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The Archaeology of Mind

Neuroevolutionary Origins of
Human Emotions

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Lucy Biven**

Foreword by Daniel J. Siegel



W. W. NORTON & COMPANY

New York • London

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Preface and Acknowledgments

ALL OF US GET ANGRY at times, especially when our interests are ignored or thwarted. Has traditional brain science told us how this emotion is created? Not yet. We all get lonely and sad at times. Has modern neuroscience sought to clarify those aspects of our nature? We have barely begun to talk about such things, even though great progress has been made in some quarters. Most of us get great joy from interacting playfully with others; some do not, especially if they are depressed. Neuroscience has remained largely silent about the nature of joy, while psychology has seen a revolution in the study and discussion of its cognitive derivative, happiness, with few insights into the neural nature of joy.

Just like the many other emotional powers of our minds, all of which emerge from the functions of the brain, traditional neuroscience has had relatively little to tell us about how the intense emotional feelings that we call *affects* can arise from brain activities. This is because feelings are subjective experiences, and some say the traditional third-person measurements of science (i.e., external observation of phenomena) cannot deal effectively with first-person experiences. We disagree, to the extent that other mammals have evolutionarily related brain systems. Modern neuroscience is well poised to finally clarify the ways that the mammalian brain generates affective valuations of world events in the form of nonverbal feeling states—or the passions of the mind, as some Renaissance scholars would describe them.

This book describes a new scientific discipline called affective neuroscience, which seeks to illuminate how our most powerful emotional feelings—the primal emotional affects—arise from ancient neural networks situated in brain regions below the neocortical “thinking-cap.” The neocortex is an organ that generates complex cognitive abilities as well as culture, and it is definitively important for complex perceptions, learning, and cognitions. The neocortex is responsible for almost all of the cultural milestones that human beings have been able to achieve. And neuroscience has also provided an important message—practically all of the psychological specializations within the cortex are learned. None has yet been empirically demonstrated to be an intrinsic, evolutionarily dictated “module.” However, the cortex could achieve nothing without an evolved foundational mind deeper in the brain. Those ancient neural territories below the neocortex constitute our ancestral mind—the affective mind, which is evolutionarily specialized and that we share with many other animals. It is an “archaeological treasure,” for it contains the sources of some of our most powerful feelings. Those ancient subcortical brain systems are precious, multihued “jewels” for anyone wishing to understand the roots of all the basic values we have ever known and will experience in our lives. The affects are the foundations upon which the beauty and ugliness of life has been constructed. And affects also change with experience, but more quantitatively rather than qualitatively.

This book is an updating and an attempt at popularizing an earlier textbook, *Affective Neuroscience: The Foundations of Human and Animal Emotions* (Panksepp, 1998a). This text has garnered wide attention as a major new approach to the science of the emotional mind and has become a source book for clinicians who wish to understand the basic emotions of their clients. Even though work on kindred animals has been so crucial to the development of affective neuroscience, Jaak Panksepp started his

work with an interest primarily in human emotions, especially their disturbances in clinical disorder. He soon realized that deep neuroscientific understanding could not be achieved without appropriate animal models. This position has changed somewhat with the emergence of modern brain imaging, but not much if one wants to really understand the evolved functional networks of the brain. It is rather difficult to have intense emotions while lying still within brain scanners that make measurements that cannot tolerate movements. Still the new evidence obtained with those spectacular human brain imaging technologies has clarified much about the cognitive aspects of emotion but rather little about the sources of such feelings in the brain. The primary-process emotions are all connected to movements, and the evidence now indicates that raw emotional feelings arise from the same ancient brain networks that control our instinctual emotional life. Despite many theories in the field, the facts indicate that these raw emotional feelings arise from the emotional action networks of the brain.

Overall, the topic of emotions is of great interest to practically everyone—from psychiatrists who have to deal with human feelings that have become extreme, to anyone who is curious about those powerful states that govern so much of what we do and who we are in the world. We hope that what will be discovered between these covers will be of considerable use to many in their quest to understand themselves and others, including fellow animals, and to recognize how much all mammals share in the ways that they emotionally respond to the world. We suspect that many diverse groups of people will find these perspectives to be especially useful.

WHY PSYCHIATRISTS, PHYSICIANS, AND PSYCHOTHERAPISTS SHOULD UNDERSTAND THE SEVEN BASIC AFFECTIVE SYSTEMS

We have found that the ancient subcortical regions of mammalian brains contain at least seven basic affective systems: Here, we refer to these systems as SEEKING (expectancy), FEAR (anxiety), RAGE (anger), LUST (sexual excitement), CARE (nurturance), PANIC/GRIEF (sadness), and PLAY (social joy). (We will explain later why we use capitalization to label these systems; for now, suffice it to say that they designate specific functional networks of evolutionarily very ancient regions of our brains.)

This book should be of special interest to psychiatrists and other mental health professionals as well as students of the affective, behavioral, and cognitive neurosciences (each of which takes a rather different approach to the study and discussion of emotions). Our focus here will be on the *primary process* nature of these systems, but we will not neglect the levels that most other investigators are studying—the *secondary process* (inbuilt emotional learning mechanisms) and the *tertiary process* (emotional thoughts and deliberations that are so evident in human experience).

The failure of neuroscientists to deal empirically with the primary-process (evolved) level of emotional organization is impeding as coherent a synthesis of different approaches as is currently possible in emotion studies. As one ascends through the evolutionary layers of the brain and mind, there are more and more diverse ways to envision emotional life. In contrast, there is abundant evidence indicating that the basic affective systems of mammalian *brains* are ancient universal value structures of mammalian *minds* that provide evaluations of the world in the form of categories of individual affective experiences. The further up one goes in BrainMind complexity—from primary to tertiary levels—the more variable and complex the overall equation becomes. Multiple emotion streams may cross in the thinking mind, creating an enormous variety of higher emotions that are often the focus of psychologists—pride, shame, confidence, guilt, jealousy, trust, disgust, dominance, and so forth with hundreds of possible variants. However, without a clear vision of the primary processes the important work on higher processes remains profoundly incomplete. We cannot have a credible *theory of mind* without a credible understanding of the basic emotional feelings we inherit as evolutionary tools for living. It is possible that the higher (socially constructed) feelings all require

certain permutations of our evolved capacities to feel certain ways. All aspects of mental life can be influenced by our primary-process feelings, and the overall affective spectrum of the lower MindBrain is foundational for higher mental health issues. The extent to which the lower powers of the mind eventually come to be molded by the emerging higher functions will be of great interest in future work. We already know that higher brain processes can arouse emotions, as dramatically as they can reduce emotions. All this will remain a most interesting aspect of affective neuroscience for a long time to come.

