THE GREAT MENTAL MODELS

General Thinking Concepts

SHANE PARRISH

VOLUME 1

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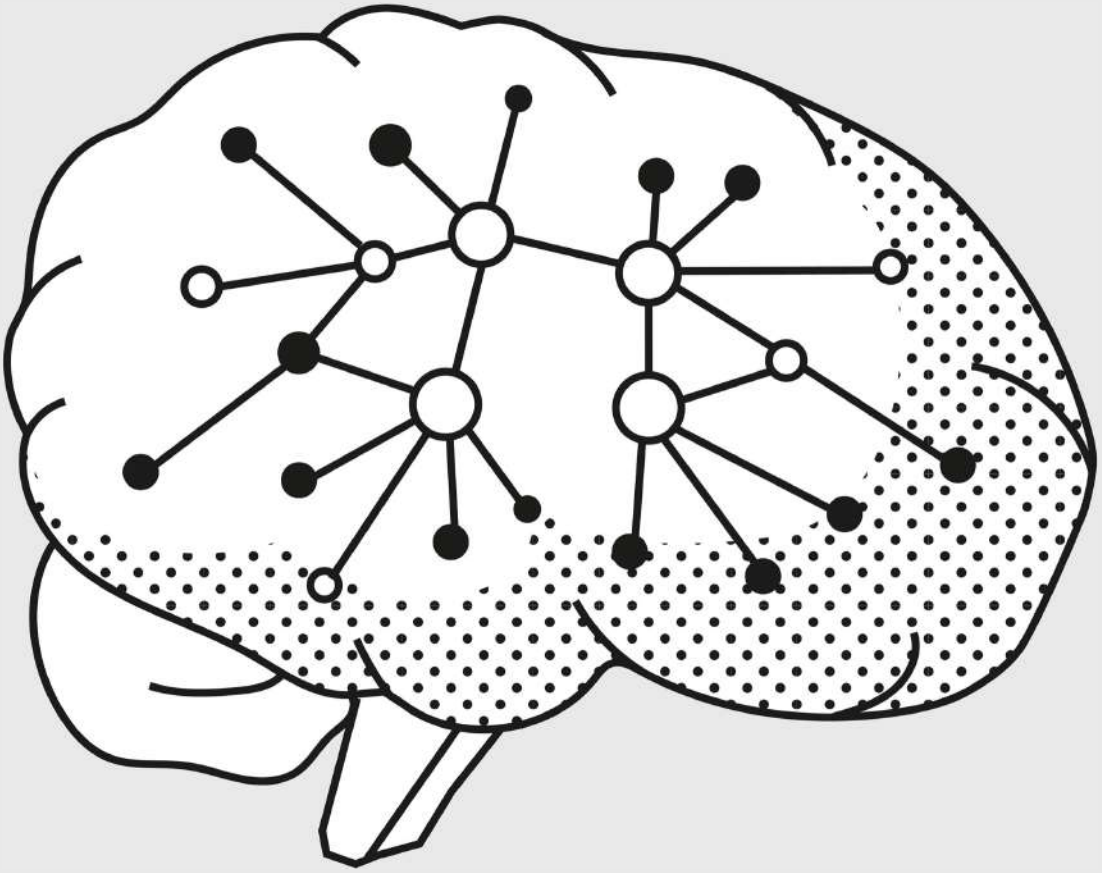


The key to better understanding the world is to build a latticework of mental models.

Preface

Education doesn't prepare you for the real world. At least, it didn't prepare me. I was two weeks into my job at an intelligence agency on September 11, 2001, when the world suddenly changed. The job I had been hired to do was no longer the one that was needed. Instead, I was thrust into a series of promotions for which I had received no guidance and that came with responsibilities I had no idea how to navigate. I had a computer science degree; I came from a world of 1s and 0s, not people, families, and interpersonal dynamics. Now, I found that my decisions affected not only my employees but their families; not only my country but other countries. The problem? I had no idea how to make decisions. I only knew I had an obligation to make the best decisions I could.

To improve my ability to make decisions, I looked around and found some mentors. I watched them carefully and learned from them. I read everything I could about making decisions. I even took some time to go back to school and earn my MBA, hoping that I would finally learn how to make better decisions, as if "making better decisions" was some end state rather than a constantly evolving journey.

My belief that the MBA program was a good use of my time eroded quickly. When I showed up to write an exam, only to find out it was an open-book test, I realized my expectations were entirely wrong and in need of updating. Was I in a master's program or grade school? Some days, I couldn't tell. And yet that program is where everything changed for me.

I realized that I couldn't fail, as long as I knew where the answers were in the books I could bring to the exams. This was quite liberating. I stopped putting effort into my assignments and started learning about someone who was often casually mentioned in class. That person was Charlie Munger. I

went from studying theoretical examples that were completely divorced from the real world to studying the wisdom behind the achievements of one of the most successful businessmen of all time. Munger, who you will come to know in these volumes, is the deceased billionaire business partner of Warren Buffett at Berkshire Hathaway. He was easy to like: intelligent, witty, and irreverent. Finding Munger opened the door to unexpected intellectual pleasure. I felt I had finally found knowledge that was useful, because it was gained from someone's real effort to better understand how the world works. It was so much more satisfying to learn from someone who had tried to put many theories into practice and was willing to share his results than from anemic economic theorists. The fact that Munger was so professionally successful made it even more compelling.

Munger had a way of thinking through problems using what he calls a broad latticework of mental models. These are chunks of knowledge from different disciplines that can be simplified and applied to better understand the world. The way Munger described it, these mental models help identify what information is relevant in any given situation and the most reasonable parameters to work within. His track record in business shows that this doesn't just make sense in theory but is devastatingly useful in practice.

I started writing about my learnings, the result being my website, *Farnam Street* (https://fs.blog). The past eight years of my life have been devoted to identifying and learning the mental models that have the greatest positive impact, and trying to understand how we think, how we update, how we learn, and how we can make better decisions.

I joke with my kids that if you want to suck up someone's brain, you should simply read a book. All the great wisdom of humanity is written down somewhere. One day, when we were talking about mental models, the kids asked if we had *the* mental models book. This made me pause. I was struck with the realization that such a book didn't exist. I didn't have something I could share with my kids, and that was a problem—a solvable problem.

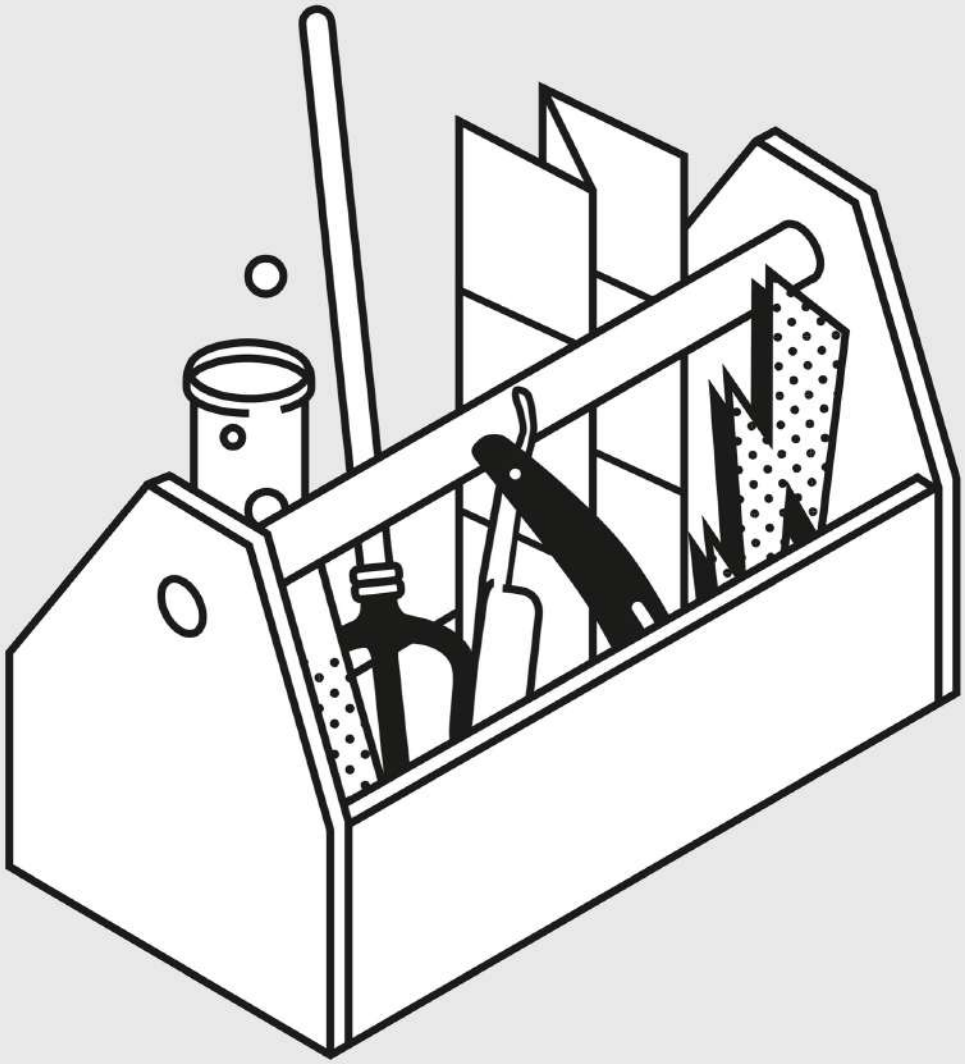
This book, and the three further volumes that follow, are the books I wish had existed years ago, when I started learning about mental models.

They are my homage to the idea that we can benefit from understanding how the world works and apply that understanding to keep us out of trouble.

The ideas in these volumes are not my own, nor do I deserve any credit for them. They come from the likes of Charlie Munger, Nassim Nicholas Taleb, Charles Darwin, Peter D. Kaufman, Peter Bevelin, Richard Feynman, Albert Einstein, and so many others. As the Roman poet Terence wrote: “Nothing has yet been said that’s not been said before.” We’ve only curated, edited, and shaped the work of others before me.

The timeless, broad ideas in these volumes are for my children, and their children, and their children’s children. In creating these books, I hope to enable others to approach problems with clarity and confidence, helping to make their journey through life more successful and rewarding.

Introduction: Acquiring Wisdom



You’re only as good as your tools.

It is remarkable how much long-term advantage people like us have gotten by trying to be consistently not stupid, instead of trying to be very intelligent.

—CHARLIE MUNGER

In life and business, the person with the fewest blind spots wins. Blind spots are the source of all poor decisions. Think about it: If you had perfect information, you would always make the best decision. In a poker game where you could see everyone's cards, you'd play your hand perfectly. You wouldn't make any mistakes.

Unfortunately, we have a lot of blind spots. And while we can't eliminate them, we can reduce them. Reducing blind spots means we see, interact with, and move closer to understanding reality. We think better. And thinking better is about finding simple processes that help us work through problems from multiple dimensions and perspectives, allowing us to better choose solutions that fit the objective. The skill behind finding the right solutions for the right problems is one form of wisdom.

This book is about the pursuit of that type of wisdom—the pursuit of uncovering how things work, the pursuit of going to bed smarter than when we woke up. It is a book about getting out of our own way so we can better understand how the world really is. Decisions based on improved understanding will be better than ones based on ignorance. While, inevitably, we can't predict which problems will crop up in life, we can learn time-tested ideas that help position us for whatever the world throws at us.

Perhaps more importantly, this book is about *avoiding* problems. This often comes down to understanding a problem accurately and seeing the secondary and subsequent consequences of any proposed action. The author and explorer of mental models Peter Bevelin put it best: "I don't want to be a great problem solver. I want to avoid problems—prevent them from happening and do it right from the beginning."[1]

How can we do things right from the beginning?

We must understand how the world works and adjust our behavior accordingly. Contrary to what we're led to believe, thinking better isn't about being a genius. It is about the processes we use to uncover reality and the choices we make once we do.

How This Book Can Help You

This is the first of four volumes aimed at defining and exploring the Great Mental Models—those with the broadest utility across our lives.

Mental models describe the way the world works. They shape how we think, how we understand, and how we form beliefs. Largely subconscious, mental models operate below the surface. We're not generally aware of them, and yet when we look at a problem, they're the reason we consider some factors relevant and others irrelevant. They are how we infer causality, match patterns, and draw analogies. They are how we think and reason.

A mental model is a compression of how something works. Any idea, belief, or concept can be distilled down. Like maps, mental models reveal key information while ignoring the nonessential. For example, you likely have a useful idea about how inertia works, even though you don't know all the technical details.

Mental models help us better understand the world. While this might sound a bit academic, it's not. For example, velocity helps us understand that both speed and direction matter. Reciprocity helps us understand how going positive and going first gets the world to do most of the work for us. The idea of a margin of safety helps us understand that things don't always go as planned. Relativity shows us how a different perspective changes everything. The list goes on.

It doesn't matter what the model is or where it comes from—the question to ask yourself is whether it is useful. The world is not divided into distinct disciplines. For example, business professors won't discuss physics in their lectures, but they should. Velocity teaches us that going in the right direction matters more than how fast you go. Kinetic energy teaches us that your company's velocity matters more than its size when creating an impact in the market. Understanding and applying these insights helps you outperform your competition.

While it helps to think of each model as a map, collectively they act as lenses through which you can see the world. Each lens (model) offers a different perspective, revealing new information. Looking through one lens lets you see one thing, and looking through another reveals something different. Looking through them both reveals more than looking through each one individually.

Whether we realize it or not, mental models help us think at the subconscious level. They shape what we see, what we choose to ignore, and what we miss entirely. While there are millions of mental models, these volumes focus on the ones with the greatest utility—the all-star team of mental models.

Volume 1 presents the first nine models, which are general thinking concepts. Although these models are hiding in plain sight, they are useful tools that you likely were never directly taught. Put to proper use, they will improve your understanding of the world we live in and your ability to look at a situation through different lenses, each of which reveals a different layer. They can be used in a wide variety of situations and are essential to making rational decisions, even when there is no clear path. Collectively, they will allow you to walk around any problem in a three-dimensional way.

Our approach to the Great Mental Models rests on the idea that the fundamentals of knowledge are available to everyone. There is no discipline that is off-limits—the core ideas from all fields of study contain principles that reveal how the universe works and are therefore essential to navigating it. Our models come from fundamental disciplines that most of us have never studied, but no prior knowledge is required, only a sharp mind with a desire to learn.

Why Mental Models?

There is no system that can prepare us for all risks. Factors of chance introduce a level of complexity to any situation that is not entirely

predictable. But being able to draw on a repertoire of timeless mental models can help us minimize risk by better understanding the forces that are at play. *Likely* consequences don't have to be a mystery.

Not having the ability to shift perspective by applying knowledge from multiple disciplines makes us vulnerable. Mistakes can become catastrophes whose effects keep compounding, creating stress and limiting our choices. Multidisciplinary thinking—learning these mental models and applying them across our lives—creates less stress and more freedom. The more we can draw on the diverse knowledge contained in these models, the more solutions will present themselves.

Understanding Reality

"Understanding reality" is a vague phrase, one you've already encountered a few times as you've read this book. Of course, we want to understand reality, but how do we do that? And why is it important?

In order to see a problem for what it is, we must first break it down into its substantive parts, so the interconnections can reveal themselves. This bottom-up perspective allows us to expose what we believe to be the causal relationships within the problem and determine how they will govern the situation both now and in the future. Being able to accurately describe the full scope of a situation is the first step to understanding it.

Using the lenses of our mental models helps us illuminate these interconnections. The more lenses used on a given problem, the more reality reveals itself. The more of reality we see, the fewer blind spots we have. The fewer blind spots we have, the better the options at our disposal.

Simple and well-defined problems won't need many lenses, as the variables that matter are known; so too are the interactions between them. In such cases, we generally know what to do to get the intended result with the fewest side effects possible. When problems are more complicated, however, the value of having a brain full of lenses becomes readily apparent.

That’s not to say all lenses (or models) apply to all problems. They don’t. And it’s not to say that having more lenses (or models) will be an advantage in thinking through all problems; it won’t. This is why learning and applying the Great Mental Models is a process that takes some work. But the truth is, most problems are multidimensional, and thus having more lenses often offers significant help with the problems we are facing.

Keeping Your Feet on the Ground

In Greek mythology, Antaeus was the human-giant son of Poseidon, god of the sea, and Gaia, Mother Earth. Antaeus had a strange habit: he would challenge all those who passed through his country to a wrestling match. As in wrestling today, the goal was to force the opponent to the ground. Antaeus always won, and his defeated opponents’ skulls were used to build a temple to his father. While Antaeus was undefeated and nearly undefeatable, there was a catch to his invulnerability. His epic strength depended on constant contact with the earth; when he lost touch with the earth, he lost all his strength. The great hero lost to Heracles, who simply lifted him off the ground.

On the way to the Garden of the Hesperides, Heracles was to fight Antaeus as one of his twelve labors. After a few rounds in which Heracles flung the giant to the ground, only to watch him revive, he realized he could not win by using traditional wrestling techniques. Instead, Heracles fought to lift Antaeus off the ground. With the earthly connection broken, Antaeus was separated from the source of his power, causing him to lose his strength. From that point on, it was easy for Heracles to crush him.[2],[3]

When understanding is separated from reality, we lose our powers to make better decisions. Understanding must constantly be tested against reality and updated accordingly. This isn’t a box we can tick, a task with a definite beginning and end, but rather a continuous process.

We all know the person who seems to have all the answers. They know how to fix all the problems at work, solve world hunger, and get in shape (if

only they wanted to). If you don't test your ideas against the real world—if you don't keep contact with the earth—how can you be sure you understand it? While pontificating with friends over a bottle of wine at dinner can be fun, the only way you'll know the extent to which you understand reality is to put your ideas into action.

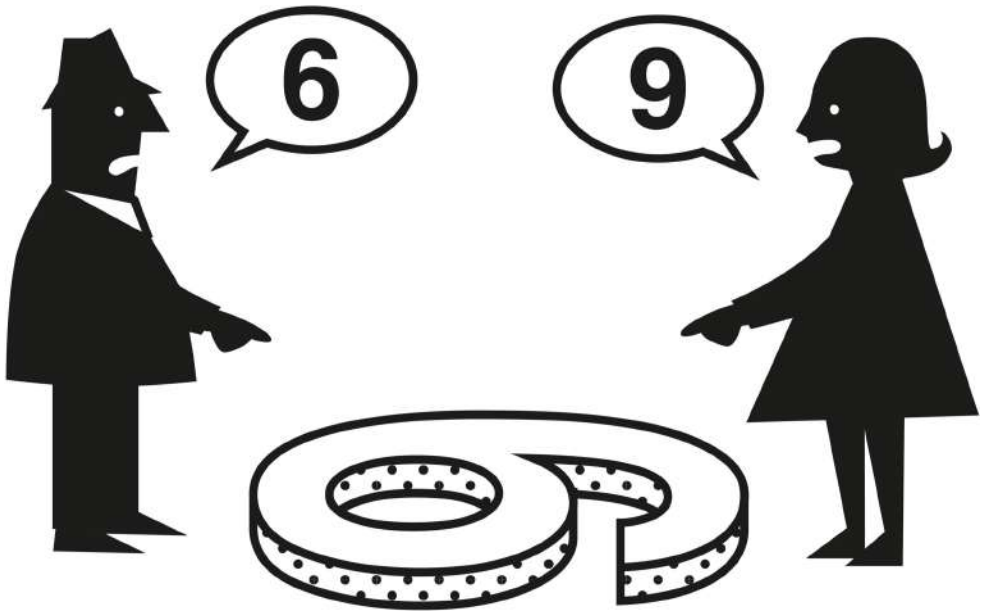
Getting in Our Own Way

The biggest barrier to learning from the world is ourselves. It's hard to understand a system that we are part of because we have blind spots, where we can't see what we aren't looking for and don't notice what we don't notice.

> There are these two young fish swimming along, and they happen to meet an older fish, swimming the other way, who nods at them and says, "Morning, boys. How's the water?" And the two young fish swim on for a bit, and then eventually one of them looks over at the other and goes, "What the hell is water?"
>
> **—DAVID FOSTER WALLACE**[4]

Our failures to update our mental models as we interact with the world spring primarily from three factors: not having the right perspective or vantage point, ego-induced denial, and distance from the consequences of our decisions. As we will learn in greater detail throughout these volumes on mental models, all of these can get in the way. They make it easier to keep our existing and flawed beliefs than to update them accordingly. Let's briefly flesh out these flaws:

The first flaw is failure of perspective. We have a hard time seeing any system that we are a part of. We think our angle of perception is the right one and the only one.



Galileo had a great analogy to describe the limits of our default perspective: Imagine you are on a ship that has reached constant velocity (meaning there is no change in speed or direction). You are belowdecks, and there are no portholes. You drop a ball from your raised hand to the floor. To you, it looks as if the ball is dropping straight down, thereby confirming gravity is at work.

Now imagine you are a fish (with special X-ray vision) and you are watching this ship go past. You see the scientist inside, dropping a ball. You register the vertical change in the position of the ball. But you are also able to see a horizontal change. As the ball was pulled down by gravity, it also shifted its position eastward by about twenty feet. The ship moved through the water, and therefore so did the ball. The scientist onboard, with no external point of reference, was not able to perceive this horizontal shift.

This analogy shows us the limits of our perception. If we truly want to understand the results of our actions, we must be open to other perspectives. Allowing for other perspectives is also key to having productive relationships with others.

The second flaw is ego—the part of us that's afraid and always in competition. The ego is easily triggered and never feels satiated. Many of us tend to have too much invested in our opinion of ourselves to see the

world’s feedback—the feedback we need to update our beliefs about reality. This creates a profound ignorance that keeps us repeatedly banging our heads against the wall. Our inability to learn from the world because of our ego arises for many reasons, but two are worth mentioning here. First, we’re often so afraid of what others will say about us that we fail to put our ideas out there and subject them to criticism; this way, we can always be right. Second, if we do put our ideas out there, and they’re criticized, our ego steps in to protect us—we become invested in defending, instead of upgrading, our ideas. This is antithetical to growth.

The third flaw is distance. The further we are from the results of our decisions, the easier it is to maintain our current views rather than update them. When you put your hand on a hot stove, you quickly learn the natural consequence of doing so. You pay the price for your mistake. Since you are a pain-avoiding creature, you instantly update your knowledge. Before you touch another stove, you check to see if it’s hot. But you don’t just learn a micro lesson that applies in one situation. Instead, you draw a generalization, one that tells you to check before touching anything that could potentially be hot.

Large organizations often remove us from the direct consequences of our decisions. When we make decisions that other people carry out, we are one or more levels removed from their consequences and may not immediately be able to update our understanding—we come a little off the ground, if you will. The further we are from the feedback on our decisions, the easier it is to convince ourselves that we are right and avoid the challenge, the pain, of updating our views.

Admitting we’re wrong is tough. At a high level, it’s easier to fool ourselves that we’re right than it is at the micro level, because at the micro level we see and feel the immediate consequences. At a high or macro level, we are removed from the immediacy of the situation, and our ego steps in to create a narrative that suits what we want to believe, instead of what has really happened.

These flaws are the main reasons we keep repeating the same mistakes, and why we need to keep our feet on the ground as much as we can. As

Confucius reportedly said, “A man who has committed a mistake and doesn’t correct it, is committing another mistake.”

