The *Sunday Times* bestseller

DANIEL LEVITIN

The ORGANIZED MIND

Thinking Straight in the Age of Information Overload

'More insights per page than any other neuroscientist I know . . . smart, important, exquisitely written'
Daniel Gilbert, author of *Stumbling on Happiness*

Contents

ALSO BY DANIEL J. LEVITIN

This Is Your Brain on Music:
The Science of a Human Obsession

The World in Six Songs:
How the Musical Brain Created Human Nature

To my mother and father
for all they taught me

Introduction

Information and Conscientious Organization

We humans have a long history of pursuing neural enhancement—ways to improve the brains that evolution gave us. We train them to become more dependable and efficient allies in helping us to achieve our goals. Law schools, business schools, and medical schools, music conservatories and athletic programs, all strive to harness the latent power of the human brain to deliver ever higher levels of achievement, to provide an edge in a world that is increasingly competitive. Through the sheer force of human ingenuity, we have devised systems to free our brains of clutter, to help us keep track of details that we can't trust ourselves to remember. All of these and other innovations are designed either to improve the brain we have, or to off-load some of its functions to external sources.

One of the biggest advances in neural enhancement occurred only 5,000 years ago, when humans discovered a game-changing way to increase the capacity of the brain's memory and indexing system. The invention of written language has long been celebrated as a breakthrough, but relatively little has been made of what exactly were the first things humans wrote—simple recipes, sales receipts, and business inventories mostly. It was around 3000 BCE that our ancestors began to trade nomadic lifestyles for urban ones, setting up increasingly large cities and centers of commerce. The increased trade in these cities put a strain on individual merchants' memories and so early writing became an important component of recording business transactions. Poetry, histories, war tactics, and instructions for building complex construction projects came later.

Prior to the invention of writing, our ancestors had to rely on memory, sketches, or music to encode and preserve important information. Memory is fallible, of course, but not because of storage limitations so much as *retrieval* limitations. Some neuroscientists believe that nearly every conscious experience is stored somewhere in your brain; the hard part is finding it and pulling it out again. Sometimes the information that comes out is incomplete, distorted, or misleading. Vivid stories that address a very limited and unlikely set of circumstances often pop to mind and overwhelm statistical information based on a large number of observations that would be far more accurate in helping us to make sound decisions about medical treatments, investments, or the trustworthiness of people in our social world. This fondness for stories is just one of many artifacts, side effects of the way our brains work.

It's helpful to understand that our modes of thinking and decision-making evolved over the tens of thousands of years that humans lived as hunter-gatherers. Our genes haven't fully caught up with the demands of modern civilization, but fortunately human knowledge has—we now better understand how to overcome evolutionary limitations. This is the story of how humans have coped with information and organization from the beginning of civilization. It's also the story of how the most successful members of society—from successful artists, athletes, and warriors, to business executives and highly credentialed professionals—have learned to maximize their creativity, and efficiency, by organizing their lives so that they spend less time on the mundane, and more time on the inspiring, comforting, and rewarding things in life.

Cognitive psychologists have provided mountains of evidence over the last twenty years that memory is unreliable. And to make matters worse, we show staggering overconfidence in many recollections that are false. It's not just that we remember things wrongly (which would be bad enough), but we don't even *know* and women are usually found riding both in and on it, that it is one of only a small subset of motor vehicles that carries a ladder around.

If you just started thinking, at the end of that last sentence, what *other* vehicles carry ladders (for example, telephone company repair trucks or the vans belonging to window installers, roofers, and chimney sweeps), then you have come upon an important point: We can categorize objects in many, and often seemingly infinite, ways. And any one of those cues has its own route to the neural node that represents *fire truck* in your brain.

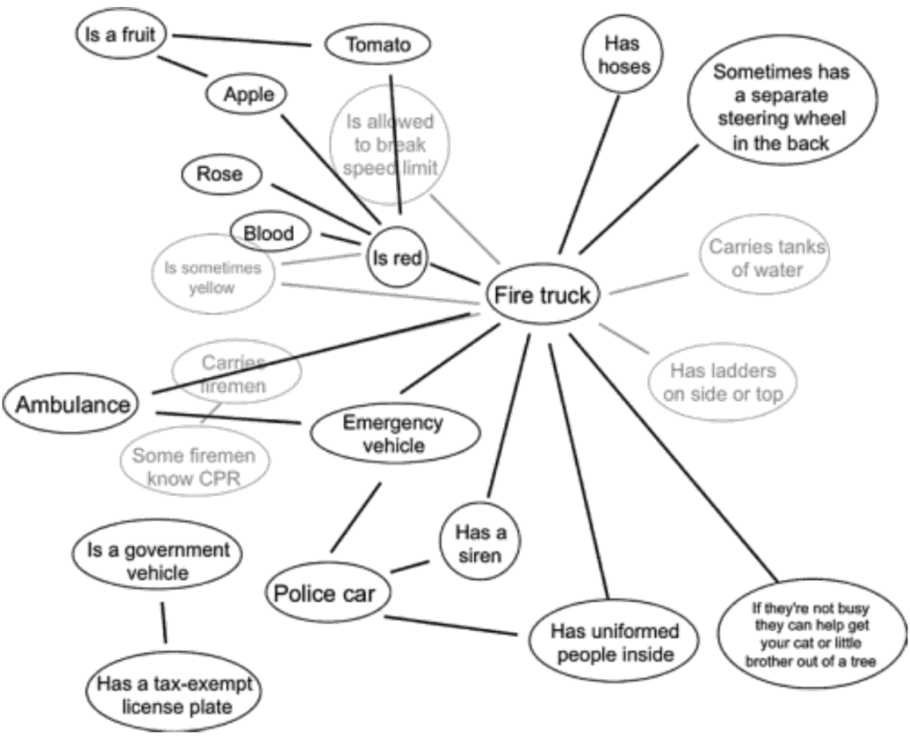
The concept of *fire truck* is represented in the picture (opposite) by a circle in the center—a node corresponding to a cluster of neurons in the brain. That neuronal cluster is connected to other neuronal clusters that represent the different features or properties of *fire truck.* In the drawing, other concepts that are most closely associated with a fire truck, and are retrieved from memory more quickly, are shown closer to the fire truck node. (In the brain, they may not actually be physically closer, but the neural connections are stronger, allowing for easier retrieval.) Thus, the node containing the fact that a fire truck is red is closer than the one that says it sometimes has a separate steering wheel in the back.

In addition to neural networks in the brain that represent attributes of things, those attributes are also connected associatively to other things. A fire truck is red, but we can think of many other things that are: cherries, tomatoes, apples, blood, roses, parts of the American flag, and Sun-Maid raisin boxes, for example. Did you ever wonder why, if someone asks you to name a bunch of red things, you can do it so quickly? It's because by concentrating on the thought *red,* represented here by a neural node, you're sending electrochemical activation through the network and down the branches to everything else in your brain that connects to it. Below, I've overlaid additional information that resides in a typical neural network that begins with *fire truck*

—nodes for other things that are red, for other things that have a siren, and so forth.

Thinking about one memory tends to activate other memories. This can be both an advantage and a disadvantage. If you are trying to retrieve a particular memory, the flood of activations can cause competition among different nodes, leaving you with a traffic jam of neural nodes trying to get through to consciousness, and you end up with nothing.

The ancient Greeks sought to improve memory through brain training methods such as memory palaces and the method of loci. At the same time, they and the Egyptians became experts at externalizing information, inventing the modern library, a grand repository for externalized knowledge. We don't know why these simultaneous explosions of intellectual activity occurred when they did (perhaps daily human experience had hit a certain level of complexity). But the human need to organize our lives, our environment, even our thoughts, remains strong. This need isn't simply learned, it is a biological imperative—animals organize their environments instinctively. Most mammals are biologically programmed to put their digestive waste away from where they eat and sleep. Dogs have been known to collect their toys and put them in baskets; ants carry off dead members of the colony to burial grounds; certain birds and rodents create symmetrically organized barriers around their nests in order to more easily detect intruders.



A key to understanding the organized mind is to recognize that on its own, it doesn't organize things the way you might want it to. It comes preconfigured, and although it has enormous flexibility, it is built on a system that evolved over hundreds of thousands of years to deal with different kinds and different amounts of information than we have today. To be more specific:

The brain isn't organized the way you might set up your home office or bathroom medicine cabinet. You can't just put things anywhere you want to. The evolved architecture of the brain is haphazard and disjointed, and incorporates multiple systems, each of which has a mind of its own (so to speak). Evolution doesn't *design* things and it doesn't build systems—it *settles on* systems that, historically, conveyed a survival benefit (and if a better way comes along, it will adopt that). There is no overarching, grand planner engineering the systems so that they work harmoniously together. The brain is more like a big, old house with piecemeal renovations done on every floor, and less like new construction.

Consider this, then, as an analogy: You have an old house and everything is a bit outdated, but you're satisfied. You add a room air conditioner during one particularly hot summer. A few years later, when you have more money, you decide to add a central air-conditioning system. But you don't remove that room unit in the bedroom—why would you? It might come in handy and it's already there, bolted to the wall. Then a few years later, you have a catastrophic plumbing problem—pipes burst in the walls. The plumbers need to break open the walls and run new pipes, but your central air-conditioning system is now in the way, where some of their pipes would ideally go. So they run the pipes through the attic, the long way around. This works fine until one particularly cold winter when your uninsulated attic causes your pipes to freeze. These pipes wouldn't have frozen if you had run them through the walls, which you couldn't do because of the central air-conditioning. If you had planned all this from the start, you would have done things differently, but you didn't—you added things one thing at a time, as and when you needed them.

Evolution has built our brain in much the same way. Of course, evolution has no will, no plan. Evolution didn't *decide* to give you memory for where you put things. Your *place memory* system came about gradually, through the processes of descent with modification and natural selection, and it evolved separately from your memory for facts and figures. The two systems might come to work together through further evolutionary processes, but they are not necessarily going to do so, and in some cases, they may be in conflict with each other.

It might be helpful to learn *how* our brain organizes information so that we can use what we have, rather than fight against it. It is built as a hodgepodge of different systems, each one solving a particular adaptive problem. Occasionally they work together, occasionally they're in conflict, and occasionally they aren't even talking to one another. Two of the key ways that we can control and improve the process are to pay special attention to the way we enter information into our memory—*encoding*—and the way we pull it out—*retrieval*. This will be unpacked in Chapters 2 and 3.

