



## CHAPTER ONE

# Born to Love

## Why People Need People

**L**ove makes the world go round, no doubt about it. We're created in love, or some approximation thereof, when egg meets sperm. Then we're carried and cradled under our mother's heart from conception to birth, dependent on love for our very survival for the next several years—and when we're grown and independent, the dance starts all over again, with us meeting, mating, making love and, sometimes, new lives.

Along the way, all of us seek to get and give love: erotic love, romantic love, brotherly love, platonic love, the love of animals, parents, children, and God. It's about when mum meets babe, boy meets girl, girl meets girl, boy meets other boy, man meets dog—the whole mess of attachment and relating that our brains crave to develop and stay healthy and happy.

Scientists can see it in our brains and in our biochemistry, but we know it's so even without the evidence: we're hardwired to love. We crave sex, connection, and companionship so much that we will do almost anything and put up with almost anything to have love and loving relationships.

When we don't have loving connections, we don't do very well. Research proves it over and over again: lonely and disconnected people are sicker, more prone to depression, die younger, and are at greater risk of losing their memories and their minds as they age. An equally impressive group of recent studies shows the inverse is true: people who are married, mated, or have a circle of friends have longer, healthier, and happier lives and a lower risk of developing dementia in old age.

In a series of fascinating experiments from the 1950s, psychology professor Harry Harlow at the University of Wisconsin at Madison demonstrated vividly and heartbreakingly what we primates will do for love.

Harlow was raising rhesus macaque monkeys from birth for his research, using the most accepted scientific methods for human child care. At that time, experts believed that nourishment—food—was the most important need of a newborn primate and the reason babies clung to their mothers. In fact, child-rearing theories of the time discouraged “spoiling” babies, even newborns, with too much attention. The best scientific institutions and hospitals isolated infants to lower risks of infection and provided good physical care and food but little, if any, attention or touching.

Harlow applied these accepted principles from human child care in raising the infant monkeys. But he noticed that while they thrived physically, they were mentally distraught, some to the point of self-mutilation. He wondered whether what the newborns were missing was a mother. So in an odd and brilliant experiment, he gave them a choice of two artificial ones.

One mother was a wire form with a warming device covered with soft cloth but with no food; the other was a bare wire frame that offered

a nipple and bottle. The baby monkeys, Harlow discovered, became deeply attached to the cloth mother and approached the wire mother only for food. They claimed and clung to the soft warm form, rejecting any replacements. Even when sharp spikes or cold jets of air were thrust randomly out of the mother's body, the rhesus babies still clung to it. Comfort, not food, was what the babies craved.

Videos of the babies suffering in these experiments are painful to watch. Yet the prevailing child-rearing theories of that time considered this deprivation the best, most scientific way to care for human babies as well. Harlow's experiments were controversial and contributed to stricter regulation of animal experiments. His work also contributed, perhaps inadvertently, to the revolution about the best care for human newborns.

## **Do You See What I See? How Mirror Neurons Connect Us**

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Where and how does this near-desperate need for love—so basic that we're born craving it—live in the brain?

Neuroscientists know that love and sex activate our powerful dopamine-driven reward and pleasure system. Neurohormones such as oxytocin, the hormone of attachment that is released in both mother and child and in lovers after orgasm, play a crucial role in our ability to love and be loved. (For more on oxytocin, see “The Chemistry of Love” later in this chapter.)

Thanks to new imaging technology such as functional magnetic resonance imaging (fMRI), researchers are discovering what parts of the brain surge with activity when we feel love and lust in many different guises. And they are discovering that our yearning for connection may be based at least in part in our very neural physiology—on the activity of subsets of brain cells called *mirror neurons*, which are specialized to respond to others. These specific neurons may be

responsible for empathy, altruism, our ability to understand others, and possibly synchronized swimming, line dancing, and the appeal of pornography.

Mirror neurons are exactly what they sound like: they are neurons in several parts of the brain that mirror and mimic the activities we see, hear, deduce, and perhaps feel from others. They are a sort of mind-reading fail-safe for connection and communication. And they are bred into our brain.

The presence of mirror neurons, which were discovered less than two decades ago, is often linked with what's called "theory of mind": the ability we develop naturally by the age of four or so that allows us to interpret the thoughts and feelings of others and to understand that others have beliefs, desires, and intentions that are different from our own.