Physicians, especially psychiatrists, must know about these affective systems, because they afford new insights into mind-body interactions. Some such interactions are already well known. Consider, for example, the misery of sustained anxiety, an expression of the FEAR system. Arousal of the FEAR system eventually leads to excessive production of cortisol. Under optimal conditions when an animal is afraid, the secretion of cortisol mobilizes glucose as an energy supply for the skeletal muscles in the case the animal decides to flee. In this way, cortisol secretion is beneficial. However, excessive secretion can begin to damage the body if elevations are sustained for too long. Normally when cortisol has circulated through the blood back up to the brain, the paraventricular nucleus (PVN) of the hypothalamus exerts an inhibitory effect that stops further release of cortisol. If, however, a person or animal is subjected to an excessive amount of stress—when they are chronically frightened or anxious—the PVN may not be able to stop the production of cortisol.

Although the intensities and time patterns of the emotional effects of cortisol can vary dramatically from one person to another, all visceral organs and many areas of the brain, as well as the immune system, can be adversely affected by a prolonged excess of cortisol. Many resulting stress-induced cascades in the brain and body can contribute to these adverse effects as well. Prolonged high cortisol levels are common in a number of psychiatric syndromes, most especially in depression. It is not known exactly how excessive secretion of cortisol can promote clinical depression. However, disruptions in the normal production of a variety of growth factors, such as BDNF (Brain-Derived Neurotrophic Factor) have been implicated. Play tends to promote positive affect partly through such chemistries (see [Chapter 10](#)), providing evidence for the common-sense principle that positive and negative feelings counteract each other in the affective economy of the mind.

In addition, when people are severely depressed they often suffer from hippocampal damage, because an excess of cortisol can cause hippocampal cells to shrivel and at times even die off. Perhaps surprisingly to some, simply tickling rats and provoking the rats to “laugh” can promote the sprouting of new neurons in the hippocampus (see [Chapter 10](#)). The hippocampus is a brain structure that is essential for the creation of declarative and episodic memories—conscious memories of knowledge and experiences (see [Chapter 6](#)). Without this brain region, one would live in a perpetual present, with no memory of events that have passed. Thus, excessive cortisol release can participate in a number of serious mental disorders, including memory deficits.

Similarly, in small doses, opiates will elevate mood and promote social solidarity. In large doses they promote intoxication. In fact, appropriate amounts of endogenous opioids can have medical and beneficial effects. For example, the placebo effect, whereby patients respond favorably to fake medications, can be explained in terms of this emotional chemistry. If a patient feels that his needs are being considered and tended to, then the positive feelings of being cared for are accompanied by the release, in the brain, of calming endogenous opioids, which diminish the feelings associated with the GRIEF/PANIC system.

In addition to producing good emotional feelings, opioids also reduce stressful arousal, reduce feelings of physical as well as psychological pain, and produce various immune benefits. So the patients will feel comforted and be much better off medically than they would be if they thought that no one seemed to care. We now know that the placebo effect is real medicine that operates mainly

through the activation of brain opioid systems. These healing tendencies can thus be reduced, and even eliminated, by drugs like naloxone and naltrexone, which block the effects of opioids.

In the past, when an apparently healthy patient appeared emotionally agitated and complained of physical symptoms, doctors tended to believe that the symptoms were psychosomatic, “all in the mind,” and therefore not physical or “real.” This is no longer an accepted view of psychosomatic illness. As soon as we recognize that affects emerge from emotional systems that are fueled by brain chemicals that can also exert an eventual effect on the functioning of the brain and the body, then the division between emotional and physical disorders narrows to the point of extinction. Although it may appear that the mind and the brain are different entities, the mind being incorporeal, and the brain being physical, they are really one and the same thing. The MindBrain (or BrainMind) is a unified entity lacking any boundary with the body—it is integral to the physical system as a whole.

An understanding of brain emotional systems, and the psychological and bodily symptoms that they can generate, is not only important for medicine in general; it also offers a totally new perspective for contemporary psychiatry. Affective neuroscience points the way to treating the real and specific symptoms of emotional imbalances, the natural *endophenotypes* of the BrainMind, rather than vague nosological abstractions such as autism, depression, and schizophrenia, which were handed down to us with pre-neuroscientific classifications of mental disorders. These diagnostic concepts have been inferred from average clinical presentations. But we now know that all of them are highly nebulous—each diagnostic category is a conceptual umbrella for a host of overlapping MindBrain problems.

For example, rats are inherently afraid of the smell of a predator. They also have an inherent fear of well-lit open spaces and thus prefer to be in dark and hidden areas. They often also exhibit symptoms of fear (commonly measured by freezing behaviors, elevations in blood pressure, and increased frequency of defecation) when placed in an unfamiliar cage. Common antianxiety drugs such as benzodiazepines quell the fear of open spaces and of a new cage. Rats still remain afraid of predator smell, however, suggesting that this is a somewhat different kind of fear. Surprisingly, morphine, which is so effective in reducing separation distress, is able to reduce a rat’s fearful responses to the smell of predators. Ordinarily we lump different kinds of fear into a single category, but affective brain research suggests that there are neural models for distinct types of fear and anxiety. If this is so, then we should be able to develop specific drugs to treat each type. As we will explore in detail in a later chapter, there are convincing distinctions to be made between trepidation of the kind associated with physical danger (the FEAR system) and the panicky type of fear associated with separation anxiety (the GRIEF/PANIC system).

For quite a while, the development of psychiatric medicine has been stifled by man-made concepts gleaned from complex symptomatology rather than from brain research. If psychiatric research were linked more to the actual emotional symptoms of the MindBrain and more productively linked to functional neuroscience, we might make much faster progress. For instance, we might easily develop specific drugs for irritability and anger. This is presently difficult to achieve because no official diagnostic categories have been designed for excessive anger (except perhaps for Intermittent Explosive Disorder). Yet society as a whole, and children in particular, are frequently victims of excessive RAGE. We already have medications such as Substance P receptor antagonists, and the drug aprepitant (a medication currently used to treat nausea), which should, if one can generalize from the animal data, reduce angry irritability (see [Chapter 4](#)). There is presently considerable excitement in pursuing a better understanding of such emotional endophenotypes, so that our diagnostic tools can be radically revised and so that better medicines can be developed.

Knowledge of the seven basic emotional systems has begun to revolutionize the practice of psychotherapy because it offers the most comprehensive, data-based brain taxonomy of primary process emotions that is currently available. Knowledge of these systems also entails a mo

comprehensive view of how human emotions operate. We help to provide a data-based taxonomy for discussing the foundations of emotional life, and we provide many examples of the importance of specific brain functions in affective life—for instance, the powerful role of endogenous opioids and oxytocin in the positive affect of supportive social relationships. This provides neurobiologic support for the view that healthy emotional development relies heavily on maintenance of supportive human interactions. In dire circumstances, the prescription of safe medications that support such brain chemistries can promote and solidify psychotherapeutic practice.

Just to highlight our approach to key conceptual issues in psychotherapy, let us consider how the present view contrasts with some of the tenets of classical psychoanalytic thought. We do this with intellectual admiration for the theoretical subtleties of that field, but here we focus mainly on how we would view primary affective processes differently than psychoanalytic theorists, whose views were based on clinical insights rather than on neuroscientific research.