Most of the time, we don’t even perceive whatever conflicts with our beliefs. It’s much easier to go on thinking what we’ve already been thinking than go through the pain of updating our existing false beliefs. When it comes to seeing what is—that is, understanding reality—we can follow Charles Darwin’s advice to notice things “which easily escape attention” and ask why things happened.[5]

We also tend to undervalue elementary ideas and overvalue complicated ones. This makes sense: Most of us get jobs based on some form of specialized knowledge. We don’t think we have much value if we know the things everyone else does, so we focus our effort on developing unique expertise to set ourselves apart. In an effort to ensure that our contributions are unique, we often end up rejecting simple solutions and focusing instead on complexity. But simple ideas are of great value because they can help us prevent complex problems.

In identifying the Great Mental Models, we have looked for elementary principles, the ideas from multiple disciplines that form a timeless foundation for thought. It may seem bold to suggest that the same principles can improve everyone’s life, but the universe works in the same way no matter where you are in it. This is part of what makes the Great Mental Models so valuable—by understanding the principles, you can easily change tactics and apply the ones you need for your particular circumstances.

> Most geniuses—especially those who lead others—prosper not by deconstructing intricate complexities but by exploiting unrecognized simplicities.
>
> **—ANDY BENOIT**[6]

These elementary ideas, so often overlooked, come from multiple disciplines including biology, physics, chemistry, and more. They help us understand the interconnections of the world and see it for how it really is. This understanding in turn allows us to develop causal relationships, which allow us to match patterns, which allow us to draw analogies—all of this so we can navigate reality with clarity on the real dynamics involved.

Understanding Is Not Enough

Understanding reality is not everything. The pursuit of understanding fuels meaning and adaptation, but this understanding by itself is not enough.

Understanding becomes useful only when we *adjust our behavior and actions accordingly*. The Great Mental Models are not just theory; they are actionable insights that can be used to create positive change in your life. What good is it to know that you constantly interrupt people, if you fail to adjust your behavior in light of this understanding? Granted, recognizing a mistake is easier than changing our behavior, since behavior patterns tend to be ingrained. It takes effort to change behavior, but your effort will be well spent. Don’t give up; change requires consistency. If you stick with it, you’ll see the fruits of your new understanding and its many downstream effects in real life.

Understand and Adapt or Fail

Now you can see how we make suboptimal decisions and repeat mistakes: We are afraid to learn and to admit when we don’t know enough. This is the mindset that leads to poor initial decisions. These poor decisions are a source of stress and anxiety and consume massive amounts of time. Not when we’re making them—no, when we’re making them, they seem natural, because they align with how we *want* things to work.

We get tripped up when the world doesn’t work the way we want it to or when we fail to see what is. We end up negotiating with reality, in a fight

we are sure to lose; we think the world should work the way we want it to rather than the way it does. Instead of updating our views, we double down on our effort, accelerating our frustration and anxiety. It's only weeks or months later, when we're spending massive amounts of time fixing our mistakes, that we truly feel their weight. Then we wonder why we have no time for family and friends and why we're so consumed by things outside of our control.

It's easy to convince ourselves that these results stem from circumstances outside of our control. Even if that is partially true, it is not helpful. Passivity means that we rarely reflect on our previous decisions and attitudes and their outcomes. Without reflection, we cannot learn.[7] Without learning, we are doomed to repeat mistakes, become frustrated when the world doesn't work the way we want it to, and wonder why we are falling further behind. The cycle goes on.

Like it or not, we are not passive participants in our decision making. The world does not act on us as much as it reveals itself to us and we respond to it. We need to pay close attention to what's happening. Ego gets in the way of this attention, locking reality behind a door that it controls with a gating mechanism. Only through persistence in the face of having the door slammed on us over and over can we begin to see the light on the other side.

Ego usually works against us. It's that part of the mind that's always comparing and finding lack, fear, and unfairness. Things are never good enough for the ego. It always wants more—more money, more attention, more recognition. And sometimes it leads us to do reckless things to prove we are more. But whether ego is good or bad for you depends on the dose. In small amounts, ego is our friend.

If we had a perfect view of the world and made decisions rationally, we would never attempt to do the amazing things that make us human. Ego propels us. Why, without ego, would we even attempt to travel to Mars? After all, it's never been done before. We'd never start a business, because most of them fail. We need to learn to understand when ego serves us and when it hinders us. When we strive more toward outcomes rather than

personal status—especially if those outcomes benefit more people than ourselves—that's a good use of ego.

Ego can be blinding when we optimize for short-term status protection over long-term happiness. This is the difference between being right and being effective. As we mature, our understanding of things turns from black-and-white to shades of gray. The world is smarter than we are and it will teach us all we need to know if we're open to its feedback—if we keep our feet on the ground.

Mental Models and How to Use Them

Perhaps an example will help illustrate the mental models approach. Think of gravity, something we learned about as kids and perhaps studied more formally in college as adults. We each have a mental model about gravity, whether we know it or not. That model helps us understand how gravity works. We don't know all the details, but we know the basics.

Our model of gravity plays a fundamental role in our lives. It explains the movement of Earth around the sun. It informs the design of bridges and airplanes. It's one of the models we use to evaluate the safety of leaning on a guardrail or repairing a roof. But we also apply our understanding of gravity in other, less obvious ways. We use the model as a metaphor to explain the influence of strong personalities, as when we say, "He was pulled into her orbit." This is a reference to our basic understanding of the role of mass in gravity—the more there is, the stronger its pull. It also informs some classic sales techniques: Gravity diminishes with distance, and so too does your propensity to make an impulse purchase. Good salespeople know that the more distance you get, in time or geography, between yourself and the object of your desire, the less likely you are to buy it. Salespeople try to keep the pressure on, to get you to buy right away, before you can change your mind.

Gravity has been around since before humans, so we can consider it to be time-tested, reliable, and representative of reality. Our understanding of

gravity—in other words, our mental model—lets us anticipate what will happen and helps us explain what has happened. We don't need to be able to describe the physics in detail for the model to be useful.

However, not every model is as reliable as gravity, and all models are flawed in some way. Some are reliable in some situations but useless in others. Some are too limited in their scope to be of much use. Others are unreliable because they haven't been tested and challenged; yet others are just plain wrong. In every situation, we need to figure out which models are reliable and useful. We must also discard or update the unreliable ones, because unreliable or flawed models come with a cost.

For a long time, people believed that bloodletting cured many different illnesses. This mistaken belief led doctors to contribute to the deaths of many of their patients. When we use flawed models, we are more likely to misunderstand the situation, the variables that matter, and the cause-and-effect relationships between those variables. Because of such misunderstandings, we often take suboptimal actions, like draining so much blood out of patients that they die of it.

Better models mean better thinking. The more accurately our models explain reality, the more they improve our thinking. Understanding reality is the name of the game. Understanding not only helps us decide which actions to take but helps us avoid actions that have a big downside that we otherwise would not be aware of. When we understand, not only do we see the immediate problem with more accuracy, we can also begin to see the second-, third-, and higher-order consequences of various choices. This understanding helps us eliminate avoidable errors. Sometimes, making good decisions boils down to avoiding bad ones.

Flawed beliefs, regardless of the intentions behind them, cause harm when they are put into action. When it comes to applying mental models, we tend to run into trouble either when our model of reality is wrong—that is, it doesn't survive real-world experience—or when our model is right, but we apply it to a situation where it doesn't belong.

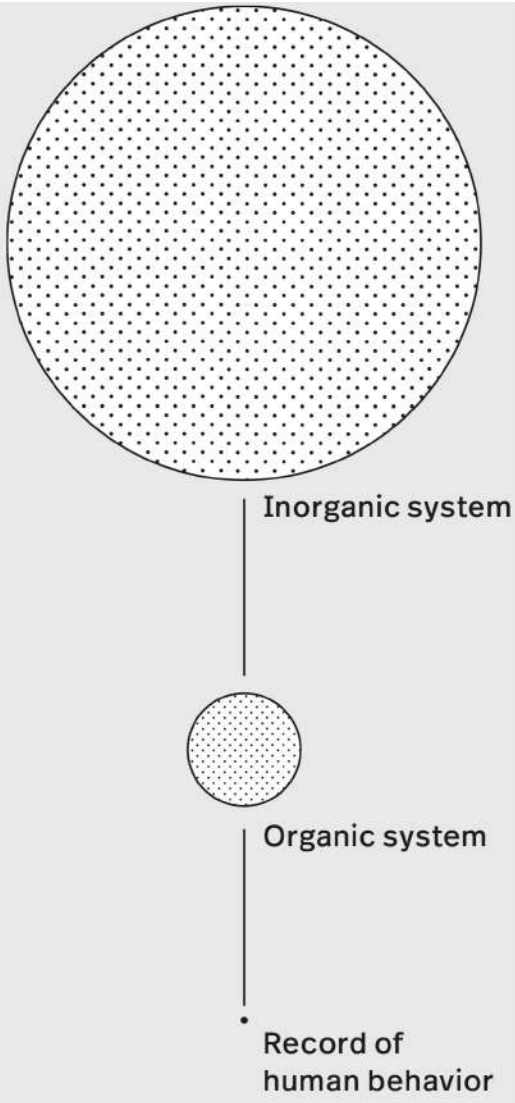
Models that don't hold up to reality cause mistakes. The model of bloodletting caused unnecessary deaths because it weakened patients when

they needed all their strength to fight their illnesses. It hung around for such a long time because it was part of a package of flawed models, such as ones explaining the causes of sickness and how the human body worked, that made it difficult to determine exactly where the bloodletting model didn’t fit with reality.

We compound the problem of flawed models when we fail to update our models after evidence indicates they are wrong. Only by repeatedly testing our models against reality *and* being open to feedback can we update our understanding of the world and change our thinking. We need to look at the results of applying a model over the largest sample size of problems possible to be able to refine it so that it aligns with how the world actually works.

What Can the Three Buckets of Knowledge Teach Us About History?

“Every statistician knows that a large, relevant sample size is their best friend. What are the three largest, most relevant sample sizes for identifying universal principles? Bucket number one is inorganic systems, which are 13.7 billion years in size. It’s all the laws of math and physics, the entire physical universe. Bucket number two is organic systems, 3.5 billion years of biology on Earth. And bucket number three is human history, you can pick your own number, I picked 20,000 years of recorded human behavior. Those are the three largest sample sizes we can access and the most relevant.”[8]



The larger and more relevant the sample size of data, the more reliable the model that's based on it. But the key to sample sizes is to look for them not just over space but over time. You need to reach back into the past as far as you can to contribute to your sample. We have a tendency to think that how the world is now is how it always was, and so we get caught up in validating our assumptions from what we find in the here and now. But the continents used to be pushed up against each other, dinosaurs walked the planet for millions of years, and we are not the only hominid to evolve. Looking to the past can provide essential context for understanding where we are now.

The Power of Acquiring New Models

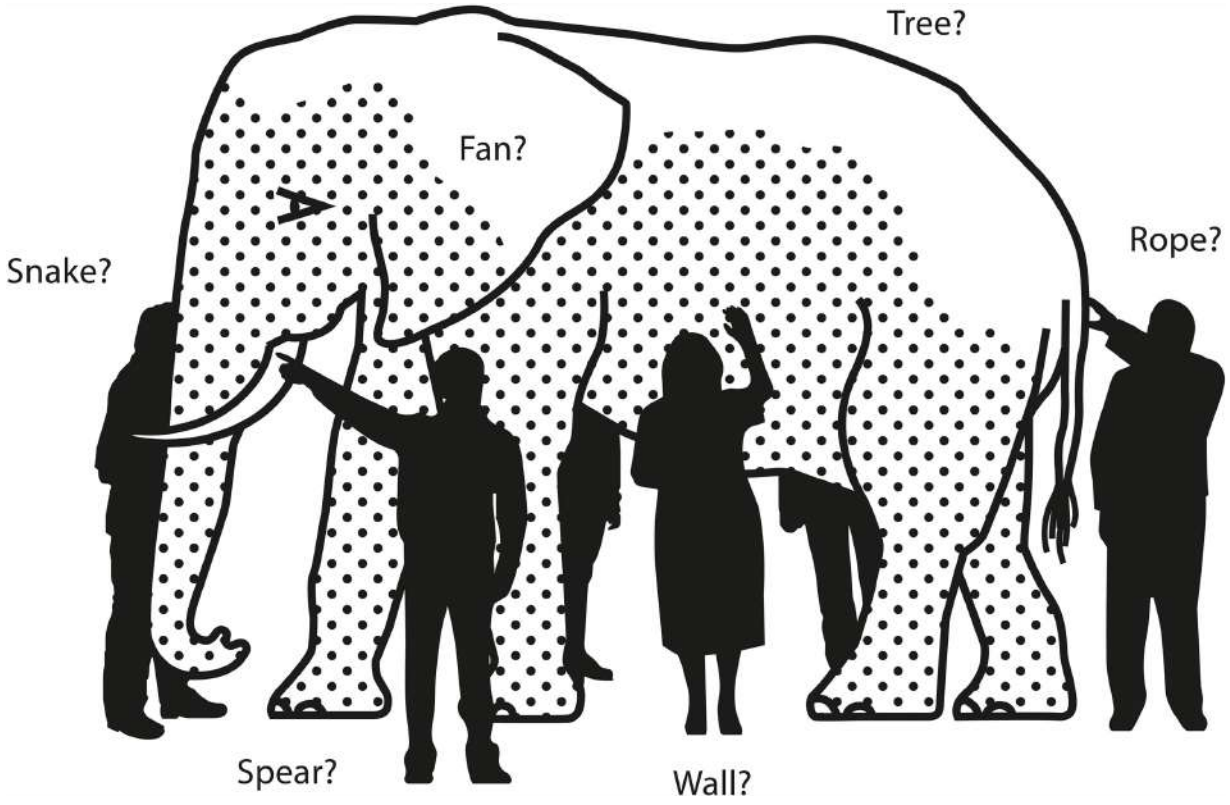
The quality of our thinking depends to a large extent on the mental models in our head. While we want useful models, we also want a wide variety of models to help us uncover what's really happening. Most of us study something specific and don't get exposure to the big ideas of other disciplines; we don't develop the multidisciplinary mindset that we need to accurately see a problem. And because we don't have the right models to understand the situation, we overuse the models we *do* have, applying them even where they don't belong.

You've likely experienced this firsthand: An engineer will often think in terms of systems by default. A psychologist will think in terms of incentives. A businessperson might think in terms of opportunity cost and risk-reward calculation. Through their respective lenses, each person sees part of the situation, the part of the world that makes sense to them. None of them, however, sees the entire situation unless they are thinking in a multidisciplinary way. In short, they have blind spots—big ones. And they're not aware of their blind spots. There is an adage that encapsulates this idea: "To the man with only a hammer, everything starts looking like a nail." Not every problem is a nail. The world is full of complications and interconnections that can only be explained through understanding multiple models.

Removing blind spots means thinking through the problem using different lenses or models. When we do this, our blind spots slowly go away, and we gain a more complete understanding of the problem.

Consider the parable of the blind men encountering an elephant for the first time, trying to understand it by touch. The first person, whose hand touches the trunk, says, "This creature is like a thick snake." For the second person, whose hand finds an ear, the elephant seems like a type of fan. The third person, whose hand is on a leg, says the elephant is a pillar, like a tree trunk. The fourth blind man, who places his hand on the creature's side,

says, “An elephant is a wall.” The fifth, who feels its tail, describes it as a rope. The last blind man touches a tusk and states that the elephant is something that is hard and smooth, like a spear. They are all right—yet they are also all wrong.



We’re much like the blind men in the classic parable, going through life trying to explain everything through our one limited lens of perspective. Too often that lens is driven by our particular field of expertise, be it economics, engineering, physics, mathematics, biology, chemistry, or something else entirely. Each of these disciplines holds some truth, and yet none of them contains the whole truth.

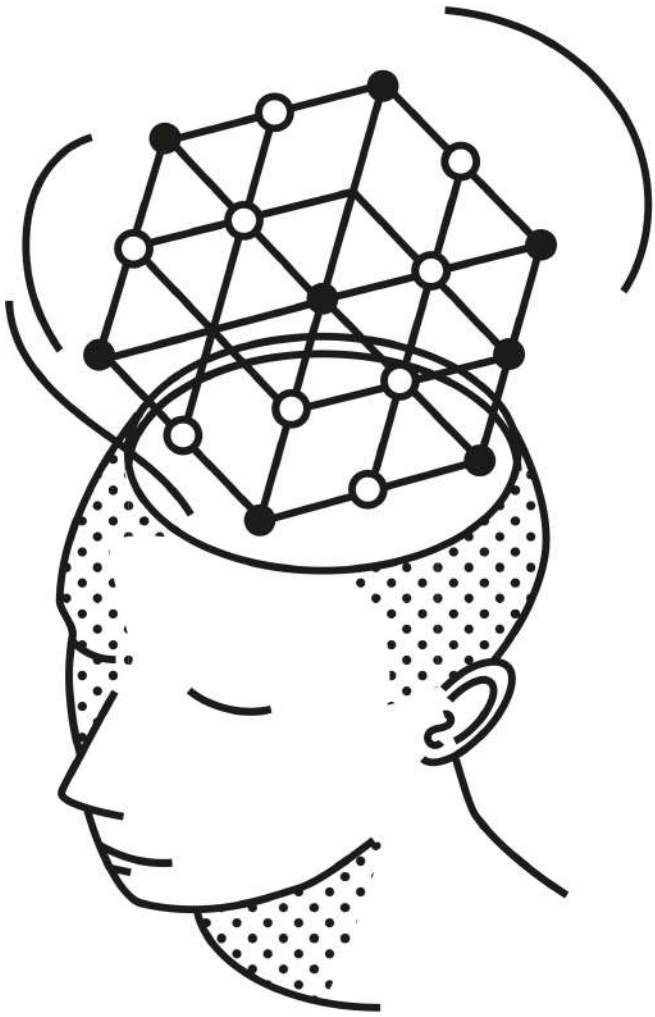
Here’s another way to look at it: Think of a forest. When a botanist looks at a forest, they focus on the ecosystem. An environmentalist sees the impact of climate change, a forest engineer the state of the trees’ growth, a businessperson the commercial value of the land. None is wrong, but neither is any of them able to describe the full scope of the forest. Sharing

knowledge, or learning the basics of other disciplines, would lead them to a more well-rounded understanding that would allow for better decisions about managing the forest.

> A lot of people start out with 400-horsepower motors but only get a hundred horsepower of output. It's way better to have a 200-horsepower motor and get it all into output.
>
> **—WARREN BUFFETT**[9]

Relying on only a few models is like having a four-hundred-horsepower brain that's generating only fifty horsepower of output. To increase your mental efficiency and reach your four-hundred-horsepower potential, you need to use Charlie Munger's latticework of mental models. Exactly the same sort of pattern that graces backyards everywhere, a lattice is a series of points that connect to and reinforce each other. The Great Mental Models can be understood in the same way—models influence and interact with each other to create a structure that can be used to evaluate and understand ideas.

In a famous speech he gave in the 1990s, Munger summed up his approach to practical wisdom: "Well, the first rule is that you can't really know anything if you just remember isolated facts and try and bang 'em back. If the facts don't hang together on a latticework of theory, you don't have them in a usable form. You've got to have models in your head. And you've got to array your experience—both vicarious and direct—on this latticework of models. You may have noticed students who just try to remember and pound back what is remembered. Well, they fail in school and in life. You've got to hang experience on a latticework of models in your head."[10]



> The chief enemy of good decisions is a lack of sufficient perspectives on a problem.
>
> **—ALAIN DE BOTTON**[11]

Expanding Your Latticework of Mental Models

A latticework is an excellent way to conceptualize mental models because it demonstrates the reality and value of interconnecting knowledge. The world does not isolate itself into discrete disciplines. We break it down that way

only because it makes it easier to study it. Once we learn something, we need to put it back into the complex system in which it occurs. We need to see where it connects to other bits of knowledge, to build our understanding of the whole. This is the value of putting the knowledge contained in mental models into a latticework.

Our latticework reduces the blind spots that limit our view of not only the immediate problem but also the second- and subsequent-order effects of our potential solutions. Without a latticework of the Great Mental Models, our decisions become harder, slower, and less creative. By using a mental models approach, by being curious about how the rest of the world works, we can complement our specializations. A quick glance at the lists of Nobel Prize winners shows that many of them, obviously extreme specialists in something, had multidisciplinary interests that supported their achievements.

To help you build your own latticework of mental models, this book, and the volumes that follow, will attempt to arm you with the big models from multiple disciplines. We'll look at biology, physics, chemistry, economics, and even psychology. We don't need to master all the details from these disciplines, just the fundamentals.

To quote Charlie Munger, "Eighty or ninety important models will carry about 90 percent of the freight in making you a worldly-wise person. And, of those, only a mere handful really carry very heavy freight."[12]

The four volumes of *The Great Mental Models* attempt to collect and make accessible organized common sense—the eighty to ninety mental models you need from the major disciplines to get started. To help you understand the models, we will relate them to stories and historical examples. My blog, *Farnam Street*, will have even more practical examples (see https://fs.blog/mental-models/).

The more high-quality mental models you have in your mental toolbox, the more likely you will have the ones needed to understand a given problem. The better you understand, the better the potential actions you can take. The better the potential actions, the fewer problems you'll encounter down the road. Better models make better decisions.

> I think it is undeniably true that the human brain must work in models. The trick is to have your brain work better than the other person's brain because it understands the most fundamental models: ones that will do the most work per unit. If you get into the mental habit of relating what you're reading to the basic structure of the underlying ideas being demonstrated, you gradually accumulate some wisdom.
>
> **—CHARLIE MUNGER**[13]

Time Invested Yields Enormous Benefits

Successful people file away a collection of fundamental, established, essentially unchanging knowledge that can be used in evaluating the infinite number of unique scenarios that show up in the real world. Each decision presents an opportunity to comb through your repertoire of models and try one out, so you can learn how to use them. This will slow you down at first—for one thing, you won't always choose the right models—but you will get better and more efficient at using mental models as time progresses.

> Disciplines, like nations, are a necessary evil that enable human beings of bounded rationality to simplify their goals and reduce their choices to calculable limits. But parochialism is everywhere, and the world badly needs international and interdisciplinary travelers to carry new knowledge from one enclave to another.
>
> **—HERBERT A. SIMON**[14]

With time and consistent effort, we begin to synthesize the ideas we learn with *reality itself*. No model contains the entire truth, whatever that may be. What good are math and biology and psychology unless we know how they fit together in reality, and how to use them to make our lives better? It would be like dying of hunger because we don't know how to combine and cook any of the foods in our pantry.

Making mistakes is part of the process of using mental models. Failing, if you acknowledge, reflect on, and learn from it, is also how you build mastery. As you use mental models, a great practice is to record and reflect on your process and results. That way, you can get better at both choosing models and applying them. Take the time to notice how you applied the models, what the process was like, and what the results were.