The need for taking charge of our attentional and memory systems has never been greater. Our brains are busier than ever before. We're assaulted with facts, pseudo facts, jibber-jabber, and rumor, all posing as information. Trying to figure out what you need to know and what you can ignore is exhausting, and at the same time, we are all doing more. Consequently, trying to find the time to schedule all our various activities has become a tremendous challenge. Thirty years ago, travel agents made our airline and rail reservations, salesclerks helped us find what we were looking for in stores, and professional typists or secretaries helped busy people with their correspondence. Now we do most of those things ourselves. The information age has off-loaded a great deal of the work previously done by people we could call information specialists onto all of the rest of us. We are doing the jobs of ten different people while still trying to keep up with our lives, our children and parents, our friends, our careers, our hobbies, and our favorite TV shows. It's no wonder that sometimes one memory gets confounded with another, leading us to show up in the right place but on the wrong day, or to we interact with them, the various biases and *mis*information we bring to those relationships, along with how to overcome them. Amos, with his colleague Daniel Kahneman (who won the Nobel Prize for their work together a few years after Amos passed away), uncovered a host of systematic errors in the way the human brain evaluates evidence and processes information. I've been teaching these to university undergraduates for twenty years, and my students have helped me to come up with ways to explain these errors so that all of us can easily improve our decision-making. The stakes are particularly high in medical decision-making, where the wrong decision has immediate and very serious consequences. It is now well documented that most MDs don't encounter these simple rules as a part of their training, don't understand statistical reasoning. The result can be muddled advice. Such advice could lead you to take medications or undergo surgeries that have a very small statistical chance of making you any better, and a relatively large statistical chance of making you worse. (Chapter 6 is devoted to this topic.)

We are all faced with an unprecedented amount of information to remember, and small objects to keep track of. In this age of iPods and thumb drives, when your smartphone can record video, browse 200 million websites, and tell you how many calories are in that cranberry scone, most of us still try to keep track of things using the systems that were put in place in a precomputerized era. There is definitely room for improvement. The dominant metaphor for the computer is based on a 1950s *Mad Men*–era strategy for organization: a desktop with folders on it, and files inside of those. Even the word *computer* is outdated now that most people don't use their computer to compute anything at all—rather, it has become just like that big disorganized drawer everyone has in their kitchen, what in my family we called the junk drawer. I went to a friend's house the other day, and here is what I found in *his* junk drawer (all I had to do was ask, “Do you have a drawer that you just throw things in when you don’t know where else to put them?”):

batteries

rubber bands

shish kebab skewers

string

twist ties

photos

thirty-seven cents in change

an empty DVD case

a DVD without a case (unfortunately, not the same one)

orange plastic covers to put over his smoke detector if he ever decides to paint the kitchen, because the paint fumes can set off the detector

matches

three wood screws of various sizes, one with stripped threads

a plastic fork

a special wrench that came with the garbage disposal; he isn’t sure what it is for

two ticket stubs from a Dave Matthews Band concert last summer

two keys that have been around for at least ten years, and no one in the house knows what they are for (but they are afraid to throw them away)

two pens, neither of which writes

a half dozen other things that he has no idea what they are for but is afraid to throw out

Our computers are *just like that* but thousands of times more disorganized. We have files we don’t know about, others that appeared mysteriously by accident when we read an e-mail, and multiple versions of the same document; it’s often difficult to tell which is the most current. Our “computing machine” has become a large, inglorious, and fantastically disorganized kitchen drawer full of electronic files, some of indeterminate origin or function. My assistant let me have a look at her computer, and a partial inventory revealed the following contents, typical, I've found, of what many people have on their computers:

photographs

videos

music

screen savers of cats wearing party hats, or smiling pigs with human mouths Photoshopped in

tax documents

travel arrangements

correspondence

checking account registers

games

appointment books

articles to read

various forms related to employment: request for time off, quarterly report, sick day accounting, request for retirement fund payroll deduction

an archived copy of this book (in case I lose mine)

dozens of lists—lists of area restaurants, university-approved hotels, office locations and phone numbers for members of the department, an emergency telephone tree, safety procedures in the event of various calamities, protocol for disposing of obsolete equipment, and so on

software updates

old versions of software that no longer work

dozens of files of foreign-language keyboard layouts and fonts in case she ever needs to type Romanian, Czech, Japanese, or ancient or modern Hebrew characters

little electronic "Post-its" reminding her where important files are located, or how to do certain things (like create a new Post-it, delete a Post-it, or change the color of a Post-it)

It's a wonder we don't lose more.

Of course, some of us are more organized than others. From the many thousands of ways that individuals differ from one another, a mathematical model can be constructed that accounts for a great deal of variation, organizing human differences into five categories:

extroversion

agreeableness

neuroticism

openness to new experience

conscientiousness

Of these five, the conscientiousness trait of being organized is most highly associated with conscientiousness. Conscientiousness comprises industriousness, self-control, stick-to-itiveness, and a desire for order. And it, in turn, is the best predictor of many important human outcomes, including mortality, longevity, educational attainment, and a host of criteria related to career success. Conscientiousness is associated with better recovery outcomes following surgery and transplants. Conscientiousness in early childhood is associated with positive outcomes decades later. Taken together, the evidence suggests that as societies become more Westernized and complex, conscientiousness becomes more and more important.

The cognitive neuroscience of memory and attention—our improved understanding of the brain, its evolution and limitations—can help us to better cope with a world in which more and more of us feel we're running fast just to stand still. The average American is sleep-deprived, overstressed, and not making enough time for things she wants to do. I think we can do better. Some of us are doing better and I've had the opportunity to talk to them. Personal assistants to Fortune 500 CEOs and to other high achievers keep their bosses working at full capacity while still finding them time for fun and relaxation. They and their bosses don't get bogged down by information overload because they benefit from the technology of organization, some of it new, some of it quite old. Some of their systems will sound familiar, some may not, still others are incredibly nuanced and subtle; nevertheless, they all can make a profound difference.

There is no one system that will work for everyone—we are each unique—but in the following chapters are general principles that anyone can apply *in their own way* to recapture a sense of order, and to regain the hours of lost time spent trying to overcome the disorganized mind.

"Yes, finally. But it's impossible to know which is best. Now ..." her voice trailed off.

"Is there a problem with the apartment?"

"No, the apartment is fine. But today is my fourth time in the bookstore. Look! An entire *row* full of pens. In Romania, we had three kinds of pens. And many times there was a shortage—no pens at all. In America, there are more than fifty different kinds. Which one do I need for my biology class? Which one for poetry? Do I want felt tip, ink, gel, cartridge, erasable? Ballpoint, razor point, roller ball? One hour I am here reading labels."

Every day, we are confronted with dozens of decisions, most of which we would characterize as insignificant or unimportant—whether to put on our left sock first or our right, whether to take the bus or the subway to work, what to eat, where to shop. We get a taste of Ioana's disorientation when we travel, not only to other countries but even to other states. The stores are different, the products are different. Most of us have adopted a strategy to get along called *satisficing,* a term coined by the Nobel Prize winner Herbert Simon, one of the founders of the fields of organization theory and information processing. Simon wanted a word to describe not getting the very best option but one that was good enough. For things that don't matter critically, we make a choice that satisfies us and is deemed sufficient. You don't really know if your dry cleaner is *the best*—you only know that they're good enough. And that's what helps you get by. You don't have time to sample all the dry cleaners within a twenty-four-block radius of your home. Does Dean & DeLuca really have the best gourmet takeout? It doesn't matter—it's good enough. Satisficing is one of the foundations of productive human behavior; it prevails when we don't waste time on decisions that don't matter, or more accurately, when we don't waste time trying to find improvements that are not going to make a significant difference in our happiness or satisfaction.

All of us engage in satisficing every time we clean our homes. If we got down on the floor with a toothbrush every day to clean the grout, if we scrubbed the windows and walls every single day, the house would be spotless. But few of us go to this much trouble even on a weekly basis (and when we do, we're likely to be labeled obsessive-compulsive). For most of us, we clean our houses until they are clean enough, reaching a kind of equilibrium between effort and benefit. It is this cost-benefits analysis that is at the heart of satisficing (Simon was also a respected economist).

Recent research in social psychology has shown that happy people are not people who have more; rather, they are people who are happy with what they already have. Happy people engage in satisficing *all of the time*, even if they don't know it. Warren Buffett can be seen as embracing satisficing to an extreme—one of the richest men in the world, he lives in Omaha, a block from the highway, in the same modest home he has lived in for fifty years. He once told a radio interviewer that for breakfasts during his weeklong visit to New York City, he'd bought himself a gallon of milk and a box of Oreo cookies. But Buffett does not satisfice with his investment strategies; satisficing is a tool for not wasting time on things that are not your highest priority. For your high-priority endeavors, the old-fashioned pursuit of excellence remains the right strategy. Do you want your surgeon or your airplane mechanic or the director of a $100 million feature film to do *just good enough* or do the best they possibly can? Sometimes you want more than Oreos and milk.

Part of my Romanian student's despondency could be chalked up to culture shock—to the loss of the familiar, and immersion in the unfamiliar. But she's not alone. The past generation has seen an explosion of choices facing consumers. In 1976, the average supermarket stocked 9,000 unique products; today that number has ballooned to 40,000 of them, yet the average person gets 80%–85% of their needs in only 150 different supermarket items. That means that we need to ignore 39,850 items in the store. And that's just supermarkets—it's been estimated that there are over one million products in the United States today (based on SKUs, or *stock-keeping units*, those little bar codes on things we buy).

