Meet Your Happy Chemicals

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for my
wonderful
husband, Bill

Introduction

Happy Chemicals Turn Off So They Can Turn On

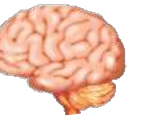
The feeling we call "happiness" comes from four special brain chemicals: *dopamine, endorphin, oxytocin* and *serotonin*. These "happy chemicals" spurt when your brain sees something good for your survival. Then they turn off, so they're ready to spurt again when something good crosses your path.

Each happy chemical triggers a different good feeling. Dopamine produces the joy of finding what you seek- the "Eureka! I got it!" feeling. Endorphin produces the oblivion that masks pain- often called "euphoria." Oxytocin produces the feeling of being safe with others- now called "bonding." And serotonin produces the feeling of being respected by others-"pride."

"I don't see happiness this way," you may say. You don't think this in words because neurochemicals work without words. But you can easily see these motivations in your fellow man. And research shows that animals have these same basic neurochemicals doing the same basic jobs. As for yourself, it's easy to believe that your verbal inner voice is your whole thought process, and ignore your neurochemical self.

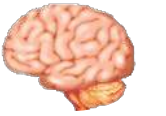
Happy chemicals are controlled by tiny brain structures that all mammals have in common: the hippocampus, amygdala,

pituitary, hypothalamus, and other parts collectively known as the **limbic system.** In humans, the limbic system is surrounded by a huge cortex. These two different brain systems are always working together, trying to keep you alive and keep your DNA alive. Each has its special job. Your cortex looks for patterns in the present that match patterns you stored in the past. Your limbic system releases neurochemicals that tell your body "*this is good for you, go toward it,*" and "*this is bad for you, avoid it.*" Your body doesn't always act on these messages because your cortex can override them. Then, your limbic system tries again. The cortex can over-ride the limbic system momentarily, but your mammal brain is the core of who you are.

Four happy chemicals	
dopamine	the joy of finding what you seek
endorphin	the oblivion that masks pain
oxytocin	the safety of social bonds
serotonin	the security of social dominance

Your brain rewards you with good feelings when you do something good for your survival. Each of the happy chemicals motivates a different type of survival behavior. Dopamine motivates you to get what you need, even when it takes lots of

effort. Endorphin motivates you to ignore pain so you can escape from harm when you're injured. Oxytocin motivates you to trust others, to find safety in companionship. And serotonin motivates you to get respect, which expands your mating opportunities and protects your offspring.

Happy survival motives	
dopamine	keep seeking rewards
endorphin	ignore physical pain
oxytocin	build social alliances
serotonin	get respect from others

The mammal brain motivates a body to go toward things that trigger happy chemicals, and avoid things that trigger unhappy chemicals. You can restrain yourself from acting on a neurochemical impulse, but then your brain generates another impulse. You are always using neurochemicals to decide what is good for you and what to avoid. Your cortex helps by directing attention and sifting information, but your limbic brain sparks the action.

We struggle to make sense of our neurochemical ups and downs because they don't come from verbal logic. They come from the operating system we've inherited from our

ancestors. Once you know how the mammal brain works, your neurochemical ups and downs are easier to accept.

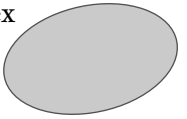
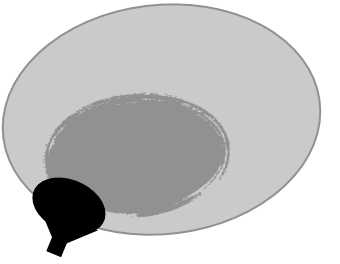
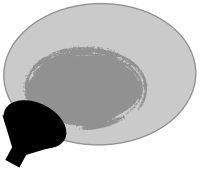
Happy chemicals did not evolve to be on all the time. They evolved to promote your survival. It may not seem that way because the mammal brain defines survival its own way. It relies on early experience, even though children can't understand survival realistically. And it cares as much for the survival of your genes as it does for your body.

This quirky brain complicates the business of being human. We have no choice but to work with the brain we've got. If you know how it works, you can get more happy chemicals from it, and avoid more unhappy chemicals.

It's foolish to think of your cortex as the good guy and your limbic system as the bad guy. You need both to make sense of the world around you. Your cortex sees the world as a chaos of detail until your limbic system labels things as good for you or bad for you. More important, your cortex cannot produce happy chemicals. If you want to be happy, you have to get it from your limbic system.

But your cortex and your limbic system are literally not on speaking terms. That's because the limbic system can't process language. When you talk to yourself, it's all in your cortex. The limbic system never tells you in words why it is spurting a happy or unhappy chemical. Animals accept their neurochemical impulses without expecting a verbal rationale. That's why animals can help us make sense of our own brain chemicals. The goal here is not to glorify animals or primitive impulses. The goal is to understand our neurochemical ups and downs.

Comparing brain parts

cortex 	extra neurons that store life experience by growing and interconnecting
limbic system 	structures that manage neuro-chemicals, such as the amygdala, hippocampus, hypothalamus
reptilian brain 	the cerebellum and brain stem (medulla oblongata and pons), which manage routine bodily functions
human 	
chimpanzee 	
gazelle 	
mouse 	
lizard 	

A hungry lion is happy when he sees prey.[1] It's not philosophical happiness. His happy chemicals cause a state of arousal that releases energy for the hunt. Lions often fail in their hunts, and they choose their targets carefully to avoid running out of energy before they get to eat. So a lion is thrilled when he sees a gazelle close at hand. His dopamine surges, which revs up his motor to pounce.

A thirsty elephant is happy when he finds water. The good feeling of quenching his thirst triggers dopamine, which makes permanent connections in his neurons. That helps him find water again in the future. He need not "try" to learn where water is. Dopamine simply paves a neural pathway. The next time he sees any sign of a water hole, electricity zips down the path to his happy chemicals. The good feeling tells him "here is what you need." Without effort or intent, happy chemicals promote survival.

But happy chemicals don't flow constantly. The lion only gets more happy chemicals when he finds more prey, and the elephant only spurts when he meets a survival need. In nature, there is no free happy chemical. Good feelings evolved because they get us to keep doing things that promote survival.

Your Happy Trails

Your feelings are unique. You have unique ways to turn on your happy chemicals because you built neural pathways from your unique life experience. When something made you feel good as a child, the happy chemicals built connections.

1 I use the male pronoun in this book because it combines with my female voice to convey the universal aspects of brain function. Female lions do most of the hunting, in fact, but gender differences are widely expounded elsewhere. This book focuses on the physiology that both genders have in common.

When something felt bad, your unhappy chemicals seared that information, too. Over time, some of your neural pathways developed into superhighways because you activated them a lot. The survival system you ended up with is not what you'd design today if you started from scratch. It's the survival system that emerged from real experience.

Your existing neural highway system makes it easy for you to like some things and dislike other things. Often, we find ourselves liking things that are not especially good for us, and fearing things that are good for us. Why would a brain that evolved for survival build such quirky pathways?

