# The Archaeology of Mind

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# The Archaeology of Mind

## Neuroevolutionary Origins of Human Emotions

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Dedicated to Tiina Alexandra Panksepp (1975–1991)

# Contents

# Preface and Acknowledgments

ALL OF US GET ANGRY at times, especially when our interests are ignored or thwarted. Has tradition brain science told us how this emotion is created? Not yet. We all get lonely and sad at times. Ha modern neuroscience sought to clarify those aspects of our nature? We have barely begun to talk abo such things, even though great progress has been made in some quarters. Most of us get great joy fro interacting playfully with others; some do not, especially if they are depressed. Neuroscience h remained largely silent about the nature of joy, while psychology has seen a revolution in the stuc 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 the brain, traditional neuroscience has had relatively little to tell us about how the intense emotion feelings that we call *affects* can arise from brain activities. This is because feelings are subjective experienced, and some say the traditional third-person measurements of science (i.e., extern observation of phenomena) cannot deal effectively with first-person experiences. We disagree, to th extent that other mammals have evolutionarily related brain systems. Modern neuroscience is we poised to finally clarify the ways that the mammalian brain generates affective valuations of wor events in the form of nonverbal feeling states—or the passions of the mind, as some Renaissanc scholars would describe them.

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

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

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 appropria
animal models. This position has changed somewhat with the emergence of modern brain imaging, b
not much if one wants to really understand the evolved functional networks of the brain. It is rath
difficult to have intense emotions while lying still within brain scanners that make measurements th
cannot tolerate movements. Still the new evidence obtained with those spectacular human brai
imaging technologies has clarified much about the cognitive aspects of emotion but rather little abo
the sources of such feelings in the brain. The primary-process emotions are all connected
movements, and the evidence now indicates that raw emotional feelings arise from the same ancie
brain networks that control our instinctual emotional life. Despite many theories in the field, the fac
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 wh
have to deal with human feelings that have become extreme, to anyone who is curious about tho
powerful states that govern so much of what we do and who we are in the world. We hope that wh
will be discovered between these covers will be of considerable use to many in their quest
understand themselves and others, including fellow animals, and to recognize how much all mamma
share in the ways that they emotionally respond to the world. We suspect that many diverse groups
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 bas
affective systems: Here, we refer to these systems as SEEKING (expectancy), FEAR (anxiety), RAG
(anger), LUST (sexual excitement), CARE (nurturance), PANIC/GRIEF (sadness), and PLAY (socia
joy). (We will explain later why we use capitalization to label these systems; for now, suffice it to sa
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 we
as students of the affective, behavioral, and cognitive neurosciences (each of which takes a rath
different approach to the study and discussion of emotions). Our focus here will be on the *primar*
*process* nature of these systems, but we will not neglect the levels that most other investigators a
studying—the *secondary process* (inbuilt emotional learning mechanisms) and the *tertiary proce*
(emotional thoughts and deliberations that are so evident in human experience).

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

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

Physicians, especially psychiatrists, must know about these affective systems, because they affo
new insights into mind-body interactions. Some such interactions are already well known. Conside
for example, the misery of sustained anxiety, an expression of the FEAR system. Arousal of the FEA
system eventually leads to excessive production of cortisol. Under optimal conditions when an anim
is afraid, the secretion of cortisol mobilizes glucose as an energy supply for the skeletal muscles
case the animal decides to flee. In this way, cortisol secretion is beneficial. However, excessiv
secretion can begin to damage the body if elevations are sustained for too long. Normally whe
cortisol has circulated through the blood back up to the brain, the paraventricular nucleus (PVN) of th
hypothalamus exerts an inhibitory effect that stops further release of cortisol. If, however, a person
animal is subjected to an excessive amount of stress—when they are chronically frightened or anxiou
—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 dramatical
from one person to another, all visceral organs and many areas of the brain, as well as the immun
system, can be adversely affected by a prolonged excess of cortisol. Many resulting stress-induce
cascades in the brain and body can contribute to these adverse effects as well. Prolonged high cortis
levels are common in a number of psychiatric syndromes, most especially in depression. It is n
known exactly how excessive secretion of cortisol can promote clinical depression. Howeve
disruptions in the normal production of a variety of growth factors, such as BDNF (Brain-Derive
Neurotrophic Factor) have been implicated. Play tends to promote positive affect partly through suc
chemistries (see Chapter 10), providing evidence for the common-sense principle that positive an
negative feelings counteract each other in the affective economy of the mind.

