A Primer on the Neurobiology of Inspiration

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This essay provides an overview of concepts critical to understanding the neurobiology of inspiration. In order to understand how we connect to and inspire one another, we must know a bit about the neuroscience of emotion, attachment and memory. Further detail can be found in *A General Theory of Love* (Random House, 2000) by Thomas Lewis, M.D., Fari Amini, M.D. and Richard Lannon, M.D.

Why ask science?

The curious seeker who wishes to know more about inspiring people might well begin with this question: "Why should I pay any attention to what *science* has to say? What can science, with its cold equations and reductionist experiments, tell me about the rich emotional lives of human beings?"

The answer is simple. The unique and vast utility of science lies in its ability to untangle what might be called the two primary threads of the human condition: 1. In order to make any headway in the world, you have to manage not to be fooled as to how the world actually works. 2. All of us are very easily fooled.

Whether we like it or not, the human brain is a disastrously imperfect instrument for delivering an unimpeded view of reality. Unless we have a tool to disentangle the truth from that which *appears* to be the truth, the possible from the actual, the plausible from the real, the might-be-true from what is *actually the case* – then we are lost, and likely to remain lost indefinitely. Nothing is easier than telling stories about how things *might* work – whether those things are plagues, cloud formations, or human emotions – but if you want to know how things *actually* work, you have to look to see if your story checks out in the real world. That's all science does, but that single activity – *looking to see if a story is consistent with what happens in the real world* – is contrary enough to human nature that five thousand years of recorded history passed before its invention.

The science of our age is sufficiently advanced that it can inform us, if we ask the right questions and know where to look, about the emotional nature of human beings. We'll cover the beginnings of that information in this paper.

A brief tour of the evolution of the brain

To understand the emotional parts of the brain, it helps to understand where they came from and why they exist at all.

A number of the same species alive on Earth three hundred million years ago still thrive: many plants and insects, fish, and a host of invertebrate life forms in the ocean. Before three hundred million years ago, no vertebrates existed on land; all of the animals with brains and

spinal cords were fish. About that time, some of these fish began to evolve organs capable of extracting oxygen from air, and, eventually, they crawled out from the sea. When their transition to a land-dwelling life was complete, they became the animals that dominated the planet during the Age of the Reptiles.

Reptiles have a particular reproductive strategy: they lay eggs, which are often tough and durable. And then they leave. Reptile progenitors typically perform no parenting duties whatsoever; the young, when hatched, fend for themselves. The vast majority die before reaching adulthood. No emotional bond between parent and offspring exists: no affiliation, no loyalty, no nurturance, no protection, no monitoring, no feeding, no communication. This method of reproduction, although it strikes us mammals as scandalously neglectful, is nonetheless quite successful, as evidenced by the persistence of the reptilian line today. For two hundred million years, their domination of the land was complete.

A hundred million years ago, the mammals arose by splitting off from the reptilian line. In school, you may have been taught that mammals differ from reptiles in that they have hair instead of scales, are warm-blooded instead of cold, and give birth instead of lay eggs. From our point of view, the major difference between mammals and reptiles is this: *instead of laying resilient eggs that hatch self-sufficient young, mammals give birth to neurologically immature, largely helpless young, who must be given extensive parental care or they will die*. Young mammals must be sheltered from extremes of heat and cold. They must be protected from predators. They must be fed. They must be bathed. They must be provided with water. Mammalian young require a number of distinctly different things, and each of the young must be given what it needs when it needs it, or it will die.

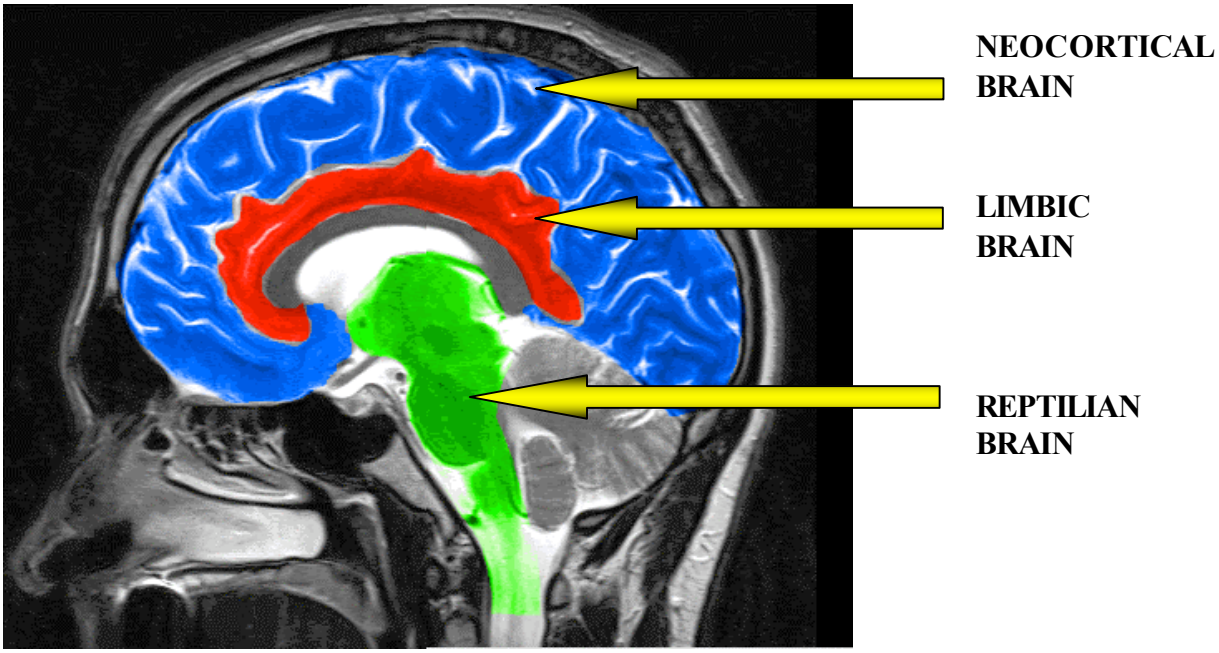
Parental mammals must therefore be able to tell what the offspring need, and they must be disposed to provide for those needs – or they will not pass their genes on to the next generation. They must not only care for the young – they must care *about* the young in a way never before seen in evolution. The mammalian way of life depends intrinsically upon the existence of emotional traits and behaviors such as loyalty, affiliation, nurturance, and communication between parent and young.