Because the brain builds on the pathways it already has. We evolved to store experience, not to delete it. Most of the time, experience holds important lessons. It helps us go toward things that helped us in the past and avoid things that endangered us. But a huge surge of happy chemical builds a huge pathway, even if too much of a good thing can hurt you. A big surge of unhappy chemical builds a big circuit that lasts even when the threat is gone. This promotes survival in a world where good things are scarce, and threats are enduring. Your brain relies on its pathways as if your life depended on it because in the state of nature, it does.

You built circuits effortlessly when you were young. Building new circuits in adulthood is like trying to slash a new trail through dense rainforest. Every step requires a huge effort, and the new trail disappears into the undergrowth if you don't use it again soon. Such trail-blazing feels inefficient and downright unsafe when a nice superhighway is nearby. That's why people tend to stick with the pathways they have.

You can build new trails through your jungle of neurons, which can turn on your happy chemicals in new ways. It's harder than you'd expect, but it's easier when you know your equipment.

The electricity in your brain flows like water. It finds the path of least resistance. Electricity doesn't flow easily along neurons you've never activated before. Each time a neural pathway is activated, electricity flows more easily. Repetition develops a neural trail slowly, the way a dirt path hardens from years of use. But neurochemicals develop a neural trail instantly, the way asphalt paves a dirt road. Your neural network grew from things you experienced repeatedly and things you experience neurochemically.

Once you've built highways to your happy chemicals, you use them, because it feels like you're promoting survival. New highways are hard to build in later life. You can always add new leaves to your neural branches, but it's harder to add new roots. It's possible, but it doesn't happen in the effortless way it did in youth. You have to spend a lot of time choosing the experiences you feed to your brain. No one can build new pathways for you, and you cannot build them for someone else. But this book will help by showing just what stimulates happy chemicals and what connects neurons. It can be your guide as you work to slash new roads and avoid old ones.

This brain we've inherited is frustrating. In its quest for survival, it often turns unhappy chemicals on and happy chemicals off. When my neurochemistry frustrates me, I remind myself that it has succeeded at promoting survival for millions of years.

The Vicious Cycle of Happy Chemicals

When your unhappy chemicals flow, you don't usually respond by thanking them for promoting your survival. Instead, you focus on ways to trigger happy chemicals. For example, when hunger triggers a bad feeling, a mammal seeks food. When cold triggers a bad feeling, a mammal seeks warmth. Just finding food and warmth triggers happy chemicals, before you actually eat or warm up. Happy chemicals flow when you see a way to meet your needs.

The human cortex is good at avoiding bad feelings. We avoid hunger and chill by planting food and stocking fuel. But unhappy chemicals remain, no matter how well we meet our needs. As soon as you're warm and fed, your brain scan for other things that can hurt you. Your survival is threatened as long as you're alive, and your brain never stops looking for survival threats.

A mammal must take risks to get its needs met. It risks getting killed by a predator while foraging for food. It risks social conflict when seeking mates. It risks losing its offspring before grandchildren have been produced to preserve its genes. Unhappy chemicals are the brain's way of alerting us to such risks.

Unhappy chemicals feel bad because that works. It gets your attention, fast. It's comforting to know that bad feelings have a purpose. When a hungry gazelle smells a lion, bad feelings motivate it to run rather than keep eating. The gazelle survives because the smell of a lion triggers a feeling that's much worse than ordinary hunger. Once the gazelle escapes from the lion, the bad feeling of hunger gets its attention again, and it looks for a safe place to forage. We are alive today because

unhappy chemicals got our ancestors' attention to one survival threat after another.

Bad feelings are produced by *cortisol*. Your response to cortisol depends on what it's paired with, be it low blood sugar, the scent of a predator, social exclusion, or myriad other danger signals. When your cortisol flows, it links the neurons active in your brain at that moment. This wires you to recognize those danger cues in the future. A young gazelle has cortisol spurts while following its mother, and the pathways it builds prepare it to survive when its mother is gone. Survival knowledge builds without effort or intent because neurochemicals pave pathways.

When you feel a cortisol alert, your brain looks for a way to make it stop. Sometimes the solution is obvious, like pulling your hand off a hot stove. But bad feelings don't always have obvious causes. And they don't always have obvious cures. Such feelings keep commanding your attention with the sense that you must "do something." Your brain keeps scanning the world for a way to make bad feelings stop.

That "do something" feeling promotes survival, but it also causes trouble. It motivates us to do anything that stops the cortisol. Can eating a donut fix a career or romantic setback? From your brain's perspective, it can. Consciously, you know the donut doesn't solve the problem. But when something changes unhappy chemicals to happy chemicals, your brain learns from the experience. When donuts trigger happy chemicals (because fat and sugar are scarce in nature), a neural pathway is paved. The next time you have that "do something" feeling, this pathway is one "something" you "know." You may not act on it, because you also know the consequences, and you've built other

"do something" pathways. But it remains in your mammal brain's arsenal of survival strategies.

Cortisol is triggered by disappointment. Your mammal brain alerts you when your expectations are not met. That "do something!" feeling gets your attention as long as expectations of romance or success are disappointed, and your brain responds with the strategies it has learned.

We evolved to learn from experience. It might seem that people don't learn from experience until you look at it neurochemically. Neurochemicals are molecules that make physical changes in the brain. These changes help you navigate through the world by triggering good or bad feelings when something felt good or bad in your past. This promotes survival when things that trigger good feelings are good for survival. And when these feelings are bad for survival, we can "second guess" our neurochemical steering mechanism with our big cortex. That's what the cortex evolved for. But it can't work alone. It is always working along with our neurochemistry.

Each brain has a network of connections built from experiences that felt good in the past. These connections represent simple things like donuts and complex things like social trust and practical skills. By the time you are old enough to choose your own course of action, you already have a brain full of circuits that turn your neurochemicals on and off. These circuits are what you "know" about how to survive in the world. You can stop yourself from acting on your neurochemical impulses, which gives your brain time to search for a Plan B. But you are always relying on your existing pathways to plot a course that leads away from cortisol and toward happy chemicals.

When you succeed at triggering happy chemicals, the spurt is soon over. To get more, you have to do more. That is how a brain keeps prodding a body to do what it takes to keep its DNA alive. Happy chemicals get re-absorbed and your awareness of survival threats resumes. You get that "do something" feeling, and you ponder your options by sending electricity down the pathways you have.

The brain's quest for happy chemicals often leads to a vicious cycle because of the side effects. "Everything I like is illegal, immoral or fattening," goes the old saying. Happy chemicals exist because of their side effects, thanks to natural selection. When happy chemicals dip and we seek more, we get more side effects. They can accumulate to the point where they trigger unhappy chemicals. Now, the behavior you use to trigger happiness creates more unhappiness. And the more cortisol you produce, the more motivated you are to repeat the behavior you expect to make you happy. You are wired for frustration.

