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THE POWER OF HABIT

WHY WE DO WHAT WE DO IN LIFE AND BUSINESS

"SHARP, PROVOCATIVE, and USEFUL." —Jim Collins, author of *Good to Great*

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Charles Duhigg

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THE POWER OF HABIT

Why We Do What We Do in Life and Business

CHARLES DUHIGG

Random House New York

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PROLOGUE
The Habit Cure

She was the scientists' favorite participant.

Lisa Allen, according to her file, was thirty-four years old, had started smoking and drinking when she was sixteen, and had struggled with obesity for most of her life. At one point, in her mid-twenties, collection agencies were hounding her to recover $10,000 in debts. An old résumé listed her longest job as lasting less than a year.

The woman in front of the researchers today, however, was lean and vibrant, with the toned legs of a runner. She looked a decade younger than the photos in her chart and like she could out-exercise anyone in the room. According to the most recent report in her file, Lisa had no outstanding debts, didn't drink, and was in her thirty-ninth month at a graphic design firm.

"How long since your last cigarette?" one of the physicians asked, starting down the list of questions Lisa answered every time she came to this laboratory outside Bethesda, Maryland.

"Almost four years," she said, "and I've lost sixty pounds and run a marathon since then." She'd also started a master's degree and bought a home. It had been an eventful stretch.

The scientists in the room included neurologists, psychologists, geneticists, and a sociologist. For the past three years, with funding from the National Institutes of Health, they had poked and prodded Lisa and more than two dozen other former smokers, chronic overeaters, problem drinkers, obsessive shoppers, and people with other destructive habits. All of the participants had one thing in common: They had remade their lives in relatively short periods of time. The researchers wanted to understand how. So they measured subjects' vital signs, installed video cameras inside their homes to watch their daily routines, sequenced portions of their DNA, and, with technologies that allowed them to peer inside people's skulls in real time, watched as blood and electrical impulses flowed through their brains

while they were exposed to temptations such as cigarette smoke and lavish meals.[prl.1] The researchers' goal was to figure out how habits work on a neurological level—and what it took to make them change.

"I know you've told this story a dozen times," the doctor said to Lisa, "but some of my colleagues have only heard it secondhand. Would you mind describing again how you gave up cigarettes?"

"Sure," Lisa said. "It started in Cairo." The vacation had been something of a rash decision, she explained. A few months earlier, her husband had come home from work and announced that he was leaving her because he was in love with another woman. It took Lisa a while to process the betrayal and absorb the fact that she was actually getting a divorce. There was a period of mourning, then a period of obsessively spying on him, following his new girlfriend around town, calling her after midnight and hanging up. Then there was the evening Lisa showed up at the girlfriend's house, drunk, pounding on her door and screaming that she was going to burn the condo down.

"It wasn't a great time for me," Lisa said. "I had always wanted to see the pyramids, and my credit cards weren't maxed out yet, so … "

On her first morning in Cairo, Lisa woke at dawn to the sound of the call to prayer from a nearby mosque. It was pitch black inside her hotel room. Half blind and jet-lagged, she reached for a cigarette.

She was so disoriented that she didn't realize—until she smelled burning plastic—that she was trying to light a pen, not a Marlboro. She had spent the past four months crying, binge eating, unable to sleep, and feeling ashamed, helpless, depressed, and angry, all at once. Lying in bed, she broke down. "It was like this wave of sadness," she said. "I felt like everything I had ever wanted had crumbled. I couldn't even smoke right.

"And then I started thinking about my ex-husband, and how hard it would be to find another job when I got back, and how much I was going to hate it and how unhealthy I felt all the time. I got up and knocked over a water jug and it shattered on the floor, and I started crying even harder. I felt desperate, like I had to change something, at least one thing I could control."

She showered and left the hotel. As she rode through Cairo's rutted streets in a taxi and then onto the dirt roads leading to the Sphinx, the pyramids of Giza, and the vast, endless desert around them, her self-pity,

for a brief moment, gave way. She needed a goal in her life, she thought. Something to work toward.

So she decided, sitting in the taxi, that she would come back to Egypt and trek through the desert.

It was a crazy idea, Lisa knew. She was out of shape, overweight, with no money in the bank. She didn't know the name of the desert she was looking at or if such a trip was possible. None of that mattered, though. She needed something to focus on. Lisa decided that she would give herself one year to prepare. And to survive such an expedition, she was certain she would have to make sacrifices.

In particular, she would need to quit smoking.

When Lisa finally made her way across the desert eleven months later—in an air-conditioned and motorized tour with a half-dozen other people, mind you—the caravan carried so much water, food, tents, maps, global positioning systems, and two-way radios that throwing in a carton of cigarettes wouldn't have made much of a difference.

But in the taxi, Lisa didn't know that. And to the scientists at the laboratory, the details of her trek weren't relevant. Because for reasons they were just beginning to understand, that one small shift in Lisa's perception that day in Cairo—the conviction that she *had* to give up smoking to accomplish her goal—had touched off a series of changes that would ultimately radiate out to every part of her life. Over the next six months, she would replace smoking with jogging, and that, in turn, changed how she ate, worked, slept, saved money, scheduled her workdays, planned for the future, and so on. She would start running half-marathons, and then a marathon, go back to school, buy a house, and get engaged. Eventually she was recruited into the scientists' study, and when researchers began examining images of Lisa's brain, they saw something remarkable: One set of neurological patterns—her old habits—had been overridden by new patterns. They could still see the neural activity of her old behaviors, but those impulses were crowded out by new urges. As Lisa's habits changed, so had her brain.