This goes a long way toward explaining how and why we can act in unison and partnership, how we can understand each other—and why and how long-term partners, spouses, and friends appear to read each other's minds, anticipate each other's actions and reactions, and even start to look alike.

These specialized neurons are busy both when we act and when we observe the same action performed by another. That means that parts of our brain become active when we witness other people's actions in the same way that our brain does when we perform those same actions ourselves. The actions we mirror include not just what we do but the way emotions are displayed, cuing us to the emotional content of statements and actions.

Mirror neurons may teach us both how to connect and keep us connected. They help give us a direct internal experience and understanding of another person's action, intention, or emotion, and they underlie our ability to imitate another's action and thereby learn. That imitation means, neuroscientists say, that we can literally experience what others do and feel. It explains why we wince when we see others hurt and the truth in the statement, "I feel your pain."

Scientists discovered mirror neurons in the 1990s by happenstance while researching brain activity in monkeys. Neuroscientists Giacomo Rizzolatti, Leonardo Fogassi, and Vittorio Gallese of the University of Parma in Italy had run electrodes to individual neurons in a monkey's premotor cortex to study brain activity as the monkey reached for different objects.

Then these scientists began to notice something strange: when one of them happened to be reaching for something within the monkey's line of vision, the monkey's premotor neurons fired just as they had when the monkey grasped something itself. The researchers could hardly believe what they had witnessed. But after replicating that experiment and similar ones many times, they realized they had discovered something new. They at first called it "monkey see, monkey do," a good description, but hardly scientific: it was replaced with the more academic and equally descriptive term, *mirror neurons*, when they published their findings.

Since then, the findings have been greatly expanded by the team in Parma, working often with Marco Iacoboni, Michael A. Arbib of the University of Southern California, and Christian Keysers of the University of Groningen in the Netherlands. The researchers have learned, for instance, that mirror neurons do not only fire when an animal is watching someone else perform an action. Mirror neurons also fire if a monkey hears the sound of someone doing something it has experienced—say, tearing a piece of paper.

And as the scientists began studying humans, using brain imaging rather than electrodes, they found that humans have mirror neurons in higher numbers and in more places than did the monkeys. Mirror neurons revealed themselves not only in the premotor cortex and the inferior parietal areas—areas associated with movement and perception—but also in the medial temporal cortex and the insula: regions that correspond to our abilities to comprehend someone else's feelings and use language.

Further experiments showed that mirror neurons help us share other people's experiences as reflected in their expressions, providing a biological basis for the well-known contagiousness of yawns, laughter, and good or bad moods. Newborns search the faces of their mothers or other caregivers and imitate the expressions they see almost from the moment of birth.

Studies also have shown that our mirror neurons can be choosy: they respond to the context of a situation and what we perceive to be its purpose, not only to specific muscle movements of others. Neurons that discharge when a monkey watches a human reach for an object, for example, will continue to respond to the logical progression of the movement even if much of it is hidden by a screen. Recently researchers have discovered that human infants less than a year old respond the same way in similar tests.

Another study showed that mirror neurons play a key role in perceiving intentions—the first step in understanding others and also in building social relations and feeling empathy. Iacoboni had volunteers watch films of people reaching for various objects within a teatime setting—a teapot, a mug, a pitcher of milk, a plate of pastries, napkins—in different contexts. In every instance, a basic collection of “grasping” mirror neurons fired. But different additional mirror neurons would also fire depending on what action was suggested by various details in the scene. If the viewer saw a neatly set table and expected the hand to pick up a teacup to drink, one array fired; if the viewer saw a messy table and expected the hand to pick up a cup to clear it away, another group of neurons fired.

Malfunctioning or absent mirror neurons have been considered one of the possible contributors to the poor social skills of those with autism, Asperger's syndrome, and other mental disorders.

If mirror neurons allow us to feel what others are feeling (at least in part), they explain the power of imitation and may explain some of the “how” of human loving and connection.

## ALL THE WORLD LOVES A LOVER: WHY HAPPY PEOPLE HAVE HAPPY FRIENDS

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Sociologists have long noted that human behavior appears to be contagious, but they had no scientific basis for how or why. Social scientists Nicholas Christakis and James Fowler have come up with some interesting theories, based on studying mirror neurons and analyzing data from the Framingham Heart Study, a mother lode of information. Begun in 1948 by the National Heart Institute, the study has followed more than fifteen thousand Framingham, Massachusetts, residents and their descendants over decades, bringing them to a doctor's office every four years, on average, for a comprehensive physical examination and quizzing them multiple times about their lives.

