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Anatomy of an Emotional Hijacking

Life is a comedy for those who think and a tragedy for those who feel.

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It was a hot August afternoon in 1963, the same day that the Rev. Martin Luther King, Jr., gave his "I Have a Dream" speech to a civil rights march on Washington. On that day Richard Robles, a seasoned burglar who had just been paroled from a three-year sentence for the more than one hundred break-ins he had pulled to support a heroin habit, decided to do one more. He wanted to renounce crime, Robles later claimed, but he desperately needed money for his girlfriend and their three-year-old daughter.

The apartment he broke into that day belonged to two young women, twenty-one-year-old Janice Wylie, a researcher at *Newsweek* magazine, and twenty-three-year-old Emily Hoffert, a grade-school teacher. Though Robles chose the apartment on New York's swanky Upper East Side to burglarize because he thought no one would be there, Wylie was home. Threatening her with a knife, Robles tied her up. As he was leaving, Hoffert came home. To make good his escape, Robles began to tie her up, too.

As Robles tells the tale years later, while he was tying up Hoffert, Janice Wylie warned him he would not get away with this crime: She would remember his face and help the police track him down. Robles, who had promised himself this was to have been his last burglary, panicked at that, completely losing control. In a frenzy, he grabbed a soda bottle and clubbed the women until they were unconscious, then, awash in rage and fear, he slashed and stabbed them over and over with a kitchen knife. Looking back on that moment some twenty-five years later, Robles lamented, "I just went bananas. My head just exploded."

To this day Robles has lots of time to regret those few minutes of rage unleashed. At this writing he is still in prison, some three decades later, for what became known as the "Career Girl Murders."

Such emotional explosions are neural hijackings. At those moments, evidence suggests, a center in the limbic brain proclaims an emergency, recruiting the rest of the brain to its urgent agenda. The hijacking occurs in an instant, triggering this reaction crucial moments before the neocortex, the thinking brain, has had a chance to glimpse fully what is happening, let alone decide if it is a good idea. The hallmark of such a hijack is that once the moment passes, those so possessed have the sense of not knowing what came over them.

These hijacks are by no means isolated, horrific incidents that lead to brutal crimes like the Career Girl Murders. In less catastrophic form—but not necessarily less intense—they happen to us with fair frequency. Think back to the last time you "lost it," blowing up at someone—your spouse or child, or perhaps the driver of another car—to a degree that later, with some reflection and hindsight, seemed uncalled for. In all probability, that, too, was such a hijacking, a neural takeover which, as we shall see, originates in the amygdala, a center in the limbic brain.

Not all limbic hijackings are distressing. When a joke strikes someone as so uproarious that their laughter is almost explosive, that, too, is a limbic response. It is at work also in moments of intense joy: When Dan Jansen, after several heartbreaking failures to capture an Olympic Gold Medal for speed skating (which he had vowed to do for his dying sister), finally won the Gold in the 1,000-meter race in the 1994 Winter Olympics in Norway, his wife was so overcome by the excitement and happiness that she had to be rushed to emergency physicians at rinkside.

THE SEAT OF ALL PASSION

In humans the amygdala (from the Greek word for "almond") is an almond-shaped cluster of interconnected structures perched above the brainstem, near the bottom of the limbic ring. There are two amygdalas, one on each side of the brain, nestled toward the side of the head. The human amygdala is relatively large compared to that in any of our closest evolutionary cousins, the primates.

The hippocampus and the amygdala were the two key parts of the primitive "nose brain" that, in evolution, gave rise to the cortex and then the neocortex. To this day these limbic structures do much or most of the

brain's learning and remembering; the amygdala is the specialist for emotional matters. If the amygdala is severed from the rest of the brain, the result is a striking inability to gauge the emotional significance of events; this condition is sometimes called "affective blindness."

Lacking emotional weight, encounters lose their hold. One young man whose amygdala had been surgically removed to control severe seizures became completely uninterested in people, preferring to sit in isolation with no human contact. While he was perfectly capable of conversation, he no longer recognized close friends, relatives, or even his mother, and remained impassive in the face of their anguish at his indifference. Without an amygdala he seemed to have lost all recognition of feeling, as well as any feeling about feelings.[1] The amygdala acts as a storehouse of emotional memory, and thus of significance itself; life without the amygdala is a life stripped of personal meanings.

More than affection is tied to the amygdala; all passion depends on it. Animals that have their amygdala removed or severed lack fear and rage, lose the urge to compete or cooperate, and no longer have any sense of their place in their kind's social order; emotion is blunted or absent. Tears, an emotional signal unique to humans, are triggered by the amygdala and a nearby structure, the cingulate gyrus; being held, stroked, or otherwise comforted soothes these same brain regions, stopping the sobs. Without an amygdala, there are no tears of sorrow to soothe.

Joseph LeDoux, a neuroscientist at the Center for Neural Science at New York University, was the first to discover the key role of the amygdala in the emotional brain.[2] LeDoux is part of a fresh breed of neuroscientists who draw on innovative methods and technologies that bring a previously unknown level of precision to mapping the brain at work, and so can lay bare mysteries of mind that earlier generations of scientists have found impenetrable. His findings on the circuitry of the emotional brain overthrow a long-standing notion about the limbic system, putting the amygdala at the center of the action and placing other limbic structures in very different roles.[3]

LeDoux's research explains how the amygdala can take control over what we do even as the thinking brain, the neocortex, is still coming to a

decision. As we shall see, the workings of the amygdala and its interplay with the neocortex are at the heart of emotional intelligence.

THE NEURAL TRIPWIRE

Most intriguing for understanding the power of emotions in mental life are those moments of impassioned action that we later regret, once the dust has settled; the question is how we so easily become so irrational. Take, for example, a young woman who drove two hours to Boston to have brunch and spend the day with her boyfriend. During brunch he gave her a present she'd been wanting for months, a hard-to-find art print brought back from Spain. But her delight dissolved the moment she suggested that after brunch they go to a matinee of a movie she'd been wanting to see and her friend stunned her by saying he couldn't spend the day with her because he had Softball practice. Hurt and incredulous, she got up in tears, left the cafe, and, on impulse, threw the print in a garbage can. Months later, recounting the incident, it's not walking out she regrets, but the loss of the print.

It is in moments such as these—when impulsive feeling overrides the rational—that the newly discovered role for the amygdala is pivotal. Incoming signals from the senses let the amygdala scan every experience for trouble. This puts the amygdala in a powerful post in mental life, something like a psychological sentinel, challenging every situation, every perception, with but one kind of question in mind, the most primitive: "Is this something I hate? That hurts me? Something I fear?" If so—if the moment at hand somehow draws a "Yes"—the amygdala reacts instantaneously, like a neural tripwire, telegraphing a message of crisis to all parts of the brain.

In the brain's architecture, the amygdala is poised something like an alarm company where operators stand ready to send out emergency calls to the fire department, police, and a neighbor whenever a home security system signals trouble.

When it sounds an alarm of, say, fear, it sends urgent messages to every major part of the brain: it triggers the secretion of the body's fight-or-flight hormones, mobilizes the centers for movement, and activates the cardiovascular system, the muscles, and the gut.[4] Other circuits from the amygdala signal the secretion of emergency dollops of the hormone

norepinephrine to heighten the reactivity of key brain areas, including those that make the senses more alert, in effect setting the brain on edge. Additional signals from the amygdala tell the brainstem to fix the face in a fearful expression, freeze unrelated movements the muscles had underway, speed heart rate and raise blood pressure, slow breathing. Others rivet attention on the source of the fear, and prepare the muscles to react accordingly. Simultaneously, cortical memory systems are shuffled to retrieve any knowledge relevant to the emergency at hand, taking precedence over other strands of thought.

And these are just part of a carefully coordinated array of changes the amygdala orchestrates as it commandeers areas throughout the brain (for a more detailed account, see Appendix C). The amygdala's extensive web of neural connections allows it, during an emotional emergency, to capture and drive much of the rest of the brain—including the rational mind.

THE EMOTIONAL SENTINEL

A friend tells of having been on vacation in England, and eating brunch at a canalside cafe. Taking a stroll afterward along the stone steps down to the canal, he suddenly saw a girl gazing at the water, her face frozen in fear. Before he knew quite why, he had jumped in the water—in his coat and tie. Only once he was in the water did he realize that the girl was staring in shock at a toddler who had fallen in—whom he was able to rescue.

What made him jump in the water before he knew why? The answer, very likely, was his amygdala.

In one of the most telling discoveries about emotions of the last decade, LeDoux's work revealed how the architecture of the brain gives the amygdala a privileged position as an emotional sentinel, able to hijack the brain.[5] His research has shown that sensory signals from eye or ear travel first in the brain to the thalamus, and then—across a single synapse—to the amygdala; a second signal from the thalamus is routed to the neocortex—the thinking brain. This branching allows the amygdala to begin to respond *before* the neocortex, which mulls information through several levels of brain circuits before it fully perceives and finally initiates its more finely tailored response.

