of a set of appropriate responses will occur. The net result is that bodily sensations often accompany appraisals and when they do they are a part of the conscious experience of emotions. Because cognitive processing is not linked up with responses in this obligatory way, intense bodily sensations are less likely to occur in association with mere thoughts.

The conversion of emotions into thoughts has allowed emotion to be studied using the tools and conceptual foundations of cognitive science. There are now numerous computer simulations of appraisal and other emotional processes⁶¹ and some proponents of this AI approach to emotion believe that emotions can be programmed in computers.⁶² The following limerick spun by an AI researcher summarizes the beliefs and hopes of the field:

*A computer so stolid and stern
Can simulate man to a turn.
Though it lacks flesh and bones
And erogenous zones,
It can teach—but, oh can man learn?*⁶³

Simulations do indeed have much to offer as an approach to modeling aspects of the mind. However, as the next limerick (though tasteless) reminds us, minds feel as well as think, and feelings involve more than thinking.

*There was once an ardent young suitor
Who programmed a female computer,
But he failed to connect
The affective effect,
So there wasn't a thing he could do to 'er.*⁶⁴

And, finally, we are also reminded by a limerick that there may be some things that a computer just can't do. This limerick needs to be

prefaced with a reminder that in the old days computers were fed information on cards with holes punched out of them that were read by special sensing devices, and that some aspects of computer memory were stored on endless spools of magnetic tape.

*There was once a passionate dame
Who wanted some things made plain,
So she punched up the cards,
Filled tape by the yards,
But—somehow—it just wasn't the same!*⁶⁵

Where Do We Go from Here?

I have tried to make a clear statement about what emotion is not. It is not merely a collection of thoughts about situations. It is not simply reasoning. It cannot be understood by just asking people what went on in their minds when they had an emotion.

Emotions are notoriously difficult to verbalize. They operate in some psychic and neural space that is not readily accessed from consciousness. Psychiatrists' and psychologists' offices are kept packed for this very reason. Yet, much of our understanding of the way the emotional mind works has been based on studies that have used verbal stimuli as the gateway to emotions or verbal reports to measure emotions.

Consciousness and its sidekick, natural language, are new kids on the evolutionary block—unconscious processing is the rule rather than the exception throughout evolution. And the coin of the evolutionarily old unconscious mental realm is nonverbal processing. Given that so much work on unconscious processing (cognitive and emotional) has focused on verbal processes, we probably have a highly inaccurate picture of the level of sophistication of unconscious processes in humans. And we will not likely begin to fully understand the workings of human unconscious processes until we turn away from the use of verbal stimuli and verbal reports.

It is a testament to human vanity and linguistic chauvinism that the ancestral functions of the brain are characterized as the negation of newly evolved ones. Animals were unconscious and nonverbal long before they were conscious and verbal. Fortunately, ancestral func-

tions, like certain emotional processing functions, are preserved in the human brain, and we can turn to studies of animals to discover how these work in humans as well.

Obviously, we cannot explain everything about human emotions by studying animals. But, as I hope to show you, we have been able to come to a very good understanding of some basic emotional mechanisms that are common to humans and other animals. With this information in hand, we are in a much better position to understand how newly evolved functions, like language and consciousness, contribute to emotions, and particularly how language and consciousness interact with the underlying nonverbal and unconscious systems that make up the heart and soul of the emotional machine.

4

THE HOLY GRAIL



The brain is my second favorite organ.

Woody Allen¹

A MAJOR GOAL OF modern brain science is to figure out in as much detail as possible where different functions live in the brain. Knowing “where” a function is located is the first step toward understanding “how” it works. Not surprisingly, emotions are functions that scientists have traditionally been interested in localizing in the brain.

For more than a century, crusades have been made through the cerebral promised land in search of the emotional Holy Grail, the brain region or network that will explain where guilt and shame and fear and love come from. Around mid-century it seemed that the prize was finally in hand when the limbic system theory of emotion was proposed.² This remarkable conception gave an explanation of emotional life in terms of a brain network that evolved to subserve functions necessary for the survival of the individual and species. The limbic system theory claimed nothing short of having found the physical basis of the Freudian id.

But by the early 1980s, very little research on the brain mechanisms of emotion was being conducted. No doubt, the extension of the cognitive revolution (which excluded emotion as a research topic) into brain science contributed to this, but so too did the apparent thoroughness of the limbic system theory as an account of emotion. The emotional brain seemed, at least in general terms, to be understood.

It would be hard to overestimate the impact of the limbic system concept. It had a tremendous influence not only on the way we think