Sifting through the data and connecting what they found to behavior and mirror neuron research, the scientists speculate that mirror neurons may explain why fat people have fat friends, happy people have happy friends, and long-time spouses often die soon after the death of a loved one—the so-called widowhood effect. (See Chapter Seven, “You’ve Lost That Lovin’ Feelin’.”)

They speculate that we pick up unconscious signals from those nearest and dearest to us about what is considered normal and even desirable. So if our friends are overweight or alcoholic, we adjust our subconscious image of what is a desirable weight or alcohol intake and pack on the pounds and the booze. The closer the relationship is with this person, the more we are affected by the other's activities. Happiness is the same: a smiling face coaxes us to smile in response, and the giddy happiness of the newly in love is known to be infectious.

You've probably also noted that your own expressions have an effect on how you feel, another reason to put on a happy face. Psychologist Paul Ekman, who confirmed that the facial expression of emotions is the same the world over, inadvertently discovered the effect that making faces has on our emotions. While simulating and recording a wide range of facial expressions in front of a mirror, he discovered that some days he would just be bummed out: he realized that these turned out to be the days he was experimenting with making sad, angry, or distressed expressions.

## **The Dangers of Involuntary Mind Merging**

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Of course, you need to take care what you hold up to those mirrors: mirror neurons do not always reflect well on us, Marco Iacoboni notes.

Take the example of violent video games (and possibly violent pornography). Iacoboni's initial studies suggest that such games reinforce, at a basic neuronal level, an association of pleasure and accomplishment with inflicting harm—even if it's virtual harm—an impetus that we would not ordinarily want to encourage. He has speculated that imitative violence may so powerfully affect mirror neurons that if it is reinforced by other input, we may not be able to control acting it out.

Iacoboni has also said that mirror neurons work best in real life when people are face-to-face, and he concedes that virtual reality, films, and videos of anything are but shadowy substitutes. Still, violent videos and games stimulate mirror neurons. And since the neurons mirror the action, it is not so virtual, but as if one was experiencing the activity firsthand. Mirror neurons then might explain the power of pornographic films. And wouldn't you know it, the French have done a study to try to prove it.

Men get sexually aroused by looking at pornography, but it hasn't been known exactly how that worked in the brain. A group of French scientists devised an experiment to study it. They hooked a group of men up to a volumetric penile plethysmograph (an instrument that measures blood volume in the penis) and an fMRI brain scanner and then showed them sexy videos. When the men (and their penises) responded sexually, researchers could see activity in brain areas that contain mirror neurons (the left frontal operculum and the inferior parietal lobules). And when correlated to the measurements taken from the penile plethysmograph, the level of activity in those brain areas predicted the magnitude of the measured erection. Several other brain areas were also activated. More research is needed to understand the role of mirror neurons in pornography.



## The Chemistry of Love

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Your brain is more than its neurons. When people smitten with love or lust say there is chemistry or electricity between them, they speak the truth: the brain (and your love life) is powerfully affected by honest-to-goodness electrical sparks—tiny amounts of electricity created by chemical reactions that transmit information among your neurons. Specialized chemicals called neurotransmitters and hormones fan the flames.

Love in your brain, then, is indeed a potent brew. It involves the blending and balance of more than one hundred of those hormones and neurochemical messengers. Lust is driven by testosterone (in men and in women), norepinephrine gives that excitatory rush, and dopamine provides the over-the-moon high that rivals heroin in its orgasmic and addictive kick. These chemicals can so heighten the passion of sex and sexual craving that it becomes a basic need, such as hunger or thirst—so powerful it can feel like an obsessive compulsive disorder.

Lasting love and devotion can be credited to the kinder, gentler neurohormone oxytocin, also known as the “cuddle hormone,” which is produced in the brains of newborns, nursing mothers, and at orgasm. It’s the hormone of love, trust, and attachment and is involved in every kind of human and mammal bonding. Unlike the hot spurs of testosterone and dopamine, oxytocin contributes to feelings of comfort and security.