Over time, you will develop your knowledge of which situations are best tackled through which models. Don't give up on a model if it doesn't help you right away. Learn more about it and try to figure out exactly why it didn't work. It may be that you have to improve your understanding of it, or that there were aspects to the situation that you did not consider, or that your focus was on the wrong variable. So keep a journal. Write down your experiences. When you identify a model at work in the world, write that down too. Then you can explore the applications you've observed and start to be more in control of the models you use every day. For instance, instead of falling victim to confirmation bias, you will become able to step back and see it at work in yourself and others. Once you get practice with them, you will start to naturally apply models as you go through your daily life, from reading the news to contemplating a career move.

As we have seen, we can run into problems when we apply models to situations in which they don't fit. If a model is useful—and we can define "useful," here, as offering a different perspective that uncovers a blind spot in our understanding of a problem—it is wise to invest time and energy into understanding why it worked, so we know when to use it again.

At the beginning, the process is more important than the outcome. As you use the models, stay open to feedback loops. Reflect and learn. You will get better. It will become easier. Results will become more profoundly useful, more broadly applicable, and more memorable. While this book isn't intended to be a book specifically about making better decisions, it will help you make better decisions.

Mental models are not an excuse to create a lengthy decision process. Rather, their aim is to help you move away from seeing things the way you think they should be and toward seeing them the way they are. Right now,

you are touching only one part of the elephant, so you are making all decisions based on your understanding that it's a wall, or a rope, not an animal. As soon as you begin to take in the knowledge that other people have of the world, like learning the perspectives others have on the elephant, you will start having more success, because your decisions will be aligned with how the world really is.

When you start to understand the world better, when the whys become less mysterious, you will gain confidence in how you navigate. Successes will accrue. More success means more time, less stress, and, ultimately, a more meaningful life.

Time to dive in.

The Map Is Not the Territory

Reality check.

Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful.

—GEORGE E. P. BOX[1]

The map of reality is not reality. Even the best maps are imperfect. That's because maps are reductions of what they represent. If a map were to represent the territory with perfect fidelity, it would no longer be a reduction and thus would no longer be useful to us. A map can also be a snapshot from a point in time, representing something that no longer exists. This is important to keep in mind as we think through problems and seek to make better decisions.

We use maps every day to simplify complexity. A great example is the financial statements of a company, which are meant to distill the complexity of thousands of transactions into something manageable. Yet they tell us nothing about whether the product is good for the customer or what's really going on in the company. A policy document on office procedure, a manual on parenting a two-year-old, or your performance review—all are models, or maps, that simplify some complex territory to guide you through it.

Relying solely on maps can lead you to the wrong conclusion. You need to touch the territory.

Very early in the history of Amazon, Jeff Bezos was going over a set of documents with his team at the weekly business review. He'd heard that a bunch of customers were complaining (the territory) about call wait times, and yet looking at the data (the map), he couldn't figure out why. "When the data and the anecdotes disagree," he said in an interview, "the anecdotes are usually right."[2] At the meeting, the head of customer service reported the wait-time metric as under sixty seconds, which was in line with expectations. Bezos paused the meeting, picked up the phone, and dialed the 1-800 number for customer service. He waited on hold for over ten minutes, which made the point: something was wrong with the data collection.

Mental models are maps. While they might not be perfectly accurate, they are useful. Mental models and maps are both useful to the extent they are explanatory and predictive.

Key Elements of a Map

In 1931, the mathematician Alfred Korzybski presented a paper on mathematical semantics in New Orleans. Most of the paper reads like a complex, technical argument on the relationship of mathematics to human language, and of both of these to physical reality. However, with this paper, Korzybski introduced and popularized the concept that *the map is not the territory*—in other words, the description of the thing is not the thing itself. The model is not reality. The abstraction is not the abstracted.

Specifically, in Korzybski's own words:[3]

1. **A map may have a structure similar or dissimilar to the structure of the territory.** The London Underground map is super useful to travelers. The train drivers don't use it at all! Maps describe a territory in a useful way, but with a specific purpose in mind. They cannot be everything to everyone.

2. **Two similar structures have similar logical characteristics.** If a correct map shows Dresden as located between Paris and Warsaw, a similar relation is found in the actual territory. If you have a map showing where Dresden is, you should be able to use it to get there.

3. **A map is not the actual territory.** The London Underground map does not convey what it's like to be standing in Covent Garden Station, nor would you use it to navigate out of the station.

4. **An ideal map would contain the map of the map, the map of the map of the map, etc., endlessly.** We may call this characteristic self-reflexiveness. Imagine using an overly complicated "Guide to Paris"

> on a trip to France, and then having to purchase another book, the "Guide to the Guide to Paris," and so on. Ideally, you'd never have any issues—but eventually, the level of detail would be overwhelming.

The only way we can navigate the complexity of the world is through some sort of abstraction. When we read the news, we're consuming abstractions of events created by other people. The authors consumed vast amounts of information, reflected upon it, and drew some conclusions that they share with us. But something is also lost in the process: the specific and relevant details that were compressed into the abstraction. And, because we often consume these abstractions as gospel, without having done the hard mental work of creating them ourselves, it's tricky for us to see when the map no longer agrees with the territory. We inadvertently forget that the map is not reality. It's the illusion of knowledge.

But My GPS Didn't Show That Cliff

We need maps and models as guides. But frequently, we don't remember that our maps and models are abstractions, and thus we fail to understand their limits. We forget there is a territory that exists separately from the map. This territory contains details the map doesn't describe. We run into problems when our knowledge becomes knowledge of the *map* rather than of the actual underlying territory it describes.

Reality is messy and complicated, so our tendency to simplify it is understandable. However, if the aim becomes simplification rather than understanding, we start to make bad decisions. When we mistake the map for the territory, we start to think we have all the answers. We create static rules or policies that deal with the map but forget that we exist in a constantly changing world. When we close off or ignore feedback loops, we don't see that the terrain has changed and we dramatically reduce our ability to adapt to a changing environment.

We can’t use maps as dogma. Maps and models are not meant to live forever as static references. The world is dynamic. As territories change, our tools to navigate them must be flexible, to handle a wide variety of situations or adapt to the changing times. If the value of a map or model is related to its ability to predict or explain, then it needs to represent reality. If reality has changed, the map must change.

Take Newtonian physics. For hundreds of years, it served as an extremely useful model for understanding the workings of our world. From gravity to celestial motion, Newtonian physics was a wide-ranging map.

Then, in 1905, Albert Einstein, with his theory of special relativity, changed our understanding of the universe in a huge way. He replaced the understanding handed down by Isaac Newton hundreds of years earlier. He created a new map.

Newtonian physics is still a *very* useful model. One can use it reliably to predict the movement of objects large and small (with some limitations, as pointed out by Einstein). And, on the flip side, Einstein’s physics is still not totally complete: with every year that goes by, physicists become increasingly frustrated with their inability to tie it into small-scale quantum physics. Another map may yet come. But what physicists do so well, and most of us do so poorly, is carefully delimit what Newtonian and Einsteinian physics are able to explain. They know, down to many decimal places, where those maps are useful guides to reality and where they aren’t. And when they hit uncharted territory, like quantum mechanics, they explore it carefully, instead of assuming the maps they have can explain it all.

Maps Can’t Show Everything

Some of the biggest map/territory problems are the risks of the territory that are not shown on the map. When we’re following the map without looking around, we trip right over these risks. Any user of a map or model must realize that we do not understand a model, map, or reduction unless we

understand and respect its limitations. If we don’t understand what the map does and doesn’t tell us, it can be useless or even dangerous.

The Tragedy of the Commons

> What is common to many is taken least care of, for all men have greater regard for what is their own than for what they possess in common with others.
>
> —ARISTOTLE[4]

The Tragedy of the Commons is a parable that illustrates why common resources get used more than is desirable from the standpoint of society as a whole. Garrett Hardin wrote extensively about this concept.

> Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, “What is the utility to me of adding one more animal to my herd?” This utility has one negative and one positive component.

1. The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.
2. The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of 1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another

> animal to his herd. And another; and another.... But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit–in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.[5]

Economist Elinor Ostrom wrote about being cautious with maps and models when looking at different governance structures for common resources. She was worried that the Tragedy of the Commons model (see sidebar), which shows how a shared resource can be destroyed through bad incentives, was too general and did not account for how people, in reality, solved the problem. She explained the limitations of using models to guide public policy, namely, that they often become metaphors: “What makes these models so dangerous…is that the constraints that are assumed to be fixed for the purpose of analysis are taken on faith as being fixed in empirical settings.”[6]

This is a double problem. First, having a general map, we may assume that if a territory matches the map in a couple of respects, it matches the map in all respects. Second, we may cling to what we know rather than update our information; we may think adherence to the map is more important than taking in new information about a territory. Ostrom asserts that one of the main values of using models as maps in public policy discussions is in the thinking that is generated. Models are tools for exploration, not doctrines to force conformity. They are guidebooks, not laws.

In order to use a map or model as accurately as possible, we should take into account three important principles:

1. Reality is the ultimate update.

2. Consider the cartographer.

3. Maps can influence territories.

Reality is the ultimate update: When we enter new and unfamiliar territory, it’s nice to have a map on hand. In everything from traveling to a new city to becoming a parent for the first time, we benefit from maps that we can use to improve our ability to navigate the terrain. But territories change, sometimes faster than the maps and models that describe them. We

can and should update our maps based on our own experiences in the territory. That's how good maps are built: through feedback loops created by explorers.

We can think of stereotypes as maps. Sometimes they are useful—we have to process large amounts of information every day, and simplified chunks such as stereotypes can help us sort through this information with efficiency. The danger, as with all maps, comes when we forget that the territory is more complex than the map. People constitute far more territory than a stereotype can possibly represent.

In the early 1900s, Europeans were snapping pictures all over Palestine, leaving a record that may have reflected their ethnographic perspective but did not cover Karimeh Abbud's perception of her culture. She began to take photos of those around her, becoming the first Arab woman to set up her own photo studio in Palestine. Her pictures reflected a different take on the territory—she rejected the European style and aimed to capture the middle class of Palestine as they were. She tried to let her camera record the territory as she saw it, rather than manipulating the images to follow a narrative.

Abbud's informal style and desire to photograph the variety around her, from landscapes to intimate portraits, have left a legacy far beyond the photos themselves.[7],[8] She contributed a different perspective, a new map, with which to explore the history of the territory of Palestine.

We do have to remember, though, that a map captures a territory at a moment in time. Just because it might have done a good job at depicting what was at the time it was made, there is no guarantee that it depicts what is there now or what will be there in the future. The faster the rate of change in the territory, the harder it will be for a map to keep up-to-date.

> Viewed in its development through time, the map details the changing thought of the human race, and few works seem to be such an excellent indicator of culture and civilization.
>
> **—NORMAN J. W. THROWER**[9]

Consider the cartographer: Maps are not purely objective creations. They reflect the values, standards, and limitations of their creators.

One way to see how maps lack objectivity is in the changing national boundaries that make up our world maps. Countries come and go depending on shifting political and cultural sensibilities. When we look at the world map we have today, we tend to associate societies with nations, assuming that the borders reflect a common identity shared by everyone contained within them. However, as historian Margaret MacMillan pointed out, nationalism is a very modern construct, and in some sense has developed with, not in advance of, the maps that set out the shapes of countries.[10] We should not, then, assume that our maps depict an objective view of the geographical territory. For example, historians have shown that the modern borders of Syria, Jordan, and Iraq reflect British and French determination to maintain influence in the Middle East after World War I.[11] Thus, they are a better map of Western interest than of local custom and organization.

Models are most useful when we consider them in the context in which they were created. What was the cartographer trying to achieve? How does this influence what is depicted in the map?

Maps can influence territories: This problem was part of the central argument put forth by Jane Jacobs in her groundbreaking work *The Death and Life of Great American Cities*. Jacobs chronicled the efforts of city planners who came up with elaborate models for the design and organization of cities, without paying any attention to how cities actually work. They then tried to fit the cities into the model. She describes how cities were changed to correspond to these models, and the often negative consequences of these efforts. “It became possible also to map out master plans for the statistical city, and people take these more seriously, for we are all accustomed to believe that maps and reality are not necessarily related, or that if they are not, we can make them so by altering reality.”[12]

Jacob’s book is, in part, a cautionary tale about what can happen when faith in the model influences the decisions we make in the territory—when we try to fit complexity into the simplification.

> In general, when building statistical models, we must not forget that the aim is to understand something about the real world. Or predict, choose an action, make a decision, summarize evidence, and so on, but always about the real world, not an abstract mathematical world: our models are not the reality.
>
> **—DAVID HAND**[13]

Conclusion

The map is not the territory is a reminder that our mental models of the world are not the same as the world itself. It's a caution against confusing our abstractions and representations with the complex, ever-shifting reality they aim to describe.

Mistaking the maps for the territory is dangerous. Consider the person who has a great résumé and checks all the boxes on paper but can't do the actual job. Updating our maps is a difficult process of reconciling what we want to be true with what is true.

In many areas of life, we are offered maps by other people. We are reliant on the maps provided by experts, pundits, and teachers. In these cases, the best we can do is to choose our mapmakers wisely, to seek out those who are rigorous, transparent, and open to revision.

Ultimately, the map/territory distinction is an invitation to engage with the world as it is, not just as we imagine it to be. And remember, when you don't make the map yourself, choose your cartographer wisely.

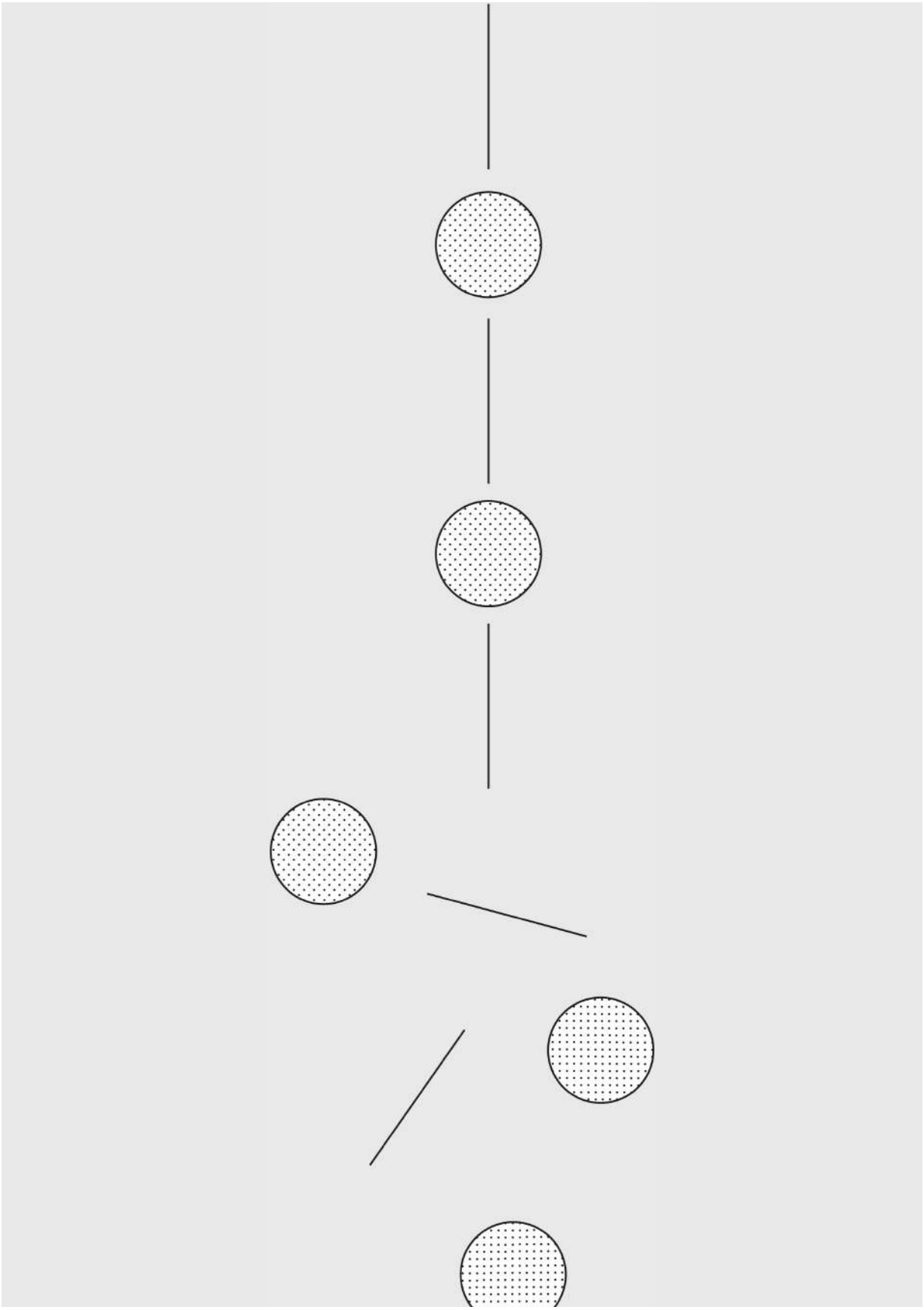
Models of Management

Let's take a model of management. There are hundreds of them, dating back at least to *The Principles of Scientific Management*, by Frederick Taylor, which had factory managers breaking down tasks into small pieces, forcing their workers to specialize, and financially incentivizing them to complete those specialized tasks efficiently. It was a brute-force method, but it worked pretty well.

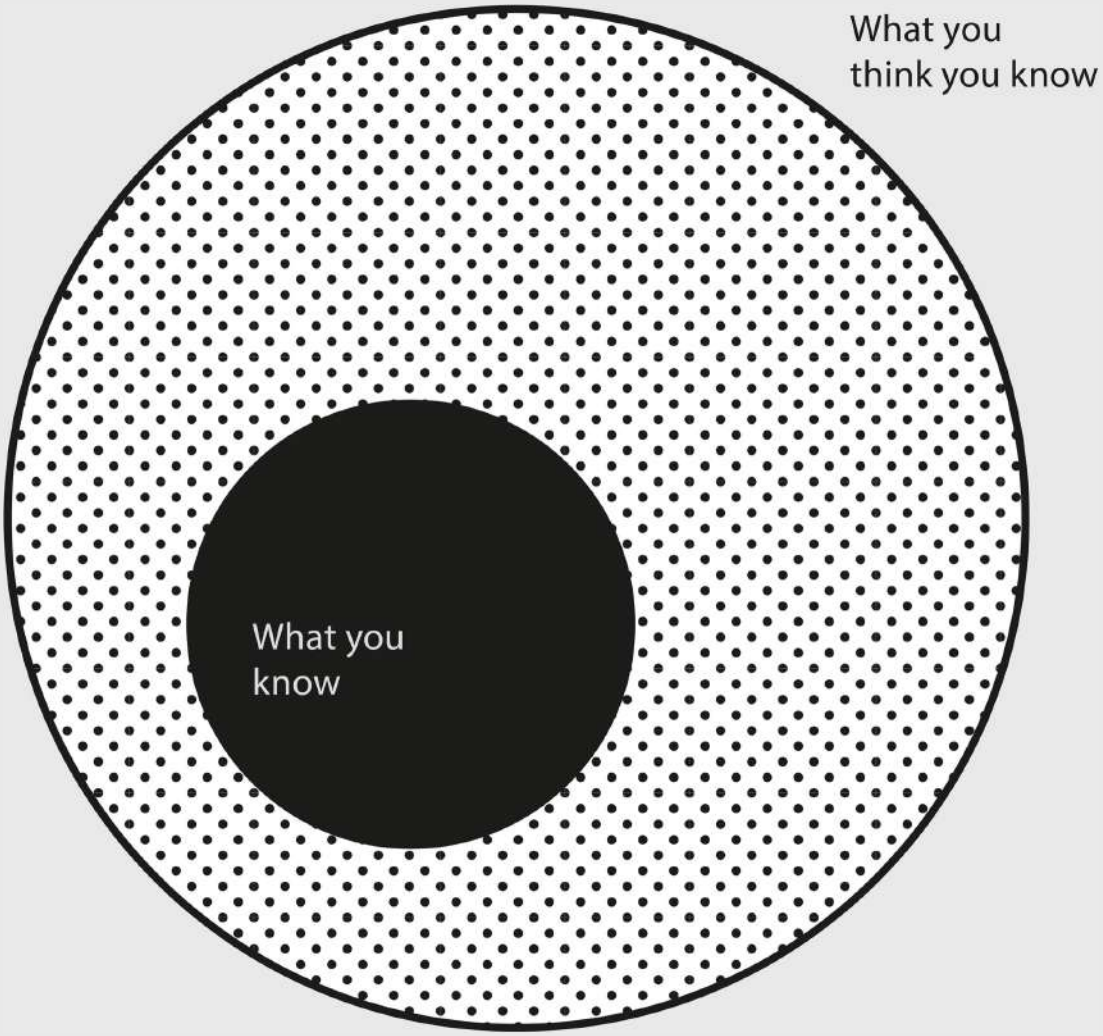
As time went on and the economy increasingly moved away from manufacturing, other theories gained popularity, and Taylor's model is no longer used by anyone of note. That does not mean it wasn't useful; for a time, it was. It's just that reality is more complicated than Taylor's model. Eventually, it had to contend with at least the following factors:

1. As more and more people learn what model you're using to manipulate them, they may decide not to respond to your incentives.
2. As your competitors gain knowledge of the model, they respond in kind by adopting the model themselves, thus flattening the playing field.
3. The model may have been useful mostly in a factory setting, and not in an office setting or a technology-development setting.
4. Human beings are not simple automatons: a more complete model would hone in on other motivations they might have besides financial ones.

And the list goes on. Clearly, though Taylor's model was effective for a time, it was effective with limitations. As with Einstein eclipsing Newton in physics, better models in management came along in time.



Circle of Competence



What don’t you know?

I’m no genius. I’m smart in spots—but I stay around those spots.

—THOMAS J. WATSON[1]

Understanding where you have an edge in competence and where you don't helps you prevent problems, spot opportunities, and learn. We all have a circle of competence—an area in which we have a lot of knowledge. The size of that circle is not as important as knowing when you are approaching its perimeter.

Within your circle of competence, you operate with a clear advantage. As you approach the perimeter (the limitations of your knowledge), your advantage starts to decrease. As you cross the perimeter, not only does your advantage vanish, it goes negative. Suddenly, you find yourself playing in an area where others have an advantage.

To get the most out of this mental model, we will explore the following:

1. What is a circle of competence?
2. How do you know when you have one?
3. How do you build and maintain one?
4. How do you operate outside of one?

What is a circle of competence? Imagine an old man who's spent his entire life in a small town. He's the Lifer. No detail of the goings-on in the town has escaped his notice over the years. He knows the lineage, behaviors, attitudes, job, income, and social status of every person in town. Bit by bit, he has built up that knowledge over a long period of observation and participation in town affairs.

The Lifer knows all the secrets. He knows where the bodies are buried and who buried them. He knows who owes money to whom, who gets along with whom, and whom the town depends on to keep moving forward.

He knows about that time the mayor cheated on his taxes. He knows about the time the town flooded—how many inches high the water was, and exactly who helped whom and who didn't.

Now imagine a stranger enters the town, in from the Big City. Within a few days, the Stranger decides that he knows all there is to know about the town. He's met the mayor, the sheriff, the bartender, and the shopkeeper, and he can get around fairly easy. It's a small town, and he hasn't come across anything surprising.