Vicious cycles are everywhere. Some of the most familiar ones are alcohol, junk food, compulsive spending, and drugs. Other well-known vicious cycles are risk-taking, getting angry, falling in love, and rescuing others. Each of these behaviors can make you feel good in a moment when you were feeling bad. The good feeling means happy chemicals are building connections, making it easier to trigger good feelings in that way in the future. Over time, a neural superhighway develops. Now your brain activates that behavior effortlessly. But too much of a good thing triggers unhappy chemicals, which let you know that it's time to stop. It's hard to stop, however, because your brain seeks happy chemicals. So the same behavior

can trigger both happy and unhappy feelings at once, like driving with one foot on the accelerator and one on brake.

You can stop this vicious cycle in one instant. Just resist that "do something" feeling and live with the cortisol. This is not easy because cortisol screams for your attention. It did not evolve for you to sit around and accept it. But you can build the skill of doing nothing during a cortisol alert, despite that urge to make it go away in any way possible. That frees you to activate an alternative happy circuit instead of the old-familiar one. A virtuous circle starts in that moment.

But what if you don't have an alternative circuit at the ready? That's where this book comes in. It shows how new highways to your happy chemicals can be built. That may feel

awkward because we rely so heavily on circuits that built themselves. We've all built circuits with conscious effort, like the ones that do long division and define vocabulary words. But the circuits that tell you what's good and bad for you are built from lived experience. You have to feed your brain new experiences for it to learn new ways of feeling good. And you have to keep doing it until the new circuit is big enough to compete with the ones you've already built by accident.

We think it should be easy to build new circuits since our old ones got there without struggle. This book shows why it's so hard to remodel your neural infrastructure.

Your brain likes your old circuits, even when they lead you astray. That's because electricity zipping down a well-worn pathway gives you the feeling that you know what's going on. When you refuse to use your old pathways, you may feel lost. You may even feel like you're threatening your own survival, though you're doing precisely the opposite.

The bad feeling of resisting a habit eases once a new habit forms. You can do that in 45 days. If you repeat a new thought or behavior every day without fail, in 45 days a new pathway will invite electricity away from the old path. The new choice will not make you happy on Day 1, and it may not make you happy on Day 40. Even on Day 45, your new circuit cannot trigger happy chemicals constantly. But it can trigger enough to free you from a vicious cycle. On Day 46, you'll be ready to start building another new circuit. Over time, you can build many new ways to trigger happy chemicals, as long as you're willing to repeat a behavior for 45 even if it doesn't feel good.

A vicious cycle is easy to see in someone else. That's why people are often tempted to take charge of other people's

happiness, even while doing nothing about a vicious cycle of their own. But each person must manage their own limbic system. No one else can reach into your brain and trigger your happy chemicals for you. Only you can make connections in your brain, and you cannot make connections in someone else's brain. If you focus your life on other people's brains, you may fail to fix their vicious cycles and your own.

Modern society is not the cause of vicious cycles. Our ancestors had their own variations. They felt good when they made human sacrifices, and when the good feeling passed they made more sacrifices. Over time, humans developed better ways to trigger happy chemicals and avert unhappy chemicals.

It's not easy being a mammal with a big cortex. We have enough neurons to imagine things that don't exist instead of just focusing on what is. This allows us to improve things, but it also leave us feeling that something is wrong with the world as it is. A vicious cycle often results. The more you make yourself happy by imagining a "better world," the less invested you are in the world as it is. This can lead to bad decisions that trigger unhappy chemicals, motivating you to live in your imagined world even more. Reality is a disappointment compared to the ideal world that a cortex can imagine.

What About Love?

You've probably heard that loving others is the key to happiness. It's a good principle, but it only provides limited insight into your happy chemicals.

Love triggers huge neurochemical ups and downs because it plays a huge role in the survival of your genes. Our

brain uses happy chemicals to reward behaviors that promote what biologists call "reproductive success." You may not care about reproducing and you surely have another definition for success. You may feel sure that your love is selfless and completely unconcerned with your genes. But you are here today because your ancestors successfully competed for mates and kept their offspring alive long enough to successfully mate. Your limbic system was naturally selected over millions of years for its ability to reproduce. As soon as a mammal is safe from immediate harm, its thoughts turn to reproductive success in all of its aspects.

Sex and romance are just the obvious examples. Nurturing children promotes your genes, so it's not surprising that it stimulates happy chemicals. Competing successfully for quality mates promotes your genes, and it stimulates happy chemicals. Over the millennia, some DNA made a lot of copies of itself and some made none at all. A conscious intent to reproduce is not necessary for neurochemicals to motivate behavior. For example, animals avoid in-breeding. They don't do that consciously, but natural selection weeded out in-breeders, leaving brains that produced alternative behaviors to flourish. Our brains are inherited from the flourishers.

Unhappy chemicals promote reproductive success too. In nature, females often watch their offspring get eaten alive by predators, and males suffer conflict and rejection in their quest for mates. The bad feeling of cortisol motivates an animal to do what it takes avoid threats and trigger happy chemicals. Bad feelings motivate a mother mammal to guard her child constantly, and search for the nourishment she needs to sustain

her milk. Bad feelings motivate a male mammal to avoid conflicts he's likely to lose, and risk conflicts he's likely to win.

Social alliances promote reproductive success in the state of nature. Mammals with more social allies and more status in their social group tend to have more surviving offspring. Natural selection produced a brain good at social skills as a result. The mammal brain promotes social success by rewarding it with happy chemicals. And if your social standing is threatened, the mammal brain warns you with cortisol because it's a threat to your DNA in the state of nature.

Each happy chemical rewards love in a different way. When you know how each one is linked to reproductive success, the frustrations of life make sense.

Dopamine is stimulated by the "chase" aspect of love. It's also triggered when a baby hears his mother's footsteps. Dopamine alerts us that our needs are about to be met. Female chimpanzees are known to be partial to males who share their meat after a hunt. Females reproduction depends heavily on protein, which is scarce in the rainforest. So opportunities to meet this need trigger lots of dopamine. For humans, finding "the one" makes you high on dopamine because a longer quest to meet a need stimulates a longer surge.

Oxytocin is stimulated by touch, and by social trust. In animals, touch and trust go together. Apes only allow trusted companions to touch them because they know from experience that violence can erupt in an instant. In humans, oxytocin is stimulated by everything from holding hands to feeling supported to orgasm. Holding hands stimulates a small amount of oxytocin, but when repeated over time, as in the case of an elderly couple, it builds up a circuit that easily triggers social

trust. Sex triggers a lot of oxytocin at once, yielding lots of social trust for a very short time. Childbirth triggers a huge oxytocin spurt, both in mother and child. Nurturing other people's children can stimulate it too, as can nurturing adults, depending on the circuits one has built. Friendship bonds stimulate oxytocin, and in the monkey and ape world, research shows that individuals with more social alliances have more reproductive success.