All this ignoring and deciding comes with a cost. Neuroscientists have discovered that unproductivity and loss of drive can result from *decision overload.* Although most of us have no trouble ranking the importance of decisions if asked to do so, our brains don't automatically do this. Ioana knew that keeping up with her coursework was more important than what pen to buy, but the mere situation of facing so many trivial decisions in daily life created neural fatigue, leaving no energy for the important decisions. Recent research shows that people who were asked to make a series of meaningless decisions of just this type—for example, whether to write with a ballpoint pen or a felt-tip pen—showed poorer impulse control and lack of judgment about subsequent decisions. It's as though our brains are configured to make a certain number of decisions per day and once we reach that limit, we can't make any more, regardless of how important they are. One of the most useful findings in recent neuroscience could be summed up as: *The decision-making network in our brain doesn't prioritize.*

Today, we are confronted with an unprecedented amount of information, and each of us generates more information than ever before in human history. As former Boeing scientist and *New York Times* writer Dennis Overbye notes, this information stream contains "more and more information about our lives—where we shop and what we buy, indeed, where we are right now—the economy, the genomes of countless organisms we can't even name yet, galaxies full of stars we haven't counted, traffic jams in Singapore and the weather on Mars." That information "tumbles faster and faster through bigger and bigger computers down to everybody's fingertips, which are holding devices with more processing power than the Apollo mission control." Information scientists have quantified all this: In 2011, Americans took in five times as much information every day as they did in 1986—the equivalent of 175 newspapers. During our leisure time, not counting work, each of us processes 34 gigabytes or 100,000 words every day. The world's 21,274 television stations produce 85,000 hours of original programming every day as we watch an average of 5 hours of television each day, the equivalent of 20 gigabytes of audio-video images. That's not counting YouTube, which uploads 6,000 hours of video every hour. And computer gaming? It consumes more bytes than all other media put together, including DVDs, TV, books, magazines, and the Internet.

Just trying to keep our own media and electronic files organized can be overwhelming. Each of us has the equivalent of over half a million books stored on our computers, not to mention all the information stored in our cell phones or in the magnetic stripe on the back of our credit cards. We have created a world with 300 exabytes (300,000,000,000,000,000,000 pieces) of human-made information. If each of those pieces of information were written on a 3 x 5 index card and then spread out side by side, just one person's share—*your* share of this information—would cover every square inch of Massachusetts and Connecticut combined.

Our brains do have the ability to process the information we take in, but at a cost: We can have trouble separating the trivial from the important, and all this information processing makes us tired. Neurons are living cells with a metabolism; they need oxygen and glucose to survive and when they've been working hard, we experience fatigue. Every status update you read on Facebook, every tweet or text message you get from a friend, is competing for resources in your brain with important things like whether to put your savings in stocks or bonds, where you left your passport, or how best to reconcile with a close friend you just had an argument with.

The processing capacity of the conscious mind has been estimated at 120 bits per second. That bandwidth, or window, is the speed limit for the traffic of information we can pay conscious attention to at any one time. While a great deal occurs below the threshold of our awareness, and this has an impact on how we feel and what our life is going to be like, in order for something to become encoded as part of your experience, you need to have paid conscious attention to it.

What does this bandwidth restriction—this information speed limit—mean in terms of our interactions with others? In order to understand one person speaking to us, we need to process 60 bits of information per second. With a processing limit of 120 bits per second, this means you can barely understand two people talking to you at the same time. Under most circumstances, you will not be able to understand three people talking at the same time. We're surrounded on this planet by billions of other humans, but we can understand only two at a time at the most! It's no wonder that the world is filled with so much misunderstanding.

With such attentional restrictions, it's clear why many of us feel overwhelmed by managing some of the most basic aspects of life. Part of the reason is that our brains evolved to help us deal with life during the hunter-gatherer phase of human history, a time when we might encounter no more than a thousand people across the entire span of our lifetime. Walking around midtown Manhattan, you'll pass that number of people in half an hour.

Attention is the most essential mental resource for any organism. It determines which aspects of the environment we deal with, and most of the time, various automatic, subconscious processes make the correct choice about what gets passed through to our conscious awareness. For this to happen, millions of neurons are constantly monitoring the environment to select the most important things for us to focus on. These neurons are collectively the *attentional filter*. They work largely in the background, outside of our conscious awareness. This is why most of the perceptual detritus of our daily lives doesn't register, or why, when you've been driving on the freeway for several hours at a stretch, you don't remember much of the scenery that has whizzed by: Your attentional system "protects" you from registering it because it isn't deemed important. This calm and preventing us from being in the here and now: Did I turn off the stove? What will I do for lunch? When do I need to leave here in order to get to where I need to be next?

What if you could rely on others in your life to handle these things and you could narrow your attentional filter to that which is right before you, happening right now? I met Jimmy Carter when he was campaigning for president and he spoke as though we had all the time in the world. At one point, an aide came to take him off to the next person he needed to meet. Free from having to decide when the meeting would end, or any other mundane care, really, President Carter could let go of those inner nagging voices and be *there.* A professional musician friend who headlines big stadiums constantly and has a phalanx of assistants describes this state as being "happily lost." He doesn't need to look at his calendar more than a day in advance, allowing each day to be filled with wonder and possibility.

If we organize our minds and our lives following the new neuroscience of attention and memory, we can all deal with the world in ways that provide the sense of freedom that these HSPs enjoy. How can we actually leverage this science in everyday life? To begin with, by understanding the architecture of our attentional system. To better organize our mind, we need to know how it has organized itself.

Two of the most crucial principles used by the attentional filter are *change* and *importance.* The brain is an exquisite change detector: If you're driving and suddenly the road feels bumpy, your brain notices this change immediately and signals your attentional system to focus on the change. How does this happen? Neural circuits are noticing the smoothness of the road, the way it sounds, the way it feels against your rear end, back, and feet, and other parts of your body that are in contact with the car, and the way your visual field is smooth and continuous. After a few minutes of the same sounds, feel, and overall look, your conscious brain relaxes and lets the attentional filter take over. This frees you up to do other things, such as carry on a conversation or listen to the radio, or both. But with the slightest change—a low tire, bumps in the road—your attentional system pushes the new information up to your consciousness so that you can focus on the change and take appropriate action. Your eyes may scan the road and discover drainage ridges in the asphalt that account for the rough ride. Having found a satisfactory explanation, you relax again, pushing this sensory decision-making back down to lower levels of consciousness. If the road seems visually smooth and you can't otherwise account for the rough ride, you might decide to pull over and examine your tires.

The brain's change detector is at work all the time, whether you know it or not. If a close friend or relative calls on the phone, you might detect that her voice sounds different and ask if she's congested or sick with the flu. When your brain detects the change, this information is sent to your consciousness, but your brain doesn't explicitly send a message when there is no change. If your friend calls and her voice sounds normal, you don't immediately think, "Oh, her voice is the same as always." Again, this is the attentional filter doing its job, detecting change, not constancy.

The second principle, importance, can also let information through. Here, importance is not just something that is objectively important but something that is personally important to you. If you're driving, a billboard for your favorite music group might catch your eye (really, we should say catch your *mind*) while other billboards go ignored. If you're in a crowded room, at a party for instance, certain words to which you attach high importance might suddenly catch your attention, even if spoken from across the room. If someone says "fire" or "sex" or your own name, you'll find that you're suddenly following a conversation far away from where you're standing, with no awareness of what those people were talking about before your attention was captured. The attentional filter is thus fairly sophisticated. It is capable of monitoring lots of different conversations as well as their semantic content, letting through only those that it thinks you will want to know about.

Due to the attentional filter, we end up experiencing a great deal of the world on autopilot, not registering the complexities, nuances, and often the beauty of what is right in front of us. A great number of failures of attention occur because we are not using these two principles to our advantage.

A critical point that bears repeating is that attention is a limited-capacity resource—there are definite limits to the number of things we can attend to at once. We see this in everyday activities. If you're driving, under most circumstances, you can play the radio or carry on a conversation with someone else in the car. But if you're looking for a particular street to turn onto, you instinctively turn down the radio or ask your friend to hang on for a moment, to stop talking. This is because you've reached the limits of your attention in trying to do these three things. The limits show up whenever we try to do too many things at once. How many times has something like the following happened to you? You've just come home from grocery shopping, one bag in each hand. You've balanced them sufficiently to unlock the front door, and as you walk in, you hear the phone ringing. You need to put down the grocery bags in your hands, answer the phone, perhaps being careful not to let the dog or cat out the open door. When the phone call is over, you realize you don't know where your keys are. Why? Because keeping track of *them*, too, is more things than your attentional system could handle.

The human brain has evolved to hide from us those things we are not paying attention to. In other words, we often have a cognitive blind spot: We don't know what we're missing because our brain can completely ignore things that are not its priority at the moment—even if they are right in front of our eyes. Cognitive psychologists have called this blind spot various names, including *inattentional blindness.* One of the most amazing demonstrations of it is known as the basketball demo. If you haven't seen it, I urge you to put this book down and view it now before reading any further. The video can be seen here: http://www.youtube.com/watch?v=vJG698U2Mvo. Your job is to count how many times the players wearing the white T-shirts pass the basketball, while ignoring the players in the black T-shirts.

(Spoiler alert: If you haven't seen the video yet, reading the next paragraph will mean that the illusion won't work for you.) The video comes from a psychological study of attention by Christopher Chabris and Daniel Simons. Because of the processing limits of your attentional system that I've just described, following the basketball and the passing, and keeping a mental tally of the passes, takes up most of the attentional resources of the average person. The rest are taken up by trying to ignore the players in the black T-shirts and to ignore the basketball they are passing. At some point in the video, a man in a gorilla suit walks into the middle of things, bangs his chest, and then walks off. The majority of the people watching this video don't see the gorilla. The reason? The attentional system is simply overloaded. If I had *not* asked you to count the basketball passes, you would have seen the gorilla.

A lot of instances of losing things like car keys, passports, money, receipts, and so on occur because our attentional systems are overloaded and they simply *can't* keep track of everything. The average American owns thousands of times more possessions than the average hunter-gatherer. In a real biological sense, we have more things to keep track of than our brains were designed to handle. Even towering intellectuals such as Kant and Wordsworth complained of information excess and sheer mental exhaustion induced by too much sensory input or mental overload. This is no reason to lose hope, though! More than ever, effective *external* systems are available for organizing, categorizing, and keeping track of things. In the past, the only option was a string of human assistants. But now, in the age of automation, there are other options. The first part of this book is about the biology underlying the use of these external systems. The second and third parts show how we can all use them to better keep track of our lives, to be efficient, productive, happy, and less stressed in a wired world that is increasingly filled with distractions.