In the Stranger's mind, he's convinced he knows pretty much everything a Lifer would know; with his keen eye, he has sized up the town in no time. He makes assumptions based on what he has learned so far and figures he knows enough to get his business done. This belief, however, stems from a false sense of confidence that likely causes him to take more risks than he realizes. Without intimately knowing the history of the town, how can he be sure that he has picked the right land for development or negotiated the best price?

After all, what kind of knowledge does he really have, compared to the Lifer?

The difference between the detailed web of knowledge in the Lifer's head and the surface knowledge in the Stranger's head is the difference between being inside a circle of competence and being outside its perimeter. True knowledge of a complex territory cannot be faked. When it comes to this town, the Lifer could stump the Stranger in no time, but not the other way around. Consequently, as long as the Lifer is operating in his circle of competence, he will always have a better understanding of reality to use in making decisions. Having this deep knowledge gives him flexibility in responding to challenges, because he will likely have more than one solution to every problem. This depth also increases his efficiency—he can eliminate bad choices quickly because he has all the pieces of the puzzle.

What happens when you take the Lifer/Stranger idea seriously and try to delineate carefully the domains in which you're one or the other? There is no definitive checklist for figuring this out, but if you don't have at least a

few years and a few failures under your belt, you cannot consider yourself competent in a circle.

> We shall be unable to turn natural advantage to account unless we make use of local guides.
>
> **—SUN TZU**[2]

For most of us, climbing to the summit of Mount Everest is outside our circle of competence. Not only do we have no real idea how to do it, but—even more scary—should we attempt it, we don't even know what we don't know. If we studied hard, maybe we'd figure out the basics. We'd learn about the training, the gear, the process, the ideal time of year to climb, all the things an outsider could quickly come to know. But at what point would you be satisfied that you knew enough to get up there, and back, with your life intact? And how confident would you be in this assessment?

There are approximately two hundred bodies on Mount Everest (to say nothing of the ones that have been removed). None of those people thought Everest would take their life. The climate preserves their corpses, almost as a warning. The ascent to the summit takes you past the bodies of people who once shared your dreams.

Since the first recorded attempts to climb Mount Everest, in 1922, all climbers have relied on the specialized knowledge of the Sherpa people to help navigate the terrain of the mountain. Indigenous to the region, Sherpas grew up in the shadow of the mountain, making them uniquely placed to develop the expertise necessary to get to the top.

Sherpa Tenzing Norgay led the team that made the first successful ascent,[3] and a quarter of all subsequent ascents have been made by Sherpas (some going as many as sixteen times).[4],[5] Although the mountain is equally risky for everyone, most people who climb Everest do it only once. For the Sherpas, working and climbing various parts of the

mountain is their day job. Would you try to climb Everest without their help?

The physical challenges alone of reaching the summit are staggering. It is a climate that humans aren't suited for. There isn't enough oxygen in the air, and the top of the mountain is regularly pummeled by winds of more than 150 miles an hour—stronger than a Category 5 hurricane. You don't get to the top on a whim, and you don't survive with only luck. Norgay worked for years as a trekking porter and was part of a team that tried to ascend Everest in 1935. He finally succeeded in reaching the summit in 1953, after twenty years of climbing and trekking in the region. He developed his expertise through lots of lucky failures. After summitting Everest, Norgay opened a mountaineering school, to train other locals as guides, and a trekking company, to take others climbing in the Himalayas.

When it comes to the competence required to climb Mount Everest, Norgay is around the closest someone could come to being a Lifer.

> I never allow myself to have an opinion on anything that I don't know the other side's argument better than they do.
>
> **—CHARLIE MUNGER**[6]

How Do You Know When You Have a Circle of Competence?

Within our circles of competence, we know what we *don't* know. We can make decisions quickly and relatively accurately. We can accurately define the problem. We possess detailed knowledge of additional information we might need to make a decision. We have a proven track record. We can seamlessly adapt our language to a different level, zooming in or out. We know what is knowable.

Within our circle of competence, we can anticipate and respond to counterarguments, because we understand them better than the person

making them. We also have a lot of options when we confront problems in our circles of competence. Our deep fluency in the subjects we are dealing with means we can draw on different information resources and understand what can be adjusted and what is invariant.

A circle of competence cannot be built quickly. We don't become Lifers overnight, or as the result of taking a few courses or working at something for a few months—being a Lifer requires more than skimming the surface. In Alexander Pope's poem "An Essay on Criticism," he writes:

> A little learning is a dangerous thing;
> Drink deep, or taste not the Pierian spring:
> There shallow draughts intoxicate the brain,
> And drinking largely sobers us again.[7]

There is no shortcut to understanding. Building a circle of competence takes years of experience, of making mistakes, and of actively seeking out better methods of practice and thought.

How Do You Build and Maintain a Circle of Competence

One of the essential requirements of a circle of competence is that you can never take it for granted. The terrain is always shifting. You can't operate as if a circle of competence is a static thing that, once attained, is attained for life. The world is dynamic. Knowledge gets updated, and so too must your circle.

There are three key practices needed to build and maintain a circle of competence: curiosity and a desire to learn, monitoring, and feedback.

First, you have to be willing to learn. Learning comes when experience pairs with reflection. Experiences can be yours or those of others, absorbed through books, articles, and conversations. Learning everything on your own is costly and slow. You are one person. Learning from the experiences

of others is much more productive. The key to learning is reflecting on those experiences and compressing them into something usable. You need to approach your circle of competence with curiosity, seeking out information that can help you expand and strengthen it.

> I want to think about things where I have an advantage over other people. I don't want to play a game where people have an advantage over me.... I don't play in a game where other people are wise and I am stupid. I look for a game where I am wise and they are stupid. And believe me, it works better.
>
> **—CHARLIE MUNGER**[8]

Second, you need to monitor your track record in areas in which you have, or want to have, a circle of competence. And you need to have the courage to monitor *honestly*, so the feedback you receive can be used to your advantage.

The reason we have such difficulty with overconfidence—as demonstrated in studies that show that most of us are much worse drivers, lovers, managers, traders (and many other things) than we think we are—is because we have a problem with honest self-assessment. We don't keep the right records, because we don't *really* want to know what we're good and bad at. Ego is a powerful enemy when it comes to better understanding reality.

But protecting your ego won't work if you're trying to assess or build your circle of competence. You need to keep a precise diary of your thinking. If you're an investor, this might be information about your trades in the stock market. If you are in a leadership position, you need to observe and chronicle the results of your decisions and evaluate the outcomes based on what you set out to achieve. You need to be honest about your failures in order to reflect on and learn from them. That's what it takes.

You need to make the invisible thoughts in your head visible. Keeping a journal of your own performance is the easiest and most private way to give self-feedback. Journals allow you to step out of your automatic thinking and

ask yourself: What went wrong? How could I do better? Monitoring your own performance allows you to see patterns that you simply couldn't see before. This type of analysis is painful for the ego, which is also why it helps build a circle of competence. You can't improve if you don't know what you're doing wrong.

Finally, you must occasionally solicit other perspectives. This helps build a circle of competence but is also critical for maintaining one.

A lot of professionals have an ego problem: their view of themselves does not line up with the way other people see them. Before people can change, they need to be familiar with these outside perspectives. We need to go to people we trust, who can give us honest feedback about our traits. These people are in a position to observe us operating within our circles, and are thus able to offer relevant perspectives on our competence. Another option is to hire a coach.

Atul Gawande is one of the top surgeons in the United States. When he wanted to get better at being a surgeon, he hired a coach. This is terribly difficult for anyone to do, let alone a doctor. At first, Gawande felt embarrassed. It had been over a decade since he was evaluated by another person, in medical school. "Why," he asked, "should I expose myself to the scrutiny and fault-finding?"[9]

The coaching worked. Gawande later wrote that he got two things out of this experience. First, he received information about something he couldn't see himself and that no one else would point out (if they noticed it at all): knowledge of where his skill and technique were suboptimal. The second thing he gained was the ability to provide better feedback to other doctors.

It is extremely difficult to maintain a circle of competence without an outside perspective. We usually have too many biases to rely solely on our own observations. It takes courage to solicit external feedback, so if you notice yourself start to manifest defensiveness, focus instead on the result you hope to achieve.

How Do You Operate Outside a Circle of Competence?

Part of the advantage to understanding your circle of competence is understanding when you are approaching, or arrive on the other side of, its perimeter.

Since we can't be inside a circle of competence in everything, when we find ourselves Strangers in a place filled with Lifers, what do we do? We don't always get to "stay around our spots." We must develop a repertoire of techniques for managing when we're outside of our sphere, which happens all the time.[10]

The Problem of Incentives

The problem of incentives can really skew how much you can rely on someone else's circle of competence. This problem is particularly acute in the financial realm. Until recently, nearly all financial products we might be pushed into had commissions attached to them—in other words, our adviser made more money by giving us one piece of advice rather than another, regardless of its wisdom. Fortunately, the rise of products like index funds of the stock and bond markets has mostly alleviated the issue. Still, in cases like receiving financial advice, we're not on solid ground until we know, in some detail, the compensation arrangement our adviser is under.

The same goes for buying furniture, buying a house, or buying a washing machine at a retail store. What does the knowledgeable adviser stand to gain from our purchase?

It goes beyond sales, of course. Whenever we are getting advice, it is from a person whose set of incentives is not the same as ours. It is not being cynical to know that this is the case and to act accordingly.

Suppose we want to take our car to a mechanic. Most of us, especially in this day and age, are complete Strangers in that land; we therefore are available to be taken advantage of. Not only is there an asymmetry in our general knowledge base about the mechanics of a car, there is usually an asymmetry of knowledge about the actual current problem with the car. We haven't been under the hood, but the mechanic has. We know his incentive in this situation—it's to get us to spend as much as possible while still retaining us as a customer. The only solution, at least until we reach a certain level of trust with our mechanic, is to suck it up and learn a bit of the trade.

Fortunately, these days, that is easy with the aid of the internet. And we don't need to do our learning ahead of time; we can learn on an as-needed basis. The way to do it, in this case, would be to defer all decisions on major repair spending until you've had time to poke around the resources you can find online and at least confirm that the mechanic isn't making a major bluff.

There are three practices necessary to successfully operating outside a circle of competence:

1. Learn the basics of the realm you're operating in, while still acknowledging that you're a Stranger, not a Lifer. Keep in mind that basic information is easy to obtain and tends to seduce the acquirer into possessing unwarranted confidence.

2. Talk to someone whose circle of competence in the area is strong. Take the time to do a bit of research, to define questions you need to ask and information you need to obtain to make a good decision. If you ask an expert what to do, they will give you an answer, but you won't have learned anything. If you ask them what variables matter in this situation and why, you'll learn not only what they would do but why they would do it. Furthermore, when you need the advice of others, especially in higher-stakes situations, ask questions to probe the limits of their circles of competence. Then, ask yourself how the situation might influence the information they choose to provide to you (always remember: consider the cartographer).

3. Use a broad understanding of the basic mental models of the world to augment your limited understanding of the field in which you find yourself a Stranger. These will help you identify the foundational concepts that would be most useful, which will then serve as a guide to help you navigate the situation you are in.

There are inevitably areas where you are going to be a Stranger, even in the profession in which you excel. It is impossible for our circles of competence to encompass the entire world. Even if we're careful to know the boundaries of our circles and take them seriously, we can't *always* operate inside our circles. Life is simply not that forgiving. We have to make HR decisions without being experts in human psychology, implement technology without having the faintest idea how to fix it if something goes

wrong, or design products with an imperfect understanding of our customers. These decisions may be outside our circles, but they still have to get made.

When Queen Elizabeth I of England ascended to the throne, the security of her reign was by no means assured. The tumultuous years under her father, brother, and sister had contributed to a political situation that was precarious at best. England was in a religious crisis that was threatening the stability of the kingdom, and the nation was essentially broke.

Elizabeth knew there were aspects of leading the country that were outside her circle of competence. She had an excellent education and had spent most of her life just trying to survive. Perhaps that is why she was so able to identify and admit to what she didn't know.

In her first speech as queen, Elizabeth announced, "I mean to direct all my actions by good advice and counsel."[11] After outlining her intent upon becoming queen, she proceeded to build her Privy Council—effectively the royal advisory board. She didn't copy her immediate predecessors by filling her council with yes-men or wealthy incompetents who happened to share her religious values. To develop stability and achieve continuity, she blended the old and the new. She kept the group small, so that real discussions could happen. She wanted a variety of opinions that could be challenged and debated.[12]

In large measure due to the advice she received from this council—advice that was the product of open debate that took in the circles of competence of each of the participants—Elizabeth took England from a country of civil unrest and frequent persecution to one that inspired loyalty and creativity in its citizens. She sowed the seeds for the empire that would eventually come to control one-quarter of the globe.

Conclusion

The first rule of competition is, you are more likely to win if you play where you have an advantage. Doing so requires a firm understanding of

what you know and what you don’t know. Your circle of competence is your personal sphere of expertise, the area where your knowledge and skills are concentrated. It’s the domain where you have a deep understanding, where your judgments are reliable, and your decisions are sound.

The size of your circle isn’t as important as knowing the boundaries. The wise person is the one who knows the limits of their knowledge, who can say with confidence, “This falls within my circle,” or “This is outside my area of expertise.”

Operating within your circle of competence is a recipe for confidence and effectiveness. But venturing outside your circle of competence is a recipe for trouble. You’re like a sailor navigating unfamiliar waters without a map, at the mercy of currents and storms you don’t fully understand. This isn’t to say that you should never venture outside your circle. Learning new things, gaining new skills, mastering new domains is one of the beautiful things about life.

Celebrate your expertise, but also acknowledge your limitations.

> Ignorance more often begets confidence than knowledge.
>
> **—CHARLES DARWIN**[13]

Staying in Your Circle

Berkshire Hathaway's Warren Buffett is well-known for using the circle of competence as a filter for potential investments. When asked, he has recommended that each individual stick to their area of special competence and be very reluctant to stray from it. For when we stray too far, we get into areas where we don't even know what we don't know. We may not even know the questions we need to ask.

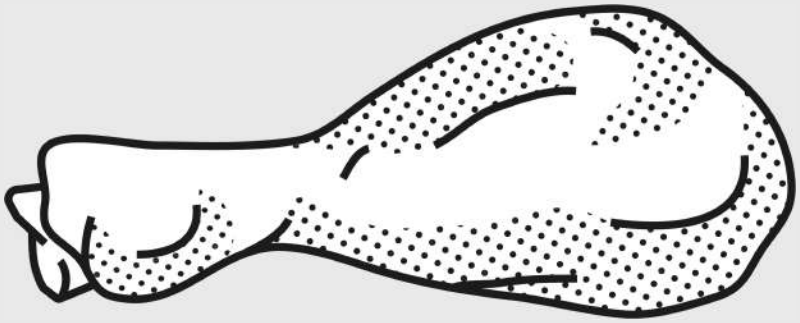
To explain his point, Buffett gives the example of Rose Blumkin, a Russian immigrant who ran one of his businesses, the famous Nebraska Furniture Mart. Blumkin spoke little English and could barely read or write, yet had a head for two things: numbers and home furnishings. She stuck to those areas and built one of the country's great retailing establishments. Here is the story in Buffett's words:

> I couldn't have given her two hundred million dollars' worth of Berkshire Hathaway stock when I bought the business because she doesn't understand stock. She understands cash. She understands furniture. She understands real estate. She doesn't understand stocks, so she doesn't have anything to do with them. If you deal with Mrs. B in what I would call her circle of competence…she is going to buy five thousand end tables this afternoon (if the price is right). She is going to buy twenty different carpets in odd lots, and everything else like that [snaps fingers], because she understands carpets. She wouldn't buy a hundred shares of General Motors if it was at fifty cents a share.[14]

Rose Blumkin's iron focus on the things she knew best was largely responsible for her massive success, in spite of the obstacles she faced.

SUPPORTING IDEA:

Falsifiability



KARL POPPER WROTE, "A THEORY is part of empirical science if and only if it conflicts with possible experiences and is therefore in principle falsifiable by experience."[15] The idea here is that if you can't prove something wrong, you can't really prove it right either.

Thus, in Popper's words, science requires testability: "If observation shows that the predicted effect is definitely absent, then the theory is simply refuted."[16] A good theory must have an element of risk to it—namely, it has to risk being wrong. It must be able to be proven wrong under stated conditions.

In a true science, as opposed to a pseudoscience, the following statement can be easily made: "If *x* happened, it would show demonstrably that theory *y* is not true." We can then design an experiment—a physical one, or sometimes a thought experiment—to figure out if *x* actually does happen. Falsification is the opposite of verification: you must try to show that the theory is *incorrect* and, if you fail to do so, you actually strengthen it. To understand how this works in practice, think of evolution. As mutations appear, natural selection eliminates those that don't work, thereby strengthening the fitness of the rest of the population.

Consider Popper's discussion of the concept of falsifiability in the context of Freud's psychoanalytic theory, which is broadly about repressed childhood memories influencing our unconscious, which in turn affects our behavior. Popper was careful to say that it is not possible to prove that Freudianism is either true or not true, at least in part. We can simply say that we don't know whether it's true, because it does not make specific, testable predictions. It may have many kernels

of truth in it, but we can't tell. The theory would have to be restated in a way that would allow for experience to refute it.

Another interesting piece of Popper's work was an attack on what he called "historicism"—the idea that history has fixed laws or trends that inevitably lead to certain outcomes. Historicism includes the tendency to use examples from the past to make definitive conclusions about what is going to happen in the future.

Popper considered this kind of thinking pseudoscience—or, worse, a dangerous ideology that tempts wannabe state planners and utopians to control society. He did not consider historicist doctrines falsifiable. There is no way, for example, to test whether there is a "Law of Increasing Technological Complexity" in human society, as many are tempted to claim these days, because it is not actually a testable hypothesis. Instead of calling these ideas interpretations, historicists call them "laws," or some similarly connotative word that implies an unchanging and universal state that is not open to debate, thereby giving them an authority that they haven't earned. Too frequently, these postulated "laws" become immune to falsifying evidence—any new evidence is interpreted through the lens of the theory.

For example, we can certainly find confirmation for the idea that humans have progressed, in a specifically defined way, toward increasing technological complexity. But is that a "law" of history, in the sense of being inviolable? Was it always going to be this way? No matter what the starting conditions or developments along the way, were humans always going to increase our technological prowess? We really can't say.

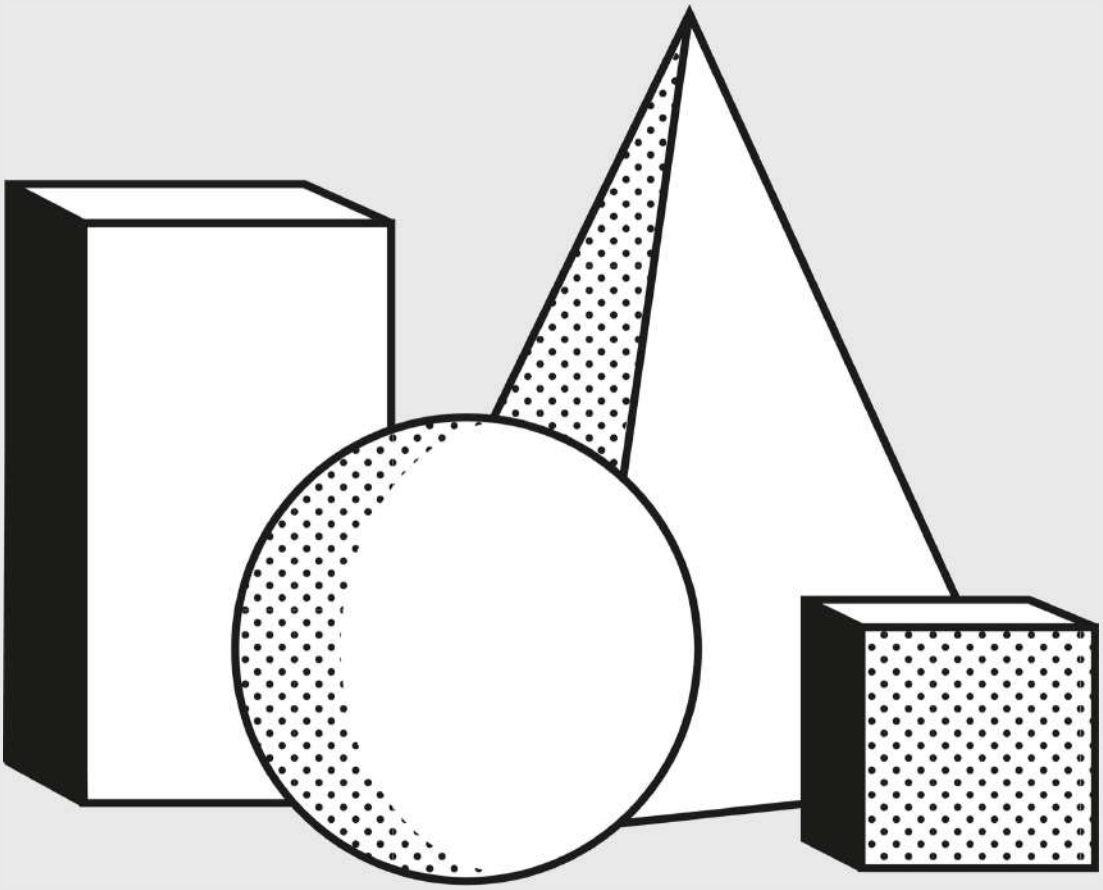
Here, we hit on the problem of trying to assert any fundamental law by which human history must inevitably progress. Trend is not destiny. Even if we can derive and understand certain laws of human biological nature, the trends of history itself are dependent on conditions, and conditions change.

Bertrand Russell's classic example of the chicken that gets fed every day is a great illustration of this concept.[17] Daily feedings have been going on for as long as the chicken has observed, and thus it supposes that these feedings are a guaranteed part of its life and will continue in perpetuity. The feedings appear as a law—until the day the chicken gets its head chopped off. They are then revealed to be a trend, not a predictor of the future state of affairs.

Another way to look at it is to examine how we tend to view the worst events in history. We tend to assume that the worst that has happened is the worst that *can* happen, and then prepare for that. We forget that "the worst" once smashed a previous understanding of what was the worst. Therefore, we need to prepare more for the extremes allowable by physics rather than for what has happened until now.

Applying the filter of falsifiability helps us sort through which theories are more robust. If a theory can't ever be proven false, because we have no way of testing it, then the best we can do is try to determine its probability of being true.

First Principles Thinking



Go back to basics.

I don’t know what’s the matter with people: they don’t learn by understanding; they learn by some other way—by rote or something. Their knowledge is so fragile!

—RICHARD FEYNMAN[1]

First principles thinking is one of the best ways to discover new solutions. Sometimes called “reasoning from first principles,” it’s a tool to help break down complicated problems by separating what we know is absolutely true from anything that is an assumption. What remain are the essentials. If you know the first principles of something, you can build the rest of your knowledge around them to produce something new.

While you could take this way of thinking down to an atomic level, a lot of value is gained by simply going a level or two deeper than most people. [2] Solutions are based on what you see. Different answers reveal themselves at different levels.

If I hand you a house made from Lego blocks, you know it’s possible to make a house. Thinking at the first layer, you might move a few blocks around and, in the process, slightly improve the house. Most people stop here. They are presented with something that already exists and they endeavor to make it slightly better. Going a layer deeper and breaking the Lego house into individual pieces opens the door to possibility: not only can you build a better house, you can build something entirely different.