Commitment is fueled by oxytocin and its companion neurohormone vasopressin. In women, oxytocin stimulates birth contractions, the letting down of breast milk, mother love, and bonding with both a nursing infant and a postcoital lover. In both men and women (but more in women), it increases during sex and surges at orgasm, playing a role in pair bonding (and possibly an evolutionary adaptation for long-term care of helpless infants). It’s the hormone that attaches newborns to their moms and also, it turns out, to the dads

### ***Love Potions: The Love Stars of Brain Chemistry***

These are the chemicals most involved in sex, love, and bonding:

- *Testosterone*. This is the steroid hormone that makes men male and drives their aggression and sexual urges, but it's also key for desire in women, where it's produced in much smaller amounts.
- *Estrogen*. This steroid hormone makes women female, regulates reproductive cycles and menstruation, and is important for mental health. Men need some estrogen for sperm production and possibly desire.
- *Progesterone*. It balances estrogen and has such major effects on fertilization and reproduction that it's known as the hormone of pregnancy.
- *Dopamine*. Lust is enhanced by dopamine, a neurohormone of many roles produced by the hypothalamus, which triggers the release of testosterone, the hormone that drives sexual desire in women as well as men. Dopamine is vital for voluntary movement, attentiveness, motivation, and pleasure, and it's the key player in addiction, ecstasy, and love. It's the fire in your fireworks.
- *Oxytocin*. Love is supported by oxytocin, a hormone secreted by the pituitary. Oxytocin reinforces attachment and trust and is vital for childbirth and breastfeeding. In both men and women (but more in women), it increases during sex and surges at orgasm, playing a role in pair bonding (and possibly an evolutionary adaptation for long-term care of helpless infants).
- *Vasopressin*. Also known as arginine vasopressin, it regulates the body's retention of water, but more important to us in this context, it resembles and acts much like oxytocin, facilitating and coordinating reward circuits crucial for bonding.

- *Norepinephrine*. Also known as adrenaline, it keeps us alert and jumps in when we need a sudden burst of energy. It's produced and released by the adrenal glands in times of stress and excitement. A little bit hypes desire; too much can increase anxiety or tension.
- *Serotonin*. This mood leveler helps regulate memory, emotion, sleep, appetite, and mood, among other functions. Too little serotonin is connected with depression, and too much serotonin withers sexual desire, as those on serotonin-enhancing antidepressants know all too well.
- *Endorphins*: These act as hormones and neurotransmitters to reduce pain sensations and increase pleasure. No wonder: these are your body's natural narcotics. The word is a combination of end(ogenous) and (m)orphine. They surge with exercise, orgasm, and love.

who participate actively in child care. Researchers are finding that those powerful neurochemicals, when released in the presence of a loved one, can basically train us to become addicted to the object of our affection.

There seems to be a balancing act going on among all these love-related hormones that may help explain some of the progression of love from hot, mad lust and sex to comfortable, loving companionship. High levels of testosterone that fuel desire actually suppress the release of the attachment hormones oxytocin and vasopressin—and high levels of oxytocin and vasopressin offset the crazy passion effects of testosterone, dopamine, and norepinephrine, leading to calmer feelings of attachment. Research shows that a man's levels of testosterone actually go down when he holds a baby.

## **Love Is Everywhere: Where Love Grows in the Brain**

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The number and types of brain scans that show activity in a living, loving brain in real time are increasing and increasingly popular (Don't we all want to know the secrets of love in our brain?), and some of the findings show that love involves a network of areas in the brain, regardless of the object of your affections.

It's also true that different sections of the brain become involved in specific and different types of love, from wild erotic passion to the unshakable devotion of maternal or unconditional love. But many areas overlap: Stephanie Ortigue at the University of Syracuse, who is researching the relationship of different kinds of love to specific brain areas, finds that a dozen sections of the brain often work in tandem with the release of those powerful love chemicals of dopamine, oxytocin, and vasopressin.

Ortigue, Francesco Bianchi-Demicheli, and colleagues reviewed a sampling of a half-dozen fMRI brain studies, looking for some common ground about where love resides. In examining the fMRI studies of the brains of those deeply, truly, and madly in love—those in the thralls of romantic passionate love—they confirmed what earlier studies show: such passion recruits brain areas involving emotion, motivation, reward, social cognition, attention, and self-representation. In other words, they found activity in the same brain regions that are buzzing when they are under the influence of cocaine, especially the dopaminergic subcortical system (including the ventral tegmental area and caudate nucleus).