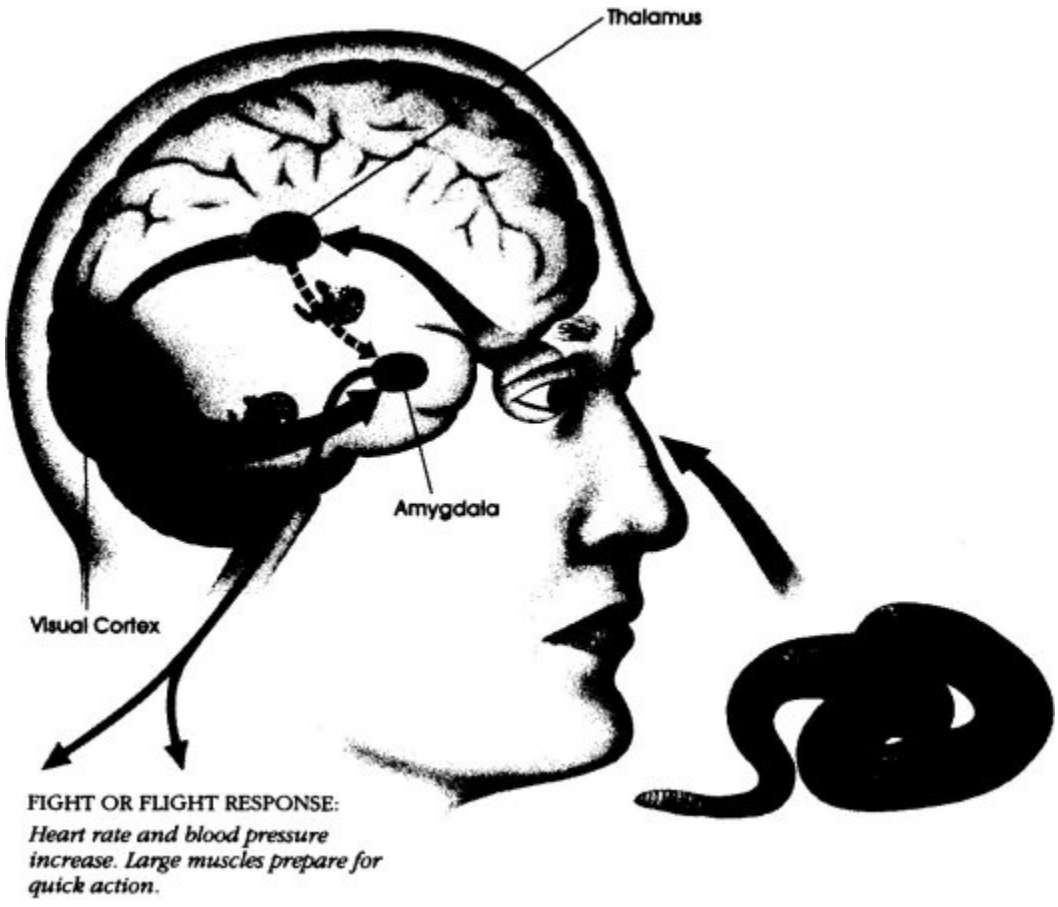
LeDoux's research is revolutionary for understanding emotional life because it is the first to work out neural pathways for feelings that bypass the neocortex. Those feelings that take the direct route through the amygdala include our most primitive and potent; this circuit does much to explain the power of emotion to overwhelm rationality.

The conventional view in neuroscience had been that the eye, ear, and other sensory organs transmit signals to the thalamus, and from there to sensory processing areas of the neocortex, where the signals are put together into objects as we perceive them. The signals are sorted for meanings so that the brain recognizes what each object is and what its presence means. From the neocortex, the old theory held, the signals are sent to the limbic brain, and from there the appropriate response radiates out through the brain and the rest of the body. That is the way it works much or most of the time—but LeDoux discovered a smaller bundle of neurons that leads directly from the thalamus to the amygdala, in addition to those going through the larger path of neurons to the cortex. This smaller and shorter pathway—something like a neural back alley—allows the amygdala to receive some direct inputs from the senses and start a response *before* they are fully registered by the neocortex.

This discovery overthrows the notion that the amygdala must depend entirely on signals from the neocortex to formulate its emotional reactions. The amygdala can trigger an emotional response via this emergency route even as a parallel reverberating circuit begins between the amygdala and neocortex. The amygdala can have us spring to action while the slightly slower—but more fully informed—neocortex unfolds its more refined plan for reaction.

LeDoux overturned the prevailing wisdom about the pathways traveled by emotions through his research on fear in animals. In a crucial experiment he destroyed the auditory cortex of rats, then exposed them to a tone paired with an electric shock. The rats quickly learned to fear the tone, even though the sound of the tone could not register in their neocortex. Instead, the sound took the direct route from ear to thalamus to amygdala, skipping all higher avenues. In short, the rats had learned an emotional reaction without any higher cortical involvement: The amygdala perceived, remembered, and orchestrated their fear independently.

"Anatomically the emotional system can act independently of the neocortex," LeDoux told me. "Some emotional reactions and emotional memories can be formed without any conscious, cognitive participation at all." The amygdala can house memories and response repertoires that we enact without quite realizing why we do so because the shortcut from thalamus to amygdala completely bypasses the neocortex. This bypass seems to allow the amygdala to be a repository for emotional impressions and memories that we have never known about in full awareness. LeDoux proposes that it is the amygdala's subterranean role in memory that explains, for example, a startling experiment in which people acquired a preference for oddly shaped geometric figures that had been flashed at them so quickly that they had no conscious awareness of having seen them at all![6]



A visual signal first goes from the retina to the thalamus, where it is translated into the language of the brain. Most of the message then goes

to the visual cortex, where it is analyzed and assessed for meaning and appropriate response; if that response is emotional, a signal goes to the amygdala to activate the emotional centers. But a smaller portion of the original signal goes straight from the thalamus to the amygdala in a quicker transmission, allowing a faster (though less precise) response. Thus the amygdala can trigger an emotional response before the cortical centers have fully understood what is happening.

Other research has shown that in the first few milliseconds of our perceiving something we not only unconsciously comprehend what it is, but decide whether we like it or not; the "cognitive unconscious" presents our awareness with not just the identity of what we see, but an opinion about it.[7] Our emotions have a mind of their own, one which can hold views quite independently of our rational mind.

THE SPECIALIST IN EMOTIONAL MEMORY

Those unconscious opinions are emotional memories; their storehouse is the amygdala. Research by LeDoux and other neuroscientists now seems to suggest that the hippocampus, which has long been considered the key structure of the limbic system, is more involved in registering and making sense of perceptual patterns than with emotional reactions. The hippocampus's main input is in providing a keen memory of context, vital for emotional meaning; it is the hippocampus that recognizes the differing significance of, say, a bear in the zoo versus one in your backyard.

While the hippocampus remembers the dry facts, the amygdala retains the emotional flavor that goes with those facts. If we try to pass a car on a two-lane highway and narrowly miss having a head-on collision, the hippocampus retains the specifics of the incident, like what stretch of road we were on, who was with us, what the other car looked like. But it is the amygdala that everafter will send a surge of anxiety through us whenever we try to pass a car in similar circumstances. As LeDoux put it to me, "The hippocampus is crucial in recognizing a face as that of your cousin. But it is the amygdala that adds you don't really like her."

The brain uses a simple but cunning method to make emotional memories register with special potency: the very same neurochemical alerting systems that prime the body to react to life-threatening emergencies by fighting or

fleeing also stamp the moment in memory with vividness.[8] Under stress (or anxiety, or presumably even the intense excitement of joy) a nerve running from the brain to the adrenal glands atop the kidneys triggers a secretion of the hormones epinephrine and norepinephrine, which surge through the body priming it for an emergency. These hormones activate receptors on the vagus nerve; while the vagus nerve carries messages from the brain to regulate the heart, it also carries signals back into the brain, triggered by epinephrine and norepinephrine. The amygdala is the main site in the brain where these signals go; they activate neurons within the amygdala to signal other brain regions to strengthen memory for what is happening.

This amygdala arousal seems to imprint in memory most moments of emotional arousal with an added degree of strength—that's why we are more likely, for example, to remember where we went on a first date, or what we were doing when we heard the news that the space shuttle *Challenger* had exploded. The more intense the amygdala arousal, the stronger the imprint; the experiences that scare or thrill us the most in life are among our most indelible memories. This means that, in effect, the brain has two memory systems, one for ordinary facts and one for emotionally charged ones. A special system for emotional memories makes excellent sense in evolution, of course, ensuring that animals would have particularly vivid memories of what threatens or pleases them. But emotional memories can be faulty guides to the present.

OUT-OF-DATE NEURAL ALARMS

One drawback of such neural alarms is that the urgent message the amygdala sends is sometimes, if not often, out-of-date—especially in the fluid social world we humans inhabit. As the repository for emotional memory, the amygdala scans experience, comparing what is happening now with what happened in the past. Its method of comparison is associative: when one key element of a present situation is similar to the past, it can call it a "match"—which is why this circuit is sloppy: it acts before there is full confirmation. It frantically commands that we react to the present in ways that were imprinted long ago, with thoughts, emotions, reactions learned in response to events perhaps only dimly similar, but close enough to alarm the amygdala.

Thus a former army nurse, traumatized by the relentless flood of ghastly wounds she once tended in wartime, is suddenly swept with a mix of dread, loathing, and panic—a repeat of her battlefield reaction triggered once again, years later, by the stench when she opens a closet door to find her toddler had stashed a stinking diaper there. A few spare elements of the situation is all that need seem similar to some past danger for the amygdala to trigger its emergency proclamation. The trouble is that along with the emotionally charged memories that have the power to trigger this crisis response can come equally outdated ways of responding to it.

The emotional brain's imprecision in such moments is added to by the fact that many potent emotional memories date from the first few years of life, in the relationship between an infant and its caretakers. This is especially true for traumatic events, like beatings or outright neglect. During this early period of life other brain structures, particularly the hippocampus, which is crucial for narrative memories, and the neocortex, seat of rational thought, have yet to become fully developed. In memory, the amygdala and hippocampus work hand-in-hand; each stores and retrieves its special information independently. While the hippocampus retrieves information, the amygdala determines if that information has any emotional valence. But the amygdala, which matures very quickly in the infant's brain, is much closer to fully formed at birth.