Everything that exists is effectively a set of Lego blocks, assembled in a certain way, that can be taken apart and reassembled. A bike is just a seat, chain, body, handlebars, etc. Breaking the bike down into its parts allows you to reassume the parts into something new. However, you can also go deeper, melting the parts into their core metals and making a shield, sword, or anything else, limited only by material and imagination.

The idea of building knowledge from first principles has a long tradition in philosophy. In the Western canon it goes back to Plato, with significant contributions from Aristotle and Descartes. Essentially, these thinkers were looking for foundational knowledge that would not change and on which

we could build everything else, from our ethical systems to our social structures.

First principles thinking doesn't have to be quite so grand. When we do it, we aren't necessarily looking for absolute truths—millennia of epistemological inquiry have shown us that these are hard to come by, and the scientific method has demonstrated that knowledge can be built only when we are actively trying to falsify it (see "Supporting Idea: Falsifiability"). Rather, first principles thinking identifies the elements that are, in the context of any given situation, irreducible.

First principles do not provide a checklist of things that will always be true; our knowledge of first principles changes as we understand more. They are the foundation on which we must build, and thus will be different in every situation—but the more we know, the more we can challenge. For example, if we are considering how to improve the energy efficiency of a refrigerator, the laws of thermodynamics can be taken as first principles. However, a theoretical chemist or physicist might want to explore entropy, and thus further break the second law of thermodynamics into its underlying principles and the assumptions that were made because of them. First principles are the boundaries that we must work within in any given situation, so when it comes to thermodynamics, an appliance maker might have different first principles than a physicist.

Techniques for Establishing First Principles

If we never learn to take something apart, test our assumptions about it, and reconstruct it, we end up bound by what other people tell us is possible. We end up trapped in the way things have always been done. When the environment changes, we just continue as if things were the same, making costly mistakes along the way.

Some of us are naturally skeptical of what we're told: Maybe it doesn't match up to our experiences. Maybe it's something that used to be true but isn't true anymore. Or maybe we just think differently about something.

When it comes down to it, everything that is not a law of nature is just a shared belief. Money is a shared belief. So is a border. So is Bitcoin. So is love. The list goes on.

There are two techniques we can use to change the level where we are looking at a situation, identify the first principles, and cut through the dogma and shared belief: Socratic questioning and the Five Whys.

Socratic questioning: Socratic questioning can be used to establish first principles through stringent analysis. This is a disciplined questioning process used to establish truths, reveal underlying assumptions, and separate knowledge from ignorance. The key distinction between Socratic questioning and ordinary discussion is that the former seeks to draw out first principles in a systematic manner. Socratic questioning generally follows this process:

1. Clarifying your thinking and explaining the origins of your ideas. (Why do I think this? What exactly do I think?)
2. Challenging assumptions. (How do I know this is true? What if I thought the opposite?)
3. Looking for evidence. (How can I back this up? What are my sources?)
4. Considering alternative perspectives. (What might others think? How do I know I am correct?)
5. Examining consequences and implications. (What if I am wrong? What are the consequences if I am?)
6. Questioning the original questions. (Why did I think that? Was I correct? What conclusions can I draw from the reasoning process?)

Socratic questioning stops you from relying on your gut and limits strong emotional responses. This process helps you build something that

lasts.

The Five Whys: The Five Whys is a method rooted in the behavior of children. Children instinctively think in first principles; just like us, they want to understand what's happening in the world. To do so, they intuitively break through the fog with a game some parents have come to dread but that is exceptionally useful for identifying first principles: repeatedly asking "why."

The goal of the Five Whys is to traverse different levels until we land on a "what" or "how." It is not about introspection, such as asking, "Why do I feel like this?" Rather, it is about systematically delving further into a statement or concept so that you can separate reliable knowledge from assumption. If your "whys" result in a statement of falsifiable fact, you have hit a first principle. If they end up with a "because I said so" or "it just *is*," you know you have landed on an assumption that may be based on popular opinion, cultural myth, or dogma. These are not first principles.

There is no doubt that both of these methods slow us down in the short term. They seem to get in the way of what we want to accomplish. We must pause, think, and research. And after we employ them a couple of times, we realize that often, after one or two questions, we are lost. We actually don't know how to answer most of the questions. But when we are confronted with our own ignorance, we can't just give up or resort to self-defense. If we do, we will never identify the first principles we have to work with and will instead make mistakes that will slow us down in the long term.

> Science is much more than a body of knowledge. It is a way of thinking.
>
> **—CARL SAGAN**[3]

Using First Principles Thinking to Blow Past Inaccurate Assumptions

The discovery that a bacterium, not stress, causes the majority of stomach ulcers is a great example of what can be accomplished when we push past assumptions to get at first principles. For centuries following the discovery of bacteria, scientists thought that bacteria could not grow in the stomach, on account of its acidity. If you had surveyed doctors and medical research scientists in the 1960s or ’70s, they likely would have postulated this as a first principle. When a patient came in complaining of stomach pain, no one ever looked for a bacterial cause.

It turned out, however, that a sterile stomach was not a first principle—it was an assumption. As Kevin Ashton writes in his book on creativity, discovery, and invention, “the dogma of the sterile stomach said that bacteria could not live in the gut.”[4] Because this dogma was taken as truth, for a long time, no one ever looked for evidence that it could be false.

That changed for good with the discovery of *Helicobacter pylori* bacterium and its role in stomach ulcers. When pathologist Robin Warren saw bacteria in samples from patients’ stomachs, he realized that stomachs were not, in fact, sterile. He started collaborating with Barry Marshall, a gastroenterologist, and together they found bacteria in loads of stomachs. If the sterile stomach wasn’t a first principle, then, when it came to stomachs, what was?

Marshall, in an interview with *Discover*, recounts that Warren gave him a list of twenty patients identified as possibly having cancer—but when Warren looked, he had found, instead, the same bacteria in all of them. He said, “Why don’t you look at their case records and see if they’ve got anything wrong with them?” Since they now knew stomachs weren’t sterile, they could question all the associated dogma about stomach disease and use some Socratic-type questioning to identify the first principles at play. They spent years challenging their related assumptions, clarifying their thinking, and looking for evidence.[5]

Their story ultimately had a happy ending: in 2005, Marshall and Warren were awarded the Nobel Prize, and now stomach ulcers are regularly treated effectively with antibiotics, improving and saving the lives of millions of people. But many practitioners and scientists rejected their

findings for decades. The dogma of the sterile stomach was so entrenched as a first principle that it was hard for many to admit that it rested on some incorrect assumptions that ultimately ended with the explanation, “because that’s just the way it is.” Even though, as Ashton notes, “*H. pylori* has now been found in medical literature dating back to 1875,”[6] it was Warren and Marshall who were able to show that “because I said so” wasn’t enough to count the sterile stomach as a first principle.

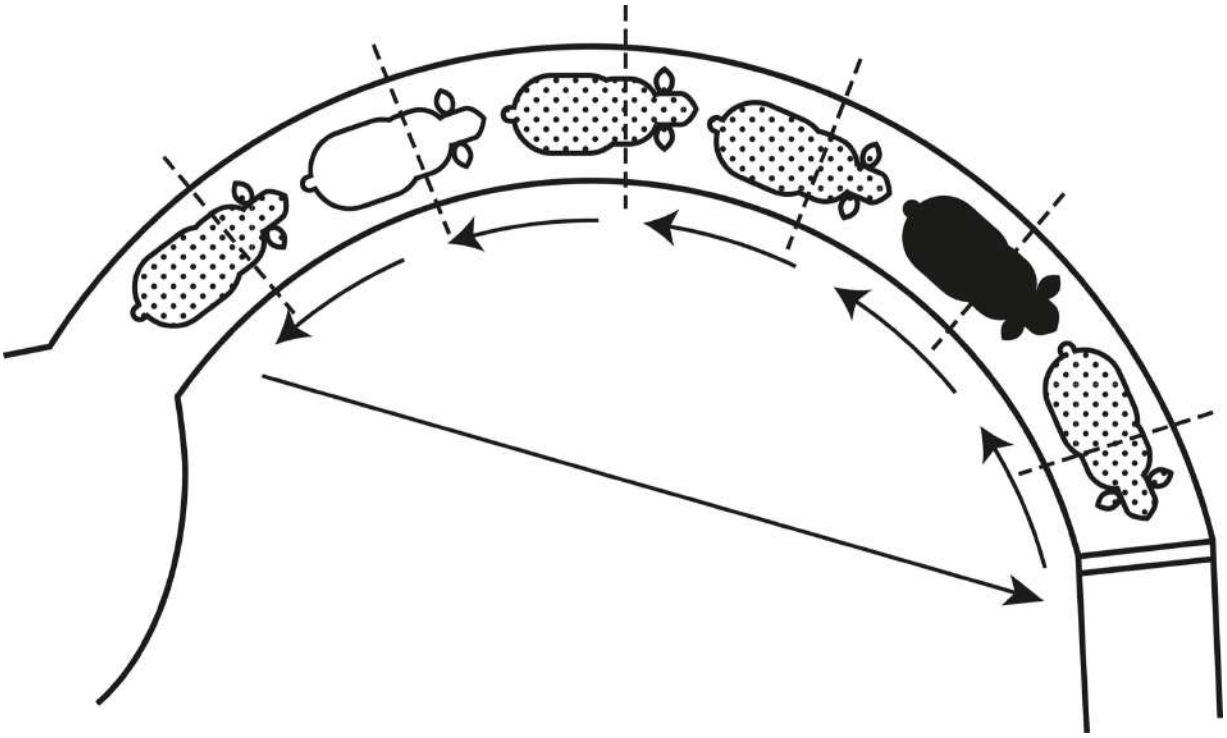
Incremental Innovation and Paradigm Shifts

Understanding how and why something works is a key step to improving it. First principles thinking helps us avoid the problem of relying on someone else’s tactics without understanding the rationale behind them.

Temple Grandin is famous for a couple of reasons. First, she is autistic, and was one of the first people to publicly disclose this fact and give insight into the inner workings of one type of autistic mind. Second, she is a scientist who has developed many techniques to improve the welfare of livestock in the agricultural industry.

One of the approaches Grandin pioneered was the curved cattle chute. Before her experiments, cattle were herded through a straight chute. Curved chutes, Grandin found, “are more efficient for handling cattle because they take advantage of the natural behavior of cattle. Cattle move through curved races more easily because they have a natural tendency to go back to where they came from.”[7] Of course, science doesn’t stop with one innovation, and animal scientists continue to study the best way to treat livestock animals.

Stockmanship Journal presented research that questioned the efficiency of Grandin’s curved chute. It demonstrated that sometimes, the much simpler straight chute would achieve the same effect in terms of cattle movement. The journal then sought out Grandin’s response, which is invaluable for teaching us the necessity of first principles thinking.



Grandin explained that curved chutes are not a first principle. She designed them as a tactic to address the first principle of animal handling that she identified in her research—essentially, that reducing stress to the animals is the single most important aspect of handling them and affects everything from their conception rates to their weight to their immune systems. When designing a livestock environment, she noted, a straight chute could work if it is part of a system that reduces stress to the animals. If you know the principles, you can change the tactics.[8]

Sometimes, we don’t want to fine-tune what is already there—we are skeptical, or curious, and are not interested in accepting what already exists as our starting point. When we start with the idea that the way things are might not be the way they have to be, we put ourselves in the right frame of mind to identify first principles. The real power of first principles thinking is moving away from random change and into choices that have a real possibility of success.

> As to methods, there may be a million and then some, but principles are few. The man who grasps principles can successfully select his own methods. The man who tries methods, ignoring principles, is sure to have trouble.
>
> **—HARRINGTON EMERSON**[9]

Conclusion

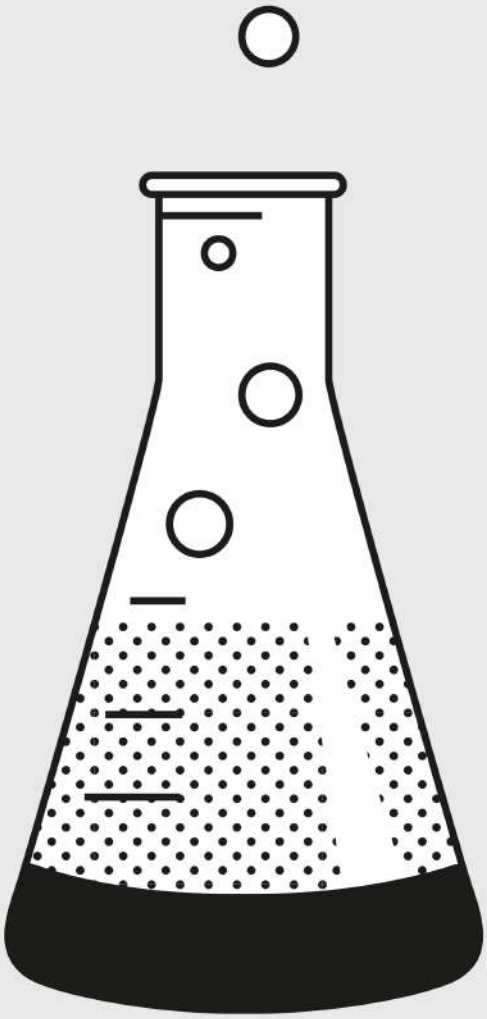
First principles thinking is the art of breaking down complex problems into their most fundamental truths. It's a way of thinking that goes beyond the surface and allows us to see things from a new perspective.

Thinking in terms of first principles allows us to identify the root causes and strip away the layers of complexity and focus on the most effective solutions. Reasoning from first principles allows us to step outside the way things have always been done and instead see what is possible.

First principles thinking is not easy. It requires a willingness to challenge the status quo. This is why it's often the domain of rebels and disrupters who believe there must be a better way. It's the thinking of those who are willing to start from scratch and build from the ground up.

In a world focused on incremental improvement, first principles thinking offers a competitive advantage because almost no one does it.

Thought Experiment



Imagine the possibilities.

Creativity is intelligence having fun.

—ANONYMOUS[1]

Thought experiments can be defined as "devices of the imagination used to investigate the nature of things."[2] Many disciplines, such as philosophy and physics, make use of thought experiments to examine what can be known. In doing so, they open new avenues for inquiry and exploration.

Thought experiments are powerful because they help us learn from our mistakes and avoid future ones. They let us evaluate the potential consequences of our actions, take on the impossible, and reexamine history to make better decisions. They can help us figure out both what we really want and the best way to get there.

The Ovarian Lottery

We can use thought experiments to reveal blind spots.

Warren Buffett, one of the most famous investors in the history of the world, often uses thought experiments to educate. In pointing out the role of luck, he says, *Imagine that it is twenty-four hours before you are going to be born, and a genie comes to you*.[3]

To further paraphrase this thought experiment: "The genie says you can determine the rules of the society you are about to enter and you can design anything you want. You get to design the social rules, the economic rules, the governmental rules. And those rules are going to prevail for your lifetime and your children's lifetime and your grandchildren's lifetime."

"But," he adds, "there is a catch."

"You don't know whether you're going to be born rich or poor, male or female, infirm or able-bodied, in the United States or Afghanistan. All you know is that you get to take one ball out of a barrel."

He goes on to tell you that through dumb luck, he and his business partner were born in the United States and, as a result, had a staggering advantage. He won the ovarian lottery.

While how hard you work might improve your relative success, the ovarian lottery determines much of your absolute success.

Betting on Basketball

Suppose I asked you to tell me who would win in a game of basketball: NBA champion LeBron James or filmmaker Woody Allen? How much would you bet that your answer was correct?

I think you'd get me an answer quickly, and I hope you'd bet all you had.

Next, suppose I asked you to tell me who'd win in a game of basketball: NBA champion LeBron James or NBA champion Kevin Durant? How much would you bet that your answer was correct?

A little harder, isn't it? Would you bet anywhere near all you had on being right?

Let's think this through. You attempted to answer both questions in the same way—you imagined the contests. Perhaps more importantly, you *didn't* attempt to answer either of them by calling up Messrs. James, Allen, and Durant and inviting them over for an afternoon of basketball. You simply simulated the games in your mind.

In the first case, your knowledge of James (young, tall, athletic, and skilled), Allen (old, small, frail, and funny), and the game of basketball gave you a clear mental image. The disparity between the players' abilities makes the question (and the bet) a total no-brainer.

In the second case, your knowledge of James and Durant may well be extensive, but that doesn't make it an easy bet. They're both professional basketball players who are quite similar in size and ability, and both of them are likely to go down as among the best ever to play the game. It's doubtful that one is *much* better than the other in a one-on-one match. The only way

to answer the question for sure would be to see them play. And even then, a one-off contest is not going to be definitive.

A better way to answer the “who would win” question is through a remarkable ability of the human brain—the ability to conduct a detailed thought experiment. Its chief value is that it lets us do things in our heads we cannot do in real life, and so explore situations from more angles than we can physically examine and test for.

Thought experiments are more than daydreaming. To be useful, they require the same rigor as a traditional experiment. Much like the scientific method, a thought experiment generally has the following steps:

1. Ask a question.
2. Conduct background research.
3. Construct a hypothesis.
4. Test with (thought) experiments.
5. Analyze outcomes and draw conclusions.
6. Compare to hypothesis and adjust accordingly (new question, etc.).

In the James/Allen experiment above, we started with a question: Who would win in a game of basketball? If you didn’t already know who those people were, finding out would have been a necessary piece of background research. Then you would come out with your hypothesis (James all the way!) and think it through.

One of the real powers of the thought experiment is that there is no limit to the number of times you can change a variable to see if it influences the outcome. In order to place your bet, you would want to estimate: In how many possible basketball games does Woody Allen beat LeBron James? Out of a hundred thousand game scenarios, Allen probably wins only in the few where LeBron starts the game by breaking an ankle. Experimenting to

discover the full spectrum of possible outcomes gives you a better appreciation for what you can influence and what you can reasonably expect to happen.

Let's now explore a few areas in which thought experiments are tremendously useful.

1. Imagining physical impossibilities
2. Reimagining history
3. Intuiting the nonintuitive

Imagining physical impossibilities: Albert Einstein was a great user of the thought experiment because it is a way to logically carry out a test in one's own head that would be very difficult or impossible to perform in real life. With this tool, we can solve problems with intuition and logic whose conditions cannot be demonstrated physically.

One of Einstein's notable thought experiments involved an elevator.[4] Imagine you were in a closed elevator, feet glued to the floor. Absent any other information, would you be able to know whether the elevator was in outer space, with a string pulling the elevator upward at an accelerating rate, or sitting on Earth, being pulled down by gravity? By running the thought experiment, Einstein concluded that you would not.

This led to the formulation of Einstein's second major theory, the general theory of relativity—his universal theory of gravity. Einstein's hypothesis was that the force you feel from acceleration and the force you feel from gravity don't just *feel* the same—they are the same! Gravity, he decided, must work similarly to the accelerating elevator. We can't build elevators in space, but we can still define some of the properties they would have if we could. This gives us enough information to test the hypothesis. Eventually, Einstein worked it all out—mathematically and in great detail—but he started with a simple thought experiment, impossible to actually perform.

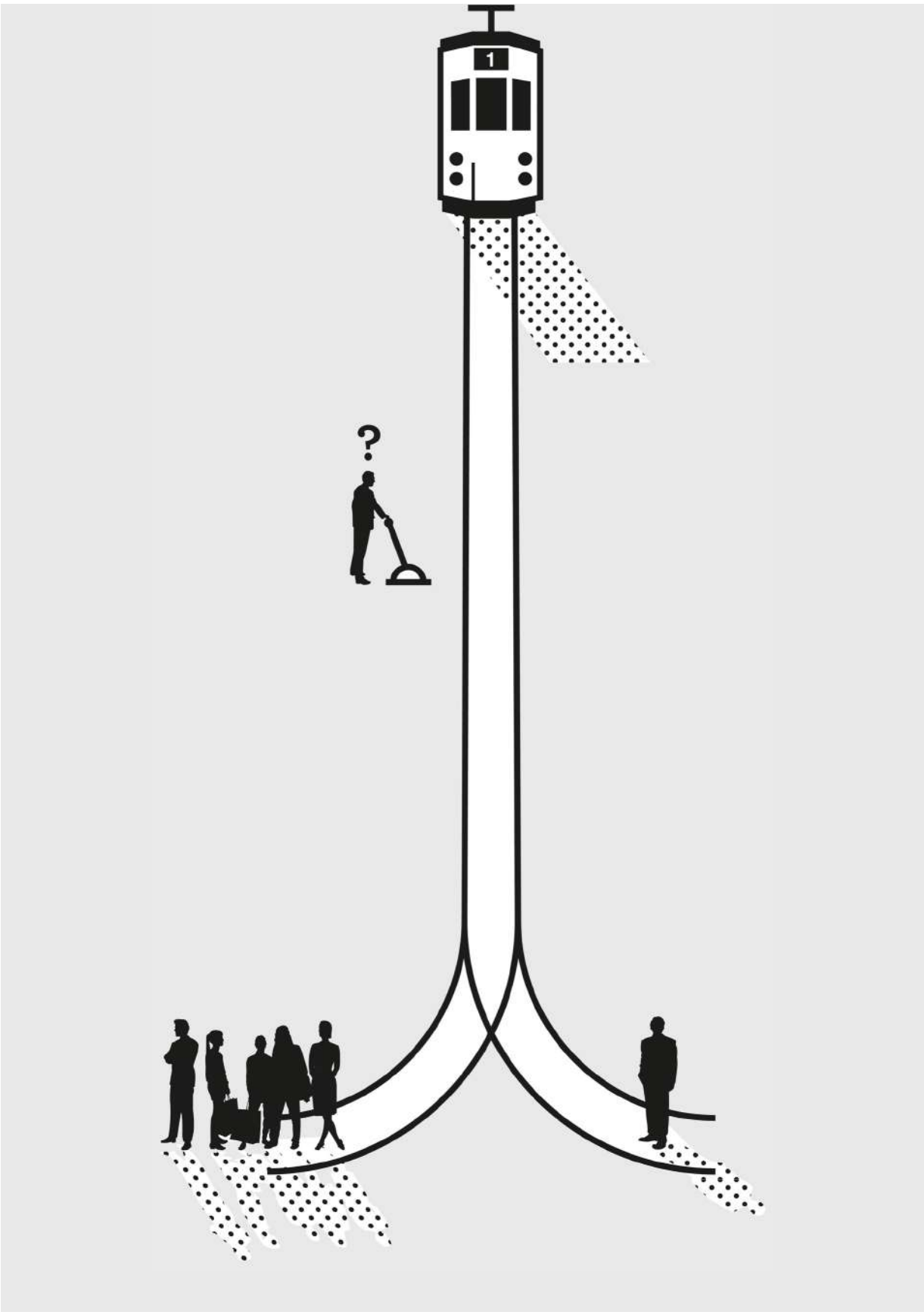
This type of thought experiment need not apply only to physics and is reflected in some of our common expressions. When we say, “if money were no object” or “if you had all the time in the world,” we are asking someone to conduct a thought experiment, because removing that variable (money or time) is physically impossible. In reality, money is always an object, and we never have all the time in the world. But the act of detailing the choices we would make in these alternate realities that have properties otherwise similar to our current one—doing the thought experiment—is what leads to insights regarding what we value in life and where to focus our energies.