Although psychotherapy has evolved in many different directions in the past half century, many therapists are continuing to rely on psychoanalytic theories to inform them about basic affect. Moreover, currently popular views of emotion, which envision some variation on a simple polar schematic of positive and negative affective valence, modulated by high and low arousal, have really not fallen all that far from the psychoanalytic tree. Freud maintained that human drives are rooted in our physiological needs, and he grouped these together into only two categories of drive: *libido* and *aggression*. Drives find psychic expression in wishful thoughts—in thoughts that are imbued with affective color. According to Freudian theory, the two main affects concerned wishes about sexual desires and aggressive urges.

Freud argued for several types of drive expression, each rooted in different stages of libidinal development: oral, anal, phallic, and oedipal. Aggressive drive was similarly partitioned along these developmental stages. This gave broader scope to the two interacting drives and their consequent affective wishes. Nevertheless, the range of discrete affects was considerably more limited than those produced by the seven affective systems that have since been revealed by neuroscientific research. We are happy to note that the SEEKING system provides an interesting parallel to Freud's libidinal drive (insofar as he saw libido as a generic appetitive force, rather than in narrowly sexual terms). It is difficult to reconcile Freud's views on anxiety, however, as well as his views on lust in relation to attachment and affectionate bonds, and much else besides, with the knowledge we have derived from rigorous neuroscientific investigation.

Most modern psychoanalytic and cognitive-behavioral approaches to therapy fail to clearly identify SEEKING as a basic emotional urge. Some researchers also tend to confuse FEAR and PANIC/GRIEF, seeing anxiety as a single manifestation. The importance of social interaction is also insufficiently highlighted in many psychoanalytic theories. Freudians see social interaction as a derivative means of gratifying sexual and aggressive impulses. Social needs are not seen as basic urges that might, at times, supersede sex or aggression in importance, even at the level of primary instinctual impulses. Although object-relations theorists stress the importance of interpersonal needs, they tend to focus on early relationships within the family, particularly the mother/child bond. Today we have more information about the importance of PLAY, for example, and the associated basic psychology of social dominance.

At the same time, what we have to offer here says little about the unique, idiographic aspects of human mental life with which each psychotherapist must contend. There are higher, tertiary-process cognitive functions with which emotions will interact in real life. But by clarifying the primal mental energies that need to be considered as we try to help people in emotional distress, it may simplify the tertiary-process tasks of the psychotherapist. How? That would require another book. But perhaps one insight may suffice for now: The lower brain seems to be organized in such a way that one primary

affective state prevails at any one time. This “monomania,” for lack of a better word, also coaxes the cognitive apparatus “to follow” with obsessive self-serving ruminations. The goal of therapy is to facilitate a more complex perspective taking in the higher mental apparatus—what Aristotle called *phronesis*, becoming master of one’s passions by understanding “low-minded” ways.

Perhaps this central problem in the clinical practice of classic psychoanalysis can be addressed by affective neuroscience. As we see it, a key reason that classic psychoanalysis may have been less effective than it could have been lay in the fact that *interpretation*—the crux of the talking cure—was long deemed to be the main psychotherapeutic tool. Psychoanalysts tended to concentrate on the relationship between affective states and their corresponding cognitive manifestations (wishes). They have long assumed that by interpreting relevant thoughts and ideas, by uncovering their origins in childhood and explaining their primitive emotional meaning, a patient will be cured. But how do we know this can untangle the emotional “knots” of most people’s lives?

Suppose that in childhood a boy had endured physical and emotional abuse at the hands of his father. In adulthood, this man himself tended to bully those who were weak. A psychotherapist would help the patient to identify problematic areas in his adult personality, namely his tendency to bully or even abuse others, and would then trace these traits back to childhood. The therapist would perhaps interpret that this man bullied the weak and abused the vulnerable in order to vent his rage at his father in a way that would not result in retaliation. Other interpretations might highlight the possibility that he bullied others in order to restore his masculine self-esteem. As a result of these and still other interpretations, the patient would presumably be cured or at least proceed to have a happy life. In this vision cognitive issues were seen as a gateway to emotional ones.

The psychoanalytic tradition was followed, during the behaviorist era, with highly focused “behavior modification therapies,” where both the cognitive and emotional issues were put aside and therapists sought to mold maladaptive behavior patterns by adjusting reinforcement contingencies. With the cognitive revolution, the focus shifted to “cognitive behavioral therapies” (CBT) that were remarkably effective for some disorders such as specific phobias (Beck, 1976). Now, with the recognition that emotional tides lie at the core of psychiatric disorders, the winds are shifting again.

The primacy of affect in BrainMind evolution suggests that therapies must have clear visions of human affective life, so that therapists can provide optimal understanding of and help for psychiatric problems. Indeed, such bottom-up views may turn the cognitive “interpretive” type of emotion theorizing in psychology and philosophy on its head. Clearly, even though cognitive issues loom large in tertiary-process emotions, primary-process emotions have to be dealt with on their own terms. When traditional modes of therapy (psychoanalysis or CBT) fail to quell emotional storms, the probably medication is warranted. At present, most of these medications do not exist because psychiatrists do not know enough about the anatomy and chemistry of the emotional brain. We hope that this book may stimulate more research that will result in the creation of such medications. In this sense, what is needed is a fuller integration of all the therapeutic traditions, from dynamic psychoanalytic to the new generations of affective balance therapies that will be the major focus of this book (see [Chapter 12](#)).

For instance, considering the case discussed above, suppose that the abuse suffered in childhood had fatefully sensitized the FEAR and RAGE systems in ways that made commensurate affects difficult or impossible to quell. Even if the therapist succeeded in convincing the patient about the origins of his problems and even if the patient was well aware that he was unfair and unjust to others, this might not be enough to effect any cure because he would still suffer from an overwhelming irritability, which may present itself as an apparent wish to bully.

Neuroscience supports this supposition. Two millennia ago, Plutarch noted that “the continuance and frequent fits of anger produce in the soul a propensity to be angry: which oft-times ends in cholera.”

bitterness, and moroseness, when the mind becomes ulcerated, peevish and querulous and is wounded by the least occurrence.” Plutarch, it seems, was correct. We now know that the RAGE circuits of the brain can be sensitized and become hyper-responsive. Thus, even if the patient fully understood the origins of his rage, and made an extreme effort of will to curb his rage, he might not be able to stop feeling chronically irritated, and he would remain emotionally ill. Perhaps others might be spared the deleterious effects of his anger, but the patient himself might continue to suffer as much as he did prior to therapy, perhaps even more, when he at least had an outlet for the feelings that he could not control.