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

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

In addition to producing good emotional feelings, opioids also reduce stressful arousal, reduc
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 th
no one seemed to care. We now know that the placebo effect is real medicine that operates mainl

through the activation of brain opioid systems. These healing tendencies can thus be reduced, and eve 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 physical symptoms, doctors tended to believe that the symptoms were psychosomatic, "all in th mind," and therefore not physical or "real." This is no longer an accepted view of psychosomat illness. As soon as we recognize that affects emerge from emotional systems that are fueled by bra chemicals that can also exert an eventual effect on the functioning of the brain and the body, then th division between emotional and physical disorders narrows to the point of extinction. Although it ma appear that the mind and the brain are different entities, the mind being incorporeal, and the bra being physical, they are really one and the same thing. The MindBrain (or BrainMind) is a unifi 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 the can generate, is not only important for medicine in general; it also offers a totally new perspective f contemporary psychiatry. Affective neuroscience points the way to treating the real and specif symptoms of emotional imbalances, the natural *endophenotypes* of the BrainMind, rather than vagu nosological abstractions such as autism, depression, and schizophrenia, which were handed down to with pre-neuroscientific classifications of mental disorders. These diagnostic concepts have bee 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 well-lit open spaces and thus prefer to be in dark and hidden areas. They often also exhibit sympton of fear (commonly measured by freezing behaviors, elevations in blood pressure, and increase frequency of defecation) when placed in an unfamiliar cage. Common antianxiety drugs such benzodiazepines quell the fear of open spaces and of a new cage. Rats still remain afraid of predat smell, however, suggesting that this is a somewhat different kind of fear. Surprisingly, morphin which is so effective in reducing separation distress, is able to reduce a rat's fearful responses to th smell of predators. Ordinarily we lump different kinds of fear into a single category, but affectiv brain research suggests that there are neural models for distinct types of fear and anxiety. If this is s then we should be able to develop specific drugs to treat each type. As we will explore in detail in later chapter, there are convincing distinctions to be made between trepidation of the kind associate with physical danger (the FEAR system) and the panicky type of fear associated with separatio anxiety (the GRIEF/PANIC system).

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

Knowledge of the seven basic emotional systems has begun to revolutionize the practice psychotherapy because it offers the most comprehensive, data-based brain taxonomy of primar 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 fo discussing the foundations of emotional life, and we provide many examples of the importance specific brain functions in affective life—for instance, the powerful role of endogenous opioids an 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 supportiv human interactions. In dire circumstances, the prescription of safe medications that support such bra chemistries can promote and solidify psychotherapeutic practice.

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

Although psychotherapy has evolved in many different directions in the past half century, man 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 pol schematic of positive and negative affective valence, modulated by high and low arousal, have real not fallen all that far from the psychoanalytic tree. Freud maintained that human drives are rooted our physiological needs, and he grouped these together into only two categories of drive: *libido* an *aggression*. Drives find psychic expression in wishful thoughts—in thoughts that are imbued wi affective color. According to Freudian theory, the two main affects concerned wishes about sexua desires and aggressive urges.

Freud argued for several types of drive expression, each rooted in different stages of libidin development: oral, anal, phallic, and oedipal. Aggressive drive was similarly partitioned along thes developmental stages. This gave broader scope to the two interacting drives and their conseque affective wishes. Nevertheless, the range of discrete affects was considerably more limited than tho produced by the seven affective systems that have since been revealed by neuroscientific research. W are happy to note that the SEEKING system provides an interesting parallel to Freud's libidinal driv (insofar as he saw libido as a generic appetitive force, rather than in narrowly sexual terms). It difficult to reconcile Freud's views on anxiety, however, as well as his views on lust in relation t attachment and affectionate bonds, and much else besides, with the knowledge we have derived fro rigorous neuroscientific investigation.