Productivity and efficiency depend on systems that help us organize through categorization. The drive to categorize developed in the prehistoric wiring of our brains, in specialized neural systems that create and maintain meaningful, coherent amalgamations of things—foods, animals, tools, tribe members—in coherent categories. Fundamentally, categorization reduces mental effort and streamlines the flow of information. We are not the first generation of humans to be complaining about too much information.

Information Overload, Then and Now

Humans have been around for 200,000 years. For the first 99% of our history, we didn't do much of anything but procreate and survive. This was largely due to harsh global climatic conditions, which stabilized sometime around 10,000 years ago. People soon thereafter discovered farming and irrigation, and they gave up their nomadic lifestyle in order to cultivate and tend stable crops. But not all farm plots are the same; regional variations in sunshine, soil, and other conditions meant that one farmer might grow particularly good onions while another grew especially good apples. This eventually led to specialization; instead of growing all the crops for his own family, a farmer might grow only what he was best at and trade some of it for things he wasn't growing. Because each farmer was producing only one crop, and more than he needed, marketplaces and trading emerged and grew, and with them came the establishment of cities.

The Sumerian city of Uruk (~5000 BCE) was one of the world's earliest large cities. Its active commercial trade created an unprecedented volume of business transactions, and Sumerian

With the Industrial Revolution and the rise of science, new discoveries grew at an enormous clip. For example, in 1550, there were 500 known plant species in the world. By 1623, this number had increased to 6,000. Today, we know 9,000 species of grasses alone, 2,700 types of palm trees, 500,000 different plant species. And the numbers keep growing. The increase of scientific information alone is staggering. Just three hundred years ago, someone with a college degree in "science" knew about as much as any expert of the day. Today, someone with a PhD in biology can't even know all that is known about the nervous system of the squid! Google Scholar reports 30,000 research articles on that topic, with the number increasing exponentially. By the time you read this, the number will have increased by at least 3,000. The amount of scientific information we've discovered in the last twenty years is more than all the discoveries up to that point, from the beginning of language.

Five exabytes (5×10^{18}) of *new* data were produced in January 2012 alone—that's 50,000 times the number of words in the entire Library of Congress.

This information explosion is taxing all of us, every day, as we struggle to come to grips with what we really need to know and what we don't. We take notes, make To Do lists, leave reminders for ourselves in e-mail and on cell phones, and we still end up feeling overwhelmed.

A large part of this feeling of being overwhelmed can be traced back to our evolutionarily outdated attentional system. I mentioned earlier the two principles of the attentional filter: change and importance. There is a third principle of attention—not specific to the attentional filter—that is relevant now more than ever. It has to do with the difficulty of *attentional switching.* We can state the principle this way: Switching attention comes with a high cost.

Our brains evolved to focus on one thing at a time. This enabled our ancestors to hunt animals, to create and fashion tools, to protect their clan from predators and invading neighbors. The attentional filter evolved to help us to stay on task, letting through only information that was important enough to deserve disrupting our train of thought. But a funny thing happened on the way to the twenty-first century: The plethora of information and the technologies that serve it changed the way we use our brains. Multitasking is the enemy of a focused attentional system. Increasingly, we demand that our attentional system try to focus on several things at once, something that it was not evolved to do. We talk on the phone while we're driving, listening to the radio, looking for a parking place, planning our mom's birthday party, trying to avoid the road construction signs, and thinking about what's for lunch. We can't truly think about or attend to all these things at once, so our brains flit from one to the other, each time with a neurobiological switching cost. The system does not function well that way. Once on a task, our brains function best if we stick to that task.

To pay attention to one thing means that we *don't* pay attention to something else. *Attention is a limited-capacity resource.* When you focused on the white T-shirts in the basketball video, you filtered out the black T-shirts and, in fact, most other things that were black, including the gorilla. When we focus on a conversation we're having, we tune out other conversations. When we're just walking in the front door, thinking about who might be on the other end of that ringing telephone line, we're not thinking about where we put our car keys.

Attention is created by networks of neurons in the prefrontal cortex (just behind your forehead) that are sensitive only to dopamine. When dopamine is released, it unlocks them, like a key in your front door, and they start firing tiny electrical impulses that stimulate other neurons in their network. But what causes that initial release of dopamine? Typically, one of two different triggers:

1. Something can grab your attention automatically, usually something that is salient to your survival, with evolutionary origins. This *vigilance* system incorporating the attentional filter is always at work, even when you're asleep, monitoring the environment for important events. This can be a loud sound or bright light (the startle reflex), something moving quickly (that might indicate a predator), a beverage when you're thirsty, or an attractively shaped potential sexual partner.
2. You effectively *will* yourself to focus only on that which is relevant to a search or scan of the environment. This deliberate filtering has been shown in the laboratory to actually change the sensitivity of neurons in the brain. If you're trying to find your lost daughter at the state fair, your visual system reconfigures to look only for things of about her height, hair color, and body build, filtering everything else out. Simultaneously, your auditory system retunes itself to hear only frequencies in that band where her voice registers. You could call it the *Where's Waldo?* filtering network.

In the *Where's Waldo?* children's books, a boy named Waldo wears a red-and-white horizontally striped shirt, and he's typically placed in a crowded picture with many people and objects drawn in many colors. In the version for young children, Waldo might be the only red thing in the picture; the young child's attentional filter can quickly scan the picture and land on the red object—Waldo. Waldo puzzles for older age groups become increasingly difficult—the distractors are solid red and solid white T-shirts, or shirts with stripes in different colors, or red-and-white vertical stripes rather than horizontal.

Where's Waldo? puzzles exploit the neuroarchitecture of the primate visual system. Inside the occipital lobe, a region called the visual cortex contains populations of neurons that respond only to certain colors—one population fires an electrical signal in response to red objects, another to green, and so on. Then, a separate population of neurons is sensitive to horizontal stripes as distinct from vertical stripes, and within the horizontal stripes neurons, some are maximally responsive to wide stripes and some to narrow stripes.

If only you could send instructions to these different neuron populations, telling some of them when you need them to stand up straight and do your bidding, while telling the others to sit back and relax. Well, you can—this is what we do when we try to find Waldo, search for a missing scarf or wallet, or watch the basketball video. We bring to mind a mental image of what we're looking for, and neurons in the visual cortex help us to imagine in our mind's eye what the object looks like. If it has red in it, our red-sensitive neurons are involved in the imagining. They then automatically tune themselves, and inhibit other neurons (the ones for the colors you're not interested in) to facilitate the search. *Where's Waldo?* trains children to set and exercise their visual attentional filters to locate increasingly subtle cues in the environment, much as our ancestors might have trained their children to track animals through the forest, starting with easy-to-see and easy-to-differentiate animals and working up to camouflaging animals that are more difficult to pick out from the surrounding environment. The system also works for auditory filtering—if we are expecting a particular pitch or timbre in a sound, our auditory neurons become selectively tuned to those characteristics.

When we willfully retune sensory neurons in this way, our brains engage in top-down processing, originating in a higher, more advanced part of the brain than sensory processing.

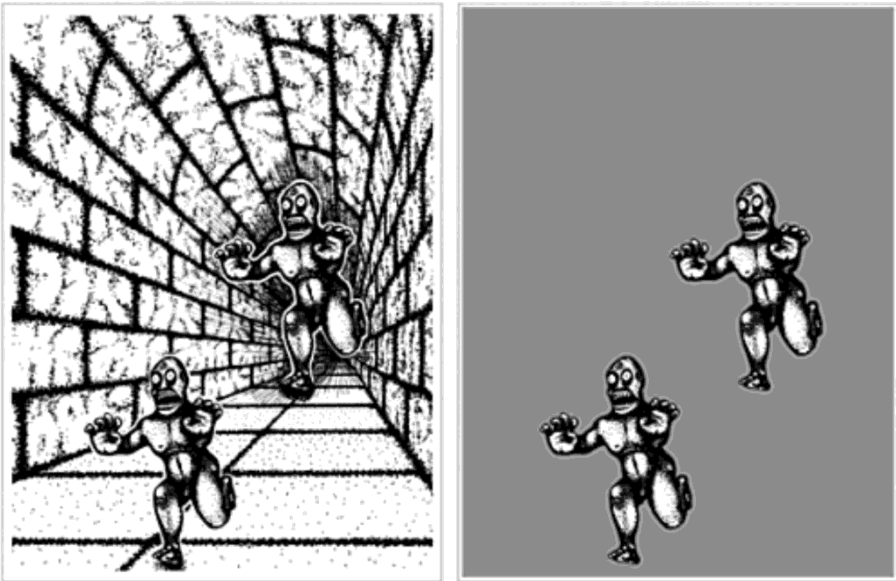
It is this top-down system that allows experts to excel in their domains. It allows quarterbacks to see their open receivers and not be distracted by other players on the field. It allows sonar operators to maintain vigilance and to easily (with suitable training) distinguish an enemy submarine from a freighter ship or a whale, just by the sound of the *ping*. It's what allows conductors to listen to just one instrument at a time when sixty are playing. It's what allows you to pay attention to this book even though there are probably distractions around you right now: the sound of a fan, traffic, birds singing outdoors, distant conversations, not to mention the visual distractions in the periphery, outside the central visual focus of where you're holding your book or screen.

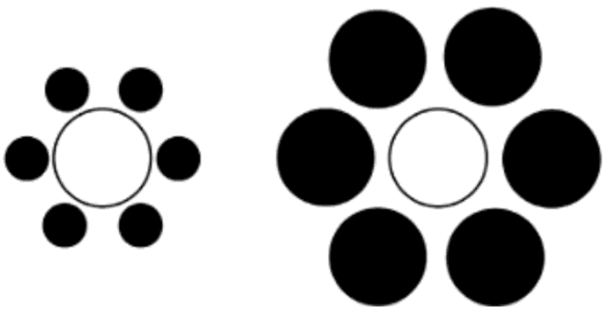
If we have such an effective attentional filter, why can't we filter out distractions better than we can? Why is information overload such a serious problem now?