The point is that thoughts are not always stronger than affects, which is why cognitive interpretations often do not work well with serious psychopathologies. Indeed, clients can be confused by complexities that the therapist sees “clearly.” When affects maintain the upper hand, the talking cure is apt to fail because the interpretive method, the cardinal psychotherapeutic tool, can frequently be ineffective in the face of our primal passions. Perhaps this is why even Freud himself looked forward to the day when it would be possible to exercise a direct chemical influence on the drives, he saw them. But this does not mean that psychotherapy should simply be replaced by pharmacotherapy. Affective neuroscience research highlights that clinicians should not treat human beings as if they were bags of neurochemicals or “brains in vats.” Affective feelings are part of the full equation, and they should not be ignored when psychiatrists seek new treatments for problems. Also, the mammalian brain is fundamentally a social brain, and it needs to be treated as such. The basic emotion systems do not operate in a social vacuum, even at the primary-process level. Thus, almost all mind-medicine interventions need to be complemented by appropriate psychosocial help, not only to trace and unravel the secondary- and tertiary-process derivatives of (perhaps lifelong) basic emotional imbalances, but also to guide, facilitate, and activate the desired primary-process affects. Positive affects can promote resilience, which can have lasting beneficial effects for many emotional problems. Affective neuroscience highlights that the role of social emotions in all future therapeutic schools of thought must remain in focus in order for lasting improvements to be maximized.

OTHER AUDIENCES

All people who wish to be well informed about human emotion—from parents to educators—will want to understand how feelings are created from within the brain. These affective systems have important implications for most academic disciplines that deal with human beings, from philosophy to economics and from the arts to the social sciences.

Parents

Parents will want to know about these systems in order to assess normal development in their children. If one sees a felicitous balance of all systems, this indicates that children are developing emotionally healthy ways. But if a particular system is over—or under—aroused, this may indicate a problem. For example, an excessively studious or serious child may have an underactive PLAY system. The PLAY system allows children to learn about social rules of conduct—for example, when to cooperate and when to compete, and at times to retreat in good-humored ways and let someone else win. When animals engage in rough-and-tumble play and one animal wins more than 70% of the time, the losing animal no longer enjoys the game and may drop out of such interactions entirely. So when children play, they learn valuable social skills, such as the necessity of reciprocity and giving way to

occasion. Children will learn these skills because, if they do not, their playmates may begin to reject them.

Parents should understand the importance of maintaining an optimal balance of positive affects for their children, especially when they are very young. Subcortical emotional systems can become sensitized by experience. Neuroscientists are beginning to learn how emotional brain systems are molded, often permanently, through life experiences, just like the muscles and bones that carry our bodies dynamically into the world develop and strengthen over time. These changes can extend to the level at which genes become activated, sometimes leading to lifelong patterns of affective strengths and weaknesses. Understanding these *epigenetic* (environmentally induced) long-term changes in gene expressions and hence often the lifelong strengths and weaknesses of the BrainMind will be a most exciting forthcoming chapter in emotion research.

Therefore, children are blessed if they have received a great deal of nurturing CARE, leading to the formation of secure social bonds, with positive attachment facilitated by low activity of the PANIC/GRIEF system. If the child has had the opportunity to engage in abundant joyful play, and the child's curiosity has been stimulated, then the neural circuits that support these capacities will be more robust throughout life. If, on the other hand, the child has been subjected to untoward frustrations that engender her RAGE system, or if the child has endured high levels of FEAR or PANIC/GRIEF, then her capacity for these negative feelings will be enlarged. However, this does not mean that parents need to protect their children from negative emotions. All children must learn to cope with them because they are a natural part of living. It is reasonable to believe that all the negative emotions, in small manageable doses, facilitate long-term psychological resilience that may help ward off longer-lasting future disappointments that could lead to depression.

Teachers

Teachers will surely benefit from knowing about the seven basic affective systems. All good teachers stimulate the SEEKING system when they make learning an exciting experience rather than purely a matter of rote memorization. However, given that much learning involves some measure of drudgery, teachers also need to impose social sanctions. The conscientious child is rewarded with praise engendering satisfying feelings emanating from the positive social bonding arms of the CARE and GRIEF/PANIC systems. The recalcitrant child, however, must often endure the threat of disapproval with accompanying activation of the negative arm of the above social-affect systems, not to mention the throes of RAGE and FEAR. If so, that child's life will be ruled by negative affect and worry rather than the positive affects that can spur children on to greater accomplishments. A second chance offered gracefully to children with excessive negative affect, can be a wonderful life-sustaining experience. In any event, well-ministered social constraints can fortify children's ability to tolerate frustration and prepare them to deal with inevitable setbacks in adult life.

We will even emphasize how abundant physical play may reduce the incidence of impulsivity and problems such as Attention-Deficit Hyperactivity Disorder (ADHD). When children have fulfilled their natural urge to play physically, they are better prepared to sit still and pay attention in the classroom. The re-introduction of play might work best if we make recess the first class of each day. In effect, this need used to be met when children walked to school and arrived early enough to meet up with and engage playmates before classes started.

Managers and Supervisors

Certain emotional types seem to work best in specific roles and environments. Every manager needs to win the trust and respect of employees. Employees should feel that managers will help them with their problems at work, and managers should be confident that employees will meet their responsibilities. This implicit social contract is built on the mutuality of the CARE system. They must give each other what *they* need to feel secure and to excel. Managers also know the importance of team cohesion. Team days can support this process by fostering a spirit of PLAY, whereby members of a large working group share the opportunity to interact in more intimate and relaxed environments. This kind of playful interaction cements social bonds that are important for the solidarity of the workforce.

Animal Behaviorists

People who work with animals will find much important information here about the emotions that control animal behavior. Indeed, one of the most sensitive and hence foremost animal behaviorists in the United States, Temple Grandin—a highly accomplished person with autism—has brought forward such information in her compelling book *Animals Make Us Human* (2009). This work also helps to affirm long-held beliefs that animals do, in fact, have emotional feelings. Indeed, there is a rapidly growing movement, outside the academic disciplines, to recognize and value the emotions of other animals, but much of that is based on well-reasoned beliefs and fascinating anecdotes rather than on well-collected scientific facts.

The evidence summarized in our book aims to provide an empirical rather than an opinion-based view of what emotional minds are really like in mammalian species. The current evidence-based view is that all other mammals are full of emotional passion—they are quite full of affects. As we shall see, this is now a conclusion supported by vast amounts of experimental evidence (massively detailed in Panksepp, 1998a, and more modestly here). Those who remain in denial are adhering to a time-honored skepticism. In so doing, they typically fail to integrate modern affective neuroscientific research into their thinking. Perhaps other mammals cannot think about their affective lives in the ways that we do (their tertiary processes may be very different), but robust evidence indicates that they do experience a full range of primary-process affects.

We could go on about those who could benefit from understanding affective neuroscience: philosophers, politicians, artists, and other cultural leaders who want to make a better world. But most of all, we think that every person, to some extent, would want to become conversant with these basic tools for living that Mother Nature has endowed within our brains.

ACKNOWLEDGMENTS

We both have much to be thankful for.