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

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

affective state prevails at any one time. This "monomania," for lack of a better word, also coaxes th
cognitive apparatus "to follow" with obsessive self-serving ruminations. The goal of therapy is
facilitate a more complex perspective taking in the higher mental apparatus—what Aristotle calle
*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 b
affective neuroscience. As we see it, a key reason that classic psychoanalysis may have been le
effective than it could have been lay in the fact that *interpretation*—the crux of the talking cure—w
long deemed to be the main psychotherapeutic tool. Psychoanalysts tended to concentrate on th
relationship between affective states and their corresponding cognitive manifestations (wishes). The
have long assumed that by interpreting relevant thoughts and ideas, by uncovering their origins
childhood and explaining their primitive emotional meaning, a patient will be cured. But how do w
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 h
father. In adulthood, this man himself tended to bully those who were weak. A psychotherapist woul
help the patient to identify problematic areas in his adult personality, namely his tendency to bully
even abuse others, and would then trace these traits back to childhood. The therapist would perha
interpret that this man bullied the weak and abused the vulnerable in order to vent his rage at h
father in a way that would not result in retaliation. Other interpretations might highlight th
possibility that he bullied others in order to restore his masculine self-esteem. As a result of these an
still other interpretations, the patient would presumably be cured or at least proceed to have a happi
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 focuse
"behavior modification therapies," where both the cognitive and emotional issues were put aside an
therapists sought to mold maladaptive behavior patterns by adjusting reinforcement contingencie
With the cognitive revolution, the focus shifted to "cognitive behavioral therapies" (CBT) that we
remarkably effective for some disorders such as specific phobias (Beck, 1976). Now, with th
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
human affective life, so that therapists can provide optimal understanding of and help for psychiatr
problems. Indeed, such bottom-up views may turn the cognitive "interpretive" type of emotio
theorizing in psychology and philosophy on its head. Clearly, even though cognitive issues loom larg
in tertiary-process emotions, primary-process emotions have to be dealt with on their own term
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 becaus
psychiatrists do not know enough about the anatomy and chemistry of the emotional brain. We hop
that this book may stimulate more research that will result in the creation of such medications. In
sense, what is needed is a fuller integration of all the therapeutic traditions, from dynami
psychoanalytic to the new generations of affective balance therapies that will be the major focus
this book (see Chapter 12).

For instance, considering the case discussed above, suppose that the abuse suffered in childhood ha
fatefully sensitized the FEAR and RAGE systems in ways that made commensurate affects difficult
impossible to quell. Even if the therapist succeeded in convincing the patient about the origins of h
problems and even if the patient was well aware that he was unfair and unjust to others, this might n
be enough to effect any cure because he would still suffer from an overwhelming irritability, whic
may present itself as an apparent wish to bully.

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

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

The point is that thoughts are not always stronger than affects, which is why cognitiv interpretations often do not work well with serious psychopathologies. Indeed, clients can be confuse by complexities that the therapist sees "clearly." When affects maintain the upper hand, the talkin cure is apt to fail because the interpretive method, the cardinal psychotherapeutic tool, can frequent be ineffective in the face of our primal passions. Perhaps this is why even Freud himself looke 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 b pharmacotherapy. Affective neuroscience research highlights that clinicians should not treat huma beings as if they were bags of neurochemicals or "brains in vats." Affective feelings are part of th full equation, and they should not be ignored when psychiatrists seek new treatments for problem Also, the mammalian brain is fundamentally a social brain, and it needs to be treated as such. Th basic emotion systems do not operate in a social vacuum, even at the primary-process level. Thu almost all mind-medicine interventions need to be complemented by appropriate psychosocial hel not only to trace and unravel the secondary- and tertiary-process derivatives of (perhaps lifelon basic emotional imbalances, but also to guide, facilitate, and activate the desired primary-proce affects. Positive affects can promote resilience, which can have lasting beneficial effects for man emotional problems. Affective neuroscience highlights that the role of social emotions in all futu therapeutic schools of thought must remain in focus in order for lasting improvements to b maximized.

## OTHER AUDIENCES

All people who wish to be well informed about human emotion—from parents to educators—wi want to understand how feelings are created from within the brain. These affective systems hav important implications for most academic disciplines that deal with human beings, from philosophy 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 the 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 problem. For example, an excessively studious or serious child may have an underactive PLA system. The PLAY system allows children to learn about social rules of conduct—for example, whe to cooperate and when to compete, and at times to retreat in good-humored ways and let someone el win. When animals engage in rough-and-tumble play and one animal wins more than 70% of the tim the losing animal no longer enjoys the game and may drop out of such interactions entirely. So whe children play, they learn valuable social skills, such as the necessity of reciprocity and giving way o