LeDoux turns to the role of the amygdala in childhood to support what has long been a basic tenet of psychoanalytic thought: that the interactions of life's earliest years lay down a set of emotional lessons based on the attunement and upsets in the contacts between infant and caretakers.[9] These emotional lessons are so potent and yet so difficult to understand from the vantage point of adult life because, believes LeDoux, they are stored in the amygdala as rough, wordless blueprints for emotional life. Since these earliest emotional memories are established at a time before infants have words for their experience, when these emotional memories are triggered in later life there is no matching set of articulated thoughts about the response that takes us over. One reason we can be so baffled by our emotional outbursts, then, is that they often date from a time early in our lives when things were bewildering and we did not yet have words for comprehending

events. We may have the chaotic feelings, but not the words for the memories that formed them.

WHEN EMOTIONS ARE FAST AND SLOPPY

It was somewhere around three in the morning when a huge object came crashing through the ceiling in a far corner of my bedroom, spilling the contents of the attic into the room. In a second I leapt out of bed and ran out of the room, terrified the entire ceiling would cave in. Then, realizing I was safe, I cautiously peered back in the bedroom to see what had caused all the damage—only to discover that the sound I had taken to be the ceiling caving in was actually the fall of a tall pile of boxes my wife had stacked in the corner the day before while she sorted out her closet. Nothing had fallen from the attic: there was no attic. The ceiling was intact, and so was I.

My leap from bed while half-asleep—which might have saved me from injury had it truly been the ceiling falling—illustrates the power of the amygdala to propel us to action in emergencies, vital moments before the neocortex has time to fully register what is actually going on. The emergency route from eye or ear to thalamus to amygdala is crucial: it saves time in an emergency, when an instantaneous response is required. But this circuit from thalamus to amygdala carries only a small portion of sensory messages, with the majority taking the main route up to the neocortex. So what registers in the amygdala via this express route is, at best, a rough signal, just enough for a warning. As LeDoux points out, "You don't need to know exactly what something is to know that it may be dangerous."[10]

The direct route has a vast advantage in brain time, which is reckoned in thousandths of a second. The amygdala in a rat can begin a response to a perception in as little as twelve milliseconds—twelve thousandths of a second. The route from thalamus to neocortex to amygdala takes about twice as long. Similar measurements have yet to be made in the human brain, but the rough ratio would likely hold.

In evolutionary terms, the survival value of this direct route would have been great, allowing a quick-response option that shaves a few critical milliseconds in reaction time to dangers. Those milliseconds could well have saved the lives of our protomammalian ancestors in such numbers that this arrangement is now featured in every mammalian brain, including

yours and mine. In fact, while this circuit may play a relatively limited role in human mental life, largely restricted to emotional crises, much of the mental life of birds, fish, and reptiles revolves around it, since their very survival depends on constantly scanning for predators or prey. "This primitive, minor brain system in mammals is the main brain system in non-mammals," says LeDoux. "It offers a very rapid way to turn on emotions. But it's a quick-and-dirty process; the cells are fast, but not very precise."

Such imprecision in, say, a squirrel, is fine, since it leads to erring on the side of safety, springing away at the first sign of anything that might signal a looming enemy, or springing toward a hint of something edible. But in human emotional life that imprecision can have disastrous consequences for our relationships, since it means, figuratively speaking, we can spring at or away from the wrong thing—or person. (Consider, for example, the waitress who dropped a tray of six dinners when she glimpsed a woman with a huge, curly mane of red hair—exactly like the woman her ex-husband had left her for.)

Such inchoate emotional mistakes are based on feeling prior to thought. LeDoux calls it "precognitive emotion," a reaction based on neural bits and pieces of sensory information that have not been fully sorted out and integrated into a recognizable object. It's a very raw form of sensory information, something like a neural *Name That Tune,* where, instead of snap judgments of melody being made on the basis of just a few notes, a whole perception is grasped on the basis of the first few tentative parts. If the amygdala senses a sensory pattern of import emerging, it jumps to a conclusion, triggering its reactions before there is full confirming evidence —or any confirmation at all.

Small wonder we can have so little insight into the murk of our more explosive emotions, especially while they still hold us in thrall. The amygdala can react in a delirium of rage or fear before the cortex knows what is going on because such raw emotion is triggered independent of, and prior to, thought.

THE EMOTIONAL MANAGER

A friend's six-year-old daughter Jessica was spending her first night ever sleeping over at a playmate's, and it was unclear who was more nervous

about it, mother or daughter. While the mother tried not to let Jessica see the intense anxiety she felt, her tension peaked near midnight that night, as she was getting ready for bed and heard the phone ring. Dropping her toothbrush, she raced to the phone, her heart pounding, images of Jessica in terrible distress racing through her mind.

The mother snatched the receiver, and blurted, "Jessica!" into the phone —only to hear a woman's voice say, "Oh, I think this must be a wrong number...."

At that, the mother recovered her composure, and in a polite, measured tone, asked, "What number were you calling?"

While the amygdala is at work in priming an anxious, impulsive reaction, another part of the emotional brain allows for a more fitting, corrective response. The brain's clamper switch for the amygdala's surges appears to lie at the other end of a major circuit to the neocortex, in the prefrontal lobes just behind the forehead. The prefrontal cortex seems to be at work when someone is fearful or enraged, but stifles or controls the feeling in order to deal more effectively with the situation at hand, or when a reappraisal calls for a completely different response, as with the worried mother on the phone. This neocortical area of the brain brings a more analytic or appropriate response to our emotional impulses, modulating the amygdala and other limbic areas.

Ordinarily the prefrontal areas govern our emotional reactions from the start. The largest projection of sensory information from the thalamus, remember, goes not to the amygdala, but to the neocortex and its many centers for taking in and making sense of what is being perceived; that information and our response to it is coordinated by the prefrontal lobes, the seat of planning and organizing actions toward a goal, including emotional ones. In the neocortex a cascading series of circuits registers and analyzes that information, comprehends it, and, through the prefrontal lobes, orchestrates a reaction. If in the process an emotional response is called for, the prefrontal lobes dictate it, working hand-in-hand with the amygdala and other circuits in the emotional brain.

This progression, which allows for discernment in emotional response, is the standard arrangement, with the significant exception of emotional emergencies. When an emotion triggers, within moments the prefrontal lobes perform what amounts to a risk/benefit ratio of myriad possible

reactions, and bet that one of them is best.[11] For animals, when to attack, when to run. And for we humans . . . when to attack, when to run—and also, when to placate, persuade, seek sympathy, stonewall, provoke guilt, whine, put on a facade of bravado, be contemptuous—and so on, through the whole repertoire of emotional wiles.

The neocortical response is slower in brain time than the hijack mechanism because it involves more circuitry. It can also be more judicious and considered, since more thought precedes feeling. When we register a loss and become sad, or feel happy after a triumph, or mull over something someone has said or done and then get hurt or angry, the neocortex is at work.

Just as with the amygdala, absent the workings of the prefrontal lobes, much of emotional life would fall away; lacking an understanding that something merits an emotional response, none comes. This role of the prefrontal lobes in emotions has been suspected by neurologists since the advent in the 1940s of that rather desperate—and sadly misguided—surgical "cure" for mental illness: the prefrontal lobotomy, which (often sloppily) removed part of the prefrontal lobes or otherwise cut connections between the prefrontal cortex and the lower brain. In the days before any effective medications for mental illness, the lobotomy was hailed as the answer to grave emotional distress—sever the links between the prefrontal lobes and the rest of the brain, and patients' distress was "relieved." Unfortunately, the cost was that most of patients' emotional lives seemed to vanish, too. The key circuitry had been destroyed.

Emotional hijackings presumably involve two dynamics: triggering of the amygdala and a failure to activate the neocortical processes that usually keep emotional response in balance—or a recruitment of the neocortical zones to the emotional urgency. [12] At these moments the rational mind is swamped by the emotional. One way the prefrontal cortex acts as an efficient manager of emotion—weighing reactions before acting—is by dampening the signals for activation sent out by the amygdala and other limbic centers—something like a parent who stops an impulsive child from grabbing and tells the child to ask properly (or wait) for what it wants instead.[13]

The key “off switch” for distressing emotion seems to be the left prefrontal lobe. Neuropsychologists studying moods in patients with injuries to parts of the frontal lobes have determined that one of the tasks of the left frontal lobe is to act as a neural thermostat, regulating unpleasant emotions. The right prefrontal lobes are a seat of negative feelings like fear and aggression, while the left lobes keep those raw emotions in check, probably by inhibiting the right lobe.[14] In one group of stroke patients, for example, those whose lesions were in the left prefrontal cortex were prone to catastrophic worries and fears; those with lesions on the right were "unduly cheerful"; during neurological exams they joked around and were so laid back they clearly did not care how well they did.[15] And then there was the case of the happy husband: a man whose right prefrontal lobe had been partially removed in surgery for a brain malformation. His wife told physicians that after the operation he underwent a dramatic personality change, becoming less easily upset and, she was happy to say, more affectionate.[16]

The left prefrontal lobe, in short, seems to be part of a neural circuit that can switch off, or at least dampen down, all but the strongest negative surges of emotion. If the amygdala often acts as an emergency trigger, the left prefrontal lobe appears to be part of the brain's “off switch” for disturbing emotion: the amygdala proposes, the prefrontal lobe disposes. These prefrontal-limbic connections are crucial in mental life far beyond fine-tuning emotion; they are essential for navigating us through the decisions that matter most in life.