Interestingly, activity wasn't limited to the brain areas related to cocaine. Rather, love activates part of the cognitive system, confirming that love is not only an addiction or a basic emotion. Love is also cognition. Love acts, feels, and thinks. Meanwhile, areas in the loving brain concerned with fear, grieving, and self-protection, such as the amygdala, were snoozing. (Read more about this in Chapter Four, "That Old Black Magic.")

In the imaging studies of the maternal brain, they found overlap with the areas activated by passionate love such as those rich in the dopamine-reward cycle. But they also found activity in areas associated with higher thinking and processing, and with the periaqueductal (central) gray matter (PAG). This would make sense, the researchers wrote, since the PAG receives direct connections from the emotional brain and contains a high density of vasopressin receptors, which are related to oxytocin (both neurohormones important in maternal bonding as well as pair bonding) and help suppress pain during extreme emotional experiences such as childbirth.

To examine unconditional love, they reviewed studies of brains of people expressing love for those with diminished intellectual abilities. Once again, the reward system was activated (that seems to be constant for many kinds of love), but so were the PAG and the thinking brain, similar to the maternal brain.

Together, researchers conclude, the results show that different types of love call for different brain networks and that love is more than a basic emotion. Even passionate love, it turns out, involves the thinking brain. Love, they wrote, is a complex function including appraisals, goal-directed motivation, reward, self-representation, and body image. Just about any of us could have told them that, but it's good to have it scientifically verified.

## **A Brain Unable to Love: Inside the Brain of a Psychopath**

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Sometimes love messages get tangled in the brain. There are many reasons: it can be connected to genetics, prenatal conditions or birth injuries, childhood trauma, abandonment, neglect, abuse, illness, or brain damage.

Those with such problems can find it hard to form strong attachments. Others might be drawn to obsessions not condoned by most

cultures, such as a sexual attraction to children, animals, or objects. Or in a really, really bad case of miswiring or injury, the result could be a brain unable to feel emotion, empathy, or love at all: the brain of a psychopath.

These brains are not like those of the rest of us. Aided by EEGs and brain scans, scientists have discovered that psychopaths have significant and serious brain defects in areas that affect their ability to relate to others. Their brains process information differently from most other people's. It's as if they have a learning disability that impairs emotional development.

And yet one of the most striking peculiarities of psychopaths is how normal they appear at first, unlike the monsters depicted in horror and thriller films. You may not know when you are face-to-face with a psychopath since most psychopaths act just like the rest of us. They are killers making nice. Ted Bundy, for example, an attractive law student and aide to the governor of the state of Washington, was a mass rapist and murderer of thirty women. John Wayne Gacy was a Junior Chamber of Commerce's Man of the Year who murdered thirty-three teenage boys and young men. Other sociopaths are polished career criminals or con men (sociopaths are usually men).

Psychopaths are likable guys when they want to be, but they lack empathy and the most universal and basic social obligations and emotions. They are unable to read other people's cues and learn from their mistakes. They lie and manipulate, commit crimes, and might maim and murder and feel no compunction or regret. In fact, they don't feel particularly deeply about anything at all.

So much of the way regular people make sense of the world is through emotion. It informs our gut decisions, our connections to people and places, our sense of belonging and purpose. It's almost impossible to imagine life without feelings—until you meet a psychopath. They often cover up their deficiencies with a ready and engaging

## DO YOU KNOW A PSYCHOPATH?

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Chances are you've met a psychopath. People with the disorder make up 0.5 to 1 percent of the general population. When you discount children, women (since few women, for unknown reasons, are psychopaths), and the estimated 500,000 who are already imprisoned, that translates to approximately 250,000 psychopaths living freely among us in the United States.

You probably have not fallen in love with one, but it's possible. Psychopaths can appear not only normal but charming: mass murderer and rapist Ted Bundy was attractive to many women.

Without a brain scan, how can you recognize a psychopath? The test that experts use, known as the Hare Psychopathy Checklist-Revised, consists of twenty criteria. Among the items on the list are behaviors and traits such as pathological lying, poor impulse control, proneness to boredom and sexual promiscuity, and having many short-term marital relationships. Other traits are a parasitic lifestyle; irresponsibility; a record of crime and conning; lack of empathy, remorse, or guilt; and a failure to accept responsibility for actions.

charm, so it can take time to realize what you are dealing with, if you ever do. Although guilty of the most erratic, irresponsible, and sometimes destructive and violent behavior, they show none of the classic signs of mental illness. They don't have hallucinations or hear voices. They aren't confused, or anxious, or driven by overwhelming compulsions. Nor do they tend to be socially awkward. They are often of better-than-average intelligence.