It wasn't the trip to Cairo that had caused the shift, scientists were convinced, or the divorce or desert trek. It was that Lisa had focused on changing just one habit—smoking—at first. Everyone in the study had gone through a similar process. By focusing on one pattern—what is known as a

“keystone habit”—Lisa had taught herself how to reprogram the other routines in her life, as well.

It’s not just individuals who are capable of such shifts. When companies focus on changing habits, whole organizations can transform. Firms such as Procter & Gamble, Starbucks, Alcoa, and Target have seized on this insight to influence how work gets done, how employees communicate, and—without customers realizing it—the way people shop.

“I want to show you one of your most recent scans,” a researcher told Lisa near the end of her exam. He pulled up a picture on a computer screen that showed images from inside her head. “When you see food, these areas”—he pointed to a place near the center of her brain—“which are associated with craving and hunger, are still active. Your brain still produces the urges that made you overeat.

“However, there’s new activity in this area”—he pointed to the region closest to her forehead—“where we believe behavioral inhibition and self-discipline starts. That activity has become more pronounced each time you’ve come in.”

Lisa was the scientists’ favorite participant because her brain scans were so compelling, so useful in creating a map of where behavioral patterns—habits—reside within our minds. “You’re helping us understand how a decision becomes an automatic behavior,” the doctor told her.

Everyone in the room felt like they were on the brink of something important. And they were.

When you woke up this morning, what did you do first? Did you hop in the shower, check your email, or grab a doughnut from the kitchen counter? Did you brush your teeth before or after you toweled off? Tie the left or right shoe first? What did you say to your kids on your way out the door? Which route did you drive to work? When you got to your desk, did you deal with email, chat with a colleague, or jump into writing a memo? Salad or hamburger for lunch? When you got home, did you put on your sneakers and go for a run, or pour yourself a drink and eat dinner in front of the TV?

“All our life, so far as it has definite form, is but a mass of habits,” William James wrote in 1892.[prl.2] Most of the choices we make each day

may feel like the products of well-considered decision making, but they're not. They're habits. And though each habit means relatively little on its own, over time, the meals we order, what we say to our kids each night, whether we save or spend, how often we exercise, and the way we organize our thoughts and work routines have enormous impacts on our health, productivity, financial security, and happiness. One paper published by a Duke University researcher in 2006 found that more than 40 percent of the actions people performed each day weren't actual decisions, but habits.[prl.3]

William James—like countless others, from Aristotle to Oprah—spent much of his life trying to understand why habits exist. But only in the past two decades have scientists and marketers really begun understanding how habits *work*—and more important, how they change.

This book is divided into three parts. The first section focuses on how habits emerge within individual lives. It explores the neurology of habit formation, how to build new habits and change old ones, and the methods, for instance, that one ad man used to push toothbrushing from an obscure practice into a national obsession. It shows how Procter & Gamble turned a spray named Febreze into a billion-dollar business by taking advantage of consumers' habitual urges, how Alcoholics Anonymous reforms lives by attacking habits at the core of addiction, and how coach Tony Dungy reversed the fortunes of the worst team in the National Football League by focusing on his players' automatic reactions to subtle on-field cues.

The second part examines the habits of successful companies and organizations. It details how an executive named Paul O'Neill—before he became treasury secretary—remade a struggling aluminum manufacturer into the top performer in the Dow Jones Industrial Average by focusing on one keystone habit, and how Starbucks turned a high school dropout into a top manager by instilling habits designed to strengthen his willpower. It describes why even the most talented surgeons can make catastrophic mistakes when a hospital's organizational habits go awry.

The third part looks at the habits of societies. It recounts how Martin Luther King, Jr., and the civil rights movement succeeded, in part, by changing the ingrained social habits of Montgomery, Alabama—and why a similar focus helped a young pastor named Rick Warren build the nation's largest church in Saddleback Valley, California. Finally, it explores thorny

ethical questions, such as whether a murderer in Britain should go free if he can convincingly argue that his habits led him to kill.

Each chapter revolves around a central argument: Habits can be changed, if we understand how they work.

This book draws on hundreds of academic studies, interviews with more than three hundred scientists and executives, and research conducted at dozens of companies. (For an index of resources, please see the book's notes and http://www.thepowerofhabit.com.) It focuses on habits as they are technically defined: the choices that all of us deliberately make at some point, and then stop thinking about but continue doing, often every day. At one point, we all consciously decided how much to eat and what to focus on when we got to the office, how often to have a drink or when to go for a jog. Then we stopped making a choice, and the behavior became automatic. It's a natural consequence of our neurology. And by understanding how it happens, you can rebuild those patterns in whichever way you choose.

I first became interested in the science of habits eight years ago, as a newspaper reporter in Baghdad. The U.S. military, it occurred to me as I watched it in action, is one of the biggest habit-formation experiments in history.[prl.4] Basic training teaches soldiers carefully designed habits for how to shoot, think, and communicate under fire. On the battlefield, every command that's issued draws on behaviors practiced to the point of automation. The entire organization relies on endlessly rehearsed routines for building bases, setting strategic priorities, and deciding how to respond to attacks. In those early days of the war, when the insurgency was spreading and death tolls were mounting, commanders were looking for habits they could instill among soldiers and Iraqis that might create a durable peace.