Jaak is especially grateful for all the support and advice he received from his wife, Anesa Miller, who read and edited the entire manuscript. She completed this hard work while undergoing medical treatments for lymphoma. At the same time, Jaak was struggling with a different kind of lymphoma (thankfully, they are both in full remission at this time). Jaak is a member of the Center for the Study of Animal Well-Being within the Department of VCAPP (Veterinary Comparative Anatomy, Pharmacology, and Physiology) with the College of Veterinary Medicine at Washington State University. He thanks all of the fine colleagues who have helped make scientific pursuits a pleasure again. Sheri Six, Jaak's lab manager, has provided invaluable attention to the many details of keeping his lab going during these times, which in these days of modern science can be a daunting task. She

also read the manuscript with her fine eye for detail and with a mind devoted to the sensitive use of animals in research. During the past year, Mark Solms, a beloved and respected colleague, also provided useful and enthusiastic input for every chapter. At the very end of this protracted journey to publication, Tim Lyons, a former student, who had become much more than a student, returned for a few weeks at the end of the summer of 2010 to assist with the final polishing, and he smoothed many of the remaining wrinkles in the text. His energy and devotion, especially based on his training for a second career in clinical/counseling (after being a lawyer most of his professional life), improved the book substantially. Thanks to all who helped out along the way.

Jaak thanks all his fine colleagues at the related science departments of Washington State and in the humanities department of the University of Idaho for the cordial support and camaraderie they have offered throughout the half dozen years of his third academic career. After receiving his Ph.D. at the University of Massachusetts in 1969, Jaak pursued postdoctoral work at the University of Sussex and the Worcester Foundation for Experimental Biology. Jaak's vision of primary-process emotionality in the mammalian brain matured as he progressed from being Assistant Professor to Distinguished Professor of Psychobiology at Bowling Green State University (BGSU) across 30 years of work that might not have been possible elsewhere. Following his early retirement, precipitated partly by medical issues and partly by the premature death of his daughter Tiina, Jaak joined the Falk Center for Molecular Therapeutics at Northwestern University, pursuing the genetics of the affective mind with the camaraderie and intellectual and research support of Joe Moskal, Roger Kroes, and Jeff Burgdorf. He continues to collaborate with many former colleagues, especially on research on the genetics of the emotional brain, with the aspiration to identify new neurochemical pathways that control mammalian emotionality. He thanks his many colleagues at BGSU, especially Vern Bingman and Case Cromwell, who organized a Festschrift to celebrate his work in May 2010, much of which appears as a special issue of *Neuroscience and Biobehavioral Reviews*.

Jaak also thanks Audrey Gruss and friends and colleagues at the Hope for Depression Research Foundation (HDRF) for their intellectual engagement with the problem of depression and for the fruitful interactions during the past few years. Jaak is currently the research codirector of HDRF, and his ongoing research is devoted largely to developing new animal models for understanding and treating depression. He has been recognized as a revolutionary (a radical by some) in his field, with many prizes and recognitions. His work is summarized in well over 400 scientific publications, half of which are listed in biological archives, and the other half in those serving the social sciences.

Lucy Biven is the former Head of the Department of Psychotherapy at the Child and Adolescent Mental Health Service, part of the National Health Service in Leicestershire, England. She became interested in neuroscience about 20 years ago when she was appointed by the Michigan Supreme Court to devise and implement a protocol for the transfer of custody of a 2½ year old girl from the home of a couple whom the child regarded as her parents, to the home of her biological parents. Like most of her colleagues, Lucy worried about the little girl's psychological development, yet the child progressed well and today is an emotionally healthy young woman. Where did it all go right? Only neuroscience provided the answers.

Thus began an abiding interest in neuroscience. Yet even after reading extensively for a number of years, she was dissatisfied because most research focused on perception, learning and memory rather than emotion. When neuroscience did touch on emotion it was usually fear and its role in conditioned learning. Neuroscience did not focus on a full range of emotions or on emotion itself.

Then in the year 2000 she attended a symposium in London arranged by The International Neuropsychoanalysis Society, chaired by Mark Solms. Jaak Panksepp was a keynote speaker. Jaak was the first and only neuroscientist who focused squarely on the emotional brain. There followed a lengthy and instructive series of e-mails between Jaak and Lucy that ultimately resulted in the

publication of this book.

Jaak's thoughtful research has enhanced her clinical work, but there are others to whom she is grateful for their instruction and advice. First is her father, Charles Brenner, a psychoanalyst, whose clear thinking and accessible written exposition always provided an exemplary goal. Anna Freud was still intellectually vigorous when she directed London's Hampstead Clinic where Lucy trained, and to this day, she has not met a more gifted clinician. While still a student, Lucy met Vann Spruiell whose clinical and emotional honesty allowed her to see that psychoanalysis could and should be an invigorating pursuit as well as an intellectual endeavor. Along the way there have been other wonderful and influential colleagues, amongst them Josephine Klein, Anne Alvarez, and Thelma Hillaby.

Lucy was Senior Research Associate at the University of Michigan, under the inspired direction of Dr. Humberto Nagera, another brilliant clinician. She was a faculty member of the Michigan Psychoanalytic Institute, and in 1985, she received the Ira Miller memorial award for a clinical paper. She was an editorial reader for the *International Journal of Psychoanalysis* and also for the *Psychoanalytic Quarterly*.

She has written several papers about neuroscience and its relevance to psychotherapy and psychiatry and she has lectured widely in the United States, England, South Africa and Mexico. Finally, the most important person in her professional and personal life is her husband Barrie, whom she thanks with all her heart.

We both thank the fine staff at W. W. Norton who brought this work to fruition, especially Deborah Malmud, our acquisitions editor, who provided guidance and encouragement in the writing of this book.

Foreword

DANIEL J. SIEGEL, MD

AN UNDERSTANDING OF OUR INNER subjective lives and our interconnections with others is illuminated in a deep and helpful way in the in-depth journey into *The Archaeology of Mind*. By exploring our neural architecture, our social relationships, and our mental worlds and how they intertwine, neuroscientist Jaak Panksepp and psychotherapist Lucy Biven have created a detailed view into the ancient origins of human life. At the heart of this important synthesis is the notion that our subcortical circuits are the foundational substrate of “primary” experience—of emotions and motivations that shape our subjective lives, influence our behaviors, and mold our relationships. Panksepp and Biven propose that higher neocortical regions play an important—but distinctly “secondary”—role in how we learn to generate emotional responses, while the deeper, subcortical recesses that still exist within our older mammalian and reptilian circuits shape the innate textures of our everyday mental experience.

Jaak Panksepp has spent his academic life exploring the nature of these circuits, and his views serve as the essential core of this work. After a professional career devoted to advocating for the idea that non-human animals have an inner emotional world that needs to be both respected and understood, this important leader in the field of affective neuroscience has turned his focus to helping human beings using these new insights into old circuits. Panksepp is an outspoken advocate for a compassionate understanding of all members of the animal kingdom. With his work, we come to see the importance of honoring the inner core of subjective life and applying this knowledge to helping animal lives.

Whether you are a clinician, educator, researcher, or interested general reader, you will find in these pages useful and detailed information within the fascinating discussions of seven major primary circuits that form our feelings and mold our motivations: SEEKING, RAGE, FEAR, LUST, CARE, PANIC/GRIEF, and PLAY. While the interplay of these subcortical systems with the higher neocortex is naturally essential in our experience of being human, in this book we are offered a chance to dive deeply into these more ancient sources of our affective core. We know that many aspects of psychotherapy and of mental training serve as important ways the neocortex learns over time and can change various aspects of our emotional brains (see Davidson & Begley, 2012, for a helpful discussion). Mindfulness meditation, for example, has been shown to alter cortical connections in important regions that regulate emotion, attention, empathy, and self-understanding. Attachment relationships (see Schore, 2012; Cozolino, 2010) may also shape prefrontal cortical regions that link our widely separated higher and lower neural areas (see Siegel, 2012a, 2012b). And so the neocortex learns from experience.