The Trolley Experiment

Thought experiments are often used to explore ethical and moral issues. When you are dealing with questions of life and death, obviously it is not recommended to kill a bunch of people in order to determine the most ethical course of action. This, then, is where a thought experiment is extremely valuable.

One of the most famous of this type is the trolley experiment. It goes like this: Say you are the driver of a trolley that is out of control. You apply the brakes, and nothing happens. Ahead of you are five people who will die should your trolley continue on the track. At the last moment, you notice a spur that has only one person on it. What do you do? Do you continue on and kill the five, or do you divert and kill the one?

This experiment was first proposed in modern form by Philippa Foot in her paper “The Problem of Abortion and the Doctrine of the Double Effect,” and further considered extensively by Judith Jarvis Thomson in “The Trolley Problem.” In both cases, the value of the thought experiment is clear. The authors were able to explore situations that would be physically impossible to reproduce without causing serious harm and, in so doing, significantly advanced certain questions of morality. Moreover, the trolley problem remains relevant to this day, as technological advances often ask us to define when it is acceptable, and even desirable, to sacrifice one to save many (and, lest you think this is always the case, Thomson conducts another great thought experiment, considering a doctor killing one patient to save five through organ donation).[5]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Reimagining history: A familiar use of the thought experiment is to reimagine history. This one we all perform, all the time. What if I hadn't been stuck at the airport bar where I met my future business partner? Would World War I have started if Serbian nationalist Gavrilo Princip hadn't shot the archduke of Austria in Sarajevo? If Cleopatra hadn't found a way to meet Caesar, would she still have been able to take the throne of Egypt?

These approaches are called the *historical counterfactual and semifactual*. If Y happened instead of X, what would the outcome have been? Would the outcome have been the same?

As popular—and generally useful—as counter- and semifactuals are, they are also the areas of thought experiment with which we need to use the most caution. Why? Because history is what we call a chaotic system, wherein a small change in the beginning conditions can cause a *very* different outcome down the line. This is where the rigor of the scientific method is indispensable if we want to draw conclusions that are useful.

To understand it, let's think about another chaotic system we're all familiar with: the weather. Why is it that we can predict the movement of the stars but we can't predict the weather more than a few weeks out, and even then, not altogether reliably? The reason is because weather is *highly* chaotic. Any infinitesimally small error in our calculations today will change the result down the line, as rapid feedback loops occur throughout time. Since our measurement tools are not infinitely accurate, and never will be, we are stuck with the unpredictability of chaotic systems.

Compared to human systems, one could say weather is pretty reliable stuff. As anyone who's seen *Back to the Future* knows, a small change in the past could have a massive, unpredictable effect on the future. Thus, running historical counterfactuals is an easy way to accidentally mislead yourself. We simply don't know what else would have occurred had Cleopatra not met Caesar, or had you not been stuck at that airport. The potential outcomes are too chaotic.

But we can use thought experiments to *explore* unrealized outcomes—to rerun a process as many times as we like in order to see what else could have occurred and learn more about the limits we have to work with.

The events that happened in history are but one realization of the historical process—*one* possible outcome among a large variety of possible outcomes. They're like a deck of cards that has been dealt only one time. All the things that didn't happen, but could have if some little thing went another way, are invisible to us—that is, until we use our brains to generate these theoretical worlds via thought experiments.

If we can also factor in the approximate probability of these occurrences, relative to the scope of all possible ones, we can learn what the most likely outcomes are. Sometimes, it is easy to imagine ten different ways a situation could have played out differently, but more of a stretch to change the variables and still end up with the same thing.

So, let's try it. Start with a question: What if Gavrilo Princip hadn't shot Archduke Franz Ferdinand? That single act has often been credited with launching World War I, so it is a question worth asking. If we conclude the assassination started a chain reaction of which war was the inevitable result, it would certainly tell us a lot about certain causal relationships in politics, diplomacy, and possibly human psychology.

Then we need to do our background research. What do we need to know to be able to answer this question? So we look into it—treaties, conflicts, alliances, interests, personalities—enough to be able to formulate a hypothesis.

An immediate response to the assassination came two days later, on June 30, 1914. Austria changed its policy toward Serbia. Shortly after that, Germany offered full military support to Austria, and less than two months later, all of Europe was at war. Thus, a next step in our thought experiment might be to refine the question. Perhaps we'd ask something like, how did Princip's assassination of the archduke influence Austrian policy toward Serbia?

Our hypothesis could be one of the following:

1. The assassination had no effect on policy.

2. The assassination had partial effect on policy.

3. The assassination had total effect on policy.

To test any one of these, we run the experiment in our heads. We sit back and think about what the world looked like in Sarajevo on June 28, 1914: the archduke and his wife being chauffeured in their car, Gavrilo Princip cleaning his gun somewhere. Now we imagine Princip gets stomach cramps from some bad food the night before. The archduke's car makes it to its destination while Princip is curled up in bed. The archduke gives a speech, emphasizing peace. One of Princip's gang tries to assassinate the archduke but fails. How does Austria react? Is the outcome demonstrably different from what they actually did?

Princip wasn't a lone wolf, and there was a lot of resentment in Serbia toward Austria. How could the situation be changed to lead to a different Austrian policy? Given the climate at the time, is our hypothetical situation realistic? Meaning, can you construct a historically accurate scenario in which no events come to pass that prompt Austria's policy change? How many Serbians would have to get the stomach flu?

One of the goals of a thought experiment like this is to understand the situation enough to identify the decisions and actions that had impact. This process doesn't provide definitive answers, such as whether the assassination did, or did not, cause World War I. What you are trying to get to is a rough idea of how much it may have contributed to starting the war. The more scenarios you can imagine where war comes to pass without the assassination, the weaker the case for it being the critical cause. Thus, by exploring the realistic relationships between events, you can better understand the most likely effects of any one decision.

Reducing the Role of Chance

Let's try a real-world example. Suppose you were to buy a hundred thousand dollars of stock in Google, with 50 percent paid for in cash and 50 percent borrowed from the brokerage firm. (They call this a "margin loan.")

A few years later, the stock price has doubled: That means your $100,000 is worth $200,000. Since you still owe the brokerage $50,000, your own $50,000 is now worth $150,000—you've *tripled* your money! You consider yourself a financial genius.

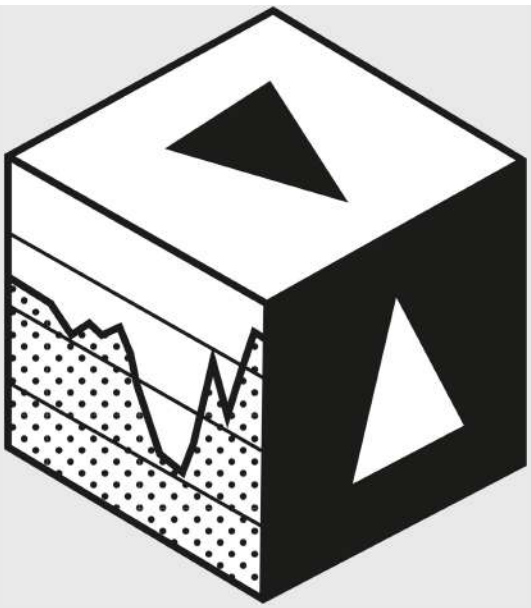
Before we land on that conclusion, though, let's run our Theoretical World Generator a bunch of times in our head. What else *could* have happened but didn't?

Google *could* have gone down 50 percent before it went up 100 percent—nearly all stocks on the exchange have had this happen to them at some time or another. In fact, Google *could* have gone down 90 percent! The whole New York Stock Exchange did just that between 1929 and 1932.

What if something like that *had* happened? The brokerage would have called in your margin loan: Game over, thanks for playing. You would have been worth zero.

Now, return to the beginning of the chapter. If you're going to buy Google on margin, is your bet that Google won't go down 50 percent more similar to the LeBron/Allen thought experiment, or the LeBron/Durant thought experiment? Running through the scenario a hundred thousand times, how many times do you go broke, and how many times do you triple your dough?

This exercise gives you some real decision-making power. It tells you about the limits of what you know and what you should attempt. It tells you, in an imprecise but useful way, a lot about how smart or stupid your decisions were, regardless of the actual outcome. It makes you aware of your process, so that even if the results are good, you can recognize when this was all down to luck and maybe you should work on your decision-making process to reduce the role of chance.



Intuiting the nonintuitive: One of the uses of thought experiments is to improve our ability to intuit the nonintuitive. In other words, a thought experiment allows us to verify whether our natural intuition is correct by running experiments in our deliberate, conscious minds that make a point clear.

An example of this is the famous "veil of ignorance" proposed by philosopher John Rawls in his influential book *A Theory of Justice*. To figure out the most fair and equitable way to structure society, he proposed that the designers of said society operate behind a veil of ignorance. This meant that they could not know who they would be in the society they were creating. If they designed the society without knowing their economic status, their ethnic background, their talents and interests, or even their gender, they would have to put in place a structure that was as fair as possible in order to guarantee the best possible outcome for themselves.[6]

Our initial intuition regarding what is fair in a society is likely to be challenged during the "veil of ignorance" thought experiment. When confronted with the question of how best to organize society, we have a general feeling that it should be "fair." But what exactly does this mean? We can use this thought experiment to test the likely outcomes of different rules and structures to come up with an aggregate of what is most fair.

We need not be constructing the legislation of entire nations for this type of thinking to be useful. Think, for example, of a company's human resources policies on hiring, office etiquette, or parental leave. What kind of policies would you design or support if you didn't know what your role in the company was, or even anything about who you were?

Conclusion

Thought experiments are the sandbox of the mind, the place where we can play with ideas without constraints. They're a way of exploring the implications of our theories, of testing the boundaries of our understanding.

They offer a powerful tool for clarifying our thinking, revealing hidden assumptions, and showing us unintended consequences.

The power of thought experiments lies in their ability to create a simplified model of reality where we can test our ideas. In the real world, there are always confounding factors, messy details that obscure the core principles at work. But in a thought experiment, we can strip away the noise and focus on the essence of the problem.

Thought experiments offer a reminder that some of the most profound insights and innovations start with a simple question: What if?

SUPPORTING IDEA:

Necessity and Sufficiency

WE OFTEN MAKE THE MISTAKE of assuming that having some necessary conditions in place means that we have the sufficient conditions in place for our desired event or effect to occur. The gap between the two is the difference between becoming a published author and becoming J. K. Rowling. Certainly, you have to know how to write well to become either, but knowing how to write well isn't sufficient to guarantee you'll become a Rowling. This is somewhat obvious to most. What's not obvious is that the gap between what is necessary to succeed and what is sufficient is often luck, chance, or some other factor beyond your direct control.

Assume you wanted to make it into the *Fortune* 500. Capital is necessary but not sufficient. Hard work is necessary but not sufficient. Intelligence is necessary but not sufficient. Billionaire success takes all of those things and more, *plus* a lot of luck. That's a big reason that there's no recipe for achieving it.

Winning a military battle is a great example of necessity and sufficiency. It is necessary to prepare for the battle by evaluating the strength and tactics of your enemy, and by developing your own plan. You need to address logistics, such as

supply chains, and have a comprehensive strategy that allows flexibility to respond to the unexpected. These things, however, are not enough to win the battle. Without them, you definitely won't be successful, but on their own they are not sufficient to guarantee success.

This concept is easily demonstrated in sports as well. To be successful at a professional level in any sport depends on some necessary conditions: you must be physically capable of meeting the demands of that sport, and have the time and means to train. Meeting these conditions, however, is not sufficient to guarantee a successful outcome. Many hardworking, talented athletes are unable to break into the professional ranks.

In mathematics, they call these groupings *sets*. The set of conditions necessary to become successful is a part of the set that is sufficient to become successful. But the sufficient set itself is far larger than the necessary set. Without that distinction, it's too easy for us to be misled by the wrong stories.

Second-Order Thinking

What happens next?

Technology is fine, but the scientists and engineers only partially think through their problems. They solve certain aspects, but not the total, and as a consequence it is slapping us back in the face very hard.

—BARBARA MCCLINTOCK[1]

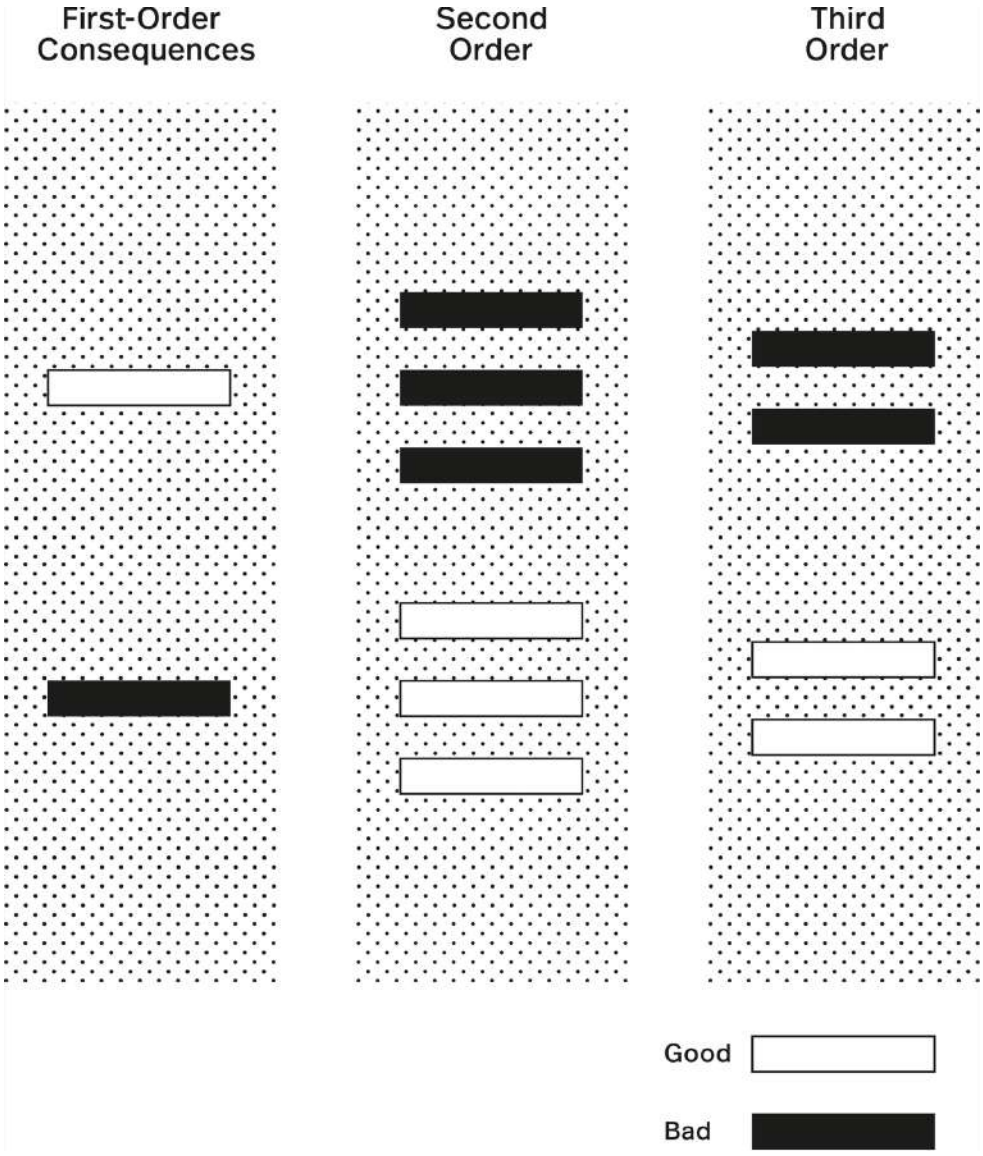
Almost everyone can anticipate the immediate results of their actions. However, few people think about what happens next.

First-order thinking is easy and common. Second-order thinking is harder and requires thinking further ahead and thinking holistically. It requires us to consider not only our actions and their immediate consequences, but the subsequent effects of those actions as well. Failing to consider the second- and third-order effects of our decisions can unleash disaster.

First-order thinking is almost always about satisfying the immediate problem. Second-order thinking, on the other hand, avoids problems before they happen by asking, “And then what?”

Without second-order thinking, it can be hard to appreciate just how often what appears to solve the immediate problem takes you further away from your objective. First-order thinking tells you the chocolate bar tastes good and will satisfy your cravings. Second-order thinking tells you that when the sugar high wears off, you’ll crash.

It is often easier to find examples of when second-order thinking *didn’t* happen—when people did not consider the effects of the effects. When someone tried to do something good, or even just benign, and instead brought calamity, we can safely assume the negative outcomes weren’t factored into their original thinking. Very often, the second level of effect is not considered until it’s too late. This concept is often referred to as the “Law of Unintended Consequences” for this very reason.



We see examples of this oversight throughout history. The British are a well-intentioned nation with an ample supply of smart politicians. However, during its colonial rule of India, the British government began to worry about the number of venomous cobras in Delhi. To reduce the population, they instituted a reward for every dead snake brought to officials. In response, Indian citizens dutifully began breeding the snakes to slaughter and bring to officials. The snake problem became worse than when the government first intervened, because the British officials didn’t think at the second level.

Second-order effects occur even with something as simple as adding traction on tires: it seems like such a great idea, because the more traction you have, the less likely you are to slide, the faster you can stop, and, thus, the safer you are. However, the second-order effects are that your engine must work harder to propel the car, you get worse gas mileage (releasing more detrimental carbon dioxide into the atmosphere), and you leave more rubber particles on the road.

This is why any comprehensive thought process considers the effects of the effects of a decision seriously. You're going to have to deal with them anyway. The genie never goes back in the bottle; you can never delete consequences to arrive back at the original starting conditions.

> Stupidity is the same as evil if you judge by the results.
>
> **—MARGARET ATWOOD**[2]

In an example of second-order-thinking deficiency, we have been feeding antibiotics to livestock for decades, to make the resulting meat safer and cheaper. Only in recent years have we begun to realize that in doing so, we have helped create bacteria that we cannot defend against.

In 1963, UC Santa Barbara ecologist Garrett Hardin proposed his First Law of Ecology: "You can never merely do one thing."[3] We operate in a world of multiple, overlapping connections, like a web, with many significant, yet obscure and unpredictable, relationships. Hardin developed second-order thinking into a tool, showing that if you don't consider "the effects of the effects," you can't really claim to be doing any thinking at all.

When it comes to the overuse of antibiotics in meat, the first-order consequence is that the animals gain more weight per pound of food consumed, and thus, there is profit for the farmer. Animals are sold by weight, so the less food you need to use to bulk them up, the more profit you make when you go to sell them. The second-order effects, however, include many serious, negative consequences. The bacteria that survive this

continued antibiotic exposure are antibiotic resistant. That means that the agricultural industry, when using these antibiotics as bulking agents, is allowing massive numbers of drug-resistant bacteria to become part of our food chain.

High degrees of connection make second-order thinking all the more critical, because denser webs of relationships make it easier for actions to have far-reaching consequences. You may be focused in one direction, not recognizing that the consequences of your decisions are rippling out all around you. Things are not produced and consumed in a vacuum.

> When we try to pick out anything by itself, we find it hitched to everything else in the Universe.
>
> **—JOHN MUIR**[4]

Second-order thinking is not a way to predict the future. You are only able to think of the likely consequences of your decisions' consequences based on the information available to you. However, this is not an excuse to power ahead and wait for post facto scientific analysis.

Could the consequences of putting antibiotics in livestock feed have been anticipated? Likely, yes, by anyone with even a limited understanding of biology. We know that organisms evolve. They adapt based on environmental pressures, and those with shorter life cycles, like bacteria, can do it quite quickly, because they have more opportunities to do so. Antibiotics, by definition, kill bacteria. Bacteria, just like all other living things, want to survive. The pressures put on them by continued exposure to antibiotics increase their pace of evolution. Over the course of many generations, eventually, mutations will occur that allow certain bacteria to resist the effects of the antibiotics. These are the bacteria that will then reproduce more rapidly, creating the situation we are now in.

Second-Order Problem

Warren Buffett used a very apt metaphor once to describe the second-order problem, likening it to a crowd at a parade: Once a few people decide to stand on their tiptoes to see better, *everyone has to stand on their tiptoes*. No one can see any better, but they're all worse off.[5]

Second-order thinking teaches us two important concepts that underline the utility of this model. If we're interested in understanding how the world works, we must think about second- and subsequent-level effects. We must understand that just because there is no immediate and visible impact from our decisions doesn't mean that we are not moving closer to or further from our objectives. How often is short-term gain worth protracted, long-term pain?

Let's look at two areas where second-order thinking can be used to great benefit:

1. Prioritizing long-term interests over immediate gains
2. Constructing effective arguments

Prioritizing Long-Term Interests

Thinking long-term eliminates a lot of poor behavior. Most people prefer to give in to instant gratification. If we want to avoid problems, however, we need to see past the immediate moment and into the future. If we forgo the immediate pleasure of candy, we improve our long-term health. The first-order effect of candy is the amazing feeling triggered by an influx of pure sugar in our system. But what are the second-order effects of regular candy consumption? Is that what I want my body or life to look like in ten years? Second-order thinking involves asking ourselves if what we are doing now is moving us closer to or further away from our objectives.

The most dangerous form of short-term thinking is one that doesn't understand that just because results are not visible doesn't mean they are not accumulating. Thinking long-term helps us see how the accumulation of tiny gains or losses moves us toward or away from our intended future.

Finding historical examples of second-order thinking can be tricky, because we don't want to evaluate based solely on the outcome: "It all turned out well, so he must have thought through the consequences of his

actions.” Even if you can glimpse the long-term gain from your short-term pain, there is no guarantee you’ll get there.

In 48 BC, Cleopatra of Egypt was in a terrible position.[6] Technically co-regent with her brother, in a family famous for murdering siblings, she was encamped in a swampy desert, ousted from the palace, with no solid plan for how to get back. She was queen, but she had made a series of unpopular decisions that left her with little political support and that gave her brother ample justification for trying to have her assassinated. What to do?

At the same time, the great Roman general Caesar arrived in Egypt, chasing down his enemy Pompey and making sure the Egyptians knew who really was in charge on the Mediterranean. Egypt was an incredibly fertile, wealthy country, and as such was of great importance to the Romans. The way they inserted themselves in Egypt, however, made them extremely unpopular there.

To survive, Cleopatra had to make some tough decisions. Should she try to work things out with her brother? Should she try to marshal some support from another country? Or should she try to align herself with Caesar?

In *Cleopatra: A Life*, Stacy Schiff explains that even in 48 BC, at the age of twenty-one, Cleopatra would have had a superb political education, based on both historical knowledge and firsthand exposure to the tumultuous events of life on the Mediterranean. She would have observed actions taken by her father, Auletes, as well as various family members, that resulted in exile, bribery, and murder from either a family member, the Romans, or the populace. She would have known that there were no easy answers. As Schiff explains, “What Auletes passed down to his daughter was a precarious balancing act. To please one constituency was to displease another. Failure to comply with Rome would lead to intervention. Failure to stand up to Rome would lead to riots.”[7]

In this situation, it was thus imperative that Cleopatra consider the second-order effects of her actions. Short-term gain might easily lead to execution (as indeed it already had for many of her relatives). If she wanted to be around for a while, she needed to balance her immediate goals of

survival and possession of the throne with the future need for support to stay on it.