HARMONIZING EMOTION AND THOUGHT

The connections between the amygdala (and related limbic structures) and the neocortex are the hub of the battles or cooperative treaties struck between head and heart, thought and feeling. This circuitry explains why emotion is so crucial to effective thought, both in making wise decisions and in simply allowing us to think clearly.

Take the power of emotions to disrupt thinking itself. Neuroscientists use the term "working memory" for the capacity of attention that holds in mind the facts essential for completing a given task or problem, whether it be the ideal features one seeks in a house while touring several prospects, or the

elements of a reasoning problem on a test. The prefrontal cortex is the brain region responsible for working memory.[17] But circuits from the limbic brain to the prefrontal lobes mean that the signals of strong emotion—anxiety, anger, and the like—can create neural static, sabotaging the ability of the prefrontal lobe to maintain working memory. That is why when we are emotionally upset we say we "just can't think straight"—and why continual emotional distress can create deficits in a child's intellectual abilities, crippling the capacity to learn.

These deficits, if more subtle, are not always tapped by IQ testing, though they show up through more targeted neuropsychological measures, as well as in a child's continual agitation and impulsivity. In one study, for example, primary school boys who had above-average IQ scores but nevertheless were doing poorly in school were found via these neuropsychological tests to have impaired frontal cortex functioning.[18] They also were impulsive and anxious, often disruptive and in trouble—suggesting faulty prefrontal control over their limbic urges. Despite their intellectual potential, these are the children at highest risk for problems like academic failure, alcoholism, and criminality—not because their intellect is deficient, but because their control over their emotional life is impaired. The emotional brain, quite separate from those cortical areas tapped by IQ tests, controls rage and compassion alike. These emotional circuits are sculpted by experience throughout childhood—and we leave those experiences utterly to chance at our peril.

Consider, too, the role of emotions in even the most "rational" decision-making. In work with far-reaching implications for understanding mental life, Dr. Antonio Damasio, a neurologist at the University of Iowa College of Medicine, has made careful studies of just what is impaired in patients with damage to the prefrontal-amygdala circuit.[19] Their decision-making is terribly flawed—and yet they show no deterioration at all in IQ or any cognitive ability. Despite their intact intelligence, they make disastrous choices in business and their personal lives, and can even obsess endlessly over a decision so simple as when to make an appointment.

Dr. Damasio argues that their decisions are so bad because they have lost access to their *emotional* learning. As the meeting point between thought and emotion, the prefrontal-amygdala circuit is a crucial doorway to the

repository for the likes and dislikes we acquire over the course of a lifetime. Cut off from emotional memory in the amygdala, whatever the neocortex mulls over no longer triggers the emotional reactions that have been associated with it in the past—everything takes on a gray neutrality. A stimulus, be it a favorite pet or a detested acquaintance, no longer triggers either attraction or aversion; these patients have "forgotten" all such emotional lessons because they no longer have access to where they are stored in the amygdala.

Evidence like this leads Dr. Damasio to the counter-intuitive position that feelings are typically *indispensable for* rational decisions; they point us in the proper direction, where dry logic can then be of best use. While the world often confronts us with an unwieldy array of choices (How should you invest your retirement savings? Whom should you marry?), the emotional learning that life has given us (such as the memory of a disastrous investment or a painful breakup) sends signals that streamline the decision by eliminating some options and highlighting others at the outset. In this way, Dr. Damasio argues, the emotional brain is as involved in reasoning as is the thinking brain.

The emotions, then, matter for rationality. In the dance of feeling and thought the emotional faculty guides our moment-to-moment decisions, working hand-in-hand with the rational mind, enabling—or disabling—thought itself. Likewise, the thinking brain plays an executive role in our emotions—except in those moments when emotions surge out of control and the emotional brain runs rampant.

In a sense we have two brains, two minds—and two different kinds of intelligence: rational and emotional. How we do in life is determined by both—it is not just IQ, but *emotional* intelligence that matters. Indeed, intellect cannot work at its best without emotional intelligence. Ordinarily the complementarity of limbic system and neocortex, amygdala and prefrontal lobes, means each is a full partner in mental life. When these partners interact well, emotional intelligence rises—as does intellectual ability.

This turns the old understanding of the tension between reason and feeling on its head: it is not that we want to do away with emotion and put reason in its place, as Erasmus had it, but instead find the intelligent balance of the two. The old paradigm held an ideal of reason freed of the pull of

emotion. The new paradigm urges us to harmonize head and heart. To do that well in our lives means we must first understand more exactly what it means to use emotion intelligently.

5
Passion's Slaves

Thou has been . . .
A man that Fortune's buffets and rewards
Has taken with equal thanks. ... Give me that man
That is not passion's slave, and I will wear him
In my heart's core, aye, in my heart of hearts
As I do thee.. ..

—HAMLET TO HIS FRIEND HORATIO

A sense of self-mastery, of being able to withstand the emotional storms that the buffeting of Fortune brings rather than being "passion's slave," has been praised as a virtue since the time of Plato. The ancient Greek word for it was *sophrosyne,* "care and intelligence in conducting one's life; a tempered balance and wisdom," as Page DuBois, a Greek scholar, translates it. The Romans and the early Christian church called it *temperantia,* temperance, the restraining of emotional excess. The goal is balance, not emotional suppression: every feeling has its value and significance. A life without passion would be a dull wasteland of neutrality, cut off and isolated from the richness of life itself. But, as Aristotle observed, what is wanted is *appropriate* emotion, feeling proportionate to circumstance. When emotions are too muted they create dullness and distance; when out of control, too extreme and persistent, they become pathological, as in immobilizing depression, overwhelming anxiety, raging anger, manic agitation.

Indeed, keeping our distressing emotions in check is the key to emotional well-being; extremes—emotions that wax too intensely or for too long—undermine our stability. Of course, it is not that we should feel only one kind of emotion; being happy all the time somehow suggests the blandness of those smiley-face badges that had a faddish moment in the 1970s. There is much to be said for the constructive contribution of suffering to creative and spiritual life; suffering can temper the soul.

Downs as well as ups spice life, but need to be in balance. In the calculus of the heart it is the ratio of positive to negative emotions that determines the sense of well-being—at least that is the verdict from studies of mood in which hundreds of men and women have carried beepers that reminded them at random times to record their emotions at that moment.[1] It is not that people need to avoid unpleasant feelings to feel content, but rather that stormy feelings not go unchecked, displacing all pleasant moods. People who have strong episodes of anger or depression can still feel a sense of well-being if they have a countervailing set of equally joyous or happy times. These studies also affirm the independence of emotional from academic intelligence, finding little or no relationship between grades or IQ and people's emotional well-being.

Just as there is a steady murmur of background thoughts in the mind, there is a constant emotional hum; beep someone at six A.M. or seven P.M. and he will always be in some mood or other. Of course, on any two mornings someone can have very different moods; but when people's moods are averaged over weeks or months, they tend to reflect that person's overall sense of well-being. It turns out that for most people, extremely intense feelings are relatively rare; most of us fall into the gray middle range, with mild bumps in our emotional roller coaster.

Still, managing our emotions is something of a full-time job: much of what we do—especially in our free time—is an attempt to manage mood. Everything from reading a novel or watching television to the activities and companions we choose can be a way to make ourselves feel better. The art of soothing ourselves is a fundamental life skill; some psychoanalytic thinkers, such as John Bowlby and D. W. Winnicott, see this as one of the most essential of all psychic tools. The theory holds that emotionally sound infants learn to soothe themselves by treating themselves as their caretakers have treated them, leaving them less vulnerable to the upheavals of the emotional brain.

As we have seen, the design of the brain means that we very often have little or no control over *when* we are swept by emotion, nor over *what* emotion it will be. But we can have some say in *how long* an emotion will last. The issue arises not with garden-variety sadness, worry, or anger; normally such moods pass with time and patience. But when these emotions

are of great intensity and linger past an appropriate point, they shade over into their distressing extremes—chronic anxiety, uncontrollable rage, depression. And, at their most severe and intractable, medication, psychotherapy, or both may be needed to lift them.

In these times, one sign of the capacity for emotional self-regulation may be recognizing when chronic agitation of the emotional brain is too strong to be overcome without pharmacologic help. For example, two thirds of those who suffer from manic-depression have never been treated for the disorder. But lithium or newer medications can thwart the characteristic cycle of paralyzing depression alternating with manic episodes that mix chaotic elation and grandiosity with irritation and rage. One problem with manic-depression is that while people are in the throes of mania they often feel so overly confident that they see no need for help of any kind despite the disastrous decisions they are making. In such severe emotional disorders psychiatric medication offers a tool for managing life better.

But when it comes to vanquishing the more usual range of bad moods, we are left to our own devices. Unfortunately, those devices are not always effective—at least such is the conclusion reached by Diane Tice, a psychologist at Case Western Reserve University, who asked more than four hundred men and women about the strategies they used to escape foul moods, and how successful those tactics were for them.[2]

Not everyone agrees with the philosophical premise that bad moods should be changed; there are, Tice found, "mood purists," the 5 percent or so of people who said they never try to change a mood since, in their view, all emotions are "natural" and should be experienced just as they present themselves, no matter how dispiriting. And then there were those who regularly sought to get into unpleasant moods for pragmatic reasons: physicians who needed to be somber to give patients bad news; social activists who nurtured their outrage at injustice so as to be more effective in battling it; even a young man who told of working up his anger to help his little brother with playground bullies. And some people were positively Machiavellian about manipulating moods—witness the bill collectors who purposely worked themselves into a rage in order to be all the firmer with deadbeats.[3] But these rare purposive cultivations of unpleasantness aside,

most everyone complained of being at the mercy of their moods. People's track records at shaking bad moods were decidedly mixed.