For one thing, we're doing more work than ever before. The promise of a computerized society, we were told, was that it would relegate to machines all of the repetitive drudgery of work, allowing us humans to pursue loftier purposes and to have more leisure time. It didn't work out this way. Instead of more time, most of us have less. Companies large and small have off-loaded work onto the backs of consumers. Things that used to be done for us, as part of the value-added service of working with a company, we are now expected to do ourselves. With air travel, we're now expected to complete our own reservations and check-in, jobs that used to be done by airline employees or travel agents. At the grocery store, we're expected to bag our own groceries and, in some supermarkets, to scan our own purchases. We pump our own gas at filling stations. Telephone operators used to look up numbers for us. Some companies no longer send out bills for their services—we're expected to log in to their website, access our account, retrieve our bill, and initiate an electronic payment; in effect, do the job of the company for them. Collectively, this is known as *shadow work*—it represents a kind of parallel, shadow economy in which a lot of the service we expect from companies has been transferred to the customer. Each of us is doing the work of others and not getting paid for it. It is responsible for taking away a great deal of the leisure time we thought we would all have in the twenty-first century.

From a strictly logical point of view, the colleague is being irrational. The brother-in-law's bad Volvo experience is a single data point swamped by tens of thousands of good experiences—it's an unusual outlier. But we are social creatures. We are easily swayed by first-person stories and vivid accounts of a single experience. Although this is statistically wrong and we should learn to overcome the bias, most of us don't. Advertisers know this, and this is why we see so many first-person testimonial advertisements on TV. "I lost twenty pounds in two weeks by eating this new yogurt—and it was delicious, too!" Or "I had a headache that wouldn't go away. I was barking at the dog and snapping at my loved ones. Then I took this new medication and I was back to my normal self." Our brains focus on vivid, social accounts more than dry, boring, statistical accounts.

We make a number of reasoning errors due to cognitive biases. Many of us are familiar with illusions such as these:





In Roger Shepard's version of the famous "Ponzo illusion," the monster at the top *seems* larger than the one at the bottom, but a ruler will show that they're the same size. In the Ebbinghaus illusion below it, the white circle on the left seems larger than the white circle on the right, but they're the same size. We say that our eyes are playing tricks on us, but in fact, our eyes aren't playing tricks on us, our brain is. The visual system uses heuristics or shortcuts to piece together an understanding of the world, and it sometimes gets things wrong.

By analogy to visual illusions, we are prone to cognitive illusions when we try to make decisions, and our brains take decision-making shortcuts. These are more likely to occur when we are faced with the kinds of Big Data that have become today's norm. We can learn to overcome them, but until we do, they profoundly affect what we pay attention to and how we process information.

The Prehistory of Mental Categorization

Cognitive psychology is the scientific study of how humans (and animals and, in some cases, computers) process information. Traditionally, cognitive psychologists have made a distinction among different areas of study: memory, attention, categorization, language acquisition and use, decision-making, and one or two other topics. Many believe that attention and memory are closely related, that you can't remember things that you didn't pay attention to in the first place. There has been relatively less attention paid to the important interrelationship among *categorization*, attention, and memory.

The act of categorizing helps us to organize the physical world-out-there but also organizes the mental world, the world-in-here, in our heads and thus what we can pay attention to and remember.

As an illustration of how fundamental categorization is, consider what life would be like if we failed to put things into categories. When we stared at a plate of black beans, each bean would be entirely unrelated to the others, not interchangeable, not of the same "kind." The idea that one bean is as good as any other for eating would not be obvious. When you went out to mow the lawn, the different blades of grass would be overwhelmingly distinct, not seen as part of a collective. Now, in these two cases, there are perceptual similarities from one bean to another and from one blade of grass to another. Your perceptual system can help you to create categories based on appearances. But we often categorize based on conceptual similarities rather than perceptual ones. If the phone rings in the kitchen and you need to take a message, you might walk over to the junk drawer and grab the first thing that looks like it will write. Even though you know that pens, pencils, and crayons are distinct and belong to different categories, for the moment they are functionally equivalent, members of a category of "things I can write on paper with." You might find only lipstick and decide to use that. So it's not your perceptual system grouping them together, but your cognitive system. Junk drawers reveal a great deal about category formation, and they serve an important and useful purpose by functioning as an escape valve when we encounter objects that just don't fit neatly anywhere else.

Our early ancestors did not have many personal possessions—an animal skin for clothing, a container for water, a sack for collecting fruit. In effect the entire natural world was their home. Keeping track of all the variety and variability of that natural world was essential, and also a daunting mental task. How did our ancestors make sense of the natural world? What kinds of distinctions were fundamental to them?

Because events during prehistory, by definition, left no historical record, we have to rely on indirect sources of evidence to answer these questions. One such source is contemporary preliterate hunter-gatherers who are cut off from industrial civilization. We can't know for sure, but our best guess is that they are living life very much as our own hunter-gatherer ancestors did. Researchers observe how they live, and interview them to find out what they know about how their own ancestors lived, through family histories and oral traditions. Languages are a related source of evidence. The "lexical hypothesis" assumes that the most important things humans need to talk about eventually become encoded in language.

One of the most important things that language does for us is help us make distinctions. When we call something edible, we distinguish it from—implicitly, automatically—all other things that are inedible. When we call something a fruit, we necessarily distinguish it from vegetables, meat, dairy, and so on. Even children intuitively understand the nature of words as restrictive. A child asking for a glass of water may complain, "I don't want *bathroom* water, I want *kitchen* water." The little munchkins are making subtle discriminations of the physical world, and exercising their categorization systems.

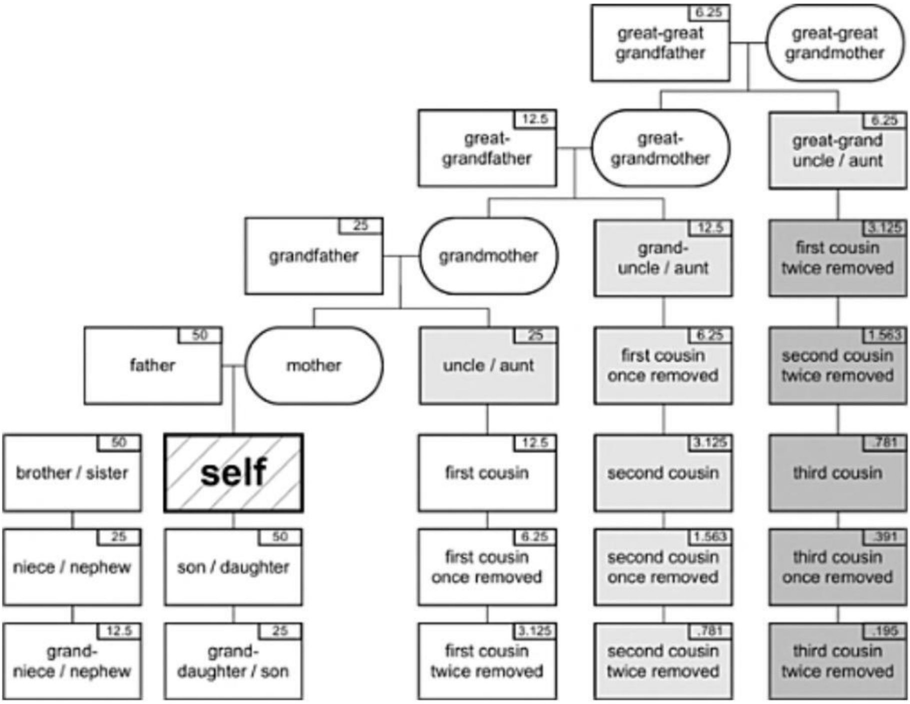
Early humans organized their minds and thoughts around basic distinctions that we still make and find useful. One of the earliest distinctions made was between now and not-now; *these* things are happening in the moment, these other things happened in the past and are now in my memory. No other species makes this self-conscious distinction among past, present, and future. No other species lives with regret over past events, or makes deliberate plans for future ones. Of course many species respond to time by building nests, flying south, hibernating, mating—but these are preprogrammed, instinctive behaviors and these actions are not the result of conscious decision, meditation, or planning.

Simultaneous with an understanding of *now* versus *before* is one of object permanence: Something may not be in my immediate view, but that does not mean it has ceased to exist. Human infants between four and nine months show object permanence, proving that this cognitive operation is innate. Our brains represent objects that are here-and-now as the information comes in from our sensory receptors. For example, we see a deer and we know through our eyes (and, downstream, a host of native, inborn cognitive modules) that the deer is standing right before us. When the deer is gone, we can remember its image and represent it in our mind's eye, or even represent it externally by drawing or painting or sculpting it.

This human capacity to distinguish the here-and-now from the here-and-not-now showed up at least 50,000 years ago in cave paintings. These constitute the first evidence of any species on earth being able to explicitly represent the distinction between what *is* here and what *was* here. In other words, those early cave-dwelling Picassos, through the very act of painting, were making in network of friends and relatives to help the young couple get started in life. According to one study, couples (especially low-income ones) who stay near the kin of one or both partners fare better in their marriages and in child rearing.

Kinship beyond the core relations of son-daughter and mother-father might seem to be entirely arbitrary, merely a human invention. But it shows up in a number of animal species and we can quantify the relations in genetic terms to show their importance. From a strictly evolutionary standpoint, your job is to propagate as many of your genes as possible. You share 50% of your genes with your mother and father or with any offspring. You also share 50% with your siblings (unless you're a twin). If your sister has children, you will share 25% of your genes with them. If you don't have any children of your own, your best strategy for propagating your genes is to help care for your sister's children, your nieces and nephews.

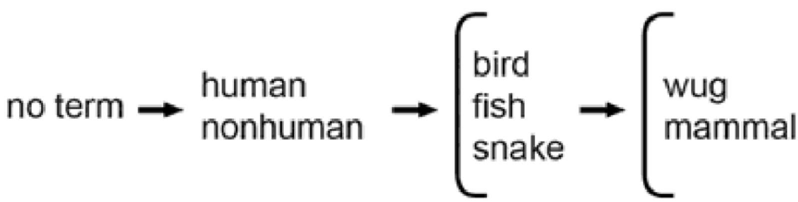
Your direct cousins—the offspring of an aunt or uncle—share 12.5% of your genes. If you don't have nephews and nieces, any care you put into cousins helps to pass on part of the genetic material that is you. Richard Dawkins and others have thus made cogent arguments to counter the claim of religious fundamentalists and social conservatives that homosexuality is "an abomination" that goes against nature. A gay man or lesbian who helps in the raising and care of a family member's child is able to devote considerable time and financial resources to propagating the family's genes. This has no doubt been true throughout history. A natural consequence of this chart is that first cousins who have children together increase the number of genes they pass on. In fact, many cultures promote marriage between first cousins as a way to increase family unity, retain familial wealth, or to ensure similar cultural and religious views within the union.