In 48 BC, Cleopatra chose to align herself with Caesar. The first-order effects of this decision, it seems likely she would have known: namely, that it would anger her brother, who would increase his plotting to have her killed, and that it would anger the Egyptian people, who didn't want a Roman involved in their affairs. She probably anticipated that there would be short-term pain, and there was. Cleopatra effectively started a civil war, including a siege on the palace that left her and Caesar trapped there for months. In addition, she had to be constantly vigilant against the assassination schemes of her brother. So why did she do it?

We will never know for sure. We can only make an educated guess. But given that Cleopatra ruled Egypt quite successfully for many years after these events, her decision was probably based on seeing the effects of the effects: if she could somehow make it through the short-term pain, her leadership had a much greater chance of being successful with the support of Caesar and Rome than without it. As Schiff notes, "The Alexandrian War gave Cleopatra everything she wanted. It cost her little."[8] In winning the civil war, Caesar got rid of all major opposition to Cleopatra and firmly aligned himself with her reign.

Being aware of second-order consequences and using them to guide your decision making may mean the short term is less spectacular, but the payoffs for the long term can be enormous. By delaying gratification now, you will save time in the future. You won't have to clean up the mess you made on account of not thinking through the effects of indulging your short-term desires.

Developing Trust for Future Success

Trust and a sense of trustworthiness are the results of multiple interactions. This is why second-order thinking is so useful and valuable. Going for the immediate payoff in our interactions with people, unless the result is a win-win, almost always guarantees that interaction will be a one-off. Maximizing benefits is something that becomes possible only over time. Thus, considering the effects of the effects of our actions on others, or on our reputations, is critical to getting people to trust us and to enjoying the benefits of cooperation that come with that trust.[9]

Constructing effective arguments: Second-order thinking can help you avert problems and anticipate challenges that you can then address in advance.

For example, you construct arguments every day: convincing your boss to take a chance on a new product, convincing your spouse to try a new parenting technique. Life is filled with the need to be persuasive. Arguments are more effective when we demonstrate that we have considered the second-order effects of a decision and put effort into verifying that these are desirable as well.

In late-eighteenth-century England, women had very few rights. Philosopher Mary Wollstonecraft was frustrated that this lack of rights limited a woman's ability to be independent and make choices on how to live her life. Instead of arguing, however, for why women should have rights, she recognized that she had to demonstrate the value that these rights would confer. She explained the benefits to society that would be realized because of the granting of those rights. She argued for the education of women because it would, in turn, make them better wives and mothers, more able to both support themselves and raise smart, conscientious children.

Her thoughts, from her book *A Vindication of the Rights of Woman*, are a demonstration of second-order thinking:

> Asserting the rights which women in common with men ought to contend for, I have not attempted to extenuate their faults; but to prove them to be the natural consequence of their education and station in society. If so, it is reasonable to suppose that they will change their character, and correct their vices and follies, when they are allowed to be free in a physical, moral, and civil sense.[10]

Empowering women was a first-order effect of recognizing that women should have rights. But by discussing the logical consequences this empowerment would have on society—the second-order effects—

Wollstonecraft started a conversation that eventually resulted in what we now call feminism. Not only would women eventually get freedoms they deserved, they would become better women and better members of society.

A Word of Caution

Second-order thinking must be tempered in one important way: you can't let it lead to the paralysis of the "slippery slope effect," the idea that if we start with action A, everything after is a slippery slope down to hell, with an inevitable chain of consequences including B, C, D, E, and F.

Garrett Hardin smartly addresses this danger in *Filters Against Folly*:

> Those who take the wedge (Slippery Slope) argument with the utmost seriousness act as though they think human beings are completely devoid of practical judgment. Countless examples from everyday life show the pessimists are wrong…. If we took the wedge argument seriously, we would pass a law forbidding all vehicles to travel at any speed greater than zero. That would be an easy way out of the moral problem. But we pass no such law.[11]

In practical life, everything has limits. Even if we consider secondary and subsequent effects, we can only go so far. During waves of prohibition fever in the United States and elsewhere, conservative abstainers have frequently made the case that taking even a *first* drink would be the first step toward a life of sin. They're right: it's true that drinking a beer *might* lead you to become an alcoholic. But not most of the time.

Thus, we need to avoid the slippery slope and the analysis paralysis it can lead to. Second-order thinking needs to evaluate the most likely effects and their most likely consequences, checking our understanding of what the *typical* results of our actions will be. If we worried about all possible effects of the effects of our actions, we would likely never do anything, and we'd

be wrong. How you balance the need for higher-order thinking with practical, limiting judgment must be taken on a case-by-case basis.

Conclusion

Second-order thinking is a method of thinking that goes beyond the surface level, beyond the knee-jerk reactions and short-term gains. It asks us to play the long game, to anticipate the ripple effects of our actions and to make choices that will benefit us not just today, but in the months and years to come.

Second-order thinking demands we ask: And then what?

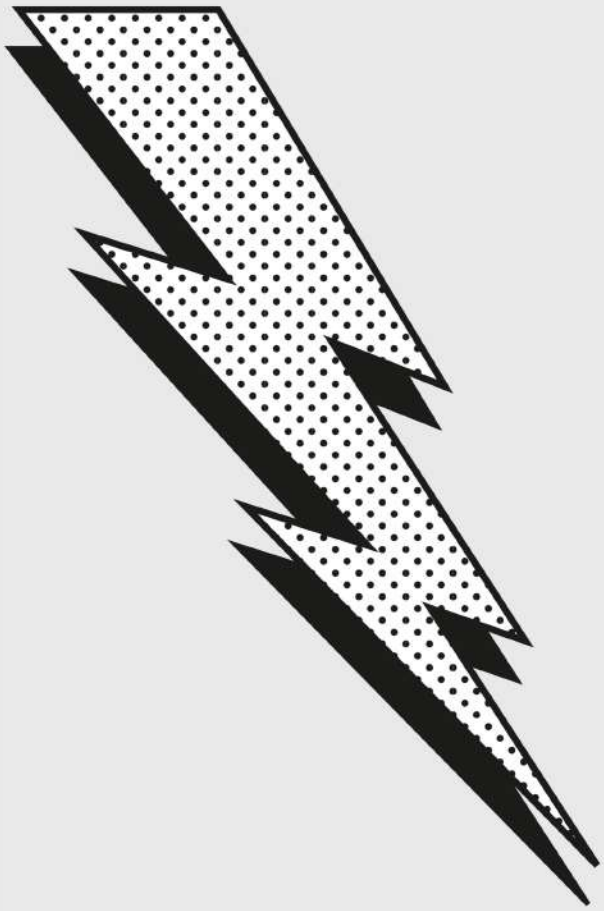
Think of a chess master contemplating her next move. She doesn't just consider how the move will affect the next turn, but how it will shape the entire game. She's thinking many steps ahead. She's considering not just her own strategy, but her opponent's likely response. This is second-order thinking in action.

In our daily lives, we're often driven by first-order thinking. We make decisions based on what makes us happy now, what eases our current discomfort or satisfies our immediate desires.

Second-order thinking asks us to consider the long-term implications of our choices, to make decisions based not just on what feels good now, but on what will lead to the best outcomes over time.

In the end, second-order thinking is about playing the long game. It's about making choices not just for the next move, but for the entire journey.

Probabilistic Thinking



What are the chances?

The theory of probability is the only mathematical tool available to help map the unknown and the uncontrollable. It is fortunate that this tool, while tricky, is extraordinarily powerful and convenient.

—BENOIT MANDELBROT[1]

Probabilistic thinking is essentially trying to estimate, using some math and logic, the likelihood of any specific outcome occurring. It is one of the best tools we have to improve the accuracy of our decisions. In a world where each moment is determined by an infinitely complex set of factors, probabilistic thinking helps us deal with uncertainty. When we know these, our decisions can be more precise and effective.

Are You Going to Get Hit by Lightning or Not?

It's worth asking why we need to think in probabilities at all. Things either are or are not, right? Either we *will* get hit by lightning today or we *won't*. The problem is, we just don't know until we live out the day—which doesn't help us at all when we make our decisions in the morning about what to do. The future is far from predetermined, and we can better navigate it by understanding the likelihood of events that could impact us.

Very few things are 100 percent certain. Nearly everything is a probability. Our lack of perfect information about the world gives rise to all of probability theory, and to its usefulness. We know now that the future is inherently unpredictable, because not all variables can be known, and even the smallest error in our data very quickly throws off our predictions. The best we can do is estimate the future by generating realistic, useful probabilities. So how do we do that?

Probability is everywhere, down to the very bones of the world. The probabilistic machinery in our minds—the cut-to-the-quick "heuristics" made so famous by the psychologists Daniel Kahneman and Amos Tversky—was evolved by the human species in a time before computers, factories, traffic, middle managers, and the stock market. It served us in a time when human life was about *survival* and still serves us well in that capacity.

Conditional Probability

Conditional probability is like Bayesian thinking (see below) in practice but comes at it from a different angle. When you use historical events to predict the future, you must be mindful of the conditions that surrounded that event.

Events can be independent, like tossing a coin, or dependent. A dependent event is one whose outcome is conditional on what preceded it. Let's say that the last three times I've hung out with you, we've gone for ice cream. I've picked vanilla each time. Do you conclude that vanilla is my favorite, and thus I will always choose it? You'd want to check first whether my choosing vanilla is independent or dependent. Am I the first to choose from among a hundred flavors? Or am I further down the line, when chocolate is no longer available?

My ice cream choice is independent if all the flavors are available each time someone in my group makes a choice. It is dependent if the preceding choices of my friends reduce what choices are available to me. In this case, the probability of my choosing vanilla is conditional on what is left after my friends make their choices.

Thus, using conditional probability means being very careful to observe the conditions preceding an event you'd like to understand.

But what about today—a time when, for most of us, survival is not so much the issue? Today, we want to *thrive*. We want to compete, and win. Mostly, we want to make good decisions in complex social systems that were not part of the world in which our brains evolved their (quite rational) heuristics.

To achieve these aims, we need to consciously add in a layer of probability awareness to our thinking.

What is probability awareness, and how can you use it to your advantage? There are three important aspects of probability that we need to explain so you can integrate them into your thinking, to get you into the ballpark and improve your chances of catching the ball:

1. Bayesian thinking
2. Fat-tailed curves
3. Asymmetries

Bayesian thinking: Thomas Bayes was an English minister in the first half of the eighteenth century, whose most famous work, "An Essay Toward Solving a Problem in the Doctrine of Chances," was brought to the attention of the Royal Society by his friend Richard Price in 1763—two years after his death. The essay, the key to what we now know as Bayes's Theorem, concerned how we should adjust probabilities when we encounter new data.

The core of Bayesian thinking (or Bayesian updating, as it can be called) is this: given that we have limited but useful information about the world, and are constantly encountering new information, we should consider what we already know—as much of it as possible—when we learn something new. Bayesian thinking allows us to use *all* relevant prior information in making decisions. Statisticians might call it a "base rate"—taking in outside information about past situations like the one you're in.

Consider the headline "Violent Stabbings on the Rise." Without Bayesian thinking, you might become genuinely afraid, because your

chance of being a victim of assault or murder is higher than it was a few months ago. But a Bayesian approach will have you putting this information into the context of what you already know about violent crime: You know that violent crime has declined to its lowest rates in decades. Your city is safer now than it has been since this measurement was started. Let's say your chance of being a victim of a stabbing last year was 1 in 10,000, or 0.01 percent. The article states, with accuracy, that violent crime has doubled. Your chance of being stabbed is now 2 in 10,000, or 0.02 percent. Is that worth being terribly worried about? The prior information here is key. When we factor it in, we realize that our safety has not really been compromised.

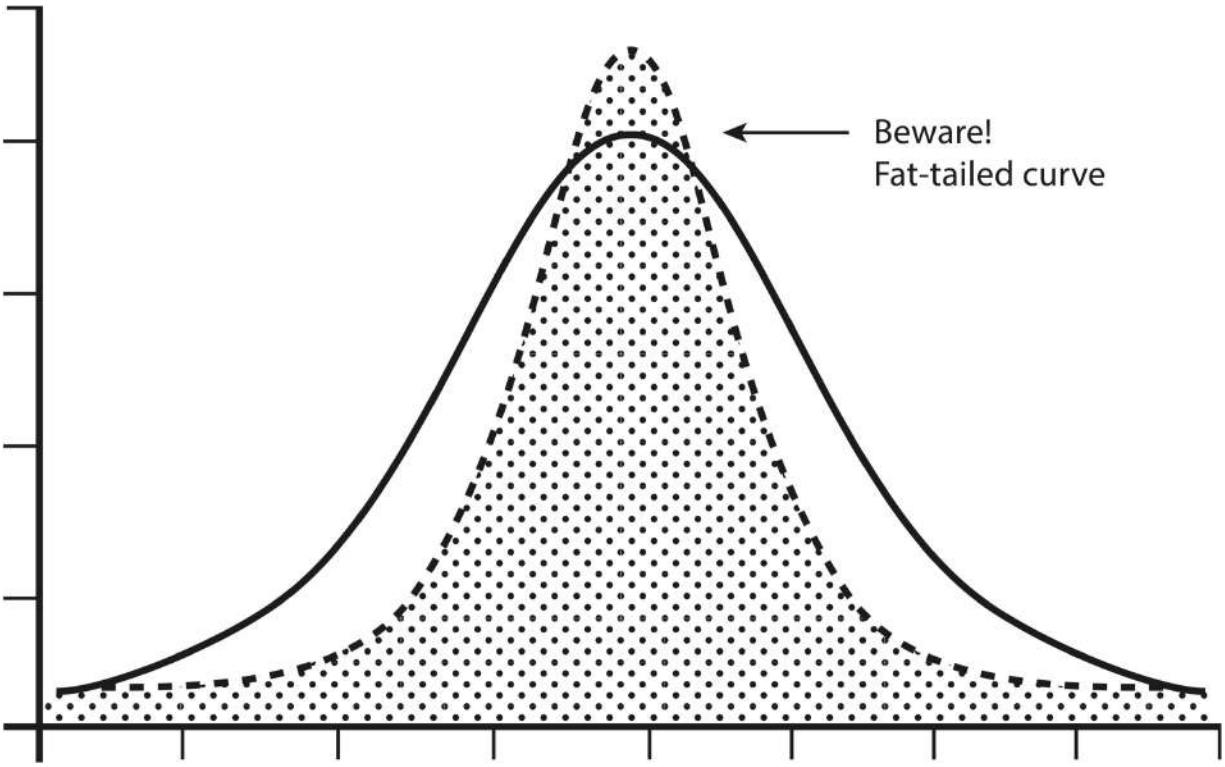
If we look at diabetes statistics in the United States, our application of prior knowledge would lead us to a different conclusion. Here, a Bayesian analysis indicates you should be concerned. In 1958, 0.93 percent of the population was diagnosed with diabetes. In 2015, it was 7.4 percent. When you look at the intervening years, the climb in diabetes diagnoses is steady, not a spike. So the prior relevant data, or "priors," indicate a trend that is worrisome.

It is important to remember that priors themselves represent probability estimates. For each bit of prior knowledge, you are not putting it in a binary structure, saying it is true or not. You're assigning it a *probability* of being true. Therefore, you can't let your priors get in the way of processing new knowledge. In Bayesian terms, this is called the "likelihood ratio" or the "Bayes factor." Any new information you encounter that challenges a prior simply means that the probability of that prior being true may be reduced. Eventually, some priors are replaced completely. Bayesian thinking is an ongoing cycle of challenging and validating what you believe you know. When making uncertain decisions, it's nearly always a mistake not to ask: What are the relevant priors? What might I already know that I can use to better understand the reality of the situation?

Fat-tailed curves: Many of us are familiar with the bell curve, that nice, symmetrical wave that captures the relative frequency of so many things from heights to exam scores. The bell curve is great because it's easy

to understand and easy to use. Its technical name is “normal distribution.” If we know we are in a bell curve situation, we can quickly identify our parameters and plan for the most likely outcomes.

Fat-tailed curves are different. Let’s take a look.



Always be extra mindful of the tails: They might mean everything.

At first glance, the two figures seem similar enough. Common outcomes cluster together, creating a wave. The difference is in the tails. In a bell curve, the extremes are predictable. There can only be so much deviation from the mean. In a fat-tailed curve, there is no real cap on extreme events.

The more extreme events that are possible, the longer the tails of the curve get. Any one extreme event is still unlikely, but the sheer number of options means that we can’t rely on the most common outcomes as representing the average. The more extreme events that are possible, the

higher the probability that one of them will occur. Crazy things are going to happen, and we have no way of identifying when.

Orders of Magnitude

Nassim Nicholas Taleb puts his finger in the right place when he points out our *naive* use of probabilities. In *The Black Swan*, he argues that any small error in measuring the risk of an extreme event can mean we're not just slightly off but *way* off—off by orders of magnitude, in fact. In other words, we're not just 10 percent wrong but ten times wrong, or a hundred times wrong, or a thousand times wrong. Something we thought could happen only once every thousand years might be likely to happen in any given year! Using false prior information results in us underestimating the probability of the future distribution being different.[2]

Think of it this way: In a bell curve situation, such as displaying the distribution of heights or weights in a human population, there are outliers on the spectrum of possibility, but the outliers have a fairly well-defined scope. You'll never meet a man who is ten times the size of an average man. But in a curve with fat tails, like wealth, the central tendency does not work the same way. You may regularly meet people who are ten, a hundred, or ten thousand times wealthier than the average person. That is a very different type of world.

Let's reapproach the example of the risk of violence we discussed in relation to Bayesian thinking. Suppose you heard that you had a greater risk of slipping on the stairs and cracking your head open than being killed by a terrorist. The statistics, the priors, seem to back it up: a thousand people slipped on the stairs and died last year in your country, and only five hundred died in terrorist attacks. Should you be more worried about stairs or terror events? Some people use examples like these to prove that terror risk is low—since the recent past shows very few deaths, why worry?[3] The problem is in the fat tails: The risk of terror violence is more like wealth, while stair-slipping deaths are more like height and weight. In the next ten years, how many events are possible? How fat is the tail?

The important thing is not to sit down and imagine every possible scenario in the tail (which, by definition, is impossible) but to deal with fat-tailed domains in the correct way: by positioning ourselves to survive or even benefit from the wildly unpredictable future, by being the only ones thinking correctly and planning for a world we don't fully understand.

Antifragility

How do we benefit from the uncertainty of a world we don't understand, one dominated by "fat tails"? Here, Nassim Nicholas Taleb's work is again instructive. In his book *Antifragile*, he explains it thus: We can think about three categories of objects—ones that are *harmed* by volatility and unpredictability, ones that are *neutral* to volatility and unpredictability, and ones that *benefit* from it.[4] The last category is antifragile—like a package that *wants* to be mishandled. Up to a point, certain things benefit from volatility, and that's how we want to be ourselves. Why? Because the world is fundamentally unpredictable and volatile, and large events—panics, crashes, wars, bubbles, and so on—tend to have a disproportionate impact on outcomes.

There are two ways to handle such a world: try to predict, or try to prepare. Prediction is tempting. For all of human history, seers and soothsayers have turned a comfortable trade. The problem is that nearly all studies of "expert" predictions in such complex real-world realms as the stock market, geopolitics, and global finance have shown again and again that, for the rare and impactful events in our world, predicting is impossible! It's more efficient to prepare.

What are some ways we can prepare—arm ourselves with antifragility—so we can benefit from the volatility of the world?

The first one is what Wall Street traders would call "upside optionality"—that is, seeking out situations that we expect to have good odds of offering us opportunities. Take the example of attending a cocktail party where a lot of people you might like to know are in attendance. While nothing is *guaranteed* to happen—you may not meet those people, and if you do, it may not go well—you give yourself the benefit of serendipity and randomness. The worst thing that can happen is...nothing. One thing you know for sure is that you'll never meet these people sitting at home. By going to the party, you improve your odds of encountering opportunity—your upside optionality.

The second thing we can do is to learn how to fail properly. Failing properly has two major components: First, never take a risk that will do you in—never get taken out of the game completely. Second, develop the personal resilience to *learn* from your failures and start again. If you follow these two rules, you can only fail temporarily.

No one likes to fail. It hurts. But failure carries with it one huge antifragile gift: learning. Those who are not afraid to fail (properly) have a huge advantage over the rest. What they learn makes them less vulnerable to the volatility of the world. They benefit from it, in true antifragile fashion.

Let's say you'd like to start a successful business, but you have no business experience. Do you attend business school, or start a business that might fail?

Business school has its benefits, but business itself—the rough, jagged real-world experience of it—teaches through rapid feedback loops of success and failure. In other words, trial and error carries the precious commodity of information.

The *Antifragile* mindset is a unique one. Whenever possible, try to create scenarios where randomness and uncertainty are your friends, not your enemies.

Asymmetries: Finally, you need to think about something we might call "metaprobability"—the probability that your probability estimates themselves are any good.

This massively misunderstood concept has to do with asymmetries. If you look at nicely polished stock pitches made by professional investors, nearly every time an idea is presented, the investor looks their audience in the eye and states that they think they're going to achieve a rate of return of 20 to 40 percent per annum, if not higher. Yet *exceedingly* few of them ever attain that mark. It's not because they don't pick any winners—it's because they get so many so wrong. They are consistently overconfident in their probabilistic estimates. (For reference, the general stock market in the United States, over a long period, has returned no more than 7 percent to 8 percent per annum, before fees.)

Another common asymmetry is people's ability to estimate the effect of traffic on travel time. How often do you leave "on time" and arrive 20 percent early? Almost never? How often do you leave "on time" and arrive 20 percent late? All the time? Exactly. Your estimation errors are asymmetric, skewing in a single direction. This is often the case with probabilistic decision making.[5]

Far more probability estimates are wrong on the "over-optimistic" side than the "under-optimistic" side. You'll rarely read about an investor who aimed for 25 percent annual return rates and who subsequently earned 40 percent over a long period of time, whereas you can throw a dart at *The Wall Street Journal* and hit the names of lots of investors who aim for 25 percent per annum with each investment and end up closer to 10 percent.

The Spy World

Successful spies are very good at probabilistic thinking. High-stakes survival situations tend to make us evaluate our environment with as little bias as possible.

When Vera Atkins was second in command of the French unit of the Special Operations Executive (SOE), a British intelligence organization during World War II that reported directly to Winston Churchill,[6] she had to make hundreds of decisions by figuring out the probable accuracy of inherently unreliable information.

Atkins was responsible for the recruitment of British agents and their deployment into occupied France. She had to decide who could do the job and where the best sources of intelligence were. These were literal life-and-death decisions, and all were based in probabilistic thinking.

First, how do you choose a spy? Not everyone can go undercover in high-stress situations and make the contacts necessary to gather intelligence. The result of failure in France during the war was not getting fired; it was death. What factors of personality and experience show that a person is right for that job? Even today, with advancements in psychology, interrogation, and polygraph tests, it's still a judgment call.

For Vera Atkins, in the 1940s, it was very much a process of assigning weight to the various factors and coming up with a probabilistic assessment of who had a decent chance of success. Who spoke French? Who had the necessary confidence? Who was too tied to family? Who had the problem-solving capabilities? From recruitment to deployment, her development of each spy was a series of continually updated educated estimates.