In order for mammals to carry out these behaviors, which reptiles lack, they must have brain structures that reptiles don't. The great French neuroanatomist Paul Broca noted that above we would call in humans the brainstem, a mammal's brain demonstrates a great arch of brain tissue not found in reptiles. He called this the *great limbic lobe*, drawing upon the Latin *limn*, meaning *line*, because he felt this innovation was the fundamental line of division between mammals and lower animals. Inside the *limbic system* we find the neural hardware for just about all of the brain's tasks related to emotion and relationships.

The third and final stage in the evolution of the human brain began several million years ago on the African plains. As a few primate species gradually evolved to be smarter and smarter, evolution witnessed the rise of the neocortex, which in humans is quite massive. The neocortex makes us smart: the ability to use logic and reason, the power to represent ideas symbolically in language and mathematics, the ability to imagine hypothetical events that have not yet occurred – these are all neocortical innovations. Whatever our shortcomings, human beings possess

extremely advanced cognitive hardware. However, the neocortex does *not* make us any more emotionally skilled than other mammals. Many relatively unintelligent mammals (rats, mice, prairie dogs) are nonetheless fully capable limbic parents, carrying out a variety of complex emotional and relationship-based tasks.

This tripartite evolutionary model of the brain is called the *triune brain* model, devised by neuroscientist and comparative neuroanatomist Paul MacLean. We encourage you to read more about it in his book, *The Triune Brain in Evolution*.



The limbic brain endows mammals with three particular attributes: emotion, attachment, and a particular kind of slow, inefficient learning. It's worth learning a bit about each of them.

Emotion

Charles Darwin proposed the first scientific theory of emotion. Not long after the publication of *On the Origin of Species,* Darwin wrote *On the Expression of the Emotions in Man and Animals*. It's an excellent read and available at this hyperlink:

http://pages.britishlibrary.net/charles.darwin3/expression/expression_intro.htm

Darwin's basic thesis was that emotions are a physical attribute of certain organisms, just as beaks and fangs and stingers are physical attributes of certain organisms. He proposed that emotions arose (like any physical attribute) in the course of evolution to serve a specific purpose that advances the reproductive fitness of the animals so equipped. If we studied emotions, he

thought, we could discover what particular fitness advantage they confer. Darwin proposed that the eyes widen in fear, for instance, so that a person can take in more of the visual field, which may be advantageous in conditions of danger. He proposed that the mouth opens in surprise to better facilitate the intake of breath, which may be necessary if the surprise should become a reason for flight.

Darwin also proposed that animals that are closely related should display similar emotional expressions, just as related animals (e.g., bats and humans) display close similarities in physical structures like the bony architecture of the hand and wrist. For this reason, he felt that the some of the emotional expressions of animals should be similar enough to be recognizable by humans, and vice versa. And, using similar reasoning, he proposed that just as basic human anatomy is identical for all human beings, basic emotional anatomy must be identical as well. Darwin postulated that the basic conformations of facial expressions would be identical in all human beings, irrespective of culture.

One of Darwin's key ideas is that emotional expressions constitute an *innate and universal language*. To test this hypothesis, researcher Paul Ekman and colleagues journeyed to New Guinea, and they showed the natives (who had never before seen people from another culture) pictures of American emotional expressions, and asked them to match them with a one-line description: the person who has just lost a child, the person who is ready to fight, the person who has just seen a dead pig lying in the road. Ekman found that although they had never seen Americans before, the New Guinea natives had no trouble interpreting American expressions of emotion. We know now that the basic form of emotional expressions is identical all over the planet. Infants are born with this knowledge encoded in the structure of their nervous systems.

Every normal person possesses, in his or her limbic brain, neural hardware dedicated to the task of analyzing the facial expressions, body posture, vocal intonations, and perhaps even olfactory cues that other mammals produce. This hardware analyzes the communicative signals that mammals give off, and it arrives at a conclusion as to the nature of the internal state of the mammals in its environment. This system is quite old and extremely quick.