THE ANATOMY OF RAGE?

Say someone in another car cuts dangerously close to you as you are driving on the freeway. If your reflexive thought is "That son of a bitch!" it matters immensely for the trajectory of rage whether that thought is followed by more thoughts of outrage and revenge: "He could have hit me! That bastard—I can't let him get away with that!" Your knuckles whiten as you tighten your hold on the steering wheel, a surrogate for strangling his throat. Your body mobilizes to fight, not run—leaving you trembling, beads of sweat on your forehead, your heart pounding, the muscles in your face locked in a scowl. You want to kill the guy. Then, should a car behind you honk because you have slowed down after the close call, you are apt to explode in rage at that driver too. Such is the stuff of hypertension, reckless driving, even freeway shootings.

Contrast that sequence of building rage with a more charitable line of thought toward the driver who cut you off: "Maybe he didn't see me, or maybe he had some good reason for driving so carelessly, such as a medical emergency." That line of possibility tempers anger with mercy, or at least an open mind, short-circuiting the buildup of rage. The problem, as Aristotle's challenge to have only *appropriate* anger reminds us, is that more often than not our anger surges out of control. Benjamin Franklin put it well: "Anger is never without a reason, but seldom a good one."

There are, of course, different kinds of anger. The amygdala may well be a main source of the sudden spark of rage we feel at the driver whose carelessness endangers us. But the other end of the emotional circuitry, the neocortex, most likely foments more calculated angers, such as cool-headed revenge or outrage at unfairness or injustice. Such thoughtful angers are those most likely, as Franklin put it, to "have good reasons" or seem to.

Of all the moods that people want to escape, rage seems to be the most intransigent; Tice found anger is the mood people are worst at controlling. Indeed, anger is the most seductive of the negative emotions; the self-righteous inner monologue that propels it along fills the mind with the most convincing arguments for venting rage. Unlike sadness, anger is energizing,

even exhilarating. Anger's seductive, persuasive power may in itself explain why some views about it are so common: that anger is uncontrollable, or that, at any rate, it *should not* be controlled, and that venting anger in "catharsis" is all to the good. A contrasting view, perhaps a reaction against the bleak picture of these other two, holds that anger can be prevented entirely. But a careful reading of research findings suggests that all these common attitudes toward anger are misguided, if not outright myths.[4]

The train of angry thoughts that stokes anger is also potentially the key to one of the most powerful ways to defuse anger: undermining the convictions that are fueling the anger in the first place. The longer we ruminate about what has made us angry, the more "good reasons" and self-justifications for being angry we can invent. Brooding fuels anger's flames. But seeing things differently douses those flames. Tice found that reframing a situation more positively was one of the most potent ways to put anger to rest.

The Rage "Rush"

That finding squares well with the conclusions of University of Alabama psychologist Dolf Zillmann, who, in a lengthy series of careful experiments, has taken precise measure of anger and the anatomy of rage.[5] Given the roots of anger in the fight wing of the fight-or-flight response, it is no surprise that Zillmann finds that a universal trigger for anger is the sense of being endangered. Endangerment can be signaled not just by an outright physical threat but also, as is more often the case, by a symbolic threat to self-esteem or dignity: being treated unjustly or rudely, being insulted or demeaned, being frustrated in pursuing an important goal. These perceptions act as the instigating trigger for a limbic surge that has a dual effect on the brain. One part of that surge is a release of catecholamines, which generate a quick, episodic rush of energy, enough for "one course of vigorous action," as Zillmann puts it, "such as in fight or flight." This energy surge lasts for minutes, during which it readies the body for a good fight or a quick flight, depending on how the emotional brain sizes up the opposition.

Meanwhile, another amygdala-driven ripple through the adrenocortical branch of the nervous system creates a general tonic background of action

readiness, which lasts much longer than the catecholamine energy surge. This generalized adrenal and cortical excitation can last for hours and even days, keeping the emotional brain in special readiness for arousal, and becoming a foundation on which subsequent reactions can build with particular quickness. In general, the hair-trigger condition created by adrenocortical arousal explains why people are so much more prone to anger if they have already been provoked or slightly irritated by something else. Stress of all sorts creates adrenocortical arousal, lowering the threshold for what provokes anger. Thus someone who has had a hard day at work is especially vulnerable to becoming enraged later at home by something—the kids being too noisy or messy, say—that under other circumstances would not be powerful enough to trigger an emotional hijacking.

Zillmann comes to these insights on anger through careful experimentation. In a typical study, for example, he had a confederate provoke men and women who had volunteered by making snide remarks about them. The volunteers then watched a pleasant or upsetting film. Later the volunteers were given the chance to retaliate against the confederate by giving an evaluation they thought would be used in a decision whether or not to hire him. The intensity of their retaliation was directly proportional to how aroused they had gotten from the film they had just watched; they were angrier after seeing the unpleasant film, and gave the worst ratings.

Anger Builds on Anger

Zillmann's studies seem to explain the dynamic at work in a familiar domestic drama I witnessed one day while shopping. Down the supermarket aisle drifted the emphatic, measured tones of a young mother to her son, about three: "Put ... it ... back!"

"But I *want* it!" he whined, clinging more tightly to a Ninja Turtles cereal box.

"Put it back!" Louder, her anger taking over.

At that moment the baby in her shopping cart seat dropped the jar of jelly she had been mouthing. When it shattered on the floor the mother yelled, "That's it!" and, in a fury, slapped the baby, grabbed the three-year-old's box and slammed it onto the nearest shelf, scooped him up by the waist, and

rushed down the aisle, the shopping cart careening perilously in front, the baby now crying, her son, his legs dangling, protesting, "Put me *down,* put me *down!"*

Zillmann has found that when the body is already in a state of edginess, like the mother's, and something triggers an emotional hijacking, the subsequent emotion, whether anger or anxiety, is of especially great intensity. This dynamic is at work when someone becomes enraged. Zillmann sees escalating anger as "a sequence of provocations, each triggering an excitatory reaction that dissipates slowly." In this sequence every successive anger-provoking thought or perception becomes a minitrigger for amygdala-driven surges of catecholamines, each building on the hormonal momentum of those that went before. A second comes before the first has subsided, and a third on top of those, and so on; each wave rides the tails of those before, quickly escalating the body's level of physiological arousal. A thought that comes later in this buildup triggers a far greater intensity of anger than one that comes at the beginning. Anger builds on anger; the emotional brain heats up. By then rage, unhampered by reason, easily erupts in violence.

At this point people are unforgiving and beyond being reasoned with; their thoughts revolve around revenge and reprisal, oblivious to what the consequences may be. This high level of excitation, Zillmann says, "fosters an illusion of power and invulnerability that may inspire and facilitate aggression" as the enraged person, "failing cognitive guidance," falls back on the most primitive of responses. The limbic urge is ascendant; the rawest lessons of life's brutality become guides to action.

Balm for Anger

Given this analysis of the anatomy of rage, Zillmann sees two main ways of intervening. One way of defusing anger is to seize on and challenge the thoughts that trigger the surges of anger, since it is the original appraisal of an interaction that confirms and encourages the first burst of anger, and the subsequent reappraisals that fan the flames. Timing matters; the earlier in the anger cycle the more effective. Indeed, anger can be completely short-circuited if the mitigating information comes before the anger is acted on.

The power of understanding to deflate anger is clear from another of Zillmann's experiments, in which a rude assistant (a confederate) insulted and provoked volunteers who were riding an exercise bike. When the volunteers were given the chance to retaliate against the rude experimenter (again, by giving a bad evaluation they thought would be used in weighing his candidacy for a job) they did so with an angry glee. But in one version of the experiment another confederate entered after the volunteers had been provoked, and just before the chance to retaliate; she told the provocative experimenter he had a phone call down the hall. As he left he made a snide remark to her too. But she took it in good spirits, explaining after he left that he was under terrible pressures, upset about his upcoming graduate orals. After that the irate volunteers, when offered the chance to retaliate against the rude fellow, chose not to; instead they expressed compassion for his plight.

Such mitigating information allows a reappraisal of the anger-provoking events. But there is a specific window of opportunity for this de-escalation. Zillmann finds it works well at moderate levels of anger; at high levels of rage it makes no difference because of what he calls "cognitive incapacitation"—in other words, people can no longer think straight. When people were already highly enraged, they dismissed the mitigating information with "That's just too bad!" or "the strongest vulgarities the English language has to offer," as Zillmann put it with delicacy.

Cooling Down

> Once when I was about 13, in an angry fit, I walked out of the house vowing I would never return. It was a beautiful summer day, and I walked far along lovely lanes, till gradually the stillness and beauty calmed and soothed me, and after some hours I returned repentant and almost melted. Since then when I am angry, I do this if I can, and find it the best cure.

The account is by a subject in one of the very first scientific studies of anger, done in 1899.[6] It still stands as a model of the second way of de-escalating anger: cooling off physiologically by waiting out the adrenal surge in a setting where there are not likely to be further triggers for rage. In

an argument, for instance, that means getting away from the other person for the time being. During the cooling-off period, the angered person can put the brakes on the cycle of escalating hostile thought by seeking out distractions. Distraction, Zillmann finds, is a highly powerful mood-altering device, for a simple reason: It's hard to stay angry when we're having a pleasant time. The trick, of course, is to get anger to cool to the point where someone can *have* a pleasant time in the first place.