Serotonin is stimulated by the status aspect of love– the pride of associating with a person of a certain stature. You may not think of your own love in this way, but you can easily see it in others. Animals with higher status in their social groups have more "reproductive success," and natural selection created a brain that seeks status by rewarding it with serotonin. This may be hard to believe, but research on huge range of species shows tremendous energy invested in the pursuit of status. Social dominance leads to more mating opportunity and more surviving offspring– and it feels good. We no longer try to survive by having as many offspring as possible, but when you receive the affection of a desirable individual, it triggers lots of serotonin, though you hate to admit it. And when you are the desired individual, receiving admiration from others, that triggers serotonin too. It feels so good that people tend to seek it again and again.

Endorphin is stimulated by physical pain. Crying also stimulates endorphin. If a loved one causes you pain, the endorphin that's released paves neural pathways, wiring you to expect a good feeling from pain in the future. People may tolerate painful relationships because their brain learned to associate it with the good feeling of endorphin. Confusing love

and pain is obviously a bad survival strategy. Roller-coaster relationships are easier to transcend when you understand endorphin.

The sex hormones, like testosterone and estrogen, are central to the feelings we associate with love. They are outside the scope of this book, however, because they do not trigger the feeling of happiness. They mediate specific physical responses instead.

Why did the brain evolve so many different ways to motivate reproductive behavior? Because keeping your DNA alive is harder than you'd think. Survival rates are low in the state of nature, and mating opportunities are harder to come by than you might expect. Your genes got wiped off the face of the earth unless you made a serious effort. Of course, animals don't consciously intend to promote their genes. But every creature alive today has inherited the brain of ancestors who did what it took to reproduce.

There is no free love in nature. Every species has a preliminary qualifying event before mating behavior. Creatures work hard for any mating opportunity that comes their way. In the end, some DNA makes lots of copies of itself, while other DNA disappears without a trace. You may say you don't care about your DNA, but you've inherited a limbic system that does.

Unhappy chemicals creep into your life as you seek love in all its forms. Animal brains release cortisol when their social overtures are disappointed. The bad feeling motivates the brain to "do something." It reminds you that your genes will be annihilated if you don't get busy. You don't need to tell yourself that in words. Natural selection created neurochemicals that give you the message non-verbally.

Losing love triggers a huge surge of unhappy chemical. That actually promotes genetic survival because the pain you associate with the old attachment leaves you available for a new attachment. The brain has trouble ending attachments because the oxytocin pathway is still there. But if you can't break an attachment, your genes are doomed. The pain of lost love re-wires your brain so you can move on. Cortisol promotes love by helping you avoid places where you're not getting it.

Love often disappoints for a subtle reason that's widely overlooked. A young child learns to expect others to meet their needs. Children cannot meet their own needs, so love equals survival to the young brain. Eventually you have to start meeting your own needs. When the expectation of being cared for is disappointed, it can feel like a survival threat. Childhood is a luxury evolved by mammals, but it comes with a painful transition from dependence to independence. Lots of cortisol is triggered as you learn that you cannot trust the world to meet your needs for you. This independence is natural, for a species can only survive if each generation learns to meet its needs without its parents. And if you had parents who were not trustworthy in the first place, you had more cortisol, sooner. The sense of disappointment and loss motivates people to let go of childhood expectations and find love in adult ways. And that keeps our genes alive.

When disappointment in love gives you that bad cortisol feeling, your brain looks for ways to trigger good feelings. There are limitless ways to do that. Sometimes a person seeks a new mating partner, and sometimes a person focuses on nurturing children. Sometimes a person tries to contribute to mankind at large and sometimes a person uses violence to hold

onto their "loved" ones. These behaviors seem very different, but they are all motivated by the expectation of happy chemicals. Expectations depend on the circuits each individual has built from life experience.

In modern times, many people expect romantic love to be part of their life all the time. Expectations were different in the past. Sex created children, and if you lived to middle age, you could expect to be surrounded by grandchildren. But people had the same basic neurochemistry. No matter how you learn to trigger happy chemicals, each burst lasts for a short time and you have to do more to get more. Maybe that's why love songs are always popular. They activate neurochemicals with fewer messy side effects.

Love triggers a cocktail of neurochemicals because it's so highly relevant to survival. But it cannot guarantee non-stop happiness. It feels like it can while you're enjoying the cocktail, however, so your brain may learn to expect that.

The Chapters Ahead

Chapter 1 describes the distinct feeling of each happy chemical. We'll see how dopamine, endorphin, oxytocin, and serotonin evolved to reward specific survival behaviors. And we'll see how rewards create expectations about future rewards.

Chapter 2 explores unhappy chemicals. They get our attention when we face threats. Unhappiness will always be with us because a big-brained social animal can always find potential threats to its prospects. The chapter presents an array of threats that alarm your limbic system without your intellect knowing why.

Chapter 3 shows how disappointment leads to a vicious cycle. Disappointment is inevitable because happy chemicals evolved to alert you to *new* survival information. The same old happy-chemical stimulators don't give you the happiness you expect after a while. But you keep expecting because the pathway is still there. If you respond by repeating the behavior over and over, side effects accumulate. The chapter describes dopamine disappointment, endorphin disappointment, oxytocin disappointment, and serotonin disappointment. The vicious cycle can stop if you build new happy circuits.

Chapter 4 shows how neural circuits develop. Life experience makes permanent physical changes in brain cells. We'll look at five kinds of physical changes, and why they occur more easily in youth. We'll see how repetition and emotion control learning, including social learning.

Chapter 5 presents strategies for building new happy circuits. Repeating a brief thought or action each day for 45 days builds a new superhighway, which relieves dependence on an old vicious cycle. Alternatives for dopamine happiness, endorphin happiness, oxytocin happiness, and serotonin happiness are suggested as a starting point.

Why do people choose to be unhappy rather than build new happy circuits? Chapter 6 explores common thought habits, such as: "I shouldn't have to do that." "It sounds selfish." "I can't lower my standards." "The system has to change first." "I won't be able to do it." Those who refuse to take responsibility for their own happy chemicals often try to make themselves responsible for other people's happy chemicals, and expect others to be responsible for theirs. The chapter explains why this strategy fails.

Chapter 7 addresses the burden of choice. We all have free will because we can use our pre-frontal cortex to inhibit our neurochemical impulses. You can make choices that increase your happiness, but it doesn't happen automatically. It requires a constant weighing of trade-offs between the potential rewards of one course of action and another. We can never predict the outcome of our actions with certainty. This exposes us to uncertainty, disappointment, frustration, and cortisol. Choice brings a huge potential for unhappy chemicals. Since the brain strives to avoid unhappy chemicals, people find ways to avoid choice. One way of doing that is to imagine "a better world" that supplies happiness constantly and eliminates unhappiness. It feels good to imagine your happiness guaranteed, without the pressure of difficult trade-offs. It feels bad to see how the real world falls short of your ideal world. But if you seek happiness by living in an imagined world, you leave your real-world choices to others. The result is disappointment and another vicious cycle. Chapter 7 shows how to break it by accepting the trade-offs and uncertainties inherent in free choice.

The Author's Note at the end of the book provides background about my personal quest for happy chemicals. The Source Note that follows explains why this book is not footnoted. At the end is a collection of postcards displaying the book's core ideas. Color downloads of these postcards are available at no charge at meetyourhappychemicals.com.