Just as our visual cortex gives us a rich experience pertaining to electromagnetic radiation in our environment, and our auditory cortex gives an experience derived from changes in air density near our heads, our emotional hardware gives us an experience derived from analysis of signals that other mammals give off: we know what's going on inside them because we can *feel* it, just as we can *see* colors and *hear* noises.

The plot thickens a bit when we realize that detecting an emotion is not solely a sensory experience. *Detecting an emotion changes the observer's own emotional tone in the direction of the emotion he's observing*. For instance, if you show a picture of an angry face to an observer, it's easy to demonstrate that the facial muscles of the observer begin to adopt the conformation of anger: brows knit, lips pursed, and so on. In fact, as more recent brain-imaging data demonstrate, observing someone else *doing* just about anything – moving fingers, picking up a box, exhibiting a sad expression, exhibiting fearful body language – activates the parts of an observer's brain that would be activated if *he himself were doing the thing he is observing*. Mammals, including normal human beings, run an internal modeling program when they view

behavior. This modeling program is facilitated by dedicated neurons called *mirror neurons.* In effect, the mammalian brain engages in the internal neural simulation of behavior it observes in others, and the simulation asks this question: "What if *I* were doing that?" This internal modeling of anger is what causes an observer's facial expression to change in the direction of anger when he sees an angry person. In a more general sense, this internal modeling process is a critical part of the neurobiological basis of empathy. It is how we *know* what another person is feeling – our brains model his behavior, including his emotional expressions, and so we feel some portion of *his* feeling in our own minds.

Because each person continuously emits emotional signals and receives emotional signals that alter him, remarkable things happen when you put people together in a group. Each person's emotional tone is influenced by every other person present. If enough people have a similar emotion, then the positive feedback quickly multiplies so that every person in the group shares a single, intense emotion. The emotion-amplifying potential of groups is likely to be one reason why people congregate for an emotional experience – a movie, a concert, a religious ceremony, a funeral. All will experience a purer and much more intense emotion than they could on their own – the movie is far more thrilling, a concert more moving, a religious service that much more awe-inspiring.

Attachment

Biology

Attachment is so intrinsic to the motivation of mammals that it is extremely hard for most people to imagine life without it. Because mammals get so easily attached, we might assume that all animals do, but this is not the case. Take the African tree frog, for instance: if two frogs have spent a good deal of time together, and we remove one of them, the remaining frog will evidence no reaction whatsoever.

In vivid contrast, mammals demonstrate dramatic behavioral and neurophysiologic changes when a relationship bond is severed. As an example, witness the fate of Damini, a 72-year-old elephant. Several years ago, Damini was housed at the Prince of Wales Zoo in Lucknow, India. A pregnant female elephant, Champakali, was housed with her, and the two became close companions. When Champakali died in childbirth, Damini appeared inconsolable. She shed tears, showed no interest in her food and water, and collapsed and died shortly thereafter. *Mammals form complex behavioral bonds with each other, and these bonds have powerful physiologic effects*. This mammalian attribute is a dramatically different from anything we see in the reptilian world.

Emotional contact is so necessary for mammals that human infants will die if deprived of it. As a number of deliberate and naturalistic experiments have demonstrated, if human infants are given food, water, and shelter, but are deprived of emotional contact, nearly all of them will die. Why should this be?

The complex neurophysiologic underpinnings of relationship bonds were first studied by Myron Hofer, now director of the Sackler Institute for Developmental Psychobiology at

Columbia University. For decades, Hofer studied the nature of the relationship between rat pups and a mother rat. He concluded the mother-pup relationship is a complex web of physiologic regulation, in which an astonishing array of maternal attributes and behaviors regulates the physiology of the rat pups – including cardiovascular parameters like heart rate and blood pressure, neurophysiologic parameters like levels of neurotransmitters and sleep patterns; metabolic and hormonal parameters like cortisol and growth hormone secretion. If one removes the mother rat, the ordered physiology of the rat pups dissolves into unregulated chaos.

Subsequent research has strongly supported the contention that *relationships regulate physiology* – not only in rats, but also in all social mammals. Like the rat pup, when deprived of parental input, a human infant's physiology devolves into chaos, the major difference being that human infants are sufficiently vulnerable that the unregulated state, if allowed to go on for very long, is frequently fatal. Infants are maximally dependent upon relationships for physiologic regulation, but even adult human beings remain embedded in a social web of physiologic regulation, of which they are often minimally aware. We can observe adult relationships regulating physiology in the common phenomenon of *menstrual synchrony*, for instance, wherein the hormonal rhythms in two women who share an emotional bond spontaneously align such that their cycles frequently begin on the same day. We can observe relationships regulating physiology in the many studies that have observed increased morbidity and mortality from a host of diseases in socially isolated people. We can even observe relationships regulating physiology in studies demonstrating that dog ownership has a substantially beneficial effect on blood pressure in those with hypertension, a strongly positive effect on survival in those who have suffered a heart attack, and can vastly reduce seizure frequency in patients with epilepsy.

One important aspect of physiology is brain function, and so if relationships regulate physiology, we should expect to find that *relationships regulate brain function*. And we do. The children of mothers who are depressed exhibit significantly lower levels of neuronal activity in the cerebral cortex, for instance, when compared with children of normal mothers.