I had been in Iraq for about two months when I heard about an officer conducting an impromptu habit modification program in Kufa, a small city ninety miles south of the capital. He was an army major who had analyzed videotapes of recent riots and had identified a pattern: Violence was usually preceded by a crowd of Iraqis gathering in a plaza or other open space and, over the course of several hours, growing in size. Food vendors would show

up, as well as spectators. Then, someone would throw a rock or a bottle and all hell would break loose.

When the major met with Kufa's mayor, he made an odd request: Could they keep food vendors out of the plazas? Sure, the mayor said. A few weeks later, a small crowd gathered near the Masjid al-Kufa, or Great Mosque of Kufa. Throughout the afternoon, it grew in size. Some people started chanting angry slogans. Iraqi police, sensing trouble, radioed the base and asked U.S. troops to stand by. At dusk, the crowd started getting restless and hungry. People looked for the kebab sellers normally filling the plaza, but there were none to be found. The spectators left. The chanters became dispirited. By 8 P.M., everyone was gone.

When I visited the base near Kufa, I talked to the major. You wouldn't necessarily think about a crowd's dynamics in terms of habits, he told me. But he had spent his entire career getting drilled in the psychology of habit formation.

At boot camp, he had absorbed habits for loading his weapon, falling asleep in a war zone, maintaining focus amid the chaos of battle, and making decisions while exhausted and overwhelmed. He had attended classes that taught him habits for saving money, exercising each day, and communicating with bunkmates. As he moved up the ranks, he learned the importance of organizational habits in ensuring that subordinates could make decisions without constantly asking permission, and how the right routines made it easier to work alongside people he normally couldn't stand. And now, as an impromptu nation builder, he was seeing how crowds and cultures abided by many of the same rules. In some sense, he said, a community was a giant collection of habits occurring among thousands of people that, depending on how they're influenced, could result in violence or peace. In addition to removing the food vendors, he had launched dozens of different experiments in Kufa to influence residents' habits. There hadn't been a riot since he arrived.

"Understanding habits is the most important thing I've learned in the army," the major told me. "It's changed everything about how I see the world. You want to fall asleep fast and wake up feeling good? Pay attention to your nighttime patterns and what you automatically do when you get up. You want to make running easy? Create triggers to make it a routine. I drill

my kids on this stuff. My wife and I write out habit plans for our marriage. This is all we talk about in command meetings. Not one person in Kufa would have told me that we could influence crowds by taking away the kebab stands, but once you see everything as a bunch of habits, it's like someone gave you a flashlight and a crowbar and you can get to work."

The major was a small man from Georgia. He was perpetually spitting either sunflower seeds or chewing tobacco into a cup. He told me that prior to entering the military, his best career option had been repairing telephone lines, or, possibly, becoming a methamphetamine entrepreneur, a path some of his high school peers had chosen to less success. Now, he oversaw eight hundred troops in one of the most sophisticated fighting organizations on earth.

"I'm telling you, if a hick like me can learn this stuff, anyone can. I tell my soldiers all the time, there's nothing you can't do if you get the habits right."

In the past decade, our understanding of the neurology and psychology of habits and the way patterns work within our lives, societies, and organizations has expanded in ways we couldn't have imagined fifty years ago. We now know why habits emerge, how they change, and the science behind their mechanics. We know how to break them into parts and rebuild them to our specifications. We understand how to make people eat less, exercise more, work more efficiently, and live healthier lives. Transforming a habit isn't necessarily easy or quick. It isn't always simple.

But it is possible. And now we understand how.

The Habits of Individuals

THE HABIT LOOP

How Habits Work

I.

In the fall of 1993, a man who would upend much of what we know about habits walked into a laboratory in San Diego for a scheduled appointment. He was elderly, a shade over six feet tall, and neatly dressed in a blue button-down shirt.[1.1] His thick white hair would have inspired envy at any fiftieth high school reunion. Arthritis caused him to limp slightly as he paced the laboratory's hallways, and he held his wife's hand, walking slowly, as if unsure about what each new step would bring.

About a year earlier, Eugene Pauly, or "E.P." as he would come to be known in medical literature, had been at home in Playa del Rey, preparing for dinner, when his wife mentioned that their son, Michael, was coming over.

"Who's Michael?" Eugene asked.[1.2]

"Your child," said his wife, Beverly. "You know, the one we raised?"

Eugene looked at her blankly. "Who is that?" he asked.

The next day, Eugene started vomiting and writhing with stomach cramps. Within twenty-four hours, his dehydration was so pronounced that a panicked Beverly took him to the emergency room. His temperature started rising, hitting 105 degrees as he sweated a yellow halo of perspiration onto the hospital's sheets. He became delirious, then violent, yelling and pushing when nurses tried to insert an IV into his arm. Only after sedation was a physician able to slide a long needle between two

vertebra in the small of his back and extract a few drops of cerebrospinal fluid.

The doctor performing the procedure sensed trouble immediately. The fluid surrounding the brain and spinal nerves is a barrier against infection and injury. In healthy individuals, it is clear and quick flowing, moving with an almost silky rush through a needle. The sample from Eugene's spine was cloudy and dripped out sluggishly, as if filled with microscopic grit.[1.3] When the results came back from the laboratory, Eugene's physicians learned why he was ill: He was suffering from viral encephalitis, a disease caused by a relatively harmless virus that produces cold sores, fever blisters, and mild infections on the skin. In rare cases, however, the virus can make its way into the brain, inflicting catastrophic damage as it chews through the delicate folds of tissue where our thoughts, dreams—and according to some, souls—reside.