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

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

Therefore, children are blessed if they have received a great deal of nurturing CARE, leading to th formation of secure social bonds, with positive attachment facilitated by low activity of th 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 b more robust throughout life. If, on the other hand, the child has been subjected to untowa frustrations that engender her RAGE system, or if the child has endured high levels of FEAR PANIC/GRIEF, then her capacity for these negative feelings will be enlarged. However, this does no mean that parents need to protect their children from negative emotions. All children must learn cope with them because they are a natural part of living. It is reasonable to believe that all th negative emotions, in small manageable doses, facilitate long-term psychological resilience that ma 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 teache stimulate the SEEKING system when they make learning an exciting experience rather than purely matter of rote memorization. However, given that much learning involves some measure of drudger teachers also need to impose social sanctions. The conscientious child is rewarded with prais engendering satisfying feelings emanating from the positive social bonding arms of the CARE an GRIEF/PANIC systems. The recalcitrant child, however, must often endure the threat of disapprova with accompanying activation of the negative arm of the above social-affect systems, not to mentio the throes of RAGE and FEAR. If so, that child's life will be ruled by negative affect and worrie rather than the positive affects that can spur children on to greater accomplishments. A second chanc offered gracefully to children with excessive negative affect, can be a wonderful life-sustainin experience. In any event, well-ministered social constraints can fortify children's ability to tolera 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 an problems such as Attention-Deficit Hyperactivity Disorder (ADHD). When children have fulfille their natural urge to play physically, they are better prepared to sit still and pay attention in th classroom. The re-introduction of play might work best if we make recess the first class of each da In effect, this need used to be met when children walked to school and arrived early enough to meet u with and engage playmates before classes started.

### *Managers and Supervisors*

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

### *Animal Behaviorists*

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

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

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

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

also read the manuscript with her fine eye for detail and with a mind devoted to the sensitive use animals in research. During the past year, Mark Solms, a beloved and respected colleague, als provided useful and enthusiastic input for every chapter. At the very end of this protracted journey t publication, Tim Lyons, a former student, who had become much more than a student, returned for few weeks at the end of the summer of 2010 to assist with the final polishing, and he smoothed mar remaining wrinkles in the text. His energy and devotion, especially based on this training for a secon career in clinical/counseling (after being a lawyer most of his professional life), improved the boo 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 th humanities department of the University of Idaho for the cordial support and camaraderie they hav offered throughout the half dozen years of his third academic career. After receiving his Ph.D. at th University of Massachusetts in 1969, Jaak pursued postdoctoral work at the University of Sussex an the Worcester Foundation for Experimental Biology. Jaak's vision of primary-process emotionality i the mammalian brain matured as he progressed from being Assistant Professor to Distinguishe Professor of Psychobiology at Bowling Green State University (BGSU) across 30 years of work th might not have been possible elsewhere. Following his early retirement, precipitated partly by medic issues and partly by the premature death of his daughter Tiina, Jaak joined the Falk Center fo Molecular Therapeutics at Northwestern University, pursuing the genetics of the affective mind wi the camaraderie and intellectual and research support of Joe Moskal, Roger Kroes, and Jeff Burgdor He continues to collaborate with many former colleagues, especially on research on the genetics of th emotional brain, with the aspiration to identify new neurochemical pathways that control mammalia 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 special issue of *Neuroscience and Biobehavioral Reviews*.

Jaak also thanks Audrey Gruss and friends and colleagues at the Hope for Depression Researc 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, an his ongoing research is devoted largely to developing new animal models for understanding an treating depression. He has been recognized as a revolutionary (a radical by some) in his field, wi many prizes and recognitions. His work is summarized in well over 400 scientific publications, half 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 Adolescen Mental Health Service, part of the National Health Service in Leicestershire, England. She becam interested in neuroscience about 20 years ago when she was appointed by the Michigan Supreme Cou to devise and implement a protocol for the transfer of custody of a 2½ year old girl from the home of couple whom the child regarded as her parents, to the home of her biological parents. Like most of h colleagues, Lucy worried about the little girl's psychological development, yet the child progresse well and today is an emotionally healthy young woman. Where did it all go right? Only neuroscien provided the answers.