In the first few years of life, a child's brain undergoes a tremendous amount of growth and development. At birth, the brain is only about one-quarter of its final size, and in the first 18 months of life, the brain is forming neuronal connections at the rate of 1.8 million per *second*. Because relationships regulate physiology, including brain function, and because the juvenile brain undergoes so much growth and development in childhood, we should expect to find that *relationships regulate brain development in young mammals*. And so we do.

An enormous and fascinating body of research demonstrates that relationships regulate brain development in mammals. Children raised in Romanian orphanages possess measurably smaller brains than normal children, and brain imaging in the orphanage-raised children reveals large-scale atrophy and neuronal death. Rhesus monkeys raised in social isolation grow to become adults that are highly abnormal, in behavior as well as a neuroanatomy and neurophysiology. A series of experiments at Emory University in Atlanta has demonstrated that interfering with maternal nurturance by making monkey mothers stressed and slightly neglectful produces permanent brain changes in the *baby* monkeys those mothers are attempting to care for. And an elegant series of experiments by Michael Meaney at McGill University has shown that in rats, altering the kind of parental care young rats get (as by depriving them of the mother rat for

15 minutes a day, for instance) produces long-lasting changes in neuronal gene regulation. This is an experimental result that should really catch our attention: in rats, the juvenile experience of nurturance *turns genes on and off inside the neurons of the baby rat's developing brain* – thereby profoundly altering the long-term behavior of those neurons, and the brain that houses them.

Psychology

Early childhood experience leads to certain predictable styles of attachment. Empathetic connection to attentive parents results in a *secure attachment* style that is protective against anxiety and depression. Securely attached people feel safe in the world and tend to perceive reality in a stable and trusting way. They anticipate that authority figures are helpful and responsive because that has been their consistent experience. They usually perceive their own vulnerability and can ask others for help. Typically, they are open to hearing other people's perspectives without a defensive response, even if the story doesn't resonate with their experience. It is also possible for them to be too trusting. Like everyone else, they see in other people mostly what they expect to see. Because they expect to find trustworthiness in authority figures, they can be blind to the hidden, self-interested agenda that some people carry within them.

People who have experienced less than optimal early parenting will have different attachment styles. One of these is called *insecure attachment*. Children acquire insecure attachment after learning that caretaking adults are erratic and unpredictable. As adults, the insecurely attached manifest clingy behavior, a need for proximity and reassurance that often strikes others as excessive, and a sense of the world being an unsteady and disconcertingly unpredictable place. In extreme cases, people with this attachment style are susceptible to joining cults or other authoritarian groups because the exchange that cults demand – money and personal identity for group membership – strikes the insecurely attached as a good bargain. Typically, the insecurely attached are readily influenced by another person's perspective.

Another major style that can arise from suboptimal parenting is termed *avoidant attachment*. These people have learned that the adults in charge of taking care of them aren't going to help them, and that they are on their own. Someone with an avoidant style come across as a *pseudo-independent* person. He behaves as though he does not need other people, does not want anybody's help, and this posture is inflexible. When his own resources are exhausted (the place where a healthy person would ask for help), the avoidant person cannot ask for help. While they may appear to be more functional than the insecurely attached, people with this attachment style are internally nervous when in close proximity with others, often embrace a role (as opposed to being authentically themselves) and frequently form artificial, pseudo-intimate connections with others. Not infrequently, they express scorn, contempt, and dismissiveness for the "weakness" in other people that makes them need help.

In contrast to the three preceding attachment styles, which are relatively structured, people who grow up in a chaotic environment develop a disorganized attachment style. This is reflected in their own inconsistent and ever-changing cognitive and emotional processing, a labile inner sense of self and turbulent relationships with others, whom they see as being in a constant state of flux reflective of their own inner world. They are usually unable to hold onto

any consistent sense of another person's perspective. Generally speaking, people with this attachment style face tremendous difficulty navigating the world. Even more extreme disruptions can occur. Patterns of attachment can be tremendously disrupted by violence, deprivation and possibly certain genetic vulnerabilities such that people can have violent, uncaring, unempathic relationships to other people. Such people can be prone to antisocial or psychopathic behavior, including unfeeling connection with other people, child or spousal abuse, and criminality.

Memory

> *Canst thou not minister to a mind diseased,*
> *Pluck from the memory a rooted sorrow,*
> *Raze out the written troubles of the brain*
> *And with some sweet oblivious antidote*
> *Cleanse the stuff'd bosom of that perilous stuff*
> *Which weighs upon the heart?*
>
> Macbeth, Act V, Scene 3

Macbeth's plaintive request to his physician has only grown in relevance in the four centuries since Shakespeare wrote these lines. We *do* have some antidotes to emotional dysfunction in our time, in the form of powerful antidepressant and mood-stabilizing medications. Even with these aids, it's *still* not so easy to pluck a rooted sorrow from the memory wherein it dwells, for the very reason that Shakespeare suggests: emotional dysfunction is, in many cases, not a smear on the window of feeling that can be wiped away, but instead it appears to be inextricably intertwined with the same stuff the self is made of. A mind afflicted by certain kinds of emotional dysfunction must, in some sense, be re-written before it can function more normally. Making these revisions is the task of psychotherapy – a task made all the harder by our own ignorance of the mechanisms of memory that underlie the construction of the self. Psychotherapy existed for most of the twentieth century, but an understanding of the workings of memory did not, and that single fact has been responsible for much hardship.