Eugene's doctors told Beverly there was nothing they could do to counter the damage already done, but a large dose of antiviral drugs might prevent it from spreading. Eugene slipped into a coma and for ten days was close to death. Gradually, as the drugs fought the disease, his fever receded and the virus disappeared. When he finally awoke, he was weak and disoriented and couldn't swallow properly. He couldn't form sentences and would sometimes gasp, as if he had momentarily forgotten how to breathe. But he was alive.

Eventually, Eugene was well enough for a battery of tests. The doctors were amazed to find that his body—including his nervous system—appeared largely unscathed. He could move his limbs and was responsive to noise and light. Scans of his head, though, revealed ominous shadows near the center of his brain. The virus had destroyed an oval of tissue close to where his cranium and spinal column met. "He might not be the person you remember," one doctor warned Beverly. "You need to be ready if your husband is gone."

Eugene was moved to a different wing of the hospital. Within a week, he was swallowing easily. Another week, and he started talking normally, asking for Jell-O and salt, flipping through television channels and complaining about boring soap operas. By the time he was discharged to a rehabilitation center five weeks later, Eugene was walking down hallways and offering nurses unsolicited advice about their weekend plans.

“I don’t think I’ve ever seen anyone come back like this,” a doctor told Beverly. “I don’t want to raise your hopes, but this is amazing.”

Beverly, however, remained concerned. In the rehab hospital it became clear that the disease had changed her husband in unsettling ways. Eugene couldn’t remember which day of the week it was, for instance, or the names of his doctors and nurses, no matter how many times they introduced themselves. “Why do they keep asking me all these questions?” he asked Beverly one day after a physician left his room. When he finally returned home, things got even stranger. Eugene didn’t seem to remember their friends. He had trouble following conversations. Some mornings, he would get out of bed, walk into the kitchen, cook himself bacon and eggs, then climb back under the covers and turn on the radio. Forty minutes later, he would do the same thing: get up, cook bacon and eggs, climb back into bed, and fiddle with the radio. Then he would do it again.

Alarmed, Beverly reached out to specialists, including a researcher at the University of California, San Diego, who specialized in memory loss. Which is how, on a sunny fall day, Beverly and Eugene found themselves in a nondescript building on the university’s campus, holding hands as they walked slowly down a hallway. They were shown into a small exam room. Eugene began chatting with a young woman who was using a computer.

“Having been in electronics over the years, I’m amazed at all this,” he said, gesturing at the machine she was typing on. “When I was younger, that thing would have been in a couple of six-foot racks and taken up this whole room.”

The woman continued pecking at the keyboard. Eugene chuckled.

“That is incredible,” he said. “All those printed circuits and diodes and triodes. When I was in electronics, there would have been a couple of six-foot racks holding that thing.”

A scientist entered the room and introduced himself. He asked Eugene how old he was.

“Oh, let’s see, fifty-nine or sixty?” Eugene replied. He was seventy-one years old.

The scientist started typing on the computer. Eugene smiled and pointed at it. “That is really something,” he said. “You know, when I was in electronics there would have been a couple of six-foot racks holding that thing!”

The scientist was fifty-two-year-old Larry Squire, a professor who had spent the past three decades studying the neuroanatomy of memory. His specialty was exploring how the brain stores events. His work with Eugene, however, would soon open a new world to him and hundreds of other researchers who have reshaped our understanding of how habits function. Squire's studies would show that even someone who can't remember his own age or almost anything else can develop habits that seem inconceivably complex—until you realize that everyone relies on similar neurological processes every day. His and others' research would help reveal the subconscious mechanisms that impact the countless choices that seem as if they're the products of well-reasoned thought, but actually are influenced by urges most of us barely recognize or understand.

By the time Squire met Eugene, he had already been studying images of his brain for weeks. The scans indicated that almost all the damage within Eugene's skull was limited to a five-centimeter area near the center of his head. The virus had almost entirely destroyed his medial temporal lobe, a sliver of cells which scientists suspected was responsible for all sorts of cognitive tasks such as recall of the past and the regulation of some emotions. The completeness of the destruction didn't surprise Squire—viral encephalitis consumes tissue with a ruthless, almost surgical, precision. What shocked him was how familiar the images seemed.

Thirty years earlier, as a PhD student at MIT, Squire had worked alongside a group studying a man known as "H.M.," one of the most famous patients in medical history. When H.M.—his real name was Henry Molaison, but scientists shrouded his identity throughout his life—was seven years old, he was hit by a bicycle and landed hard on his head.[1.4, 1.5, 1.6] Soon afterward, he developed seizures and started blacking out. At sixteen, he had his first grand mal seizure, the kind that affects the entire brain; soon, he was losing consciousness up to ten times a day.

By the time he turned twenty-seven, H.M. was desperate. Anticonvulsive drugs hadn't helped. He was smart, but couldn't hold a job.[1.7] He still lived with his parents. H.M. wanted a normal existence. So he sought help from a physician whose tolerance for experimentation outweighed his fear of malpractice. Studies had suggested that an area of the brain called the hippocampus might play a role in seizures. When the doctor proposed cutting into H.M.'s head, lifting up the front portion of his brain, and, with a

small straw, sucking out the hippocampus and some surrounding tissue from the interior of his skull, H.M.[1.8, 1.9] gave his consent.