Naturally, a therapist, teacher, parent, or others interested in how learning shapes our minds and brains will see this neuroplasticity as an important dimension of how we change across the lifespan (see Doidge, 2007 for an overview of cortical neuroplasticity). So then why should we take the time to learn about more “basic” or “primary” neural areas that may be well formed before we are born?

before extra-uterine learning begins? The answer is quite simple: These regions below the cortex serve as the substrate for both how the cortex grows in differentiated ways (see Trevarthen, 1999; McGilchrist, 2009) and how we come to experience mental life—our core, inner subjective texture of living moment by moment. Furthermore, a scientific view of these deep structures will only serve to expand our self-understanding and can offer empowering insights that may improve our lives.

In this book you'll find in-depth discussions of depression, anxiety, grief, and fear that may illuminate something about your own personal life. There are also helpful explorations of how experience shapes the circuitry of memory and emotion, forming the neural foundations of our inner lives and altering our capacity to regulate our affective responses. These discussions offer to the clinician important vistas into the nature of their client/patient's experience and how they can use this new knowledge to improve their capacity for empathic understanding and clinical intervention. The challenges people experience with social difficulties such as autism, learning issues such as attention deficit conditions, and emotion regulation problems such as disorders of mood, each take on a new light with the perspectives revealed in this work. This book also offers teachers a unique opportunity to understand the deep circuitries of motivation, emotion, and learning at the heart of the educational experience. When we realize that teacher–student relationships are based on trust, we come to see that these subcortical circuits set the stage for an effective learning relationship. If you are an academic researcher, this book provides a vast and detailed review of the subcortical aspects of affective neuroscience in one flowing narrative that may trigger some new ideas for understanding the field and perhaps may directly inform your own projects.

As someone trained both as a researcher and as a clinician, I have found this book to be a fascinating exploration of an often-ignored area of science and its application to therapeutic understanding. As an educator and the founding editor of the Norton Series on Interpersonal Neurobiology, I feel that knowing this material can help us bring more effective treatments and educational insights into our work and our world.

If I may, let me offer one suggestion here that may be helpful in the process of soaking in the pages that follow. If you are a scientist, you likely will be very interested in the ample details and abundance of academic references that are offered throughout the text. If, however, you are a clinician, educator, or general reader, you may find that a different approach to your reading will make this work more enjoyable. There is a lot of material here—written in an accessible and fascinating way—and there is no shortage of detailed discussions of neural circuits, transmitters, and the studies that illuminate what we know about them. Here is my suggestion to you: Read this work like a fascinating nonfiction story. Just like you wouldn't memorize a novel, do not worry about remembering all the details about research studies. You won't be tested on how well you've memorized what you've read! As you read in this more at-ease manner, you may find that your mind will detect patterns of information that naturally emerge over time. Initially unfamiliar terms may begin to feel familiar, unusual names more comfortable to see and say, so that you'll start to become more at home with these less common terms as you go along. The old subcortical favorites that are in the popular press—such as the amygdala and hippocampus—are all here. But you'll also meet less well-known subcortical neural regions such as the periaqueductal gray (PAG) and nucleus accumbens, which also play important roles in the archaeological narrative of our emotional lives. You may be quite familiar with dopamine and serotonin, but you'll also find detailed discussions of prolactin and oxytocin here too. Relax and just listen in to this fascinating story as it unfolds. Let go of those ancient responses of FEAR and PANIC (from childhood and school) that you may have if you try to memorize everything you read. Instead, be PLAYFUL and SEEK out just what feels relevant for you as you go along. You are about to experience Jaak Panksepp's passionate mind and his way of thinking about our neural origins. Enjoy the journey with Jaak and let yourself take in a lifetime's labor of love and learning!

The Archaeology of Mind

Ancestral Passions

. . . certain actions, which we recognize as expressive of certain states of mind, are the direct result of the constitution of the nervous system, and have been from the first independent of the will, and, to a large extent, of habit. . . . Our present subject is very obscure, but, from its importance, must be discussed at some length; and it always is advisable to perceive clearly our ignorance.

—Charles Darwin (1872)

THIS BOOK TAKES US ON an archaeological dig deep into the recesses of the mammalian brain, to the ancestral sources of our emotional minds. To the best of our knowledge, the basic biological values of all mammalian brains were built upon the same basic plan, laid out in consciousness-creating affective circuits that are concentrated in subcortical regions, far below the neocortical “thinking cap” that is so highly developed in humans. Mental life would be impossible without this foundation. There, among the ancestral brain networks that we share with other mammals, a few ounces of brain tissue constitute the bedrock of our emotional lives, generating the many primal ways in which we can feel emotionally good or bad within ourselves. As we mature and learn about ourselves, and the world in which we live, these systems provide a solid foundation for further mental developments. The subcortical brain networks are quite similar in all mammals, but they are not identical in all details. This similarity extends even to certain species of birds that, for instance, also have separation-distress PANIC networks—a GRIEF system, as we will often label it here—one of the main sources of psychological pain within their brains and ours (see [Chapter 9](#)).

We mammals and birds share many other basic emotional systems, and some even seem to exist in cold-blooded reptiles, but less is known about them. Thus, across many species of warm-blooded vertebrates, a variety of basic emotional networks are anatomically situated in similar brain regions, and these networks serve remarkably similar functions. We will discuss the nature of these brain systems that are being revealed by research on *other animals* (henceforth just “animals”). This knowledge is beginning to inform us about the deeper aspects of human nature. It provides a scientifically based vision about the origins of mind.

As briefly mentioned in the preface, the ancient subcortical regions of mammalian brains contain at least seven emotional, or affective, systems: SEEKING (expectancy), FEAR (anxiety), RAGE (anger), LUST (sexual excitement), CARE (nurturance), PANIC/GRIEF (sadness), and PLAY (social joy). Each of these systems controls distinct but specific types of behaviors associated with many overlapping physiological changes. To the best of our knowledge, these systems also generate distinct types of affective consciousness, and some of the most compelling data for that come from humans (Panksepp, 1985). As we will see, when these systems are stimulated in humans, people always experience intense emotional feelings, and presumably when the systems are normally activated by life events, they generate abundant memories and thoughts for people about what is happening to them.

The triangulation approach of affective neuroscience (discussed later in this chapter) provides an opportunity to assemble the needed evidence for these systems’ effects. But to proceed effectively we need a new language to describe the emotional systems of the brain in order to match our emerging understanding of these primary-process psychological powers. This is why we capitalize the names of the affective systems. Vernacular usages handed down from folk psychology can create

misunderstanding of these primary-process powerhouses of the mind. The capitalizations indicate that real physical and distinct networks for various emotions do exist in mammalian brains.