And now let's meet the happy chemicals.

1
Meet Your Happy Chemicals

Your feelings are unique, but the molecules that cause your feelings are the same as everyone else's.

Your life experience is unique, but it overlaps with others because each brain focuses on its own survival.

You may not think you're focused on your own survival. Your aim is loftier when you talk to yourself in words. But your happy chemicals respond to improvements in your survival prospects, however you've learned to define them.

Meet Your Dopamine

A marathon runner gets a surge of dopamine when he sees the finish line. A football player is fueled by dopamine as he scores and does a victory dance. "I did it!" the brain tells the body. It feels so good that the brain looks for ways to trigger the feeling again.

Of course, dopamine didn't evolve for crossing arbitrary lines on the ground. It evolved to release energy when you're about to meet a survival need. If an ape climbs a high tree for a delicious mango, dopamine spurts as he nears the reward. That tells his body to release the reserve tank of energy, which helps

him do what it takes to meet his needs. He doesn't say "I did it!" in words, but neurochemicals create that feeling without need for words.

When that ape was young, a bite of mango triggered his dopamine because it's full of survival-enhancing sugar. That paved a circuit which now spurts dopamine as soon as he sees a way to get another mango.

Dopamine helped our ancestors survive by managing their energy. They foraged for food by walking slowly until they saw something that looked promising. That triggered dopamine, and they surged ahead. The mammal brain scans constantly for potential rewards, and dopamine is the signal that it has found some.

Our distant ancestors didn't know where their next meal was coming from. Humans foraged constantly before they learned to store food. They survived by scanning for evidence of food and releasing their energy when something looked promising. Evidence of a reward triggers dopamine, which motivates your body to invest its energy. Even if you are not foraging in the wilderness, you are constantly deciding when it's worth making an effort and when it's better to conserve your effort. Your dopamine circuits guide that decision.

You built those circuits from past dopamine experiences. Imagine a child foraging with his mother. The child sees her get excited when they find a delicious berry patch. Before the child ever tastes a berry, his mother's excitement activates his mirror neurons and he starts triggering dopamine. Then he tastes the berry. Such intense sweetness and flavor are rare in the state of nature, so his neurochemicals tell him "Wow! This meets your needs. Get more of it!" The dopamine surge

connects all the neurons active in his brain at that moment. Those connections enable the child to find berries in the future.

The happy chemical does double duty. It creates a good feeling by unleashing energy, and it stores information that can lead you to the good feeling again. Without effort or intent, dopamine surges build a neural template that responds when you see signs of a reward you've already experienced.

Humans are not born with circuits for finding food the way most animals are. We must build these from experience. Today, we learn to forage for career opportunities, and then we might forage in a cookbook or on the Food Network. But before there were words or maps, people found food because dopamine connected neurons. When something felt good, that feeling wired you to recognize the signs when you seek more of it. Dopamine supplies the road map and the motivation to travel it.

When you taste a berry, you may not get that "Wow!" because the taste is no longer rare. Your brain saves your energy for rewards that are scarce in your life experience. When the first cherries of the season appear, I get a rush of excitement just from looking at them. But my excitement doesn't last. I can't be happy all the time by looking at cherries. My dopamine responds to things more relevant to my survival instead of wasting my energy on things that are easily available.

Social rewards can't be mass produced like sugar and berry flavoring. When you seek and find social rewards, dopamine releases energy. People invest years of effort trying to become a heart surgeon or a rock star because each step along the way triggers dopamine. Even if your goal is committing the perfect crime or living on the beach, your brain releases dopamine as you seek and find markers along the way. Which

social rewards trigger your dopamine depends on the experiences that built your circuits.

Every squirt of dopamine ends, alas, and you only get more when your brain sees another chance to approach a reward.

The fleetingness of dopamine was illuminated by a recent monkey study. The animals were trained to do a task and get rewarded with spinach. After a few days, they were rewarded with squirts of juice instead of spinach. The monkeys' dopamine soared. That seared the information: "This reeeally meets your needs" into their neurons.

The experimenters continued giving the monkeys juice, and in a few days something curious happened. No dopamine spike. The monkeys' brains stopped reacting to rewards that just came on its own. In human terms, they took it for granted.

When there's no new information, there's no need for dopamine. When you need to record new survival rewards or new ways of getting them, your dopamine is there.

This experiment has a dramatic finale. The experimenters switched back to spinach, and the monkeys reacted with fits of rage. They screamed and threw the spinach back at the researchers. They had learned to expect juice, and even though it no longer made them happy, losing it made them mad.

Such research improves our understanding of dopamine significantly. For most of human history, people functioned without scientific knowledge of their neurochemistry. Then in the 1950s, an electrode was inserted into a rat's brain in a spot later held to be its dopamine or reward center. The rat could press a lever that activated the electrode. He seized the day,

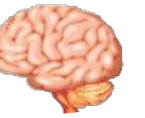
pushing the lever constantly until he dropped dead. He would not stop for food or water or attractive mates. At the time, scientists speculated that the electrode was in his "pleasure center." But why would a brain define pleasure in a way that motivated it to die rather than eat, drink or mate? Many decades of research later, we realize that it's the *expectation* of reward that triggers dopamine. The unfortunate rat kept expecting to get food from the lever because it triggered so much more dopamine than food itself.

Cocaine stimulates more dopamine than normal life. It gives you the thrill of finding berries or finishing a marathon without leaving the couch. You get the excitement of accomplishment without having to accomplish anything.

Mothers have been seen lifting cars when their child is pinned underneath. A huge potential reward triggers a huge surge of dopamine. Saving your child's life is the biggest reward there is from the perspective of your genes. A mother is not consciously thinking of her genes when she risks her life to save her child. She's not thinking at all. Such mothers report they had no idea what they were doing. The verbal part of the brain is not needed for a dopamine circuit to unleash the energy needed to do the job.

The link between dopamine and survival is not always obvious. For example, computer games stimulate dopamine, though they don't meet real needs. Computer games reward you with points that your mind may link to social rewards. You get the points by activating the seek-and-find mechanism that evolved for foraging. Dopamine surges each time you get the reward you seek. If a computer game gave you a good feeling at a time when you were feeling bad, your brain learns that it's a way

to make bad feelings go away. Gaming eliminates survival threats, from the mammal brain's perspective. The next time you feel bad, scoring points on a computer game is one way your brain knows to feel good.

Dopamine experiences	
List examples of the joy of seeking and finding: at work, at play, in yourself and others.	

Your ancestors never stopped seeking. When their bellies were full, they looked for ways to make better arrows and better shelters. They searched for days to find the right materials. It felt good because they anticipated rewards. When they found what they sought it felt good for a moment, and then they went back to seeking. The urge for more did not start with "our society." Life experience teaches you which ways of investing your effort are likely to be rewarded, whether a material reward, a social reward, or the relief of a bad feeling.