Zillmann's analysis of the ways anger escalates and de-escalates explains many of Diane Tice's findings about the strategies people commonly say they use to ease anger. One such fairly effective strategy is going off to be alone while cooling down. A large proportion of men translate this into going for a drive—a finding that gives one pause when driving (and, Tice told me, inspired her to drive more defensively). Perhaps a safer alternative is going for a long walk; active exercise also helps with anger. So do relaxation methods such as deep breathing and muscle relaxation, perhaps because they change the body's physiology from the high arousal of anger to a low-arousal state, and perhaps too because they distract from whatever triggered the anger. Active exercise may cool anger for something of the same reason: after high levels of physiological activation during the exercise, the body rebounds to a low level once it stops.

But a cooling-down period will not work if that time is used to pursue the train of anger-inducing thought, since each such thought is in itself a minor trigger for more cascades of anger. The power of distraction is that it stops that angry train of thought. In her survey of people's strategies for handling anger, Tice found that distractions by and large help calm anger: TV, movies, reading, and the like all interfere with the angry thoughts that stoke rage. But, Tice found, indulging in treats such as shopping for oneself and eating do not have much effect; it is all too easy to continue with an indignant train of thought while cruising a shopping mall or devouring a piece of chocolate cake.

To these strategies add those developed by Redford Williams, a psychiatrist at Duke University who sought to help hostile people, who are at higher risk for heart disease, to control their irritability.[7] One of his recommendations is to use self-awareness to catch cynical or hostile thoughts as they arise, and write them down. Once angry thoughts are

captured this way, they can be challenged and reappraised, though, as Zillmann found, this approach works better before anger has escalated to rage.

The Ventilation Fallacy

As I settle into a New York City cab, a young man crossing the street stops in front of the cab to wait for traffic to clear. The driver, impatient to start, honks, motioning for the young man to move out of the way. The reply is a scowl and an obscene gesture.

"You son of a bitch!" the driver yells, making threatening lunges with the cab by hitting the accelerator and brake at the same time. At this lethal threat, the young man sullenly moves aside, barely, and smacks his fist against the cab as it inches by into traffic. At this, the driver shouts a foul litany of expletives at the man.

As we move along the driver, still visibly agitated, tells me, "You can't take any shit from anyone. You gotta yell back—at least it makes you feel better!"

Catharsis—giving vent to rage—is sometimes extolled as a way of handling anger. The popular theory holds that "it makes you feel better." But, as Zillmann's findings suggest, there is an argument against catharsis. It has been made since the 1950s, when psychologists started to test the effects of catharsis experimentally and, time after time, found that giving vent to anger did little or nothing to dispel it (though, because of the seductive nature of anger, it may *feel* satisfying).[8] There may be some specific conditions under which lashing out in anger does work: when it is expressed directly to the person who is its target, when it restores a sense of control or rights an injustice, or when it inflicts "appropriate harm" on the other person and gets him to change some grievous activity without retaliating. But because of the incendiary nature of anger, this may be easier to say than to do.[9]

Tice found that ventilating anger is one of the worst ways to cool down: outbursts of rage typically pump up the emotional brain's arousal, leaving people feeling more angry, not less. Tice found that when people told of times they had taken their rage out on the person who provoked it, the net effect was to prolong the mood rather than end it. Far more effective was

when people first cooled down, and then, in a more constructive or assertive manner, confronted the person to settle their dispute. As I once heard Chogyam Trungpa, a Tibetan teacher, reply when asked how best to handle anger: "Don't suppress it. But don't act on it."

SOOTHING ANXIETY: WHAT, ME WORRY?

> Oh, no! The muffler sounds bad. . . . What if I have to take it to the shop?... I can't afford the expense.... I'd have to draw the money from Jamie's college fund.. What if I can't afford his tuition?... That bad school report last week.... What if his grades go down and he can't get into college?... Muffler sounds bad. . . .

And so the worrying mind spins on in an endless loop of low-grade melodrama, one set of concerns leading on to the next and back again. The above specimen is offered by Lizabeth Roemer and Thomas Borkovec, Pennsylvania State University psychologists, whose research on worrying —the heart of all anxiety—has raised the topic from neurotic's art to science.[10] There is, of course, no hitch when worry works; by mulling over a problem—that is, employing constructive reflection, which can look like worrying—a solution can appear. Indeed, the reaction that underlies worry is the vigilance for potential danger that has, no doubt, been essential for survival over the course of evolution. When fear triggers the emotional brain, part of the resulting anxiety fixates attention on the threat at hand, forcing the mind to obsess about how to handle it and ignore anything else for the time being. Worry is, in a sense, a rehearsal of what might go wrong and how to deal with it; the task of worrying is to come up with positive solutions for life's perils by anticipating dangers before they arise.

The difficulty is with chronic, repetitive worries, the kind that recycle on and on and never get any nearer a positive solution. A close analysis of chronic worry suggests that it has all the attributes of a low-grade emotional hijacking: the worries seem to come from nowhere, are uncontrollable, generate a steady hum of anxiety, are impervious to reason, and lock the worrier into a single, inflexible view of the worrisome topic. When this same cycle of worry intensifies and persists, it shades over the line into full-blown neural hijackings, the anxiety disorders: phobias, obsessions and

compulsions, panic attacks. In each of these disorders worry fixates in a distinct fashion; for the phobic, anxieties rivet on the feared situation; for the obsessive, they fixate on preventing some feared calamity; in panic attacks, the worries can focus on a fear of dying or on the prospect of having the attack itself.

In all these conditions the common denominator is worry run amok. For example, a woman being treated for obsessive-compulsive disorder had a series of rituals that took most of her waking hours: forty-five-minute showers several times daily, washing her hands for five minutes twenty or more times a day. She would not sit down unless she first swabbed the seat with rubbing alcohol to sterilize it. Nor would she touch a child or an animal—both were "too dirty." All these compulsions were stirred by her underlying morbid fear of germs; she worried constantly that without her washing and sterilizing she would catch a disease and die.[11]

A woman being treated for "generalized anxiety disorder"—the psychiatric nomenclature for being a constant worrier—responded to the request to worry aloud for one minute this way:

> I might not do this right. This may be so artificial that it won't be an indication of the real thing and we need to get at the real thing. . . . Because if we don't get at the real thing, I won't get well. And if I don't get well I'll never be happy. [12]

In this virtuoso display of worrying about worrying, the very request to worry for one minute had, within a few short seconds, escalated to contemplation of a lifelong catastrophe: "I'll never be happy." Worries typically follow such lines, a narrative to oneself that jumps from concern to concern and more often than not includes catastrophizing, imagining some terrible tragedy. Worries are almost always expressed in the mind's ear, not its eye—that is, in words, not images—a fact that has significance for controlling worry.

Borkovec and his colleagues began to study worrying per se when they were trying to come up with a treatment for insomnia. Anxiety, other researchers have observed, comes in two forms: *cognitive,* or worrisome thoughts, and *somatic,* the physiological symptoms of anxiety, such as

sweating, a racing heart, or muscle tension. The main trouble with insomniacs, Borkovec found, was not the somatic arousal. What kept them up were intrusive thoughts. They were chronic worriers, and could not stop worrying, no matter how sleepy they were. The one thing that worked in helping them get to sleep was getting their minds off their worries, focusing instead on the sensations produced by a relaxation method. In short, the worries could be stopped by shifting attention away.

Most worriers, however, can't seem to do this. The reason, Borkovec believes, has to do with a partial payoff from worrying that is highly reinforcing to the habit. There is, it seems, something positive in worries: worries are ways to deal with potential threats, with clangers that may come one's way. The work of worrying—when it succeeds—is to rehearse what those dangers are, and to reflect on ways to deal with them. But worry doesn't work all that well. New solutions and fresh ways of seeing a problem do not typically come from worrying, especially chronic worry. Instead of coming up with solutions to these potential problems, worriers typically simply ruminate on the danger itself, immersing themselves in a low-key way in the dread associated with it while staying in the same rut of thought. Chronic worriers worry about a wide range of things, most of which have almost no chance of happening; they read dangers into life's journey that others never notice.

Yet chronic worriers tell Borkovec that worrying helps them, and that their worries are self-perpetuating, an endless loop of angst-ridden thought. Why should worry become what seems to amount to a mental addiction? Oddly, as Borkovec points out, the worry habit is reinforcing in the same sense that superstitions are. Since people worry about many things that have a very low probability of actually occurring—a loved one dying in a plane crash, going bankrupt, and the like—there is, to the primitive limbic brain at least, something magical about it. Like an amulet that wards off some anticipated evil, the worry psychologically gets the credit for preventing the danger it obsesses about.

The Work of Worrying

She had moved to Los Angeles from the Midwest, lured by a job with a publisher. But the publisher was bought by another soon after, and she

was left without a job. Turning to freelance writing, an erratic marketplace, she found herself either swamped with work or unable to pay her rent. She often had to ration phone calls, and for the first time was without health insurance. This lack of coverage was particularly distressing: she found herself catastrophizing about her health, sure every headache signaled a brain tumor, picturing herself in an accident whenever she had to drive somewhere. She often found herself lost in a long reverie of worry, a medley of distress. But, she said, she found her worries almost addictive.

Borkovec discovered another unexpected benefit to worrying. While people are immersed in their worried thoughts, they do not seem to notice the subjective sensations of the anxiety those worries stir—the speedy heartbeat, the beads of sweat, the shakiness—and as the worry proceeds it actually seems to suppress some of that anxiety, at least as reflected in heart rate. The sequence presumably goes something like this: The worrier notices something that triggers the image of some potential threat or danger; that imagined catastrophe in turn triggers a mild attack of anxiety. The worrier then plunges into a long series of distressed thoughts, each of which primes yet another topic for worry; as attention continues to be carried along by this train of worry, focusing on these very thoughts takes the mind off the original catastrophic image that triggered the anxiety. Images, Borkovec found, are more powerful triggers for physiological anxiety than are thoughts, so immersion in thoughts, to the exclusion of catastrophic images, partially alleviates the experience of being anxious. And, to that extent, the worry is also reinforced, as a halfway antidote to the very anxiety it evoked.