For centuries, people have been aware that human memory is a tricky affair: people often behave as if they have knowledge of which they are unaware; at other times they "remember" events that never actually happened, and at other times they do not remember other events that clearly did. Devising a model of memory consistent with these phenomena and with the known physiology of the brain proved dead easy at the beginning of the twentieth century, because almost nothing was known about the brain. So extensive was the data vacuum that the early models of memory could include almost any proposition without fear of contradiction. As the century wore on, however, it became increasingly clear that the models of memory forged during that speculative phase, when the brain was a black box, were (and are) fundamentally incompatible with scientific fact.

Our field has inherited a model of memory from those early days of freewheeling speculation. Let us call that early paradigm *Model A*. Model A goes as follows: information

comes in on the mind's bottom floor, through the doors of perception, and from there wafts upward to the level of the *unconscious* (that which we cannot will ourselves to know), and then the *preconscious* (that which we do not currently know, but could, such as the sensation on the bottom of the left foot), and then the *conscious* (that which we know). At any point along this journey, information can be interrupted from progressing upward by the barrier of *repression*, which dictates that things too awful to be aware of must not be known. The difference, in this model, between conscious and unconscious memory is the repression barrier, floating like a glass ceiling between the knowable and the unknowable.

The scientific study of the brain has yielded a radically different model of memory, which we may call *Model B*. Model B posits that the brain possesses two fundamentally different memory mechanisms, each operating continuously and in tandem. The products of one memory mechanism are potentially available to consciousness; the products of the second never are. This model postulates unconscious learning and memory as a normal feature of the mundane operation of the brain. The barrier between what is knowable and not knowable has nothing to do with the emotional impact of the material itself, but instead springs from the brain's basic design, which includes a pair of distinctly different learning mechanisms.

One of these models has a future, and one of them does not. Let us take a closer look at the model – Model B – that has not yet suffered a fatal collision with fact.

Two memory mechanisms operate in tandem – one potentially conscious, one not. The potentially conscious memory is called *explicit* memory, and its shadow is called *implicit*.

Explicit Memory

In the explicit memory system, after information comes into the brain and is processed by a circuit involving the hippocampus and the cortex, some parts of that information may be available for conscious recall later. This is the kind of memory that one utilizes to remember a phone number, or to recall the details of a past event: the name of your high school geometry teacher, or the plot of the movie you saw last night. Explicit memory has two properties that concern us here: **1**. Explicit memory yields up an account of the past that is extraordinarily inaccurate, unreliable, and changeable, while supplying an utterly false impression of unswervable authenticity to the person doing the remembering. **2**. Children are not very good at it.

A huge amount of data has accumulated to indict explicit memory as a wholly unreliable witness of fact. Study after study under controlled conditions has demonstrated that, in general, people are remarkably poor at remembering what actually occurred. Instead, their memories slip and stretch like malleable fabric, including elements that never occurred, excluding ones that did, and incorporating later information, suggestions, and experiences. Explicit memory continues to change slowly over time, like a kaleidoscope that rotates with infinitesimal slowness, presenting a slightly different version of events each time a particular memory is queried. And explicit memory is an extraordinarily gullible recorder – authentic-feeling "memories" for events that never occurred are remarkably easy to create.

In one study, for instance, investigators met with children once weekly, and asked them this question: "Think real hard, and tell me if this ever happened to you. Can you remember going to the hospital with a mousetrap on your foot?" By the 10th week, 60% of the children reported that they *did* remember this incident, and were more than willing to tell an involved story about it, complete with embellished details, all of them false. In addition, child psychologists and psychiatrists watching these children could not distinguish between a child recounting a fabricated memory, or one from an event that actually occurred. And a substantial fraction of the children in the study could not subsequently be convinced that the mousetrap incident had never happened.

In another study, investigators interviewed a number of 14-year-old boys, and asked them questions about their emotional lives, such as, "What is your mother's best trait?" and "What is the nicest thing about your home life?" When they were 44 years old, the same individuals were asked to recall their earlier lives, and were asked the same questions: "When you were fourteen, what was your mother's best trait?" And so forth. Remarkably enough, the correlation between the attitudes recounted at age fourteen and recalled at age 44 was *no better than chance*. When a person asks another person about what her life was like as a young girl, how she felt and what she thought, he should keep in mind that he may well be retrieving information that has little or no factual relationship to what actually happened in her past. Asking these kinds of questions may tell him something about what is going on in her mind *now*, but it does not necessarily tell him *anything* about what was going on in her mind *then*.

Why is explicit memory so unreliable? The answer is relatively simple, although most people find it difficult to convince themselves that their own minds function according to this principle: if we show an apple to a person, and then later ask him to recall it while we scan his brain, we'll find that the same brain areas light up when we ask someone simply to *imagine* an apple without having seen it. A sensory experience and imagining that sensory experience are extremely similar in the brain, and *the brain does not do a good job of keeping track of the distinction between what it imagined and what it experienced*.