If you are studying for a math test, you are fueled by dopamine. You may or may not consider it a "good feeling." But

something in your life experience has connected math skills to other rewards. It could be material rewards, or social rewards, or just the good feeling of getting the right answer. Solving math problems is a seek-and-find activity, even though it's different from foraging. When you find that your answer is correct, you get that "I did it!" feeling, which erases any bad cortisol feelings for that moment. And if your answer is wrong, you may seek the right answer again because you still expect the reward.

Sometimes the reward you expect is another neurochemical. For example, if you expect a hug after washing the dishes, dopamine motivates you to do what it takes to get that oxytocin. If you expect a promotion after working overtime, dopamine keeps you going in expectation of the serotonin.

An athlete spends long hours training in expectation of future rewards. Each small step toward the reward triggers a small amount of dopamine. Scoring points or winning a medal triggers a big burst of dopamine. But trophies and medals are not the reward itself. They are simply evidence that the reward is approaching. An athlete expects more survival-relevant rewards, be it material rewards, or social rewards, or internal rewards, depending on the circuits that athlete has built. Dopamine tells you when to expect a reward, and you invest effort in anticipation of it. The bigger the reward and the closer you get to it, the more of that great dopamine feeling your brain releases.

Meet Your Endorphin

"Euphoria" is the word often used to describe the endorphin feeling. But this neurochemical did not evolve for good times. Physical pain is what triggers endorphin. You may

have experienced this if you took a bad fall and got up thinking you were fine, only to find yourself in pain a little later.

Endorphin masks pain for a short time, which promotes survival by giving an injured mammal a chance to reach safety. If your ancestor broke his leg while hunting, or got worn down by hunger and thirst, the oblivion of endorphin helped him keep doing what it took to save himself.

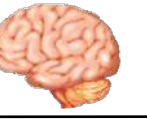
"Runners high" is the well-known endorphin experience. But a regular daily run does not make you "high." You have to push beyond your capacity to the point of distressing your body to get that good feeling. This is not necessarily a good way to promote survival. Endorphin did not evolve to motivate you to inflict pain on yourself. It evolved to help you escape pain.

Perhaps you've seen a zebra wriggle out of the jaws of a lion on a wildlife documentary. You see the zebra run for its life with its flesh ripped open by the lion's teeth. Endorphin masks the pain for a few moments, which helps the zebra escape. If it fails to escape and ends up in the lion's jaw, it will die in an endorphin haze. Nature's euthanasia is nice to know about while you watch disturbing footage of predator devouring prey. Endorphin was not meant for partying but for momentary respite in the brutal struggle for life.

The respite is brief because pain has survival value. Pain is your body's signal that something is urgently wrong. If you ignored pain all the time, you would touch hot stoves and walk on broken legs. You would not make good survival choices if you were always high on endorphin. Masking pain promotes survival in narrow circumstances, but we evolved to notice distress signals, not to mask them with oblivion.

Endorphin is called the body's "natural morphine." The truth is the opposite: morphine is artificial endorphin. Opium derivatives, like heroin, make you high because they fit into the body's natural endorphin receptors.

Laughing triggers a bit of endorphin, and so does crying. The internal convulsions of laughing and crying cause physical distress. The distress is very brief so the burst of endorphin is too. This road to euphoria is limited. Fake laughs don't trigger the internal convulsions, and real laughs only last for seconds. Real cries are painful, and fake cries don't trigger the necessary bodily distress, despite the psychic distress.

Endorphin experiences	
List examples of a good feeling that masks physical pain, in yourself and others.	

Endorphin is different from adrenaline. Skydiving and bungee jumping trigger an "adrenaline high," because you anticipate pain. Adrenaline releases the energy you need to handle an emergency. The "adrenaline junkie" is not seeking

pain– he seeks to avoid pain. The brain anticipates pain when it sees the ground rushing at you, so it releases a lot of adrenaline. When you're on a roller coaster in an amusement park, you tell yourself the threat isn't real. But your brain evolved in a world of real threats, not self-imposed, artificially concocted threats. When it sees lots of threat signals, it releases the adrenaline.

This book does not cover adrenaline because it does not cause happiness. It causes a state of arousal, as if your body is stepping on the gas. Some people get to like that feeling, but it is not a "good for you" signal from your mammal brain's perspective. It is simply a signal that something is extremely relevant to your survival, either good or bad. For example, if you are about to accept the Nobel Prize from the King of Sweden, a spurt of adrenaline tells you that the moment is important. The same spurt would alert you if your parachute didn't open. Adrenaline amplifies the positive or negative message conveyed by the other neurochemicals. It prepares you for immediate action, but it doesn't tell you whether that action should be going toward or running away.

Social pain does not trigger endorphin the way physical pain does, except for a brief laugh or cry. A broken heart doesn't trigger endorphin the way a broken bone does. In the past, daily life held so much physical pain that social pain was secondary. Today, we spend less time suffering the pain of physical labor, predator attack, or deteriorating disease. Our attention is free to focus on the pain of disappointed social expectations. This leaves us feeling that life is more painful even though it's less painful than in the past.

Meet Your Oxytocin

When you have a good feeling about someone, oxytocin causes it. When you feel you can trust a person, or you enjoy their trust in you, oxytocin is flowing. The feeling of belonging, and of safety in numbers, is oxytocin too.

Social trust improves survival prospects, and it feels good. The brain motivates you to build social bonds by rewarding them with a good feeling, and thus promotes survival.

Feeding a horse is a very simple example of the oxytocin feeling. When I walk toward a horse with food in my hand, I am not sure I want to put my fingers near those huge teeth. The horse is not sure he wants a stranger in his face. We check each other out slowly. Each brain is scanning for evidence that it's safe to trust. When both of us are satisfied that the other doesn't pose an immediate threat, we relax, and it feels good. That's the release of oxytocin.

Trust helps a horse survive in a crucial way. By trusting its herd-mates, a horse gets an extended alarm system. Each horse shares the burden of staying alert for predators. The horse that trusts his fellow horse is more likely to survive.

Mammals live in herds and packs and troops because there's safety in numbers. A mammal doesn't consciously decide whether to stick with the herd or strike out on his own when he wakes up each morning. Instead, his brain produces a good feeling near the group, and a bad feeling when separated. Cortisol surges when a herd animal can't see at least one of his group, and oxytocin surges when he's reunited with them.

Mammals leave the group when it promotes reproduction. Young mammals typically transfer to a new troop

at puberty to improve mating opportunities.[1] A mother mammal risks leaving the group to search for a lost child and to give birth. Reproductive behaviors trigger even more oxytocin that mere companionship, which motivates a mammal to leave the group when it's good for his or her genes.

When a female gives birth, her oxytocin surges. This facilitates labor and lactation, and motivates her to guard the newborn constantly. Oxytocin also spikes in the newborn's brain, so a young mammal clings to its mother long before it comprehends the danger of leaving her. Attachment to the mother is the build-up of oxytocin circuits, and over time this attachment transfers to a herd or pack or troop.