The surgery occurred in 1953, and as H.M. healed, his seizures slowed. Almost immediately, however, it became clear that his brain had been radically altered. H.M. knew his name and that his mother was from Ireland. He could remember the 1929 stock market crash and news reports about the invasion of Normandy. But almost everything that came afterward—all the memories, experiences, and struggles from most of the decade before his surgery—had been erased. When a doctor began testing H.M.'s memory by showing him playing cards and lists of numbers, he discovered that H.M. couldn't retain any new information for more than twenty seconds or so.

From the day of his surgery until his death in 2008, every person H.M. met, every song he heard, every room he entered, was a completely fresh experience. His brain was frozen in time. Each day, he was befuddled by the fact that someone could change the television channel by pointing a black rectangle of plastic at the screen. He introduced himself to his doctors and nurses over and over, dozens of times each day.[1.10]

"I loved learning about H.M., because memory seemed like such a tangible, exciting way to study the brain," Squire told me. "I grew up in Ohio, and I can remember, in first grade, my teacher handing everyone crayons, and I started mixing all the colors together to see if it would make black. Why have I kept that memory, but I can't remember what my teacher looked like? Why does my brain decide that one memory is more important than another?"

When Squire received the images of Eugene's brain, he marveled at how similar it seemed to H.M.'s. There were empty, walnut-sized chunks in the middle of both their heads. Eugene's memory—just like H.M.'s—had been removed.

As Squire began examining Eugene, though, he saw that this patient was different from H.M. in some profound ways. Whereas almost everyone knew within minutes of meeting H.M. that something was amiss, Eugene could carry on conversations and perform tasks that wouldn't alert a casual observer that anything was wrong. The effects of H.M.'s surgery had been so debilitating that he was institutionalized for the remainder of his life. Eugene, on the other hand, lived at home with his wife. H.M. couldn't

really carry on conversations. Eugene, in contrast, had an amazing knack for guiding almost any discussion to a topic he was comfortable talking about at length, such as satellites—he had worked as a technician for an aerospace company—or the weather.

Squire started his exam of Eugene by asking him about his youth. Eugene talked about the town where he had grown up in central California, his time in the merchant marines, a trip he had taken to Australia as a young man. He could remember most of the events in his life that had occurred prior to about 1960. When Squire asked about later decades, Eugene politely changed the topic and said he had trouble recollecting some recent events.

Squire conducted a few intelligence tests and found that Eugene's intellect was still sharp for a man who couldn't remember the last three decades. What's more, Eugene still had all the habits he had formed in his youth, so whenever Squire gave him a cup of water or complimented him on a particularly detailed answer, Eugene would thank him and offer a compliment in return. Whenever someone entered the room, Eugene would introduce himself and ask about their day.

But when Squire asked Eugene to memorize a string of numbers or describe the hallway outside the laboratory's door, the doctor found his patient couldn't retain any new information for more than a minute or so. When someone showed Eugene photos of his grandchildren, he had no idea who they were. When Squire asked if he remembered getting sick, Eugene said he had no recollection of his illness or the hospital stay. In fact, Eugene almost never recalled that he was suffering from amnesia. His mental image of himself didn't include memory loss, and since he couldn't remember the injury, he couldn't conceive of anything being wrong.

In the months after meeting Eugene, Squire conducted experiments that tested the limits of his memory. By then, Eugene and Beverly had moved from Playa del Rey to San Diego to be closer to their daughter, and Squire often visited their home for his exams. One day, Squire asked Eugene to sketch a layout of his house. Eugene couldn't draw a rudimentary map showing where the kitchen or bedroom was located. "When you get out of bed in the morning, how do you leave your room?" Squire asked.

"You know," Eugene said, "I'm not really sure."

Squire took notes on his laptop, and as the scientist typed, Eugene became distracted. He glanced across the room and then stood up, walked

into a hallway, and opened the door to the bathroom. A few minutes later, the toilet flushed, the faucet ran, and Eugene, wiping his hands on his pants, walked back into the living room and sat down again in his chair next to Squire. He waited patiently for the next question.

At the time, no one wondered how a man who couldn't draw a map of his home was able to find the bathroom without hesitation. But that question, and others like it, would eventually lead to a trail of discoveries that has transformed our understanding of habits' power.[1.11] It would help spark a scientific revolution that today involves hundreds of researchers who are learning, for the first time, to understand all the habits that influence our lives.

As Eugene sat at the table, he looked at Squire's laptop.

"That's amazing," he said, gesturing at the computer. "You know, when I was in electronics, there would have been a couple of six-foot racks holding that thing."

In the first few weeks after they moved into their new house, Beverly tried to take Eugene outside each day. The doctors had told her that it was important for him to get exercise, and if Eugene was inside too long he drove Beverly crazy, asking her the same questions over and over in an endless loop. So each morning and afternoon, she took him on a walk around the block, always together and always along the same route.

The doctors had warned Beverly that she would need to monitor Eugene constantly. If he ever got lost, they said, he would never be able to find his way home. But one morning, while she was getting dressed, Eugene slipped out the front door. He had a tendency to wander from room to room, so it took her a while to notice he was gone. When she did, she became frantic. She ran outside and scanned the street. She couldn't see him. She went to the neighbors' house and pounded on the windows. Their homes looked similar—maybe Eugene had become confused and had gone inside? She ran to the door and rang the bell until someone answered. Eugene wasn't there. She sprinted back to the street, running up the block, screaming Eugene's name. She was crying. What if he had wandered into traffic? How

would he tell anyone where he lived? She had been outside for fifteen minutes already, looking everywhere. She ran home to call the police.