As highlighted in a medial view of the right cerebral hemisphere (Figure 1.1), these emotion-generating brain regions are concentrated in the most ancient medial (midline) and ventral (belly-side) brain areas, ranging from (i) the midbrain, especially a region known as the periaqueductal gray (PAG), or “central gray” as it used to be called; (ii) the hypothalamus and medial thalamus, connected massively to (iii) higher brain regions, traditionally known as “the limbic system,” which include the amygdala, basal ganglia, cingulate cortex, insular cortex, hippocampus, and septal regions (see Figure 1.2, which depicts the circuits hidden inside the left hemisphere adjacent to the one in Figure 1.1); well as (iv) various medial frontal cortical and ventral forebrain regions (e.g., orbitofrontal cortex) that provide higher controls for emotional reactivity. Although the concept of the subcortical “limbic system” has been under assault for some time, all would have to admit that it was a great advance over some earlier views (e.g., the James-Lange theory) that situated emotions in higher brain regions.

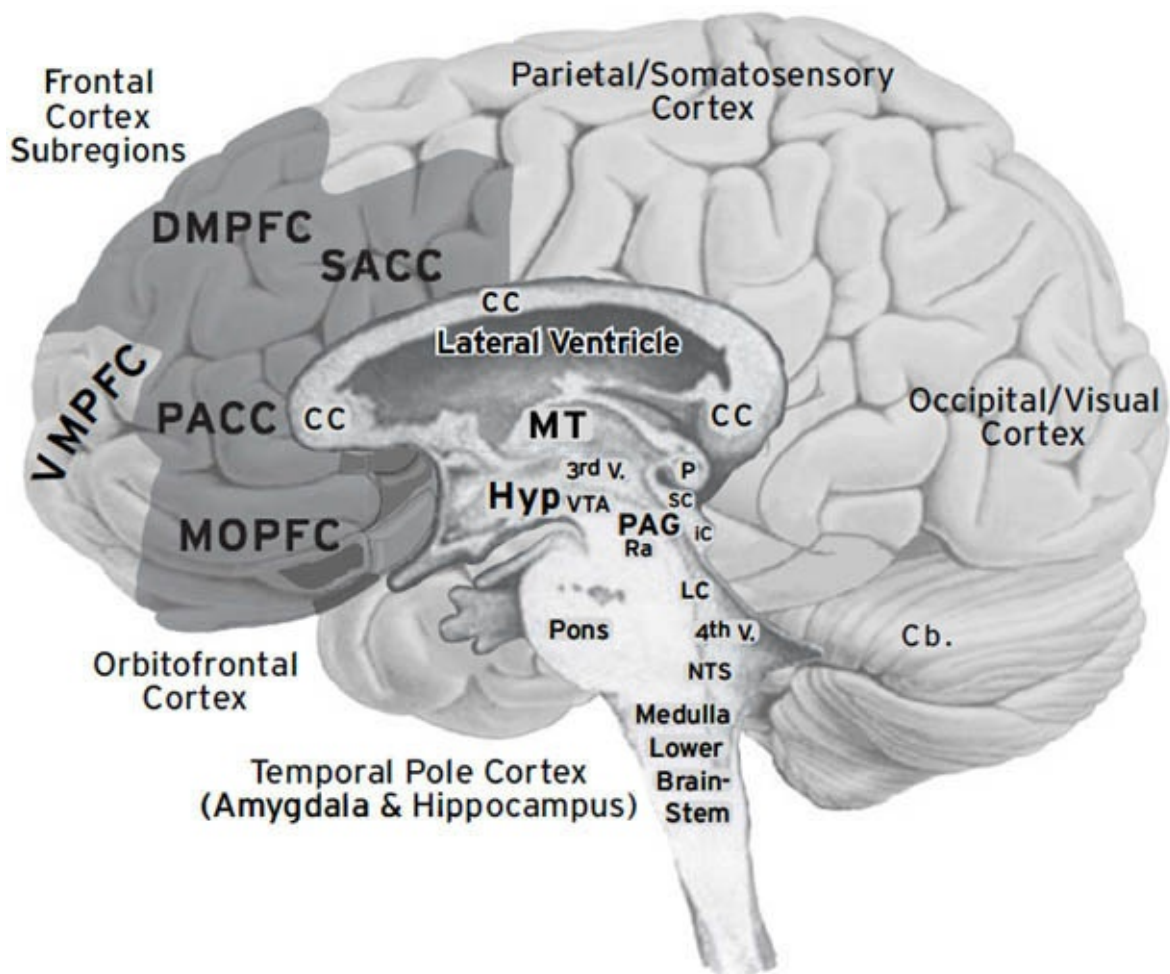


Figure 1.1. A medial view of the human brain (right hemisphere) that is highlighting some major regions of the brain. Going from front to back are the following abbreviations: DMPFC: dorsomedial prefrontal cortex; SACC: superior anterior cingulate cortex; VMPFC: ventromedial prefrontal cortex; PACC: perigenual anterior cingulate cortex; MOPFC: medial orbito-prefrontal cortex; CC: corpus callosum; MT: medial thalamus; Hyp: hypothalamus; VTA: ventral tegmental area (source of the mesolimbic dopamine system that innervates basal ganglia and medial prefrontal regions; see Chapter 3); P: pineal gland; sc: superior colliculus; ic: inferior colliculus; PAG: periaqueductal gray; Ra: Raphe dorsalis (the source of the major serotonin system innervating the limbic system); LC: Locus Coeruleus (the major source of the ascending dorsal norepinephrine pathway that feeds the whole brain).

forebrain); NTS: nucleus of the Tractus Solitarius (the location of the major internal receptor system coming from viscera via the vagus nerve); Cb: cerebellum. (We thank Georg Northoff for the use of this view of the brain.)