But chronic worries are self-defeating too in that they take the form of stereotyped, rigid ideas, not creative breakthroughs that actually move toward solving the problem. This rigidity shows up not just in the manifest content of worried thought, which simply repeats more or less the same ideas over and over. But at a neurological level there seems to be a cortical rigidity, a deficit in the emotional brain's ability to respond flexibly to changing circumstance. In short, chronic worry works in some ways, but not in other, more consequential ones: it eases some anxiety, but never solves the problem.

The one thing that chronic worriers cannot do is follow the advice they are most often given: "Just stop worrying" (or, worse, "Don't worry—be happy"). Since chronic worries seem to be low-grade amygdala episodes, they come unbidden. And, by their very nature, they persist once they arise in the mind. But after much experimentation, Borkovec discovered some simple steps that can help even the most chronic worrier control the habit.

The first step is self-awareness, catching the worrisome episodes as near their beginning as possible—ideally, as soon as or just after the fleeting catastrophic image triggers the worry-anxiety cycle. Borkovec trains people in this approach by first teaching them to monitor cues for anxiety, especially learning to identify situations that trigger worry, or the fleeting thoughts and images that initiate the worry, as well as the accompanying sensations of anxiety in the body. With practice, people can identify the worries at an earlier and earlier point in the anxiety spiral. People also learn relaxation methods that they can apply at the moment they recognize the worry beginning, and practice the relaxation method daily so they will be able to use it on the spot, when they need it the most.

The relaxation method, though, is not enough in itself. Worriers also need to actively challenge the worrisome thoughts; failing this, the worry spiral will keep coming back. So the next step is to take a critical stance toward their assumptions: Is it very probable that the dreaded event will occur? Is it necessarily the case that there is only one or no alternative to letting it happen? Are there constructive steps to be taken? Does it really help to run through these same anxious thoughts over and over?

This combination of mindfulness and healthy skepticism would, presumably, act as a brake on the neural activation that underlies low-grade anxiety. Actively generating such thoughts may prime the circuitry that can inhibit the limbic driving of worry; at the same time, actively inducing a relaxed state counters the signals for anxiety the emotional brain is sending throughout the body.

Indeed, Borkovec points out, these strategies establish a train of mental activity that is incompatible with worry. When a worry is allowed to repeat over and over unchallenged, it gains in persuasive power; challenging it by contemplating a range of equally plausible points of view keeps the one worried thought from being naively taken as true. Even some people whose

worrying is serious enough to qualify for a psychiatric diagnosis have been relieved of the worrying habit this way.

On the other hand, for people with worries so severe they have flowered into phobia, obsessive-compulsive disorder, or panic disorder, it may be prudent—indeed, a sign of self-awareness—to turn to medication to interrupt the cycle. A retraining of the emotional circuitry through therapy is still called for, however, in order to lessen the likelihood that anxiety disorders will recur when medication is stopped.[13]

MANAGING MELANCHOLY

The single mood people generally put most effort into shaking is sadness; Diane Tice found that people are most inventive when it comes to trying to escape the blues. Of course, not all sadness should be escaped; melancholy, like every other mood, has its benefits. The sadness that a loss brings has certain invariable effects: it closes down our interest in diversions and pleasures, fixes attention on what has been lost, and saps our energy for starting new endeavors—at least for the time being. In short, it enforces a kind of reflective retreat from life's busy pursuits, and leaves us in a suspended state to mourn the loss, mull over its meaning, and, finally, make the psychological adjustments and new plans that will allow our lives to continue.

Bereavement is useful; full-blown depression is not. William Styron renders an eloquent description of "the many dreadful manifestations of the disease," among them self-hatred, a sense of worthlessness, a "dank joylessness" with "gloom crowding in on me, a sense of dread and alienation and, above all, a stifling anxiety."[14] Then there are the intellectual marks: "confusion, failure of mental focus and lapse of memories," and, at a later stage, his mind "dominated by anarchic distortions," and "a sense that my thought processes were engulfed by a toxic and unnameable tide that obliterated any enjoyable response to the living world." There are the physical effects: sleeplessness, feeling as listless as a zombie, "a kind of numbness, an enervation, but more particularly an odd fragility," along with a "fidgety restlessness." Then there is the loss of pleasure: "Food, like everything else within the scope of sensation, was utterly without savor." Finally, there was the vanishing of hope as the "gray drizzle of horror" took

on a despair so palpable it was like physical pain, a pain so unendurable that suicide seemed a solution.

In such major depression, life is paralyzed; no new beginnings emerge. The very symptoms of depression bespeak a life on hold. For Styron, no medication or therapy helped; it was the passing of time and the refuge of a hospital that finally cleared away the despondency. But for most people, especially those with less severe cases, psychotherapy can help, as can medication—Prozac is the treatment of the hour, but there are more than a dozen other compounds offering some help, especially for major depression.

My focus here is the far more common sadness that at its upper limits becomes, technically speaking, a "subclinical depression"—that is, ordinary melancholy. This is a range of despondency that people can handle on their own, if they have the internal resources. Unfortunately, some of the strategies most often resorted to can backfire, leaving people feeling worse than before. One such strategy is simply staying alone, which is often appealing when people are feeling down; more often than not, however, it only adds a sense of loneliness and isolation to the sadness. That may partly explain why Tice found the most popular tactic for battling depression is socializing—going out to eat, to a ballgame or movie; in short, doing something with friends or family. That works well if the net effect is to get the person's mind off his sadness. But it simply prolongs the mood if he uses the occasion just to mull over what put him in the funk.

Indeed, one of the main determinants of whether a depressed mood will persist or lift is the degree to which people ruminate. Worrying about what's depressing us, it seems, makes the depression all the more intense and prolonged. In depression, worry takes several forms, all focusing on some aspect of the depression itself—how tired we feel, how little energy or motivation we have, for instance, or how little work we're getting done. Typically none of this reflection is accompanied by any concrete course of action that might alleviate the problem. Other common worries include "isolating yourself and thinking about how terrible you feel, worrying that your spouse might reject you because you are depressed, and wondering whether you are going to have another sleepless night," says Stanford

psychologist Susan Nolen-Hoeksma, who has studied rumination in depressed people.[15]

Depressed people sometimes justify this kind of rumination by saying they are trying to "understand themselves better"; in fact, they are priming the feelings of sadness without taking any steps that might actually lift their mood. Thus in therapy it might be perfectly helpful to reflect deeply on the causes of a depression, if that leads to insights or actions that will change the conditions that cause it. But a passive immersion in the sadness simply makes it worse.

Rumination can also make the depression stronger by creating conditions that are, well, more depressing. Nolen-Hoeksma gives the example of a saleswoman who gets depressed and spends so many hours worrying about it that she doesn't get around to important sales calls. Her sales then decline, making her feel like a failure, which feeds her depression. But if she reacted to depression by trying to distract herself, she might well plunge into the sales calls as a way to get her mind off the sadness. Sales would be less likely to decline, and the very experience of making a sale might bolster her self-confidence, lessening the depression somewhat.

Women, Nolen-Hoeksma finds, are far more prone to ruminate when they are depressed than are men. This, she proposes, may at least partly explain the fact that women are diagnosed with depression twice as often as are men. Of course, other factors may come into play, such as women being more open to disclosing their distress or having more in their lives to be depressed about. And men may drown their depression in alcoholism, for which their rate is about twice that of women.

Cognitive therapy aimed at changing these thought patterns has been found in some studies to be on a par with medication for treating mild clinical depression, and superior to medication in preventing the return of mild depression. Two strategies are particularly effective in the battle.[16] One is to learn to challenge the thoughts at the center of rumination—to question their validity and think of more positive alternatives. The other is to purposely schedule pleasant, distracting events.

One reason distraction works is that depressing thoughts are automatic, intruding on one's state of mind unbidden. Even when depressed people try to suppress their depressing thoughts, they often cannot come up with better

alternatives; once the depressive tide of thought has started, it has a powerful magnetic effect on the train of association. For example, when depressed people were asked to unscramble jumbled six-word sentences, they were much better at figuring out the depressing messages ("The future looks very dismal") than the upbeat ones ("The future looks very bright").[17]

The tendency for depression to perpetuate itself shades even the kinds of distractions people choose. When depressed people were given a list of upbeat or ponderous ways to get their minds off something sad, such as the funeral of a friend, they picked more of the melancholy activities. Richard Wenzlaff, the University of Texas psychologist who did these studies, concludes that people who are already depressed need to make a special effort to get their attention on something that is completely upbeat, being careful not to inadvertently choose something—a tearjerker movie, a tragic novel—that will drag their mood down again.

Mood-lifters

> Imagine that you're driving on an unfamiliar, steep, and winding road through fog. Suddenly a car pulls out of a driveway only a few feet in front of you, too close for you to stop in time. Your foot slams the brake to the floor and you go into a skid, your car sliding into the side of the other one. You see that the car is full of youngsters, a carpool on the way to preschool—just before the explosion of glass shattering and metal bending into metal. Then, out of the sudden silence after the collision, you hear a chorus of crying. You manage to run to the other car, and see that one of the children is lying motionless. You are flooded with remorse and sadness over this tragedy....