When she burst through the door, she found Eugene in the living room, sitting in front of the television watching the History Channel. Her tears confused him. He didn't remember leaving, he said, didn't know where he'd been, and couldn't understand why she was so upset. Then Beverly saw a pile of pinecones on the table, like the ones she'd seen in a neighbor's yard down the street. She came closer and looked at Eugene's hands. His fingers were sticky with sap. That's when she realized that Eugene had gone for a walk by himself. He had wandered down the street and collected some souvenirs.

And he had found his way home.

Soon, Eugene was going for walks every morning. Beverly tried to stop him, but it was pointless.

"Even if I told him to stay inside, he wouldn't remember a few minutes later," she told me. "I followed him a few times to make sure he wouldn't get lost, but he always came back." Sometimes he would return with pinecones or rocks. Once he came back with a wallet; another time with a puppy. He never remembered where they came from.

When Squire and his assistants heard about these walks, they started to suspect that something was happening inside Eugene's head that didn't have anything to do with his conscious memory. They designed an experiment. One of Squire's assistants visited the house one day and asked Eugene to draw a map of the block where he lived. He couldn't do it. How about where his house was located on the street, she asked. He doodled a bit, then forgot the assignment. She asked him to point out which doorway led to the kitchen. Eugene looked around the room. He didn't know, he said. She asked Eugene what he would do if he were hungry. He stood up, walked into the kitchen, opened a cabinet, and took down a jar of nuts.

Later that week, a visitor joined Eugene on his daily stroll. They walked for about fifteen minutes through the perpetual spring of Southern California, the scent of bougainvillea heavy in the air. Eugene didn't say much, but he always led the way and seemed to know where he was going. He never asked for directions. As they rounded the corner near his house, the visitor asked Eugene where he lived. "I don't know, exactly," he said.

Then he walked up his sidewalk, opened his front door, went into the living room, and turned on the television.

It was clear to Squire that Eugene was absorbing new information. But where inside his brain was that information residing? How could someone find a jar of nuts when he couldn't say where the kitchen was located? Or find his way home when he had no idea which house was his? How, Squire wondered, were new patterns forming inside Eugene's damaged brain?

II.

Within the building that houses the Brain and Cognitive Sciences department of the Massachusetts Institute of Technology are laboratories that contain what, to the casual observer, look like dollhouse versions of surgical theaters. There are tiny scalpels, small drills, and miniature saws less than a quarter inch wide attached to robotic arms. Even the operating tables are tiny, as if prepared for child-sized surgeons. The rooms are always kept at a chilly sixty degrees because a slight nip in the air steadies researchers' fingers during delicate procedures. Inside these laboratories, neurologists cut into the skulls of anesthetized rats, implanting tiny sensors that can record the smallest changes inside their brains. When the rats wake, they hardly seem to notice that there are now dozens of microscopic wires arrayed, like neurological spider webs, inside their heads.

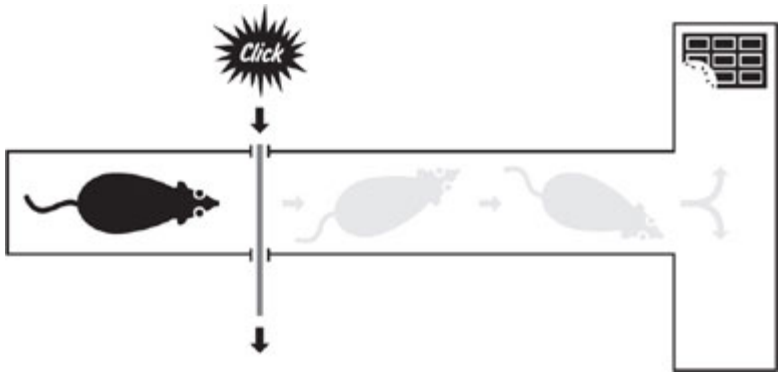
These laboratories have become the epicenter for a quiet revolution in the science of habit formation, and the experiments unfolding here explain how Eugene—as well as you, me, and everyone else—developed the behaviors necessary to make it through each day. The rats in these labs have illuminated the complexity that occurs inside our heads whenever we do something as mundane as brush our teeth or back the car out of the driveway. And for Squire, these laboratories helped explain how Eugene managed to learn new habits.

When the MIT researchers started working on habits in the 1990s—at about the same time that Eugene came down with his fever—they were curious about a nub of neurological tissue known as the basal ganglia. If you picture the human brain as an onion, composed of layer upon layer of cells, then the outside layers—those closest to the scalp—are generally the

most recent additions from an evolutionary perspective. When you dream up a new invention or laugh at a friend's joke, it's the outside parts of your brain at work. That's where the most complex thinking occurs.

Deeper inside the brain and closer to the brain stem—where the brain meets the spinal column—are older, more primitive structures. They control our automatic behaviors, such as breathing and swallowing, or the startle response we feel when someone leaps out from behind a bush. Toward the center of the skull is a golf ball–sized lump of tissue that is similar to what you might find inside the head of a fish, reptile, or mammal.[1.12] This is the basal ganglia, an oval of cells that, for years, scientists didn't understand very well, except for suspicions that it played a role in diseases such as Parkinson's.[1.13, 1.14]

In the early 1990s, the MIT researchers began wondering if the basal ganglia might be integral to habits as well. They noticed that animals with injured basal ganglia suddenly developed problems with tasks such as learning how to run through mazes or remembering how to open food containers.[1.15] They decided to experiment by employing new micro-technologies that allowed them to observe, in minute detail, what was occurring within the heads of rats as they performed dozens of routines. In surgery, each rat had what looked like a small joystick and dozens of tiny wires inserted into its skull. Afterward, the animal was placed into a T-shaped maze with chocolate at one end.