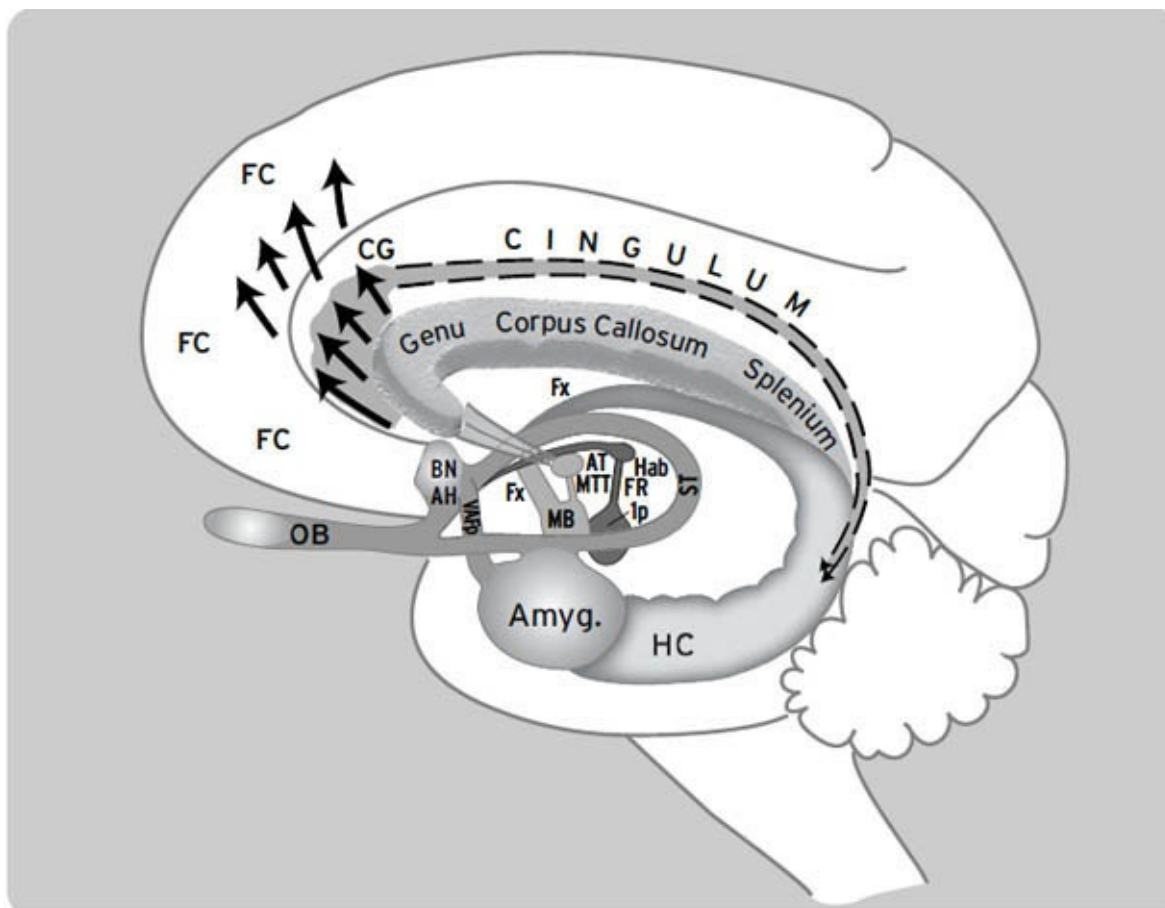


Figure 1.2. Schematic of the limbic system with the Papez circuit highlighted in stippling. FC: frontal cortex; CG: cingulate gyrus; OB: olfactory bulbs; BN: bed nucleus of the stria terminalis; AH: anterior hypothalamus; VAFp: ventral amygdalofugal pathway; Amyg.: amygdala; HC: hippocampus; Fx: fornix; AT: anterior thalamus; MB: mammillary bodies; MTT: mamillo-thalamic tract; Hab: habenula; FR: fasciculus retroflexus; ip: interpeduncular nucleus; ST: Stria Terminalis (from Panksepp, 1998a; republished with the permission of Oxford University Press).

As far as we know right now, primal emotional systems are made up of neuroanatomies and neurochemistries that are remarkably similar across all mammalian species. This suggests that these systems evolved a very long time ago and that at a *basic* emotional and motivational level, all mammals are more similar than they are different. Deep in the ancient affective recesses of our brains, we remain evolutionarily kin. This has long been evident in our body structures and biochemistries. The same types of neural paths and brain chemicals that arouse each of these seven emotional mediating systems are found within the various mammals. And according to current evidence, both humans and other mammals experience similar feelings when these systems are activated. Of course, these feelings cannot be identical, and we should not expect them to be. Evolution always adds diversity to shared general principles that, despite evolutionary diversification, provide the bridge for translating key issues from one species to many others. Many discoveries in modern medicine have been based on animal-models by using the same reasoning.

As we noted in the preface, these affective substrates are “archaeological treasures”—multi-faceted

“jewels” of mind that embody our capacity for affective experience, a capacity that we still share with our animal cousins. However, as humans, we have higher brain expansions that allow us to think deeply about our nature as well as about our options to live more cerebrally, culturally, and creatively. We can bite our tongues when we are angry and not say things that make matters worse. But many “choose” not to. We used scare quotes in the previous sentence, because for many people the emotions are not under the willful control of their higher mind. Indeed, there are reasons to believe that our neocortical functions were substantially programmed by our lower mind, in conjunction with our early rearing, leading to blessed lives (Narvaez et al., 2012; Szalavitz & Perry, 2010) or to those full of misery.

Because of our higher brain expansions, we experience life at cognitive levels that other animals cannot imagine. We can reflect on our options in subtle ways, leading to ever more subtle feelings constructed largely through learning. Our unique minds, in this world and the cosmos, arise from the cognitive riches of our higher neocortical expansions. But all the while, our higher minds remain rooted in our ancestral past. It is understandable that many wish to envision our affective lives being completely intertwined with our cognitive abilities, but from a neuro-evolutionary perspective that is not correct. Although many cognitive scientists and philosophers prefer to only think about our unique cerebral abilities, that does not serve our understanding of the origins of mind at all. But it is fascinating to think about those tertiary aspects of our minds. At that level, we have the full complexity of all the levels interacting, allowing us to even dwell on our mortality, with existential dread, or to have feelings sublime (Hoffman, 2011). It is unlikely that other animals experience the minds with such neuro-affective angst and appreciative depth. But they surely experience their primary emotions, and surely some other levels that are much harder to understand. Here our concern is to go to the deepest roots of the human mind, through an appreciation of the minds of other creatures.

Although neuroscientists have long known much about the ancient emotional circuits of our brains, these circuits have only recently been definitively linked to our emotional feelings. This allows neuroscientists to delve deeply into the neural substrates of affects—the menagerie of our basic internally generated feelings. Which brain systems bring us joy? Why are we sometimes sad? Why, sometimes, are some people always sad? How do we experience enthusiasm? What fills us with lust, anger, fear, and tenderness? The traditional behavioral and cognitive sciences cannot provide satisfactory answers to such profound issues (and not simply because researchers have failed to ask such questions).

Affective neuroscience has made a fresh start by proceeding from the bottom up, without denigrating our unique human abilities, and it is offering both a new vision of mental origins and new data to back up such assertions. Affective neuroscience seeks to link the affective mind to animal brains—to triangulate among (i) subjective mental states (most easily studied in humans), (ii) brain functions (more easily studied in animals), and (iii) the natural (instinctual) emotional behaviors that all young mammals must exhibit early in life in order to survive. This triangulation allows us to envision the ancient ground plan for human mental life and the deep neural sources of our values—our primal emotional feelings.

This knowledge points us toward the brain functions we must study in order to understand emotional disorder—the various psychiatric syndromes that cause mental chaos in both human and animal lives. But maturational experiences soon supplement those evolved tools with abundant thoughts and learning, making the overall picture very complex. However, we plan to remain, as much as possible, at the primary-process level of analysis. This is not only because that level has been neglected by those who study psychology, philosophy, and the humanities. The analysis of the unconscious secondary processes is already a robust well-established branch of behavioral neuroscience (just think of fear-conditioning, which we will dwell upon in [Chapters 5](#) and especially

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