Thus began an abiding interest in neuroscience. Yet even after reading extensively for a number o years, she was dissatisfied because most research focused on perception, learning and memory rath than emotion. When neuroscience did touch on emotion it was usually fear and its role in conditione 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 Internation Neuropsychoanalysis Society, chaired by Mark Solms. Jaak Panksepp was a keynote speaker. Jaak wa the first and only neuroscientist who focused squarely on the emotional brain. There followed lengthy and instructive series of e-mails between Jaak and Lucy that ultimately resulted in th

publication of this book.

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

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

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

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

# Foreword

**DANIEL J. SIEGEL, MD**

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

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

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

Naturally, a therapist, teacher, parent, or others interested in how learning shapes our minds an brains will see this neuroplasticity as an important dimension of how we change across the lifespa (see Doidge, 2007 for an overview of cortical neuroplasticity). So then why should we take the time 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 serv as the substrate for both how the cortex grows in differentiated ways (see Trevarthen, 199 McGilchrist, 2009) and how we come to experience mental life—our core, inner subjective texture living moment by moment. Furthermore, a scientific view of these deep structures will only serve 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 ma illuminate something about your own personal life. There are also helpful explorations of ho experience shapes the circuitry of memory and emotion, forming the neural foundations of our inn lives and altering our capacity to regulate our affective responses. These discussions offer th clinician important vistas into the nature of their client/patient's experience and how they can use th new knowledge to improve their capacity for empathic understanding and clinical intervention. Th challenges people experience with social difficulties such as autism, learning issues such as attentio deficit conditions, and emotion regulation problems such as disorders of mood, each take on a ne light with the perspectives revealed in this work. This book also offers teachers a unique opportuni to understand the deep circuitries of motivation, emotion, and learning at the heart of the education experience. When we realize that teacher–student relationships are based on trust, we come to see th these subcortical circuits set the stage for an effective learning relationship. If you are an academ researcher, this book provides a vast and detailed review of the subcortical aspects of affectiv neuroscience in one flowing narrative that may trigger some new ideas for understanding the field an 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 fascinating exploration of an often-ignored area of science and its application to therapeut understanding. As an educator and the founding editor of the Norton Series on Interperson Neurobiology, I feel that knowing this material can help us bring more effective treatments an 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 page that follow. If you are a scientist, you likely will be very interested in the ample details and abundanc of academic references that are offered throughout the text. If, however, you are a clinician, educato or general reader, you may find that a different approach to your reading will make this work mo enjoyable. There is a lot of material here—written in an accessible and fascinating way—and there no shortage of detailed discussions of neural circuits, transmitters, and the studies that illuminate wh we know about them. Here is my suggestion to you: Read this work like a fascinating nonfiction stor Just like you wouldn't memorize a novel, do not worry about remembering all the details abo research studies. You won't be tested on how well you've memorized what you've read! As you rea in this more at-ease manner, you may find that your mind will detect patterns of information th naturally emerge over time. Initially unfamiliar terms may begin to feel familiar, unusual names mo comfortable to see and say, so that you'll start to become more at home with these less common term as you go along. The old subcortical favorites that are in the popular press—such as the amygdala an hippocampus—are all here. But you'll also meet less well-known subcortical neural regions such the periaqueductal gray (PAG) and nucleus accumbens, which also play important roles in th archaeological narrative of our emotional lives. You may be quite familiar with dopamine an serotonin, but you'll also find detailed discussions of prolactin and oxytocin here too. Relax and ju listen in to this fascinating story as it unfolds. Let go of those ancient responses of FEAR and PANI (from childhood and school) that you may have if you try to memorize everything you read. Instea be PLAYFUL and SEEK out just what feels relevant for you as you go along. You are about t experience Jaak Panksepp's passionate mind and his way of thinking about our neural origins. Enjo the journey with Jaak and let yourself take in a lifetime's labor of love and learning!

# The Archaeology of Mind

# CHAPTER 1

# 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 t ancestral sources of our emotional minds. To the best of our knowledge, the basic biological values all mammalian brains were built upon the same basic plan, laid out in consciousness-creati affective circuits that are concentrated in subcortical regions, far below the neocortical "thinking ca that is so highly developed in humans. Mental life would be impossible without this foundatio There, among the ancestral brain networks that we share with other mammals, a few ounces of bra tissue constitute the bedrock of our emotional lives, generating the many primal ways in which we c feel emotionally good or bad within ourselves. As we mature and learn about ourselves, and the wor 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 detai This similarity extends even to certain species of birds that, for instance, also have separation-distre PANIC networks—a GRIEF system, as we will often label it here—one of the main sources 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 cold-blooded reptiles, but less is known about them. Thus, across many species of warm-blood vertebrates, a variety of basic emotional networks are anatomically situated in similar brain regio and these networks serve remarkably similar functions. We will discuss the nature of these bra systems that are being revealed by research on *other animals* (henceforth just "animals"). Th knowledge is beginning to inform us about the deeper aspects of human nature. It provides scientifically based vision about the origins of mind.