Touch triggers oxytocin. Primates are often seen grooming each other, running their fingers through a troop-mate's fur to remove debris. The sensation feels good to both the giver and the receiver thanks to oxytocin. Primates invest lots of time grooming each other, and it appears to establish social alliances. When there's a conflict within a primate troop, monkeys and apes rush to the aid of the individuals they groom with. Researchers find that monkeys and apes with more social alliances get better mating opportunities and have more surviving offspring. The good feeling of oxytocin motivates social grooming and that promotes survival.

The down side of herd behavior is obvious to humans. We worry about jumping over cliffs when the other lemmings jump. We worry about group-think and gangs and co-dependence. Before you dismiss the herd impulse, it's important to understand its value in nature. A solitary mammal

1 Either the males or the females disperse at puberty, depending on the species.

is quickly eaten by a predator. It's hard to stay alert for predators all the time. Sticking with a herd distributes the burden of vigilance among many eyes and ears. To us, it seems foolish to run as soon as a herd-mate runs. But the mammal who refuses to run until he sees the lion for himself is less likely to survive. Brains that refused to trust got weeded out of the gene pool, and natural selection produced a brain that is able to trust its mates.

Reptiles, by contrast, stay alone in their vigilance. A reptile has no warm and fuzzy feelings toward other reptiles. Lizards don't trust other lizards. They have a chemical equivalent of oxytocin, but they only release it during mating and childbirth. Mammals release oxytocin (and variants that differ by an atom or two) more often, and we have lots of oxytocin receptors. Each release of oxytocin links all the neurons firing at the time. We associate the good feeling with those around us, and thus attachment builds.

Attachments make mammals what they are. We care for our young, which make it possible for our young to be born without survival skills. We learn from experience instead of being born pre-programmed. Reptiles, by contrast, strike out on their own the moment they're born. Instead of relying on parental care, a young lizard starts running the instant he hatches from his shell. If he doesn't run fast enough, a parent eats him—the better to recycle the energy into another sibling instead of letting a predator get it. Fish don't even wait for their eggs to hatch. They swim off the moment their eggs are fertilized, to pursue other interests. Plants send their seed into the wind and never find out whether it grows into mighty oaks.

Plants and fish and reptiles survive because they are born with hard-wired survival knowledge. Mammals are born

fragile and stupid, but they learn from experience while under the protection of their elders. Instead of being born with a brain that develops in the safety of the uterus or egg, our brains develop by interacting with the world around us. This wires us to survive in the world we actually live in rather than the world of our ancestors.

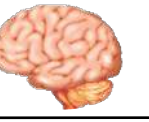
The smaller an animal's brain, the more it survives on pre-wired knowledge. The bigger an animal's brain, the more it incorporates life experience into its survival strategy. A pre-wired brain is good at surviving in a specific ecological niche, and dies quickly outside that niche. A big brain is born ready to make connections rather than with the connections themselves.

The larger a creature's brain, the longer it remains fragile after birth, because it takes time to fill a brain with a network of connections. This creates a survival challenge because fragile newborns are easily eaten by predators. In older species, females gave birth to hundreds or thousands of offspring in order for a few to survive. But that makes it impossible to invest in each one. Mammals developed a very different strategy. We have very few children and do our darnedest to keep every single one alive.

This is a risky reproductive strategy. The more you invest in each child, the more you lose if it dies. Attachment is what makes this strategy possible. Mammalian mothers guard each newborn constantly, and herds help them protect the young from predators. When a mama mammal loses a child, she loses a big chunk of her lifetime reproductive capacity, but oxytocin keeps motivating attachment.

Not long ago, most humans spent their lives in the network of attachments they were born into. Now, many people disparage attachments. Without them, however, we feel like

something is wrong. We don't know what it is, but we long for the place where "everybody knows your name." Or the concert and sports arena where thousands of people share your ups and downs from moment to moment. Or the political group that shares your anger. Or the online forum that welcomes your comments. These things feel good because social trust stimulates oxytocin. Of course, they are only brief moments of trust– small squirts of oxytocin that will soon pass. That's why the brain is always looking for a chance to get more of that oxytocin feeling.

Oxytocin experiences	
List examples of a good feeling triggered by social trust, in yourself and others.	

While trust feels good, betrayed trust feels awful. The bad feeling of disappointed trust motivates mammals to decide carefully when to trust and when to withhold trust. Big-brained primates are choosy about their friends. Instead of all-or-nothing attachment to a group, monkeys and apes have enough neurons to form individualized attachments with troop mates. They

might make an oxytocin link with one social interaction and a cortisol link with the next. Over time, you "know who your friends are" because your neurochemicals react to individuals as "good for your survival" or "bad for your survival."

When you spend time with people, you can't help noticing that social alliances are constantly being negotiated. You may find it annoying when other people do it. But when you do it, you feel like you're just trying to survive. Social alliances transform a bad, threatened feeling into a good, safe feeling, thanks to oxytocin.

Monogamy is rare in the mammal world, except in animals known to have a high level of oxytocin (or its chemical equivalents). Monogamy is common among birds, who also engage in parental care and produce an oxytocin-equivalent. Most mammals form long-term bonds with foraging partners rather than sex partners. This promotes survival. You might have mixed feelings about the people you eat and work with. You might not trust them all the time and even wonder why you put up with them at all. But when you leave them, your oxytocin falls and your mammal brain tells you that something is wrong.

Meet Your Serotonin

Getting respect feels good because it triggers serotonin. The good feeling motivates you to seek more respect, and that promotes survival. You may say you don't care about getting respect, but you can easily see this dynamic in others. In the animal world, getting respect clearly promotes an individual's DNA. They're not thinking about genes, of course. Mammals seek social dominance because serotonin makes it feel good.

In one study, an alpha vervet monkey was placed behind a one-way mirror to deprive him of the respect he usually got from his troop-mates. The mirror was placed so that the alpha could see his troop-mates, but they couldn't see him. He made the dominance gestures typical of his species, but his subordinates did not respond with submission gestures. The alpha got agitated and his serotonin level fell. Each day the experiment continued, his serotonin kept dropping and his agitation grew. He needed their submission to keep up his serotonin.

All living creatures have serotonin, even amoeba. One-celled animals use it in a way that's curiously relevant to us. We humans have more serotonin in our digestive system than we have in our brains. An amoeba is too small for a separate digestive system and nervous system, but it uses serotonin in a way that helps us understand its dual purpose. Serotonin signals the amoeba's body to move toward food, and prepare to receive food. The mechanism is astonishingly simple. An amoeba constantly forages and scans for danger by letting tiny amounts of water pass through its cell membrane. If the water sample shows a high concentration of foreign material, the amoeba interprets that as danger and it wiggles away. If the sample contains a low level of foreign material, the amoeba perceives a feeding opportunity and releases serotonin. The neurochemical causes its digestive juices to flow and its tail to forge a course straight ahead. Serotonin is the amoeba's response to the perception that it's safe to feed.