The maze was structured so that each rat was positioned behind a partition that opened when a loud click sounded.[1.16] Initially, when a rat heard the click and saw the partition disappear, it would usually wander up and down the center aisle, sniffing in corners and scratching at walls. It

appeared to smell the chocolate, but couldn't figure out how to find it. When it reached the top of the T, it often turned to the right, away from the chocolate, and then wandered left, sometimes pausing for no obvious reason. Eventually, most animals discovered the reward. But there was no discernible pattern in their meanderings. It seemed as if each rat was taking a leisurely, unthinking stroll.

The probes in the rats' heads, however, told a different story. While each animal wandered through the maze, its brain—and in particular, its basal ganglia—worked furiously. Each time a rat sniffed the air or scratched a wall, its brain exploded with activity, as if analyzing each new scent, sight, and sound. The rat was processing information the entire time it meandered.

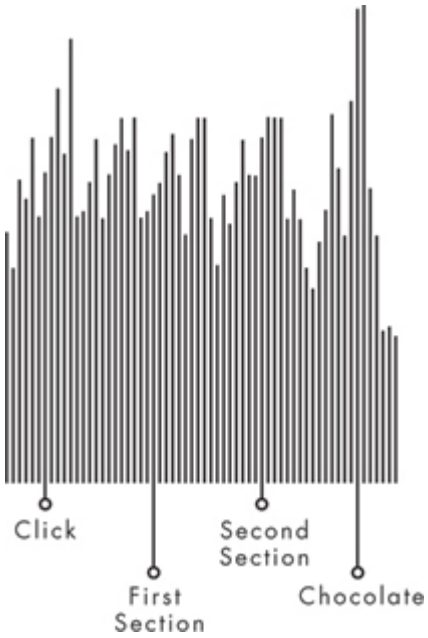
The scientists repeated their experiment, again and again, watching how each rat's brain activity changed as it moved through the same route hundreds of times. A series of shifts slowly emerged. The rats stopped sniffing corners and making wrong turns. Instead, they zipped through the maze faster and faster. And within their brains, something unexpected occurred: As each rat learned how to navigate the maze, its mental activity *decreased*. As the route became more and more automatic, each rat started thinking less and less.

It was as if the first few times a rat explored the maze, its brain had to work at full power to make sense of all the new information. But after a few days of running the same route, the rat didn't need to scratch the walls or smell the air anymore, and so the brain activity associated with scratching and smelling ceased. It didn't need to choose which direction to turn, and so decision-making centers of the brain went quiet. All it had to do was recall the quickest path to the chocolate. Within a week, even the brain structures related to memory had quieted. The rat had internalized how to sprint through the maze to such a degree that it hardly needed to think at all.

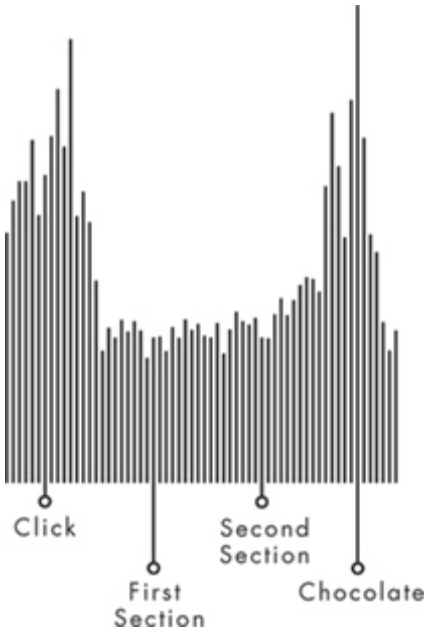
But that internalization—run straight, hang a left, eat the chocolate—relied upon the basal ganglia, the brain probes indicated. This tiny, ancient neurological structure seemed to take over as the rat ran faster and faster and its brain worked less and less. The basal ganglia was central to recalling patterns and acting on them. The basal ganglia, in other words, stored habits even while the rest of the brain went to sleep.

To see this capacity in action, consider this graph, which shows activity within a rat's skull as it encounters the maze for the first time.[1.17] Initially,

the brain is working hard the entire time:



After a week, once the route is familiar and the scurrying has become a habit, the rat's brain settles down as it runs through the maze:



This process—in which the brain converts a sequence of actions into an automatic routine—is known as "chunking," and it's at the root of how habits form.[1.18] There are dozens—if not hundreds—of behavioral chunks

that we rely on every day. Some are simple: You automatically put toothpaste on your toothbrush before sticking it in your mouth. Some, such as getting dressed or making the kids' lunch, are a little more complex.

Others are so complicated that it's remarkable a small bit of tissue that evolved millions of years ago can turn them into habits at all. Take the act of backing your car out of the driveway. When you first learned to drive, the driveway required a major dose of concentration, and for good reason: It involves opening the garage, unlocking the car door, adjusting the seat, inserting the key in the ignition, turning it clockwise, moving the rearview and side mirrors and checking for obstacles, putting your foot on the brake, moving the gearshift into reverse, removing your foot from the brake, mentally estimating the distance between the garage and the street while keeping the wheels aligned and monitoring for oncoming traffic, calculating how reflected images in the mirrors translate into actual distances between the bumper, the garbage cans, and the hedges, all while applying slight pressure to the gas pedal and brake, and, most likely, telling your passenger to please stop fiddling with the radio.