The caring for one's nephews and nieces is not limited to humans. Mole rats will care for nieces and nephews but not for unrelated young, and Japanese quails show a clear preference for mating with first cousins—a way to increase the amount of their own genetic material that gets passed on (the offspring of first cousins will have 56.25% of their DNA in common with each parent rather than 50%—that is, the "family" genes have an edge of 6.25% in the offspring of first cousins than in the offspring of unrelated individuals).

Classifications such as kinship categories aid in the organization, encoding, and communication of complex knowledge. And the classifications have their roots in animal behavior, so they can be said to be precognitive. What humans did was to make these distinctions linguistic and thus explicitly communicable information.

How did early humans divide up and categorize the plant and animal kingdom? The data are based on the lexical hypothesis, that the distinctions most important to a culture become encoded in that culture's language. With increasing cognitive and categorizational complexity comes increased complexity in linguistic terms, and these terms serve to encode important distinctions. The work of sociobiologists, anthropologists, and linguists has uncovered patterns in naming plants and animals across cultures and across time. One of the first distinctions that early humans made was between humans and nonhumans—which makes sense. Finer distinctions crept into languages gradually and systematically. From the study of thousands of different languages, we know that if a language has only two nouns (naming words) for living things, it makes a distinction between human and nonhuman. As the language and culture develop, additional terms come into use. The next distinction added is for things that fly, swim, or crawl—roughly the equivalents of *bird, fish,* and *snake.* Generally speaking, two or three of these terms come into use at once. Thus, it's unlikely that a language would have only three words for life-forms, but if it has four, they will be *human, nonhuman,* and two of *bird, fish,* and *snake.* Which two of those nouns gets added depends, as you might imagine, on the environment where they live, and on which critters the people are most likely to encounter. If the language has four such animal nouns, it adds the missing one of these three. A language with five such animal terms adds either a general term for *mammal* or a term for smaller crawling things, combining into one category what we in English call *worms* and *bugs*. Because so many preliterate languages combine worms and bugs into a single category, ethnobiologists have made up a name for that category: *wugs.*



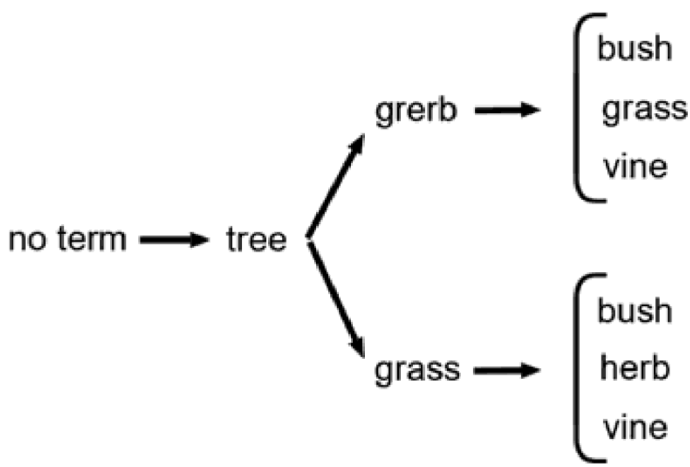
Most languages have a single folksy word for creepy-crawly things, and English is no exception. Our own term *bugs* is an informal and heterogeneous category combining ants, beetles, flies, spiders, aphids, caterpillars, grasshoppers, ticks, and a large number of living things that are biologically and taxonomically quite distinct. The fact that we still do this today, with all our advanced scientific knowledge, underscores the utility and innateness of *functional categories*. "Bug" promotes cognitive economy by combining into a single category things that most of the time we don't need to think about in great detail, apart from keeping them out of our food or from crawling on our skin. It is not the biology of these organisms that unites them, but their function in *our* lives—or our goal of trying to keep them on the outside of our bodies and not the inside.

The category names used by preliterate, tribal-based societies are similarly in contradiction to our modern scientific categories. In many languages, the word *bird* includes bats; *fish* can include whales, dolphins, and turtles; *snake* sometimes includes worms, lizards, and eels.

After these seven basic nouns, societies add other terms to their language in a less systematic fashion. Along the way, there are some societies that add an idiosyncratic term for a specific species that has great social, religious, or practical meaning. A language might have a single term for *eagle* in addition to its general term *bird* without having any other named birds. Or it might single out among the mammals a single term for *bear*.

A universal order of emergence for linguistic terms shows up in the plant world as well. Relatively undeveloped languages have no single word for plants. The lack of a term doesn't mean they don't perceive differences, and it doesn't mean they don't know the difference between spinach and skunk weed; they just lack an all-encompassing term with which to refer to plants. We see cases like this in our own language. For example, English lacks a single basic term to refer to edible mushrooms. We also lack a term for all the people you would have to notify if you were going into the hospital for three weeks. These might include close relatives, friends, your employer, the newspaper delivery person, and anyone you had appointments with during that period. The lack of a term doesn't mean you don't understand the concept; it simply means that the category isn't reflected in our language. This could be because a need for it hasn't been so pressing that a word needed to be coined.

If a language has only a single term for nonanimal living things, it is *not* the all-encompassing word *plant* that we have in English. Rather, it is a single word that maps to tall, woody growing things—what we call *trees.* When a language introduces a second term, it is either a catchall term for grasses and herbs—which researchers call *grerb*—or it is the general term for *grass* and grassy-like things. When a language grows to add a third term for plants and it already has *grerb*, the third, fourth, and fifth terms are *bush, grass,* and *vine* (not necessarily in that order; it depends on the environment). If the language already has *grass*, the third, fourth, and fifth terms added are *bush, herb,* and *vine.*



Grass is an interesting category because most of the members of the category are unnamed by most speakers of English. We can name dozens of vegetables and trees, but most of us just say "grass" to encompass the more than 9,000 different species. This naming and categorizing can be brought into stark relief by the fact that *most* of the naming we do in the plant world might be considered strictly unnecessary. Out of 30,000 edible plants thought to exist on earth, just eleven account for 93% of all that humans eat: oats, corn, rice, wheat, potatoes, yucca (also called tapioca or cassava), sorghum, millet, beans, barley, and rye. Yet our brains evolved to receive a pleasant shot of dopamine when we learn something new and again when we can classify it systematically into an ordered structure.

In Pursuit of Excellent Categorization

We humans are hardwired to enjoy knowledge, in particular knowledge that comes through the senses. And we are hardwired to impose structure on this sensory knowledge, to turn it this way and that, to view it from different angles, and try to fit it into multiple neural frameworks. This is the essence of human learning.

We are hardwired to impose structure on the world. A further piece of evidence for the innateness of this structure is the extraordinary consistency of naming conventions for biological classification (plants and animals) across widely disparate cultures. All languages and cultures—independently—came up with naming principles so similar that they strongly suggest an innate predisposition toward classification. For example, every language contains primary and secondary plant and animal names. In English we have *fir trees* (in general) and *Douglas fir* (in particular). There are *apples* and then there are *Granny Smiths, golden delicious,* and *pippins*. There are salmon and then sockeye salmon, woodpeckers and acorn woodpeckers. We look at the world and can perceive that there exists a category that includes a set of things more alike than they are unalike, and yet we recognize minor variations. This extends to man-made artifacts as well. We have chairs and easy chairs, knives and hunting knives, shoes and dancing shoes. And here's an interesting side note: Nearly every language also has some terms that mimic this structure linguistically but in fact don't refer to the same types of things. For example, in English, silverfish is an insect, not a type of fish; prairie dog is a rodent, not a dog; and a toadstool is neither a toad nor a stool that a toad might sit on.

Our hunger for knowledge can be at the roots of our failings or our successes. It can distract us or it can keep us engaged in a lifelong quest for deep learning and understanding. Some learning enhances our lives, some is irrelevant and simply distracts us—tabloid stories probably fall into this latter category (unless your profession is as a tabloid writer). Successful people are expert at categorizing useful versus distracting knowledge. How do they do it?

Of course some have that string of assistants who enable them to be in the moment, and that in turn makes them more successful. Smartphones and digital files are helpful in organizing information, but categorizing the information in a way that is helpful—and that harnesses the way our brains are organized—still requires a lot of fine-grained categorization by a human, by us.

One thing HSPs do over and over every day is *active sorting,* what emergency room nurses call *triage. Triage* comes from the French word *trier*, meaning "to sort, sift, or classify." You probably already do something like this without calling it active sorting. It simply means that you separate those things you need to deal with *right now* from those that you don't. This conscious active sorting takes many different forms in our lives, and there is no one right way. The number of categories varies and the number of times a day will vary, too—maybe you don't even need to do it every day. Nevertheless, one way or another, it is an essential part of being organized, efficient, and productive.

I worked as the personal assistant for several years for a successful businessman, Edmund W. Littlefield. He had been the CEO of Utah Construction (later Utah International), a company that built the Hoover Dam and many construction projects all over the world, including half the railroad tunnels and bridges west of the Mississippi. When I worked for him, he also served on the board of directors of General Electric, Chrysler, Wells Fargo, Del Monte, and Hewlett-Packard. He was remarkable for his intellect, business acumen, and above all, his genuine modesty and humility. He was a generous mentor. Our politics did not always agree, but he was respectful of opposing views, and tried to keep such discussions based on facts rather than speculation. One of the first things he taught me to do as his assistant was to sort his mail into four piles:

1. Things that need to be dealt with right away. This might include correspondence from his office or business associates, bills, legal documents, and the like. He subsequently performed a *fine sort* of things to be dealt with today versus in the next few days.
2. Things that are important but can wait. We called this the *abeyance pile.* This might include investment reports that needed to be reviewed, articles he might want to read, reminders for periodic service on an automobile, invitations to parties or functions that were some time off in the future, and so on.
3. Things that are *not* important and can wait, but should still be kept. This was mostly product catalogues, holiday cards, and magazines.
4. Things to be thrown out.