They just don't care, and they don't express true remorse or a desire to change. Are they mad or simply bad? Nearly every culture on earth has recorded the existence of individuals whose antisocial behavior threatens community peace.

Thanks to technology that captures brain activity in real time, experts are able to investigate what is happening inside a psychopathic brain as they think, make decisions, and react to the world around them. And what they find is that psychopaths suffer from a serious biological defect. It's as if they have a learning disability that impairs emotional development, and this disconnect is sometimes seen as early as age five.

Psychopaths are curiously oblivious to emotional cues, and they also have trouble identifying fearful facial expressions. Once fixed on a goal, psychopaths proceed as if they can't get off the train until it reaches the station. This narrowly focused, full-speed-ahead tendency, paired with the psychopath's impulsivity, produced the kind of horror described in Truman Capote's *In Cold Blood*, an all-night torture fest that appears almost aimless, the work of criminals who, having begun the violence, are blind and deaf to a victim's pleas, unable to stop until it has been completed.

Some of the early information about brain areas involved in psychopathic behavior comes from the famous and curious case of Phineas Gage, a handsome, dark-haired young man working as a construction foreman on the Rutland & Burlington Railroad in Vermont in 1848. An accidental explosion blew a tamping iron—a heavy metal rod more than three feet long—through the left side of Gage's face and out the top of his head. Such an injury seemed sure to kill or at the very least cripple, but Gage never lost consciousness and apparently recovered. However, his compatriots noticed the formerly savvy, even-tempered, and responsible Gage was now churlish and unpredictable, driven by his immediate passions. Gage had lost the use of a part of the brain called the ventromedial prefrontal cortex, an area structurally similar to its neighbor, the orbitofrontal cortex, which many scientists believe malfunctions in psychopaths.

The orbitofrontal cortex is involved in sophisticated decision-making tasks that involve sensitivity to risk, reward, and punishment. People whose brains are damaged in this area develop problems with



impulsivity and insight and lash out in response to perceived affronts—much as Gage did. In fact, such patients are often said to suffer from acquired psychopathy. But even transformed as Gage was by his accident, he did not show all the characteristics of psychopathy, such as lack of empathy.

Evidence today suggests that psychopathy is due to errors in several interconnected brain structures that are involved in emotion processing, goal seeking, motivation, and self-control, including part of the thinking brain, the orbitofrontal cortex; the fight-or-flight controlling amygdala; and the paralimbic system.

A group of fMRI images of psychopaths' brains show a pronounced thinning of the paralimbic tissue. The paralimbic system includes the anterior cingulate cortex and the insula. The anterior cingulate regulates emotional states and helps people control their impulses and monitor their behavior for mistakes. The amygdala generates emotions such as fear, and the insula plays a key role in recognizing violations of social norms, as well as in experiencing anger, fear, empathy, disgust, and pain perception. Psychopaths are unfazed by pain and notable for their fearlessness: when confronted with images such as a looming attacker or a weapon aimed their way, they literally don't blink.

One study that looked at the brains of nine men who were diagnosed as psychopaths used a new scanning technique called DTI-MRI. The team at the Institute of Psychiatry at King's College, London, found that a white matter tract called the uncinate fasciculus, which connects the amygdala and the orbitofrontal cortex (the emotional and the thinking brains, respectively), was significantly different between the psychopaths and the control group and that the more extreme the psychopathy, the greater the abnormality was. Some of the psychopaths they imaged had committed multiple rapes, manslaughter, and attempted murder. (Incidentally, none of the men were incarcerated at the time of the study, which gives one pause.)

Psychopaths are not the only ones with aberrant brains. The brains of some hard-core pedophiles also have something wrong in the frontal lobe, a region of the brain critical for impulse control among its higher-level reasoning functions. Research suggests that pedophiles might have faulty wiring and connections in the brain. A study using MRIs and computer analysis techniques found that brains of some pedophiles had significantly less white matter in brain regions involved in sexual arousal, suggesting poorer connections, among other things.