If we invite someone to imagine something, we should expect that a fair amount of the time, the person will come to have a memory of the imagined scenario, a memory that will be indistinguishable (to that person, at least) from a memory of an actual experience. Repeated studies have demonstrated this to be so. In one study, subjects attended a séance supervised by a medium, who was actually a professional magician. During the séance, he told the participants to levitate the table with their minds, and said: "That's good. Lift the table up. That's good. Keep concentrating. Keep the table in the air." When questioned two weeks later, 345 of the participants recalled having actually *seen* the table levitate, although it had done no such thing. In another study, 44% of British television viewers claimed to have seen the footage of Princess Diana's fatal accident in which her chauffeur-driven sedan crashed into a pylon in Paris. No such footage exists, but the viewers had imagined the scenario many times in the course of hearing the event described, and eventually, these imaginings became filed in the brain under the heading "Memory."

In therapy, when we ask patients who have normal-feeling memories about their childhood to relate them, it's highly doubtful that we get information that is wholly accurate

about what the past was like. If a patient doesn't remember what happened in the first place, the overwhelming likelihood is that he will never know what happened. If we invite patients to fill in the blanks by imagining one scenario or another, we can easily instill in them a memory that feel genuine and real, and we can imbue it with just about any content we choose. In the 1980s and 1990s (in the United States at least), a good many therapists did just that, and the results were appalling. We can learn the lesson of those years, so we do not have to repeat it. As voiced by the *British Journal of Psychiatry* in 1998: "We conclude that when memories are 'recovered' after long periods of amnesia, particularly when extraordinary means are used to secure the recovery of memory, there is a high probability that the memories are false."

The fallibility of explicit memory poses a grave but not insuperable problem for practitioners of psychotherapy. We would like to know what a patient has learned about relationships, because many of our patients have been exposed to emotional adversity and have learned specific and highly disadvantageous lessons from their experience. But if we cannot ask them about their emotional pasts and get anything like a reliable answer, where can we turn for access to this information?

Implicit Memory

The study of individuals who lost their capacity for explicit memory has revealed that they can still learn, in interesting and specific ways. While they cannot recall new facts or new events, they can acquire skills and habits – new motor skills like knitting, and new habits of thought like expectation. The brain has two separate and independent memory systems, one for facts and events (the *explicit* memory system) and one for skills and habits (the *implicit* system.) The first is potentially accessible by the conscious mind, and the second is not.

The *implicit memory system* scans the world for recurring regularities and patterns, and it does this without informing the conscious mind about the content of the patterns it finds. Once implicit memory has detected an underlying pattern within a series of experiences, that pattern then serves as the basis for short cuts in perception, expectation, and action.

Consider language acquisition, for instance. In school, children learn the meanings of certain words in an *explicit* fashion, through effortful memorization of vocabulary lists. But they learn *how to understand* speech and *how to speak* implicitly, and they learn these skills at a much younger age. No child has to be taught anything about how to understand or use speech; he has only to be exposed to many instances of speech, and the brain automatically acquires knowledge about the underlying grammatical, syntactical, and phonological rules that lie at the heart of any language. The process happens without any effort on the part of the learner. If a normal child hears (or sees) language, his brain gradually extracts the underlying patterns, and he becomes able to comprehend and produce speech without any effort at all.

Implicit knowledge of those underlying rules informs perception, expectation, and action. A child does not have to learn the singular and the plural forms of every noun in the English language, for instance – instead, he learns one underlying *rule*, which serves as a shortcut. In this particular case, the rule can be stated thus: *singular + s = plural*. One cat, two cats. One dog, two dogs. The rule itself is neat, compact, and efficient. A few exceptions fall outside the rule

(one radius, two radii), and the exceptions can be acquired manually. Children acquire knowledge of what we might call *the plural rule* at a very young age. If we show a four year old a picture of an imaginary creature (for which English lacks a word) and we call it a *blan*, and we then we ask him to describe what he see when we show him a picture of two such creatures, we will obtain a reliable answer: "*Two blans.*" This answer cannot occur on the basis of direct experience, because the child cannot have heard the word "blan" before our experiment. He has no *actual* basis upon which to predict the plural form of this word. Implicit knowledge of the appropriate *rule*, however, guides his expectation and his action, and his reply will be as unhesitating.

If we ask a child to explicitly *enunciate* the plural rule he is using, (even if his skill level shows us that he has learned it very well), he will be unable to do so. Because the knowledge is implicit, a child can act on the basis of what he knows about the world's regularities and underlying patterns, but he cannot describe the basis for that action. Knowledge of implicit rules guides behavior, but it does so without informing conscious awareness or comprehension.

A number of studies convincingly demonstrate that if a series of experiences possess an inherent underlying structure or patterning, then the human brain will gradually extract knowledge of those underlying regularities, regardless of the nature of the experiences or the underlying pattern. While they cannot describe implicit knowledge, and typically have no conscious awareness of it, people can act on it. When human beings act on the basis of knowledge acquired through extensive experience with a particular situation but cannot articulate the reason for acting in the way they do, we often say they are *using their intuition*. The study of implicit memory has uncovered the fact that the acquisition of intuitive knowledge is every bit as legitimate a brain function as vision or hearing. We all possess neural hardware dedicated to the task of forming intuition on the basis of repeated exposure to the world.