As briefly mentioned in the preface, the ancient subcortical regions of mammalian brains contain least seven emotional, or affective, systems: SEEKING (expectancy), FEAR (anxiety), RAGE (ange 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 ma overlapping physiological changes. To the best of our knowledge, these systems also generate distin types of affective consciousness, and some of the most compelling data for that come from huma (Panksepp, 1985). As we will see, when these systems are stimulated in humans, people alwa experience intense emotional feelings, and presumably when the systems are normally activated life events, they generate abundant memories and thoughts for people about what is happening them.

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

misunderstanding of these primary-process powerhouses of the mind. The capitalizations indicate th
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 emotio
generating brain regions are concentrated in the most ancient medial (midline) and ventral (belly-sid
brain areas, ranging from (i) the midbrain, especially a region known as the periaqueductal gra
(PAG), or "central gray" as it used to be called; (ii) the hypothalamus and medial thalamus, connecte
massively to (iii) higher brain regions, traditionally known as "the limbic system," which include th
amygdala, basal ganglia, cingulate cortex, insular cortex, hippocampus, and septal regions (see Figu
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 corte
that provide higher controls for emotional reactivity. Although the concept of the subcortical "limb
system" has been under assault for some time, all would have to admit that it was a great advance ov
some earlier views (e.g., the James-Lange theory) that situated emotions in higher brain regions.