In mammals, serotonin is the good feeling of having secure access to food or other resources. In a mammalian herd or pack or troop, food and mating opportunities are typically

dominated by stronger individuals. This may seem to conflict with one's pristine view of nature. But close observation of countless species shows that each has its way of competing for resources. When animals cooperate it makes headlines, but much of the time animals are having food fights, battling over mating opportunities, and doing everything and anything to get their kids ahead. Humans strive to curb these impulses, but we've inherited a brain that rewards social dominance with serotonin.

Imagine a piglet born in a litter of sixteen to a mother who has twelve teats. Each piglet struggles for nourishment from the moment of birth. Complex decisions are required. The more a piglet struggles, the more energy it consumes. But without struggle, it starves to death. Serotonin mediates these decisions. Each time a piglet dominates another, it gets a squirt of serotonin. That feels good, which motivates it to dominate again. The more nourishment it gets, the more its dominance-seeking efforts are likely to succeed. If it fails to dominate, its serotonin falls. That also promotes survival by reducing its motivation to dominate, so it spends less energy and survives on the food it has. The ups and the downs of serotonin both promote survival, by balancing energy expenditure with food intake.

If the piglet got seriously malnourished, its cortisol would spike. That would promote survival by triggering aggression. Aggression is different from social dominance because cortisol feels bad while serotonin feels good. Social dominance is the calm, secure feeling that your needs will be met.

When a piglet has enough energy, it strives to dominate a teat. If it succeeds, it starts striving for a better teat– one that's closer to the mother's heart. What makes the top teats better than the hind teats is still being debated by researchers, but farmers have known for centuries that piglets struggle mightily to get a better one.

Mother Pig does not intervene in this conflict. The siblings sort it out for themselves in a few days. Each piglet learns from experience. It builds expectations about which behaviors are likely to bring pain and which are likely to get rewarded. When a piglet sees a safe chance to forge ahead and meet its needs, its serotonin flows.

Nice people don't talk about the competition for resources in nature. In polite society, it's forbidden to acknowledge that social dominance feels good. But everyone has a brain that longs for the good feeling of serotonin. Everyone can see this motivation in others. The point is not that you should push your way to the best teat. The point is that your brain constantly monitors your access to the resources you need to survive. When the access seems secure, you feel good. And then you look for ways to make things more secure.

You may get annoyed when you see others trying to secure their position. But when you do it, you think, "I'm just trying to survive."

Securing resources is complicated when you live in a group. A solitary reptile doesn't worry about what others will do when it finds a piece of food. It just lunges. But if group-living mammals all lunged at a bit of food, some of them would get hurt. The smaller, weaker ones would get hurt. Avoiding injury promotes survival more than any one bit of food. So each brain

monitors those around it and decides whether it's stronger or weaker before it acts on the impulse to eat. When it's weaker, it restrains itself until the other has eaten. When a mammal sees that it's stronger, its serotonin surges and it lunges at the food. It has to eat when it can in order to survive. [2]

Studies "proving" that animals are altruistic often make the news. There's a big demand for evidence that nature is good, and researchers create a supply that meets the demand. In the name of science, hundreds of trials are done, and only the instances that can be construed as altruism are reported. Often, they emerge from artificial situations concocted in a laboratory. When adult animals snatch food from the mouths of juveniles in their daily routine, you don't hear about it in the news.

Young mammals quickly learn to avoid injury by submitting to stronger individuals. Being dominated hurts, and the cortisol it triggers wires a youth to avoid conflict. That may look like "cooperation" to the casual observer, but the animal still wants its chance to eat and reproduce. So it seizes opportunities where it's likely to win without getting injured. I am not saying we should dominate the weak. I am saying each brain is focused on meeting its needs.

Animals can't save money for a rainy day. The only way they can put something aside for the future is to invest today's extra energy into social power that can help them survive tomorrow. That's why each mammalian herd or pack or troop has its status hierarchy. The organization is not conscious, of

2 Males and females seek social dominance in ways that best promote their DNA. In most mammals, a female's reproductive success is best served by behaviors that enhance the survivability of her offspring, while a male's reproductive success is served by maximizing mating opportunities. Within these strategies, male and female brains are still monitoring when their survival needs are best served by dominating and when by submitting.

course. Each individual simply remembers whom they fear and whom they trust, and a hierarchy emerges organically. Cortisol motivates each individual to hunch down in self-defense in the face of a stronger group-mate. And serotonin motivates it to relax and swell its chest swell with pride (or air, depending on how you look at it) when it is strong enough to get respect and meet its needs.

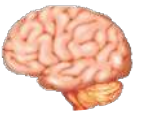
A cow who pushes her way to the center of the herd is safer from predators than a cow near the outer edge. The pushy cow improves her chances of living to reproduce and keeping her young alive. Bulls typically avoid the herd until mating time, when they ferociously battle other males for admission. The most dominant bull pushes his way to the center of the herd, where he meets and inseminates the most dominant cows. In each species, social dominance promotes reproductive success in one way or another. I am not advocating such behavior, but recognizing the effort it takes for humans to restrain these urges.

In the animal world, higher-status males generally get more mating opportunity. Higher-status females tend to be more fertile and their young have higher survival rates. Social dominance brought reproductive success, so brains that seek social dominance were naturally selected for.

Humans learn to restrain the dominance urge because that promotes social trust (oxytocin). Your brain is always trying ways to get more serotonin without losing oxytocin or increasing cortisol. For example, if your comment in a meeting gets respect, that feels good. But if you try to dominate the meeting, unfortunate side effects may catch up with you. Each time you get respect, your brain makes links that help you figure

out how to get more. Each time you lose respect, your brain makes links that help you avoid losing it in the future.

Life experience wires each brain to perceive respect in its own way. If you set your sights on being master of the universe, you may end up feeling disrespected much of the time. Your life may be fine in objective terms, but if you expect continual admiration from others, you may experience a lot of disappointment. Another person might learn to feel satisfied with the respect they are getting from their world, and thus enjoy the calm, secure feeling of serotonin.

Serotonin experiences	
Examples of social respect triggering good feelings, at work, at play, in self and others.	

Social dominance is different from socio-economic status. A person who's #3 on the world billionaire list might feel like his survival is threatened when he falls to #4. By contrast, a person with little socio-economic status could harshly dominate

those around him and feel good about it. Many social dominance strategies are unrelated to formal wealth and status. Appearance is a good example. One person may feel respected for their appearance, while another feels disrespected, even if the two people look the same. Our neurochemicals depend on the expectation circuits we've built.

Anti-depressants, like *Prozac*, are known for raising serotonin levels in the brain. The function of serotonin was not understood when anti-depressants were introduced to the public, in the same way that aspirin was used long before anyone knew how it worked. Now, animal studies offer insight into our neurochemical ups and downs. But these insights are unsettling. The dominance-seeking urges of mammals are not a simple antidote to depression. They are only a window into the value of circuits that trigger self-respect.

Each of the happy chemicals turns on for a specific, survival-relevant reason. Then it turns off so it's ready to react to the next survival opportunity that comes your way. When a happy-chemical spurt ends, unhappy chemicals get your attention. We strive to eliminate unhappy chemicals or at least mask them with happy chemicals. But unhappy chemicals are here to stay. The following chapter explains why.