Ed would periodically go through the items in all these categories and re-sort. Other people have finer-grained and coarser-grained systems. One HSP has a two-category system: things to keep and things to throw away. Another HSP extends the system from correspondence to everything that comes across her desk, either electronically (such as e-mails and PDFs) or as paper copies. To the Littlefield categories one could add subcategories for the different things you are working on, for hobbies, home maintenance, and so on.

Some of the material in these categories ends up in piles on one's desk, some in folders in a filing cabinet or on a computer. Active sorting is a powerful way to prevent yourself from being distracted. It creates and fosters great efficiencies, not just practical efficiencies but intellectual ones. After you have prioritized and you start working, knowing that what you are doing is the most important thing for you *to* be doing at that moment is surprisingly powerful. Other things can wait—*this* is what you can focus on without worrying that you're forgetting something.

There is a deep and simple reason why active sorting facilitates this. The most fundamental principle of the organized mind, the one most critical to keeping us from forgetting or losing things, is to shift the burden of organizing from our brains to the external world. If we can remove some or all of the process from our brains and put it out into the physical world, we are less likely to make mistakes. This is not because of the limited capacity of our brains—rather, it's because of the nature of memory storage and retrieval in our brains: Memory processes can easily become distracted or confounded by other, similar items. Active sorting is just one of many ways of using the physical world to organize your mind. The information you need is in the physical pile *there*, not crowded in your head *up here*. Successful people have devised dozens of ways to do this, physical reminders in their homes, cars, offices, and throughout their lives to shift the burden of remembering from their brains to their environment. In a broad sense, these are related to what cognitive psychologists call *Gibsonian affordances* after the researcher J. J. Gibson.

A Gibsonian affordance describes an object whose design features tell you something about how to use it. An example made famous by another cognitive psychologist, Don Norman, is a door. When you approach a door, how do you know whether it is going to open in or out, whether to push it or pull it? With doors you use frequently, you could try to remember, but most of us don't. When subjects in an experiment were asked, "Does your bedroom door open *in* to the bedroom or *out* into the hall?" most couldn't remember. But certain features of doors encode this information for us. They *show* us how to use them, so we don't have to remember, cluttering up our brains with information that could be more durably and efficiently kept in the external world.

As you reach for the handle of a door in your home, you can see whether the jamb will block you if you try to pull the door toward you. You are probably not consciously aware of it, but your brain is registering this and guiding your actions automatically—and this is much more cognitively efficient than your memorizing the flow pattern of every door you encounter. Businesses, office buildings, and other public facilities make it even more obvious because there are so many more people using them: Doors that are meant to be *pushed* open tend to have a flat plate and no handle on one side, or a push bar across the door. Doors that are meant to be *pulled* open have a handle. Even with the extra guidance, sometimes the unfamiliarity of the door, or the fact that you are on your way to a job interview or some other distracting appointment, will make you balk for a moment, not knowing whether to push or pull. But most of the time, your brain recognizes how the door works because of its affordance, and in or out you go.

Similarly, the design of the telephone on your desk *shows* you which part you're meant to pick up. The handset is just the size and shape to *afford* your picking it up and not picking up a different part. Most scissors have two finger holes, one larger than the other, and so you know where to put your finger and where to put your thumb (usually to the annoyance of those who are left-handed). A tea kettle's handle tells you how to pick it up. The list of affordances goes on and on.

This is why key hooks work. Keeping track of things that you frequently lose, such as car keys, glasses, and even wallets involves creating affordances that reduce the burden on your elapsed. You might have had a similar feeling the last time you sat by the ocean or a lake, letting your mind wander, and experiencing the relaxing feeling it induced. In this state, thoughts seem to move seamlessly from one to another, there's a merging of ideas, visual images, and sounds, of past, present, and future. Thoughts turn inward—loosely connected, stream-of-consciousness thoughts so much like the nighttime dream state that we call them daydreams.

This distinctive and special brain state is marked by the flow of connections among disparate ideas and thoughts, and a relative lack of barriers between senses and concepts. It also can lead to great creativity and solutions to problems that seemed unsolvable. Its discovery—a special brain network that supports a more fluid and nonlinear mode of thinking—was one of the biggest neuroscientific discoveries of the last twenty years. This network exerts a pull on consciousness; it eagerly shifts the brain into mind-wandering when you're not engaged in a task, and it hijacks your consciousness if the task you're doing gets boring. It has taken over when you find you've been reading several pages in a book without registering their content, or when you are driving on a long stretch of highway and suddenly realize you haven't been paying attention to where you are and you missed your exit. It's the same part that took over when you realized that you had your keys in your hand a minute ago but now you don't know where they are. Where *is* your brain when this happens?

Envisioning or planning one's future, projecting oneself into a situation (especially a social situation), feeling empathy, invoking autobiographical memories also involve this daydreaming or mind-wandering network. If you've ever stopped what you were doing to picture the consequence of some future action or to imagine yourself in a particular future encounter, maybe your eyes turned up or down in your head from a normal straight-ahead gaze, and you became preoccupied with thought: That's the daydreaming mode.

The discovery of this mind-wandering mode didn't receive big headlines in the popular press, but it has changed the way neuroscientists think about attention. Daydreaming and mind-wandering, we now know, are a natural state of the brain. This accounts for why we feel so refreshed after it, and why vacations and naps can be so restorative. The tendency for this system to take over is so powerful that its discoverer, Marcus Raichle, named it the *default mode.* This mode is a resting brain state, when your brain is not engaged in a purposeful task, when you're sitting on a sandy beach or relaxing in your easy chair with a single malt Scotch, and your mind wanders fluidly from topic to topic. It's not just that you *can't* hold on to any one thought from the rolling stream, it's that no single thought is demanding a response.

The mind-wandering mode stands in stark contrast to the state you're in when you're intensely focused on a task such as doing your taxes, writing a report, or navigating through an unfamiliar city. This stay-on-task mode is the other dominant mode of attention, and it is responsible for so many high-level things we do that researchers have named it "the central executive." These two brain states form a kind of yin-yang: When one is active, the other is not. During demanding tasks, the central executive kicks in. The more the mind-wandering network is suppressed, the greater the accuracy of performance on the task at hand.

The discovery of the mind-wandering mode also explains why paying attention to something takes effort. The phrase *paying attention* is well-worn figurative language, and there is some useful meaning in this cliché. Attention has a cost. It is a this-or-that, zero-sum game. We pay attention to one thing, either through conscious decision or because our attentional filter deemed it important enough to push it to the forefront of attentional focus. When we pay attention to one thing, we are necessarily taking attention away from something else.

My colleague Vinod Menon discovered that the mind-wandering mode is a network, because it is not localized to a specific region of the brain. Rather, it ties together distinct populations of neurons that are distributed in the brain and connected to one another to form the equivalent of an electrical circuit or network. Thinking about how the brain works in terms of networks is a profound development in recent neuroscience.

Beginning about twenty-five years ago, the fields of psychology and neuroscience underwent a revolution. Psychology was primarily using decades-old methods to understand human behavior through things that were objective and observable, such as learning lists of words or the ability to perform tasks while distracted. Neuroscience was primarily studying the communication among cells and the biological structure of the brain. The psychologists had difficulty studying the biological material, that is, the hardware, that gave rise to thought. The neuroscientists, being stuck down at the level of individual neurons, had difficulty studying actual behaviors. The revolution was the invention of noninvasive neuroimaging techniques, a set of tools analogous to an X-ray that showed not just the contours and structure of the brain but how parts of the brain behaved in real time during actual thought and behavior—pictures of the thinking brain at work. The technologies—positron emission tomography, functional magnetic resonance imaging, and magnetoencephalography—are now well known by their abbreviations PET, fMRI, and MEG.

The initial wave of studies focused primarily on localization of brain function, a kind of neural mapping. What part of the brain is active when you mentally practice your tennis serve, when you listen to music, or perform mathematical calculations? More recently, interest has shifted toward developing an understanding of how these regions work together. Neuroscientists have concluded that mental operations may not always be occurring in one specific brain region but, rather, are carried out by circuits, networks of related neuron groups. If someone asked, "Where is the electricity kept that makes it possible to operate your refrigerator?" where would you point? The outlet? It actually doesn't have current passing through it unless an appliance is plugged in. And once one is, it is no more the place of electricity than circuits throughout all the household appliances and, in a sense, throughout the house. Really, there is no single place where electricity is. It is a distributed network; it won't show up in a cell phone photo.

Similarly, cognitive neuroscientists are increasingly appreciating that mental function is often spread out. Language ability does not reside in a specific region of the brain; rather, it comprises a distributed network—like the electrical wires in your house—that draws on and engages regions throughout the brain. What led early researchers to think that language might be localized is that disruption to particular regions of the brain reliably caused loss of language functions. Think of the circuits in your home again. If your contractor accidentally cuts an electrical wire, you can lose electricity in an entire section of your home, but it doesn't mean that the electricity *source* was at the place that was cut—it simply means that a line necessary for transmission was disrupted. In fact, there is almost an infinity of places where cutting the wires in your house will cause a disruption to service, including cutting the wire at the source, the circuit breaker box. From where you stand in your kitchen with a blender that won't mix your smoothie, the effect is the same. It begins to look different only when you set out to repair it. This is how neuroscientists now think of the brain—as a set of intricate overlapping networks.

The mind-wandering mode works in opposition to the central executive mode: When one is activated, the other one is deactivated; if we're in one mode, we're not in the other. The job of the central executive network is to prevent you from being distracted when you're engaged in a task, limiting what will enter your consciousness so that you can focus on what you're doing uninterrupted. And again, whether you are in the mind-wandering or central executive mode, your attentional filter is almost always operating, quietly out of the way in your subconscious.

For our ancestors, staying on task typically meant hunting a large mammal, fleeing a predator, or fighting. A lapse of attention during these activities could spell disaster. Today, we're more likely to employ our central executive mode for writing reports, interacting with people and computers, driving, navigating, solving problems in our heads, or pursuing artistic projects such as painting and music. A lapse of attention in these activities isn't usually a matter of life or death, but it does interfere with our effectiveness when we're trying to accomplish something.

