

TOO MUCH INFORMATION, TOO MANY DECISIONS

The Inside History of Cognitive Overload

One of the best students I ever had the privilege of meeting was born in communist Romania, under the repressive and brutal rule of Nicolae Ceaușescu. Although his regime collapsed when she was eleven, she remembered well the long lines for food, the shortages, and the economic destitution that lasted far beyond his overthrow. Ioana was bright and curious, and although still young, she had the colors of a true scholar: When she encountered a new scientific idea or problem, she would look at it from every angle, reading everything she could get her hands on. I met her during her first semester at university, newly arrived in North America, when she took my introductory course on the psychology of thinking and reasoning. Although the class had seven hundred students, she distinguished herself early on by thoughtfully answering questions posed in class, peppering me with questions during office hours, and constantly proposing new experiments.

I ran into her one day at the college bookstore, frozen in the aisle with all the pens and pencils. She was leaning limply against the shelf, clearly distraught.

“Is everything all right?” I asked.

“It can be really terrible living in America,” Ioana said.

“Compared to Soviet Romania?!”

“Everything is so complicated. I looked for a student apartment. Rent or lease? Furnished or unfurnished? Top floor or ground floor? Carpet or hardwood floor . . .”

"Did you make a decision?"

"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 week-long 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 unconscious filter follows certain principles about what it will let through to your conscious awareness.

The attentional filter is one of evolution's greatest achievements. In nonhumans, it ensures that they don't get distracted by irrelevancies. Squirrels are interested in nuts and predators, and not much else. Dogs, whose olfactory sense is one million times more sensitive than ours, use smell to gather information about the world more than they use sound, and their attentional filter has evolved to make that so. If you've ever tried to call your dog while he is smelling something interesting, you know that it is very difficult to grab his attention with sound—smell trumps sound in the dog brain. No one has yet worked out all of the hierarchies and trumping factors in the human attentional filter, but we've learned a great deal about it. When our protohuman ancestors left the cover of the trees to seek new sources of food, they simultaneously opened up a vast range of new possibilities for nourishment and exposed themselves to a wide range of new predators. Being alert and vigilant to threatening sounds and visual cues is what allowed them to survive; this meant allowing an increasing amount of information through the attentional filter.

Humans are, by most biological measures, the most successful species our planet has seen. We have managed to survive in nearly every climate our planet has offered (so far), and the rate of our population expansion exceeds that of any other known organism. Ten thousand years ago, humans plus their pets and livestock accounted for about 0.1% of the terrestrial vertebrate biomass inhabiting the earth; we now account for 98%. Our success owes in large part to our cognitive capacity, the ability of our brains to flexibly handle information. But our brains evolved in a much simpler world with far less information coming at us. Today, our attentional filters easily become overwhelmed. Successful people—or people who can afford it—employ layers of people whose job it is to *narrow the attentional filter*. That is, corporate heads, political leaders, spoiled movie stars, and others whose time and attention are especially valuable have a staff of people around them who are effectively extensions of their own brains, replicating and refining the functions of the prefrontal cortex's attentional filter.

These highly successful persons—let's call them HSPs—have many of the daily distractions of life handled for them, allowing them to devote all of their attention to whatever is immediately before them. They seem to live completely in the moment. Their staff handle correspondence, make appointments, interrupt those appointments when a more important one is waiting, and help to plan their days for maximum efficiency (including naps!). Their bills are paid on time, their car is serviced when required, they're given reminders of projects due, and their assistants send suitable gifts to the HSP's loved ones on birthdays and anniversaries. Their ultimate prize if it all works? A Zen-like focus.

In the course of my work as a scientific researcher, I've had the chance to meet governors, cabinet members, music celebrities, and the heads of Fortune 500 companies. Their skills and accomplishments vary, but as a group, one thing is remarkably constant. I've repeatedly been struck by how liberating it is for them not to have to worry about whether there is someplace else they need to be, or someone else they need to be talking to. They take their time, make eye contact, relax, and are *really there* with whomever they're talking to. They don't have to worry if there is someone more important they should be talking to at that moment because their staff—their external attentional filters—have already determined for them that this is the best way they should be using their time. And there is a great amount of infrastructure in place ensuring that they will get to their next appointment on time, so they can let go of that nagging concern as well.

The rest of us have a tendency during meetings to let our minds run wild and cycle through a plethora of thoughts about the past and the future, destroying any aspirations for Zen-like 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 *inattention 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 climactic 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 merchants required an accounting system for keeping track of the day's inventory and receipts; *this* was the birth of writing. Here, liberal arts majors may need to set their romantic notions aside. The first forms of writing emerged not for art, literature, or love, not for spiritual or liturgical purposes, but for business—all literature could be said to originate from sales receipts (sorry). With the growth of trade, cities, and writing, people soon discovered architecture, government, and the other refinements of being that collectively add up to what we think of as civilization.