Children grow up in a world of relationships. Those relationships have order and regularity to them, just as a language does. The underlying rules regarding relationships vary considerably more from family to family than those regarding language. *If your mother has that tone in her voice, you're going to get slapped*. *When you tell your father you have done well at something, he gets angry*. And so on. Children acquire implicit knowledge of the rules that underlie relationships in the world they live in – their family. This knowledge, like all implicit knowledge, is acquired automatically, and it gives them a highly specific kind of intuition. It shapes their perception, their expectations, and their actions. Just like a child who says "Two *blans*," a person who has been exposed to a particular relationship environment will, as he lives his daily life, *act* on the basis of rules about which he has no conscious knowledge.

The fact that this kind of unconscious knowledge strongly shapes human behavior has been recognized for longer than we might suppose. Consider these words, from a prescient observer of human nature:

> **"**The more thoroughly ... we examine into what may be termed the Mechanism of Thought, the more clear does it become that not only an automatic, but an unconscious action enters largely into all its processes…. And that these

> thought patterns can lead to unconscious prejudices which we thus form, [that] are often stronger than the conscious; and they are the more dangerous, because we cannot knowingly guard against them."
>
> The psychologist William Carpenter wrote these lines in 1874.

The Subjectivity of Individual Experience

Because implicit learning mechanisms are operative in the human brain from before birth, infants and young children *extract implicit knowledge of how relationships work* based on their exposure to them. Because implicit knowledge operates without the intervention of the brain systems involved in consciousness, people extract knowledge of the implicit principles that underlie emotional life in their early environment, but they are not aware of having done so and have no conscious access to the implicit information acquired. In other words, as a normal feature of how the brain works, *people behave in relationships in accordance with implicit principles of which they are not aware*. This implicitly acquired pattern affects not only how they behave, but also what they can perceive and what they are capable of expecting.

Exposure to a specific family environment, and the subsequent encoding of implicit knowledge of the regularities within that environment, traps people within the world of the known. *They are best able to see what they have already seen most.* Their brains distort incoming information such that on an experiential level, the world does not appear ambiguous and full of new information, but instead appears to conform to the patterns and fall into the categories they already know. Human beings do not experience direct reality; instead, we experience an internal model of reality that our brain constructs on the fly. This internal model is based *in some fashion* upon actual sensory information coming from reality, but that sensory information is inevitably distorted by a number of factors, including implicit knowledge already encoded in our neuronal networks. As such, we all really are living in our own subjective world.

Because implicit knowledge is not directly accessible to the brain modules responsible for verbalization or consciousness, most people do not *know* they are trapped in an idiosyncratic world or, indeed, that they have learned anything at all. In order to correctly divine the nature of the world that any single person lives in, we have to study what he *does* more often than what he *says*.

Fundamentals of Connection

Using the preceding information from neuroscience, we can set out some general principles with regard to interactions with others.

1. People are emotional animals.

In any interaction, people will broadcast emotional signals and read the emotional signals emitted by others; thus, the emotionality of each person will be slightly altered in the direction of the others in a dynamic fashion. This will take place whether the participants will it to or not.

If you are attentive, you should be able to get an emotional "read" on another person. To the extent that the other person is attentive and healthy, he or she should be able to get an emotional read on you. The other person may suffer from pathology that interferes with his or her ability to do this in a variety of ways, but otherwise he should be able to read you as accurately as anybody else. From this, we can conclude that any attempt to make yourself difficult to read will limit your ability to connect and resonate limbically with another person. Making yourself emotionally obscure will limit your ability to inspire others. This is not to say that always broadcasting your emotions at maximum volume is the best strategy to help you connect with or influence another. Ultimately, such connection depends in large part on the accuracy with which you emotionally read other people.

2. Groups amplify and unify emotion

Because people resonate limbically, wherever they congregate, spontaneous emotional waves sweep through the crowd, both intensifying and unifying the emotional experience of each person. A skilled leader can direct and shape the direction of the wave. However, the emotionality of the group does not emanate from him, but from the contributions of each individual and the multitude of unseen interactions between individuals. The emotional power of groups is extremely potent, and can be put to socially constructive uses (e.g., rallying a congregation for a charity drive) or destructive ones (mob violence).

3. People are social mammals: they attach, and they attach in their own style.

People naturally attach to other people and to groups of people (like companies), and they are prone to attach in the manner of their learned *attachment style*. If you understand the common attachment styles, the inner emotions and outer behaviors that define them, then a great deal of otherwise baffling human behavior becomes not only comprehensible but also relatively simple.

Those who have known secure attachments in their early past, for instance, tend to expect the same from the people and groups around them. People with anxious attachment histories will attach in their own particular manner – fearing abandonment, anticipating rejection at every turn, and often precipitating the very result they dread the most. Generally speaking, attempts to connect between people with dramatically different attachment styles often feel foreign, bizarre

or empty to all parties involved. These different attachment styles are, in effect, a cultural difference of which one must be aware when trying to inspire.

Securely attached people can become inspiring leaders. Those with insecure attachment usually cannot, because what they really crave is direction from authority figures. Avoidantly attached people can rise to leadership roles, but they will not typically be capable of inspiring those with whom they work, who tend to experience them as insensitive and bullying.

4. People have an unreliable explicit memory system that's available to consciousness, and they have a reliable implicit memory system that is not.