Such heart-wrenching scenarios were used to get volunteers upset in one of Wenzlaff s experiments. The volunteers then tried to keep the scene out of their minds while they jotted notes about the stream of their thoughts for nine minutes. Each time the thought of the disturbing scene intruded into their minds, they made a check mark as they wrote. While most people thought about the upsetting scene less and less as time went on, those volunteers who were more depressed actually showed a pronounced *increase* in intruding thoughts of the scene as time passed, and even made

oblique references to it in the thoughts that were supposed to be distractions from it.

What's more, the depression-prone volunteers used other distressing thoughts to distract themselves. As Wenzlaff told me, "Thoughts are associated in the mind not just by content, but by mood. People have what amounts to a set of bad-mood thoughts that come to mind more readily when they are feeling down. People who get depressed easily tend to create very strong networks of association between these thoughts, so that it is harder to suppress them once some kind of bad mood is evoked. Ironically, depressed people seem to use one depressing topic to get their minds off another, which only stirs more negative emotions."

Crying, one theory holds, may be nature's way of lowering levels of the brain chemicals that prime distress. While crying can sometimes break a spell of sadness, it can also leave the person still obsessing about the reasons for despair. The idea of a "good cry" is misleading: crying that reinforces rumination only prolongs the misery. Distractions break the chain of sadness-maintaining thinking; one of the leading theories of why electroconvulsive therapy is effective for the most severe depressions is that it causes a loss of short-term memory—patients feel better because they can't remember why they were so sad. At any rate, to shake garden-variety sadness, Diane Tice found, many people reported turning to distractions such as reading, TV and movies, video games and puzzles, sleeping, and daydreams such as planning a fantasy vacation. Wenzlaff would add that the most effective distractions are ones that will shift your mood—an exciting sporting event, a funny movie, an uplifting book. (A note of caution here: Some distractors in themselves can perpetuate depression. Studies of heavy TV watchers have found that, after watching TV, they are generally more depressed than before they started!)

Aerobic exercise, Tice found, is one of the more effective tactics for lifting mild depression, as well as other bad moods. But the caveat here is that the mood-lifting benefits of exercise work best for the lazy, those who usually do not work out very much. For those with a daily exercise routine, whatever mood-changing benefits it offers were probably strongest when they first took up the exercise habit. In fact, for habitual exercisers there is a reverse effect on mood: they start to feel bad on those days when they skip their workout. Exercise seems to work well because it changes the

physiological state the mood evokes: depression is a low-arousal state, and aerobics pitches the body into high arousal. By the same token, relaxation techniques, which put the body into a low-arousal state, work well for anxiety, a high-arousal state, but not so well for depression. Each of these approaches seems to work to break the cycle of depression or anxiety because it pitches the brain into a level of activity incompatible with the emotional state that has had it in its grip.

Cheering oneself up through treats and sensual pleasures was another fairly popular antidote to the blues. Common ways people soothed themselves when depressed ranged from taking hot baths or eating favorite foods, to listening to music or having sex. Buying oneself a gift or treat to get out of a bad mood was particularly popular among women, as was shopping in general, even if only window-shopping. Among those in college, Tice found that eating was three times as common a strategy for soothing sadness among women than men; men, on the other hand, were five times as likely to turn to drinking or drugs when they felt down. The trouble with overeating or alcohol as antidotes, of course, is that they can easily backfire: eating to excess brings regret; alcohol is a central nervous system depressant, and so only adds to the effects of depression itself.

A more constructive approach to mood-lifting, Tice reports, is engineering a small triumph or easy success: tackling some long-delayed chore around the house or getting to some other duty they've been wanting to clear up. By the same token, lifts to self-image also were cheering, even if only in the form of getting dressed up or putting on makeup.

One of the most potent—and, outside therapy, little used—antidotes to depression is seeing things differently, or *cognitive reframing.* It is natural to bemoan the end of a relationship and to wallow in self-pitying thoughts such as the conviction that "this means I'll always be alone," but it's sure to thicken the sense of despair. However, stepping back and thinking about the ways the relationship wasn't so great, and ways you and your partner were mismatched—in other words, seeing the loss differently, in a more positive light—is an antidote to the sadness. By the same token, cancer patients, no matter how serious their condition, were in better moods if they were able to bring to mind another patient who was in even worse shape ("I'm not so bad off—at least I can walk"); those who compared themselves to healthy

people were the most depressed.[18] Such downward comparisons are surprisingly cheering: suddenly what had seemed quite dispiriting doesn't look all that bad.

Another effective depression-lifter is helping others in need. Since depression feeds on ruminations and preoccupations with the self, helping others lifts us out of those preoccupations as we empathize with people in pain of their own. Throwing oneself into volunteer work—coaching Little League, being a Big Brother, feeding the homeless—was one of the most powerful mood-changers in Tice's study. But it was also one of the rarest.

Finally, at least some people are able to find relief from their melancholy in turning to a transcendent power. Tice told me, "Praying, if you're very religious, works for all moods, especially depression."

REPRESSORS: UPBEAT DENIAL

"He kicked his roommate in the stomach . . ." the sentence begins. It ends, "... but he meant to turn on the light."

That transformation of an act of aggression into an innocent, if slightly implausible, mistake is repression captured *in vivo.* It was composed by a college student who had volunteered for a study of *repressors,* people who habitually and automatically seem to blot emotional disturbance from their awareness. The beginning fragment "He kicked his roommate in the stomach . . ." was given to this student as part of a sentence-completion test. Other tests showed that this small act of mental avoidance was part of a larger pattern in his life, a pattern of tuning out most emotional upset. [19] While at first researchers saw repressors as a prime example of the inability to feel emotion—cousins of alexithymics, perhaps—current thinking sees them as quite proficient in regulating emotion. They have become so adept at buffering themselves against negative feelings, it seems, that they are not even aware of the negativity. Rather than calling them repressors, as has been the custom among researchers, a more apt term might be *unflappables.*

Much of this research, done principally by Daniel Weinberger, a psychologist now at Case Western Reserve University, shows that while such people may seem calm and imperturbable, they can sometimes seethe with physiological upsets they are oblivious to. During the sentence-completion test, volunteers were also being monitored for their level of

physiological arousal. The repressors' veneer of calm was belied by the agitation of their bodies: when faced with the sentence about the violent roommate and others like it, they gave all the signs of anxiety, such as a racing heart, sweating, and climbing blood pressure. Yet when asked, they said they felt perfectly calm.

This continual tuning-out of emotions such as anger and anxiety is not uncommon: about one person in six shows the pattern, according to Weinberger. In theory, children might learn to become unflappable in any of several ways. One might be as a strategy for surviving a troubling situation such as having an alcoholic parent in a family where the problem itself is denied. Another might be having a parent or parents who are themselves repressors and so pass on the example of perennial cheerfulness or a stiff upper lip in the face of disturbing feelings. Or the trait may simply be inherited temperament. While no one can say as yet just how such a pattern begins in life, by the time repressors reach adulthood they are cool and collected under duress.

The question remains, of course, as to just how calm and cool they actually are. Can they really be unaware of the physical signs of distressing emotions, or are they simply feigning calm? The answer to that has come from clever research by Richard Davidson, a University of Wisconsin psychologist and an early collaborator with Weinberger. Davidson had people with the unflappable pattern free-associate to a list of words, most neutral, but several with hostile or sexual meanings that stir anxiety in almost everyone. And, as their bodily reactions revealed, they had all the physiological signs of distress in response to the loaded words, even though the words they associated to almost always showed an attempt to sanitize the upsetting words by linking them to an innocent one. If the first word was "hate," the response might be "love."

Davidson's study took advantage of the fact that (in right-handed people) a key center for processing negative emotion is in the right half of the brain, while the center for speaking is in the left. Once the right hemisphere recognizes that a word is upsetting, it transmits that information across the corpus callosum, the great divide between the brain's halves, to the speech center, and a word is spoken in response. Using an intricate arrangement of lenses, Davidson was able to display a word so that it was seen in only half of the visual field. Because of the neural wiring of the visual system, if the

display was to the left half of the visual field, it was recognized first by the right half of the brain, with its sensitivity to distress. If the display was to the right half of the visual field, the signal went to the left side of the brain without being assessed for upset.

When the words were presented to the right hemisphere, there was a lag in the time it took the unflappables to utter a response—but only if the word they were responding to was one of the upsetting ones. They had *no* time lag in the speed of their associations to *neutral words*. The lag showed up *only* when the words were presented to the right hemisphere, not to the left. In short, their unflappableness seems due to a neural mechanism that slows or interferes with the transfer of upsetting information. The implication is that they are *not* faking their lack of awareness about how upset they are; their brain is keeping that information from them. More precisely, the layer of mellow feeling that covers over such disturbing perceptions may well be due to the workings of the left prefrontal lobe. To his surprise, when Davidson measured activity levels in their prefrontal lobes, they had a decided predominance of activity on the left—the center for good feeling—and less on the right, the center for negativity.

These people "present themselves in a positive light, with an upbeat mood," Davidson told me. "They deny that stress is upsetting them and show a pattern of left frontal activation while just sitting at rest that is associated with positive feelings. This brain activity may be the key to their positive claims, despite the underlying physiological arousal that looks like distress." Davidson's theory is that, in terms of brain activity, it is energy-demanding work to experience distressing realities in a positive light. The increased physiological arousal may be due to the sustained attempt by the neural circuitry to maintain positive feelings or to suppress or inhibit any negative ones.

In short, unflappableness is a kind of upbeat denial, a positive dissociation—and, possibly, a clue to neural mechanisms at play in the more severe dissociative states that can occur in, say, post-traumatic stress disorder. When it is simply involved in equanimity, says Davidson, "it seems to be a successful strategy for emotional self-regulation" though with an unknown cost to self-awareness.