In the mind-wandering mode, our thoughts are mostly directed inward to our goals, desires, feelings, plans, and also our relationship with other people—the mind-wandering mode is active when people are feeling empathy toward one another. In the central executive mode, thoughts are directed both inward and outward. There is a clear evolutionary advantage to being able to stay on task and concentrate, but not to entering an irreversible state of hyperfocus that makes us oblivious to a predator or enemy lurking behind the bushes, or to a poisonous spider crawling up the back of our neck. This is where the attentional network comes in; the attentional filter is constantly monitoring the environment for anything that might be important.

In addition to the mind-wandering mode, the central executive, and the attentional filter, there's a fourth component of the attentional system that allows us to switch between the mind-wandering mode and the central executive mode. This switch enables shifts from one task to another, such as when you're talking to a friend at a party and your attention is suddenly shifted to that other conversation about the fire in the kitchen. It's a neural switchboard that directs your attention to that mosquito on your forehead and then allows you to go back parts of your brain that keep you on task, that help you to stay put in your chair and finish that report.

This four-circuit human attentional system evolved over tens of thousands of years—distinct brain networks that become more or less active depending on the situation—and it now lies at the center of our ability to organize information. We see it every day. You're sitting at your desk and there is a cacophony of sounds and visual distractions surrounding you: the fan of the ventilation unit, the hum of the fluorescent lights, traffic outside your window, the occasional glint of sunlight reflecting off a windshield outside and streaking across your face. Once you've settled into your work, you cease to notice these and can focus on your task. After about fifteen or twenty minutes, though, you find your mind wandering: Did I remember to lock the front door when I left home? Do I need to remind Jeff of our lunch meeting today? Is this project I'm working on right now going to get done on time? Most people have internal dialogues like this going on in their heads all the time. It might cause you to wonder who is asking the questions inside your head and—more intriguingly—who is answering them? There isn't a bunch of miniature you's inside your head, of course. Your brain, however, is a collection of semidistinct, special-purpose processing units. The inner dialogue is generated by the planning centers of your brain in the prefrontal cortex, and the questions are being answered by other parts of your brain that possess the information.

Distinct networks in your brain can thus harbor completely different thoughts and hold completely different agendas. One part of your brain is concerned with satisfying immediate hunger, another with planning and sticking to a diet; one part is paying attention to the road while you drive, another is bebopping along with the radio. The attentional network has to monitor all these activities and allocate resources to some and not to others.

If this seems far-fetched, it may be easier to visualize if you realize that the brain is already doing this all the time for cellular housekeeping purposes. For example, when you start to run, a part of your brain "asks" the question, "Do we have enough oxygen going to the leg muscles to support this activity?" while in tandem, another part sends down an order to increase respiration levels so that blood oxygenation is increased. A third part that is monitoring activity makes sure that the respiration increase was carried out per instructions and reports back if it wasn't. Most of the time, these exchanges occur below the level of consciousness, which is to say, we're not aware of the dialogue or signal-response mechanism. But neuroscientists are increasingly appreciating that consciousness is not an all-or-nothing state; rather, it is a continuum of different states. We say colloquially that this or that is happening in the subconscious mind as though it were a geographically separate part of the brain, somewhere down deep in a dank, dimly lit basement of the cranium. The more accurate neural description is that many networks of neurons are firing, much like the network of telephones simultaneously ringing in a busy office. When the activation of a neural network is sufficiently high, relative to *other* neural activity that's going on, it breaks into our attentional process, that is, it becomes captured by our conscious mind, our central executive, and we become aware of it.

Many of us hold a folk view of consciousness that is not true but is compelling because of how it feels—we feel as though there is a little version of ourselves inside our heads, telling us what is going on in the world and reminding us to take out the trash on Mondays. A more elaborated version of the myth goes something like this: There's a miniature version of us inside our heads, sitting in a comfortable chair, looking at multiple television screens. Projected on the screens are the contents of our consciousness—the external world that we see and hear, its tactile sensations, smells, and tastes—and the screens also report our internal mental and bodily states: I'm feeling hungry now, I'm too hot, I'm tired. We feel that there is an internal narrator of our lives up here in our heads, showing us what's going on in the outside world, telling us what it all means, and integrating this information with reports from inside our body about our internal emotional and physical states.

One problem with the account is that it leads to an infinite regress. Is there a miniature you sitting in a theater in your head? Does that miniature you have little eyes and ears for watching and listening to the TV screens? And a little brain of its own? If so, is there an even smaller miniature person inside *its* brain? And another miniature person inside the brain of *that* miniature person? The cycle never ends. (Daniel Dennett showed this explanation to be both logically and neurally implausible in *Consciousness Explained.*) The reality is more marvelous in its way.

Numerous special-purpose modules in your brain are at work, trying to sort out and make sense of experience. Most of them are running in the background. When that neural activity reaches a certain threshold, you become aware of it, and we call that consciousness. Consciousness itself is not a thing, and it is not localizable in the brain. Rather, it's simply the name we put to ideas and perceptions that enter the awareness of our central executive, a system of very limited capacity that can generally attend to a maximum of four or five things at a time.

To recap, there are four components in the human attentional system: the mind-wandering mode, the central executive mode, the attentional filter, and the attentional switch, which directs neural and metabolic resources among the mind-wandering, stay-on-task, or vigilance modes. The system is so effective that we rarely know what we're filtering out. In many cases, the attentional switch operates in the background of our awareness, carrying us between the mind-wandering mode and the central executive mode, while the attentional filter purrs along—we don't realize what is in operation until we're already in another mode. There are exceptions of course. We can *will* ourselves to switch modes, as when we look up from something we're reading to contemplate what is said. But the switching remains subtle:

You don't say, "I'm switching modes now"; you (or your insula) just do it.

The Neurochemistry of Attention

The last twenty years in neuroscience have also revealed an enormous amount about how paying attention actually happens. The mind-wandering network recruits neurons within the prefrontal cortex (just behind your forehead and eyes) in addition to the cingulate (a couple of inches farther back), joining them to the hippocampus, the center of memory consolidation. It does this through the activity of noradrenaline neurons in the locus coeruleus, a tiny little hub near the brainstem, deep inside the skull, which has evolved a dense mass of fibers connected to the prefrontal cortex. Despite the similarity of names, noradrenaline and adrenaline are not the same chemical; noradrenaline is most chemically similar to dopamine, from which it is synthesized by the brain. To stay in the mind-wandering mode, a precise balance must be maintained between the excitatory neurotransmitter glutamate and the inhibitory neurotransmitter GABA (gamma-Aminobutyric acid). We know dopamine and serotonin are components of this brain network, but their interactions are complex and not yet fully understood. There is tantalizing new evidence that a particular genetic variation (of a gene called COMT) causes the dopamine and serotonin balance to shift, and this shift is associated both with mood disorders and with responsiveness to antidepressants. The serotonin transporter gene SLC6A4 has been found to correlate with artistic behaviors as well as spirituality, both of which appear to favor the mind-wandering mode. Thus a connection among genetics, neurotransmitters, and artistic/spiritual thinking appears to exist. (Dopamine is no more important than glutamate and GABA and any number of other chemicals. We simply know more about dopamine because it's easier to study. In twenty years, we'll have a far more nuanced understanding of it and other chemicals.)

The central executive network recruits neurons in different parts of the prefrontal cortex and the cingulate, plus the basal ganglia deep inside the center of the brain—this executive network is not exclusively located in the prefrontal cortex as popular accounts have tended to suggest. Its chemical action includes modulating levels of dopamine in the frontal lobes. Sustained attention also depends on noradrenaline and acetylcholine, especially in distracting environments—this is the chemistry underlying the concentration it takes to focus. And while you're focusing attention on the task at hand, acetylcholine in the right prefrontal cortex helps to improve the quality of the work done by the attentional filter. Acetylcholine density in the brain changes rapidly—at the subsecond level—and its release is tied to the detection of something you're searching for. Acetylcholine also plays a role in sleep: It reaches a peak during REM sleep, and helps to prevent outside inputs from disturbing your dreaming.

In the last few years, we've learned that acetylcholine and noradrenaline appear to be integrated into the brain's circuitry via heteroreceptors—chemical receptors inside a neuron that can accept more than one type of trigger (as distinguished from the more typical autoreceptors that function like a lock and key, letting only one specific neurotransmitter into the synapse). Through this mechanism, acetylcholine and noradrenaline can influence the release of each other.

The attentional filter comprises a network in the frontal lobes and sensory cortices (auditory and visual cortex). When we're searching for something, the filter can retune neurons to match the characteristics of the thing we're searching for, such as the red and white stripes of Waldo, or the size and shape of your car keys. This allows search to be very rapid and to filter out things that are irrelevant. But due to neural noise, it doesn't always work perfectly—we sometimes look right at the thing we're searching for without realizing what it is. The attentional filter (or *Where's Waldo?* network) is controlled in part by neurons with put things down or put things away. That little bit of focus goes a long way in training the brain (specifically the hippocampus) to remember where we put things, because we're invoking the central executive to help with encoding the moment. Having systems like key hooks, cell phone trays, and a special hook or drawer for sunglasses externalizes the effort so that we don't have to keep everything in our heads. Externalizing memory is an idea that goes back to the Greeks, and its effectiveness has been confirmed many times over by contemporary neuroscience. The extent to which we do it already is astounding when you think about it. As Harvard psychologist Dan Wegner noted, "Our walls are filled with books, our file cabinets with papers, our notebooks with jottings, our homes with artifacts and souvenirs." The word *souvenir,* not coincidentally, comes from the French word for "to remember." Our computers are filled with data records, our calendars with appointments and birthdays, and students scribble answers to tests on their hands.

One current view among some memory theorists is that a very large number of the things you've consciously experienced in your life is encoded in your brain—many of the things you've seen, heard, smelled, thought, all those conversations, bicycle rides, and meals are potentially in there somewhere, provided you paid attention to them. If it's all in there, why do we forget? As Patrick Jane of *The Mentalist* described it, rather eloquently, "Memory is unreliable because the untrained brain has a crappy filing system. It takes everything that happens to you and throws it all willy-nilly into a big dark closet—when you go in there looking for something, all you can find are the big obvious things, like when your mom died, or stuff that you don't really need. Stuff that you're not looking for, like the words to 'Copacabana.' You can't find what you need, but don't panic, because it's still there."

How is this possible? When we experience any event, a unique network of neurons is activated depending on the nature of the event. Watching a sunset? Visual centers that represent shadows