In our psychotherapy training, we were told that insight changes behavior patterns, but that hypothesis is astonishingly devoid of empirical support. In fact, considerable evidence suggests any such association is untrue. Third grade children asked to solve a series of addition problems in the form of **X + Y – Y = ?** (e.g., **17 + 25 – 25 = ?**) show an initial solution time of more than 30 seconds, because they carry out each mathematical operation in sequence. After some experience with this particular problem type, children gradually develop implicit knowledge of the underlying rule (**X + Y – Y = X**) and their solution time abruptly drops to less than 10 seconds. At this point, however, although the child is *acting* on the basis of implicit knowledge (solution time < 10 seconds), he has no *conscious* awareness of it, and if queried will deny having figured out the "trick" to solving the problems quickly. After several more trials, children typically become consciously aware of their discovery and announce it, although they remain unaware that they demonstrated acquisition of the pertinent rule *before* they had insight into the nature of the problem.

Experience changes implicit knowledge, not insight. Literally hundreds of experimental psychology studies support this assertion. "What we must learn to do, we learn by doing," wrote Aristotle. He was right. If people need to learn a skill they don't possess, then that will take time – particularly if they already have pre-existing habits that must be unlearned if they are not to interfere with the acquisition of their new skill. Explicit learning is rapid; implicit learning is slow. "We can be knowledgeable with other men's knowledge, but we cannot be wise with other men's wisdom," wrote Renaissance scholar Michele de Montaigne, highlighting a distinction between explicit and implicit learning that was recognized centuries ago.

For some people, the delivery of insight can serve as a reason to act in a way that their (flawed) intuition tells them is wrong. We concede that insight can be useful in this way, as a tool of persuasion, a means to try to convince a person that the world is other than the way he sees it. But what a pale instrument of persuasion insight is! One good look around the world is enough to tell anyone that much. What in the world motivates people to act against their own intuition, then, if it is not the cool certainty of reason? Most of the time it is *faith* in another person, pure and simple. For example, a patient can find the courage to move in a direction that counterintuitive to him because his faith in the therapist's guidance is greater than his faith in himself and his own intuition. Another word that describes this behavior is *trust*.

A while ago, Tom taught a class for Buddhist priests at the San Francisco Zen Center, who wished to better understand the process of mentoring and teaching in a one-on-one setting.

Many thought that the process they engaged in with their students had little in common with psychotherapy, which they saw as a complex exercise in providing insight to people about their emotional problems. Tom was more convinced that his work and theirs were more fundamentally similar than they supposed. For weeks he struggled to convey what he thought therapy was, and how little intellectual complexity is at the heart of it. Finally, he explained it in this way:

"Look," he said, holding up a glass of water and placing it on the table. "The patient wants a drink of water. My job is to get him a drink. Every time he reaches out for the glass where he sees it, his hand closes on nothing, because the glass is *not where he sees it*. I say to the patient, 'The glass isn't over there where you are reaching. Instead, it's over here.' The patient says, 'But I can see the glass right there. I know it's there.' I say, 'Yes, I know you *see* the glass over there, but that's an illusion, a trick of the mind, a habit of perception. Maybe the water *used* to be over there. Your mind has learned a shortcut that misleads you as to the nature of *this* table before us and what's on it. You keep reaching *there*, and you keep winding up with nothing. Reach *here* instead. You'll get some water.' 'But there's nothing over there,' says the patient. 'Nothing at all.' 'I know it *looks* that way,' I say, 'but it really *isn't* that way. Try reaching over here, where the glass *really* is – what have you got to lose?' And eventually, the patient acts *against his own intuition*, and in the direction of mine. He reaches over where his eyes tell him there's nothing. His fingers close around a glass he cannot see, and at first he can't understand how that's even possible. If he stays with it, and if I'm pointing him in the right direction, he's got hold of a glass he can drink from. And then my job is done. That's all there is to it."

More goes into this process, of course, than this metaphor portrays. A story is told about the painter James Whistler, in which a man once asked Whistler how long it took him to paint one of his masterpieces. "About two hours," Whistler said. "That doesn't seem like much," said the fellow, unimpressed. "Yes, but it took me forty years to learn how to do it in two hours," Whistler replied.

Similarly obscure layers of skill reside in the expert therapist, who, above all, must be *right*: he must be *right* about how he reads the patient emotionally; *right* about where and how the patient is reaching where there is nothing, and *right* about the direction in which to encourage the patient to reach. It takes most people a long time to learn to be that right. In the pursuit of such exactitude, a therapist is free to make (as indeed most therapists make) a good many errors and missteps along the way, but he must be willing to learn enough from them to serve as a useful guide to anyone. He must be content to be a student of each patient until at long last, he learns enough to become a teacher.

We make use of these general principles about people every day in our work as therapists, trying to help patients move toward a better and more rewarding way of relating to the world. But these principles need not remain within the specialized domain of psychotherapy. If you want to be an inspiring leader, you, too, must become a student of human nature. You must grapple with how the emotional parts of human beings are constructed and how they operate in the world around you. You must come to terms with the wonderful abilities that our emotional natures bestow and with the necessary limitations and constraints that they entail. We look forward to continuing the discussion of these issues on the website and in the forum next year.