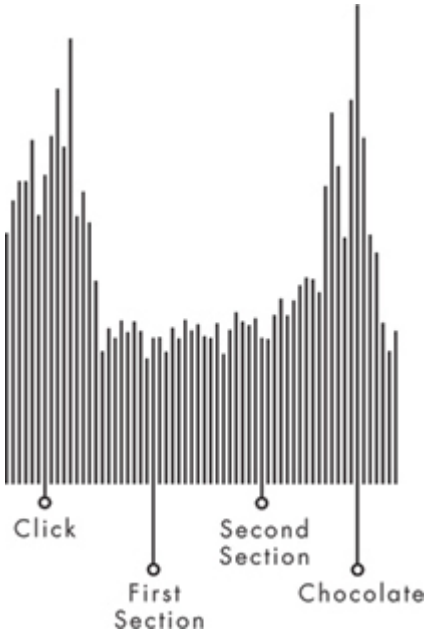
Nowadays, however, you do all of that every time you pull onto the street with hardly any thought. The routine occurs by habit.

Millions of people perform this intricate ballet every morning, unthinkingly, because as soon as we pull out the car keys, our basal ganglia kicks in, identifying the habit we've stored in our brains related to backing an automobile into the street. Once that habit starts unfolding, our gray matter is free to quiet itself or chase other thoughts, which is why we have enough mental capacity to realize that Jimmy forgot his lunchbox inside.

Habits, scientists say, emerge because the brain is constantly looking for ways to save effort. Left to its own devices, the brain will try to make almost any routine into a habit, because habits allow our minds to ramp down more often. This effort-saving instinct is a huge advantage. An efficient brain requires less room, which makes for a smaller head, which makes childbirth easier and therefore causes fewer infant and mother deaths. An efficient brain also allows us to stop thinking constantly about basic behaviors, such as walking and choosing what to eat, so we can devote mental energy to inventing spears, irrigation systems, and, eventually, airplanes and video games.

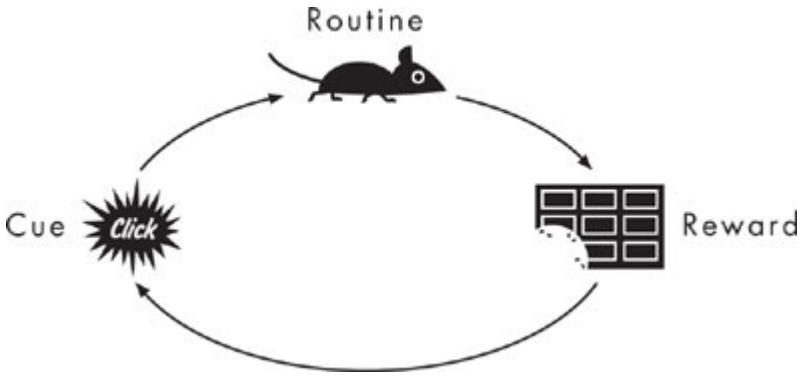
But conserving mental effort is tricky, because if our brains power down at the wrong moment, we might fail to notice something important, such as a predator hiding in the bushes or a speeding car as we pull onto the street. So our basal ganglia have devised a clever system to determine when to let habits take over. It's something that happens whenever a chunk of behavior starts or ends.

To see how it works, look closely at the graph of the rat's neurological habit again. Notice that brain activity spikes at the beginning of the maze, when the rat hears the click before the partition starts moving, and again at the end, when it finds the chocolate.



Those spikes are the brain's way of determining when to cede control to a habit, and which habit to use. From behind a partition, for instance, it's difficult for a rat to know if it's inside a familiar maze or an unfamiliar cupboard with a cat lurking outside. To deal with this uncertainty, the brain spends a lot of effort at the beginning of a habit looking for something—a cue—that offers a hint as to which pattern to use. From behind a partition, if a rat hears a click, it knows to use the maze habit. If it hears a meow, it chooses a different pattern. And at the end of the activity, when the reward appears, the brain shakes itself awake and makes sure everything unfolded as expected.

This process within our brains is a three-step loop. First, there is a *cue,* a trigger that tells your brain to go into automatic mode and which habit to use. Then there is the *routine,* which can be physical or mental or emotional. Finally, there is a *reward,* which helps your brain figure out if this particular loop is worth remembering for the future:



THE HABIT LOOP

Over time, this loop—cue, routine, reward; cue, routine, reward—becomes more and more automatic. The cue and reward become intertwined until a powerful sense of anticipation and craving emerges. Eventually, whether in a chilly MIT laboratory or your driveway, a habit is born.[1.19]

Habits aren't destiny. As the next two chapters explain, habits can be ignored, changed, or replaced. But the reason the discovery of the habit loop is so important is that it reveals a basic truth: When a habit emerges, the brain stops fully participating in decision making. It stops working so hard, or diverts focus to other tasks. So unless you deliberately *fight* a habit—unless you find new routines—the pattern will unfold automatically.

However, simply understanding how habits work—learning the structure of the habit loop—makes them easier to control. Once you break a habit into its components, you can fiddle with the gears.

"We've done experiments where we trained rats to run down a maze until it was a habit, and then we extinguished the habit by changing the