Researchers are looking for effective treatments—and you don't have to feel sympathy to want to help psychopaths. Consider it preventive and protective treatment for the rest of us. Psychopaths offend earlier, more frequently, and more violently than other criminals. If for no other reasons than to ease the prison burden, psychopaths deserve and need treatment just as anyone else with a severe mental illness: Between 15 and 35 percent of U.S. prisoners are psychopaths, and they are four to eight times more likely to commit new crimes on release. In fact, there is a direct correlation between how high people score on a screening test for psychopathy and how likely they are to violate parole.

Recent estimates put the expense of prosecuting and incarcerating psychopaths, combined with the costs of the havoc they wreak in others' lives, at \$250 billion to \$400 billion a year. An ambitious multimillion-dollar project, funded by the National Institutes of Mental Health and Drug Abuse and the John D. and Catherine T. MacArthur Foundation, is gathering genetic information, brain images, and case histories from one thousand psychopaths (using portable functional MRI scanners that can be brought inside prison walls and used on-site to scan dangerous prisoners) and compiling it all into a searchable database. The research may identify psychopaths earlier and help devise effective treatments to help them, and protect the rest of us.

## THE POWER OF LOVE—AND ITS ABSENCE

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Still doubting the power of human relationships? Consider the results of this 2010 meta analysis of 148 studies of how and why people die. Guess what ranks right up there on the top of influences on mortality? Yep. Loneliness.

Noting that the quantity and quality of social interaction are drastically declining in industrialized countries as loneliness continues to rise, the study found that the lack of relationships is comparable to well-established risk factors for death such as smoking and alcohol consumption, and is even greater than other risk factors such as physical inactivity and obesity. (See Chapter Five, “Friendship, Such a Perfect Blendship.”)

Shunning, abandonment, and forced solitary confinement are among the worst punishments, considered to be cruel and excessive or even akin to torture. They can cause physical brain damage—electroencephalograph (EEG) studies going back over decades show changes in the brain waves of prisoners after only a week or so of solitary confinement—and the rejected brain is a wretched brain. (See Chapter Seven, “You’ve Lost That Lovin’ Feelin’.”)

When the rejection or abuse is extreme, the very young brain can have its capacity for love broken, perhaps permanently. Children neglected or abandoned in orphanages from birth, where they receive adequate physical care but little human contact, often have lifelong problems relating to others and an inability to bond lovingly. Reactive attachment disorder is an issue among children who have been adopted in recent years from orphanages in eastern Europe and Russia, where they received physical care but little affection.

### **Baby Face, You’ve Got the Cutest Little Baby Face**

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If there is one type of love wired into our basic brain, that’s baby love. For example: let’s say you found a wallet on the street. What would you do? Take it to the nearest police station? Mail it back to the owner?

Keep it? The answer, it emerges, depends less on a question of individual morality and a great deal more on how the brain is wired to our collective evolutionary heritage.

In 2009 psychologist Richard Wiseman of the University of Hertfordshire in England left a bunch of wallets on the streets of Edinburgh, Scotland, each containing one of four photographs: a happy family, a cute puppy, an elderly couple, and a smiling baby. Which wallets, he wondered, would be most likely to find their way home?

There was no doubting the outcome: 88 percent of the wallets with the picture of the smiling baby were returned, beating all the others out of sight. Wiseman says that was not surprising: “The baby kicks off a caring feeling in people,” a nurturing instinct toward vulnerable infants that has evolved to safeguard the survival of our future generations.

You don’t even have to be a mother to have your brain respond to images of infants. In another 2009 study, Melanie Glocker of the Institute of Neural and Behavioral Biology at the University of Muenster in Germany flashed pictures of newborns to a group of childless women while their brains were scanned by a fMRI. Using a special image-editing program, Glocker manipulated the pictures so some of the infant faces were even more baby-like (large, round eyes; round, chubby faces) and some were less babyish (smaller eyes, narrower faces). The more babyish faces prompted an increase in activity in not just the amygdala (the brain’s emotional control tower) but also the nucleus accumbens, a key structure of the mesocorticolimbic system connected with reward.

Studies that compared adult responses to the sounds of babies and adults crying found a 900 percent increase in amygdala responses to the babies. Additional research showed that sudden and unexpected changes in the babies’ crying pitch got the most emotional brain response from adults.

Adults have many of the same protective instincts to the babies of other mammalian species, which is no doubt why they are all engineered to be so cute. Other loves may come and go, but baby love, it seems, just lasts and lasts.