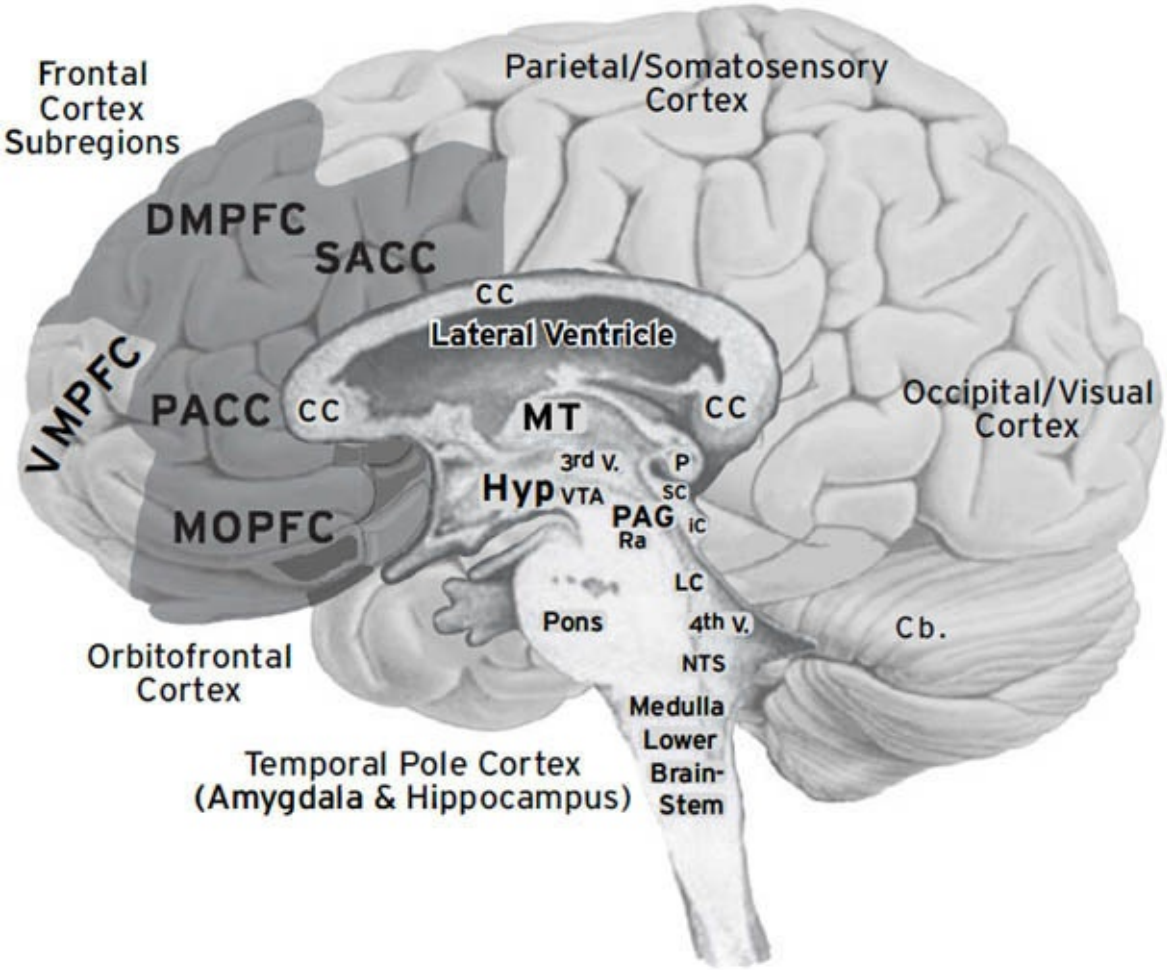


**Figure 1.1.** A medial view of the human brain (right hemisphere) that is highlighting some majo
regions of the brain. Going from front to back are the following abbreviations: DMPFC: dorsomedi
prefrontal cortex; SACC: superior anterior cingulate cortex; VMPFC: ventromedial prefrontal corte
PACC: perigenual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

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

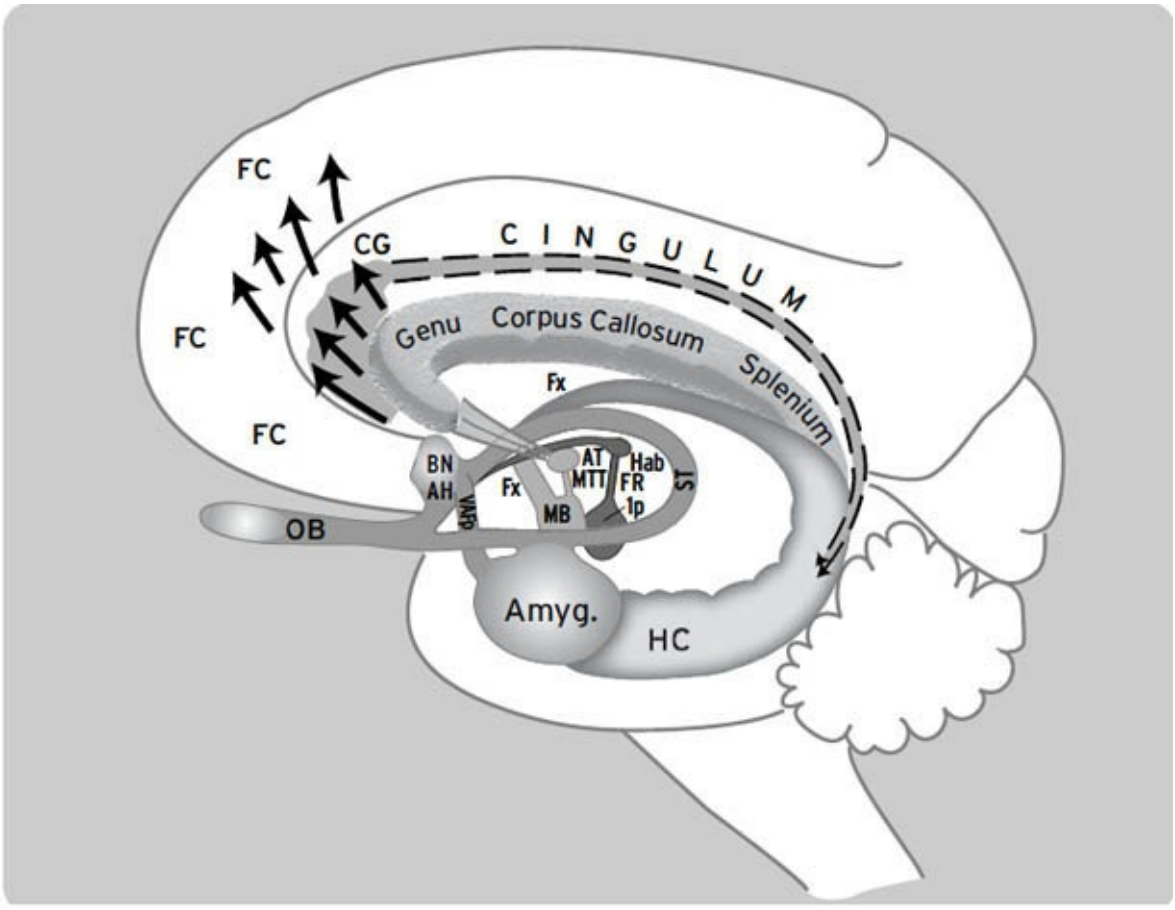


**Figure 1.2.** Schematic of the limbic system with the Papez circuit highlighted in stippling. FC: front cortex; CG: cingulate gyrus; OB: olfactory bulbs; BN: bed nucleus of the stria terminalis; AH anterior hypothalamus; VAFp: ventral amygdalofugal pathway; Amyg.: amygdala; HC: hippocampus Fx: fornix; AT: anterior thalamus; MB: mammillary bodies; MTT: mamillo-thalmic tract; Hab habenula; FR: fasciculus retroflexus; ip: interpeduncular nucleus; ST: Stria Terminalis (fro 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 an neurochemistries that are remarkably similar across all mammalian species. This suggests that the systems evolved a very long time ago and that at a *basic* emotional and motivational level, a mammals are more similar than they are different. Deep in the ancient affective recesses of our brain we remain evolutionarily kin. This has long been evident in our body structures and biochemistrie The same types of neural paths and brain chemicals that arouse each of these seven emotio mediating systems are found within the various mammals. And according to current evidence, bo humans and other mammals experience similar feelings when these systems are activated. Of cours these feelings cannot be identical, and we should not expect them to be. Evolution always ad diversity to shared general principles that, despite evolutionary diversification, provide the bridge f translating key issues from one species to many others. Many discoveries in modern medicine hav been based on animal-models by using the same reasoning.

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

"jewels" of mind that embody our capacity for affective experience, a capacity that we still share wi
our animal cousins. However, as humans, we have higher brain expansions that allow us to thi
deeply about our nature as well as about our options to live more cerebrally, culturally, and creativel
We can bite our tongues when we are angry and not say things that make matters worse. But mar
"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 belie
that our neocortical functions were substantially programmed by our lower mind, in conjunction wi
our early rearing, leading to blessed lives (Narvaez et al., 2012; Szalavitz & Perry, 2010) or to tho
full of misery.

Because of our higher brain expansions, we experience life at cognitive levels that other anima
cannot imagine. We can reflect on our options in subtle ways, leading to ever more subtle feeling
constructed largely through learning. Our unique minds, in this world and the cosmos, arise from t
cognitive riches of our higher neocortical expansions. But all the while, our higher minds rema
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 perspectiv
that is not correct. Although many cognitive scientists and philosophers prefer to only think about o
unique cerebral abilities, that does not serve our understanding of the origins of mind at all. But it
fascinating to think about those tertiary aspects of our minds. At that level, we have the fu
complexity of all the levels interacting, allowing us to even dwell on our mortality, with existenti
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 prim
emotions, and surely some other levels that are much harder to understand. Here our concern is to g
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 brain
these circuits have only recently been definitively linked to our emotional feelings. This allow
neuroscientists to delve deeply into the neural substrates of affects—the menagerie of our bas
internally generated feelings. Which brain systems bring us joy? Why are we sometimes sad? Why,
times, are some people always sad? How do we experience enthusiasm? What fills us with lust, ange
fear, and tenderness? The traditional behavioral and cognitive sciences cannot provide satisfacto
answers to such profound issues (and not simply because researchers have failed to ask suc
questions).

Affective neuroscience has made a fresh start by proceeding from the bottom up, witho
denigrating our unique human abilities, and it is offering both a new vision of mental origins and ne
data to back up such assertions. Affective neuroscience seeks to link the affective mind to anim
brains—to triangulate among (i) subjective mental states (most easily studied in humans), (ii) bra
functions (more easily studied in animals), and (iii) the natural (instinctual) emotional behaviors th
all young mammals must exhibit early in life in order to survive. This triangulation allows us
envision the ancient ground plan for human mental life and the deep neural sources of our values—o
primal emotional feelings.

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