Getting an intelligence officer ready to go is only half the battle. Where do you send them? If your information was so great that you knew exactly where to go, you probably wouldn't need an intelligence mission. Choosing a target is another exercise in probabilistic thinking. You need to evaluate the reliability of the information you have and the networks you have set up. Intelligence is not evidence. There is no chain of command or guarantee of authenticity.

The stuff coming out of German-occupied France was at the level of grainy photographs, handwritten notes that passed through many hands on the way back to headquarters, and unverifiable wireless messages sent quickly, sometimes sporadically, and with the operator under incredible

stress. When deciding what to use, Atkins had to consider the relevance, quality, and timeliness of the information she had.

She also had to make decisions based not only on what had happened but on what possibly could. Trying to prepare for every eventuality would mean that spies would never leave home, but they had to somehow prepare for a good deal of the unexpected. After all, a spy's job is often executed in highly volatile, dynamic environments. The women and men Atkins sent over to France worked in three primary occupations: organizers were responsible for recruiting locals, developing the network, and identifying sabotage targets; couriers moved information all around the country, connecting people and networks to coordinate activities; and wireless operators had to set up heavy communications equipment, disguise it, get information out of the country, and be ready to move at a moment's notice. All these jobs were dangerous. The full scope of the threats was never completely identifiable. There were so many things that could go wrong, so many possibilities for discovery or betrayal, that it was impossible to plan for them all. The average life expectancy in France for one of Atkins's wireless operators was six weeks.

Finally, the numbers suggest an asymmetry in the estimation of the probability of success of each individual agent. Of the four hundred agents that Atkins sent over to France, a hundred were captured and killed. This is not meant to pass judgment on her skills or smarts. Probabilistic thinking can only get you in the ballpark. It doesn't guarantee 100 percent success.

There is no doubt that Atkins relied heavily on probabilistic thinking to guide her decisions in the challenging quest to disrupt German operations in France during World War II. It is hard to evaluate the success of an espionage career, because it is a job that comes with a lot of loss. Atkins was extremely successful in that her network conducted valuable sabotage to support the Allied cause during the war, but the loss of life this work entailed was significant.

Conclusion

Probabilistic thinking is the art of navigating uncertainty. Successfully thinking in shades of probability means roughly identifying what matters, coming up with a sense of the odds, doing a check on our assumptions, and then deciding.

The challenge of probabilistic thinking is that it requires constant updating. As new information emerges, the probabilities change. What seemed likely yesterday may seem unlikely today. This both explains why probabilistic thinkers are always revising their beliefs with new data and why it's so uncomfortable for many people.

It's much easier to believe something false is true than deal with the fact that it might not be true. Being a probabilistic thinker means being willing to say, "I don't know for sure, but based on the evidence, I think there's a 63 percent chance of X."

The rewards of probabilistic thinking are immense. By embracing uncertainty, we can make better decisions, avoid the pitfalls of overconfidence, and navigate complex situations with greater skill and flexibility. We can be more open-minded, more receptive to new ideas, and more resilient in the face of change.

Insurance Companies

The most probability-acute businesses in the world are insurance companies—because they must be. When we think of insurance, we might think of life insurance (the probability of a policyholder dying at a certain age), or auto insurance (the probability of being in a car accident), or maybe home insurance (the probability of a tree falling on the house). With the statistics available to us, the probabilities of these things are easy to price and predict across a large enough population.

But insurance is deeply wide-ranging, and insurers will insure almost any event, for a price. Insurance policies have been taken out on Victoria's Secret models' legs, on baseball players' arms, on the Pepsi Challenge and the NCAA tournament, and even on a famous country singer's breasts!

How is this possible? Only with close attention to probability. What the great insurance companies in the world know how to do is pay attention to the important factors in a situation, even if they're not totally predictable, and price accordingly.

What is the probability of a Victoria's Secret model injuring her legs badly enough to end her career? One in 10,000? One in 100,000? Getting this calculation right would mean evaluating her lifestyle, her habits, her health, her family history—and coming up with a price and a set of conditions that are good enough, on average, to provide a profit. It's not unlike handicapping a race at the horse track. You can always say yes to insuring, but the trick is to come up with the right price. For that, we need probability.

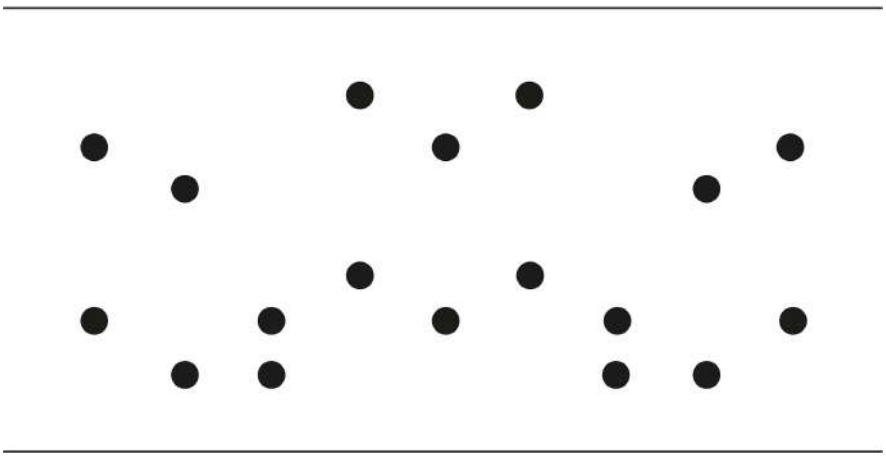
SUPPORTING IDEA:

Causation vs. Correlation

CONFUSION BETWEEN THESE TWO TERMS often leads to a lot of inaccurate assumptions about the way the world works. We notice two things happening at the same time (correlation) and mistakenly conclude that one causes the other (causation). We then often act upon that erroneous conclusion, making decisions that can have immense influence across our lives. The problem is, without a good understanding of what is meant by these terms, these decisions fail to capitalize on real dynamics in the world and instead are rendered successful only by luck.

No Correlation

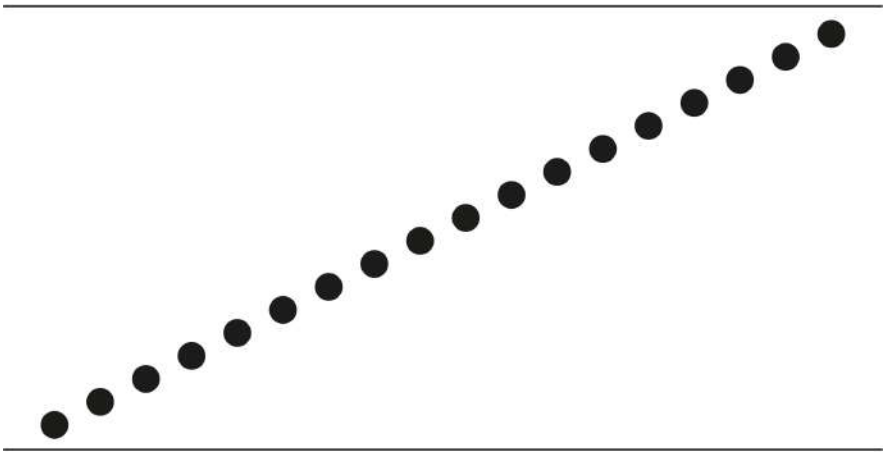
The correlation coefficient between two measures, which varies between −1 and 1, is a measure of the relative weight of the factors they share. For example, two phenomena with few shared factors, such as bottled-water consumption versus suicide rate, should have a correlation coefficient of close to 0. That is to say, if we looked at all countries in the world and plotted suicide rates in a specific year against per capita consumption of bottled water, the plot would show no pattern at all.



No Correlation

Perfect Correlation

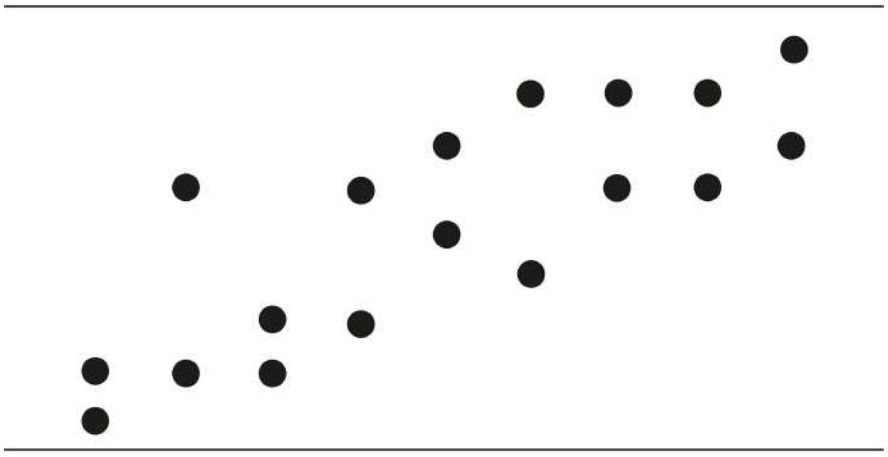
By contrast, there are measures that are solely dependent on the same factor. A good example of this is temperature. The only factor governing temperature—velocity of molecules—is shared by all scales. Thus, each degree in Celsius will have exactly one corresponding value in Fahrenheit. Therefore, temperature in Celsius and Fahrenheit will have a correlation coefficient of 1, and the plot will be a straight line.



Perfect Correlation

Weak to Moderate Correlation

There are few phenomena in human sciences that have a correlation coefficient of 1. There are, however, plenty where the association is weak to moderate, and there is *some* explanatory power between the two phenomena. Consider the correlation between height and weight, which would land somewhere between 0 and 1. While virtually every three-year-old will be lighter and shorter than every grown man, not all grown men or three-year-olds of the same height will weigh the same.



Weak to Moderate Correlation

This variation, and the corresponding lower degree of correlation, implies that, while height is a good predictor of weight, there clearly are factors other than height at play.

In addition, correlation can sometimes work in reverse. Let's say you read a study that compares alcohol consumption rates in parents and their children's corresponding academic success. The study shows a relationship between high alcohol consumption and low academic success. Is this causation or correlation? It might be tempting to conclude there's causality, such as the more parents drink, the worse their kids do in school.

However, this study has demonstrated only a *relationship*, not proved that one causes the other. The factors correlate—meaning that alcohol consumption in parents has an inverse relationship with academic success in children. It is entirely possible that having parents who consume a lot of alcohol leads to worse academic outcomes for children. It is also possible, however, that the reverse is true, or even that having kids who do poorly in school causes parents to drink more. Trying to invert the relationship can help you sort through claims to determine if you are dealing with true causation or just correlation.

Causation

Whenever correlation is imperfect, extremes will soften over time. The best will always appear to get worse, and the worst will appear to get better, regardless of any additional action. This is called regression to the mean, and it means we have to be extra careful when diagnosing causation. This is something that the general media, and sometimes even trained scientists, fail to recognize.

Consider the example Daniel Kahneman gives in *Thinking, Fast and Slow*:[7]

> Depressed children treated with an energy drink improve significantly over a three-month period. I made up this newspaper headline, but the fact it reports is true: if you treated a group of depressed children for some time with an energy drink, they would show a clinically significant improvement. It is also the case that depressed children who spend some time standing on their head or hug a cat for twenty minutes a day will also show improvement.

Whenever we come across such headlines, it is very tempting to jump to the conclusion that energy drinks, standing on the head, or hugging cats are all perfectly viable cures for depression. These cases, however, once again embody the concept of regression to the mean:

> Depressed children are an extreme group—they are more depressed than most other children—and extreme groups regress to the mean over time. The correlation between depression scores on successive occasions of testing is less than perfect, so there will be regression to the mean: depressed children will get somewhat better over time even if they hug no cats and drink no Red Bull.

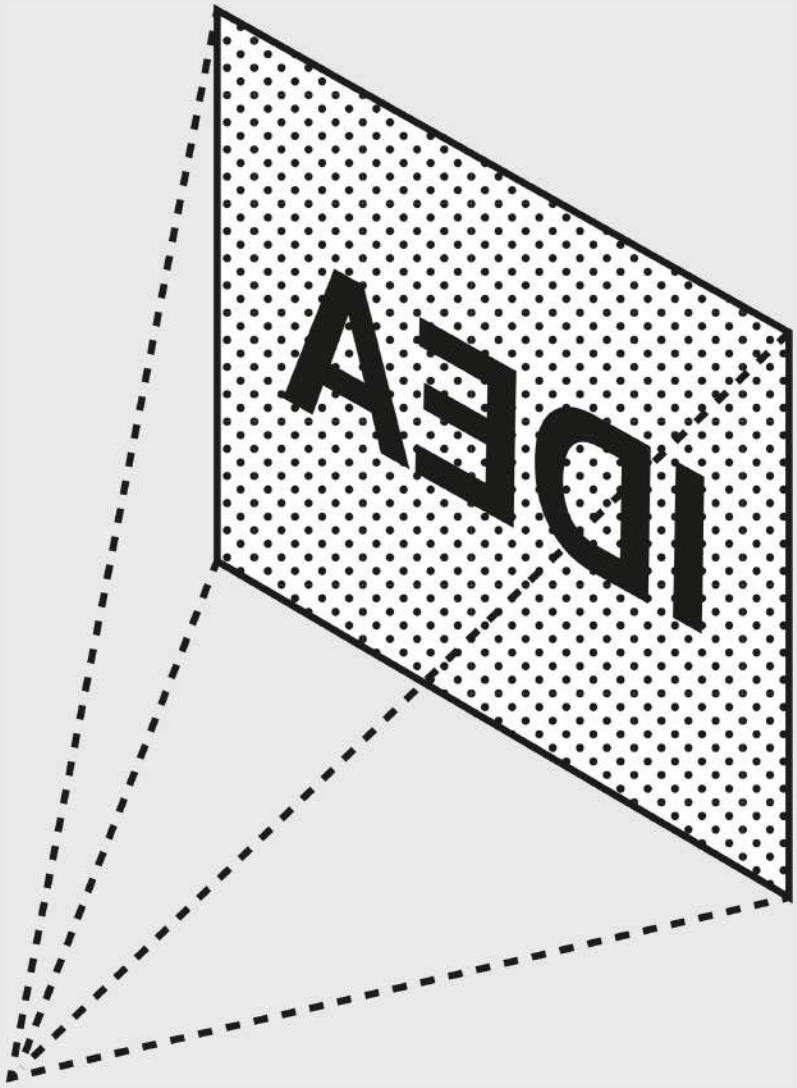
We often mistakenly attribute a specific policy or treatment as the cause of an effect, when the change in the extreme groups would have happened anyway. This presents a fundamental problem: How can we know if the effect is real or simply due to variability?

Luckily, there is a way to tell between a real improvement and something that would have happened anyway. That is the introduction of the so-called “control group,” which is expected to improve by regression alone. The aim of the research is to determine whether the treated group improves more than regression can explain.

In real-life situations assessing the performance of specific individuals or teams, where the only real benchmark is past performance and no control group can be introduced, the effects of regression can be difficult, if not impossible, to

disentangle. We can compare against industry average, peers in the cohort group, or historical rates of improvement, but none of these is a perfect measure.

Inversion



Change your perspective.

The test of a first-rate intelligence is the ability to hold two opposing ideas in mind at the same time and still retain the ability to function. One should, for example, be able to see that things are hopeless yet be determined to make them otherwise.

—F. SCOTT FITZGERALD[1]

It can be difficult to appreciate just how much avoiding the standard ways of failing dramatically increases the odds of success.

Inversion is all about identifying and removing the obstacles to success. The root of inversion is “invert,” which means to upend or turn upside down. As a thinking tool, it means approaching a situation from the opposite end of the natural starting point.

Most of us tend to think one way about a problem: forward. Inversion allows us to flip the problem around and think backward. Sometimes it’s good to start at the beginning, but it can be more useful to start at the end.

Avoiding stupidity is easier than seeking brilliance. Even when we don’t know how to achieve a particular objective, we can often identify what prevents it from happening. Perhaps you don’t know all the things that create a good night’s sleep. We can invert the problem by identifying some of the standard things that prevent us from getting a good night’s sleep, such as eating right before going to bed or consuming a lot of alcohol. Simply avoiding those two things dramatically improves the quality of our sleep.

Avoiding the Standard Ways of Failing

Warren Buffett and Charlie Munger are two of the most successful investors of all time. Their track record at Berkshire Hathaway is legendary. One underappreciated aspect of their success is how they avoided the standard ways of failing.

When asked about how otherwise smart people fail, the duo commented that it often involves drugs and leverage. “It’s insane to risk what you have and need for something you don’t really need,” Buffett says of borrowing. “You will not be way happier if you double your net worth.”

In one of his last interviews, Munger commented that one of the keys to success in life is avoiding common traps:

“My game in life was always to avoid all standard ways of failing. You teach me the wrong way to play poker and I will avoid it. You teach me the wrong way to do something else, I will avoid it. And, of course, I’ve avoided a lot, because I’m so cautious.

“Crazy is way more common than you think,” Munger said. “It’s easy to slip into crazy. Just avoid it, avoid it, avoid it.”[2]

Inversion teaches us that a great deal of wisdom can be found in knowing what to avoid.

There are two approaches to applying inversion in your life:

1. Start by assuming that what you're trying to prove is either true or false, then show what else would have to be true to make that so.
2. Instead of aiming directly for your goal, think deeply about what to *avoid* and then see what options are left over.

Set your assumptions: The nineteenth-century German mathematician Carl Jacobi became famous for several reasons—including solving some incredibly difficult problems—but is perhaps best remembered for his advice to "invert, always invert."[3]

Jacobi solved a range of problems by starting with the endpoint. When faced with proving an axiom in a difficult math problem, he might instead assume that a property of the axiom was correct and then try to determine the consequences of this assumption. From that point, he could work out surprising, and at times counterintuitive, insights.

Jacobi was not the first mathematician to use inversion. In fact, inversion is a staple of mathematical, philosophical, and scientific inquiry. We can look around today and appreciate that we can't see atoms and quarks, but we know they exist because we can make predictions about their behavior and test those predictions.

Or, we can go back 2,300 years and look at the work of the Greek mathematician Hippasus, a follower of Pythagoras.[4] (Yes, the one with the theorem.) His attempts to derive the square root of two, and his original direct approach to solving the problem (essentially, dividing larger and larger whole numbers into each other) were both fruitless and time consuming. He hit an impasse, realizing that he'd never be able to definitely solve the problem by thinking forward. In his increasing frustration, Hippasus decided to take the reverse route, thinking about what the square root of two might *imply*, and working backward from there. If he couldn't find it the way he had expected to, he'd start by proving what the number

couldn't be. His quest forever changed what we understood about mathematics and led to the discovery of the first irrational number.

Mathematics is not the only area where using inversion can produce surprising and nonintuitive results. In the 1920s, the American Tobacco Company wanted to sell more of their Lucky Strike cigarettes to women. Men were smoking, but women weren't. There were pervasive taboos against women smoking—it was seen as a man's activity. Women, therefore, presented an untapped market that had the potential to provide huge revenue. Riding on the slimness trend that had already begun, the head of the company thought that they needed to convince women that smoking would make them thinner, so he hired Edward Bernays, who came up with a truly revolutionary marketing campaign.[5],[6]

In the style of the inversion approach described above, Bernays did not ask, "How do I sell more cigarettes to women?" Instead, he wondered, if women bought and smoked cigarettes, what else would have to be true? What would have to change in the world to make smoking desirable to women and socially acceptable? Then—a step further—once he knew what needed to change, how would he achieve that?

To tackle the idea of smoking as a slimming aid, Bernays mounted a large anti-sweets campaign. After dinner, it was all about cigarettes, not dessert. Cigarettes were slimming, while desserts would ruin one's figure. But Bernays's real stroke of genius did lie solely in coming out with advertisements to convince women to stay slim by smoking cigarettes. As author Alan Axelrod puts it, "Instead, he sought nothing less than to reshape American society and culture."[7] He solicited journalists and photographers to promote the virtues of being slim. He sought testimonials from doctors about the health value of smoking after a meal. He combined this approach with "altering the very environment, striving to create a world in which the cigarette was ubiquitous." Axelrod details the full scope of Bernays's efforts:

> He mounted a campaign to persuade hotels and restaurants to add cigarettes to dessert-list menus, and he provided such magazines as

> *House and Garden* with feature articles that included menus designed to preserve readers "from the dangers of overeating."… The idea was not only to influence opinion but to remold life itself. Bernays approached designers, architects, and cabinetmakers in an effort to persuade them to design kitchen cabinets that included special compartments for cigarettes, and he spoke to the manufacturers of kitchen containers to add cigarette tins to their traditional lines of labeled containers for coffee, tea, sugar, and flour.[8]

The result was a complete shift in the consumption habits of American women. It wasn't just about selling the cigarette; it was about reorganizing society to make cigarettes an inescapable part of the American woman's daily experience.

Bernays's efforts to make women's smoking in public socially acceptable had equally startling results. He linked cigarette smoking with women's emancipation: to smoke was to be free. Cigarettes were marketed as "torches of freedom." He orchestrated public events, including an infamous parade on Easter Sunday in 1929, which featured women smoking as they walked in the parade. He left no detail unattended, so that public perception of smoking was changed almost overnight. He both normalized it and made it desirable in one swoop.

Although the Lucky Strike campaign utilized more principles than just inversion, it was the original decision to invert the approach that provided the framework from which the campaign was created and executed. Bernays didn't focus on how to sell more cigarettes to women within the existing social structure. If he had, undoubtedly sales would have been a lot more limited. Instead, he thought about what the world would look like if women smoked often and anywhere, and then set about trying to make that world a reality. Once he did that, selling cigarettes to women was comparatively easy.

This inversion approach became a staple of Bernays's work. He used the descriptor "appeals of indirection," and each time he was hired to sell a

product or service, “he instead sold whole new ways of behaving, which appeared obscure but over time reaped huge rewards for his clients and redefined the very texture of American life.”[9]

Decide what to avoid: Instead of thinking through the achievement of a positive outcome, another way to use inversion is to ask ourselves how we might achieve a *terrible* outcome, and let that guide our decision making.

Index funds are a great example of stock market inversion, promoted and brought to bear by Vanguard’s John Bogle.[10] Instead of asking how to beat the market, as so many before him had, Bogle simply recognized the difficulty of the task. Everyone is trying to beat the market. No one is doing it with any consistency, and in the process real people are losing actual money. So Bogle inverted the approach. The question then became, how can we help investors minimize losses to fees and poor money manager selection? The results were one of the greatest ideas—index funds—and one of the greatest powerhouse firms in the history of finance.

Index funds operate on the idea that accruing wealth has a lot to do with minimizing loss. Think about your personal finances: Often, we focus on positive goals, such as “I want to be rich,” and use this to guide our approach. We make investing and career choices based on our desire to accumulate wealth. We chase after magical solutions, like attempting to outsmart the stock market. These inevitably get us nowhere, and we have usually taken some terrible risks in the process that leave us worse off.

Inverting our approach, we can instead ask ourselves what the common pitfalls in investing are and how we can avoid them. For example, spending more than we make, taking on too much leverage (or paying high interest rates on debt so that we can’t tackle paying back the principal), and not starting to save as early as we can so as to take advantage of the power of compounding are all concrete financial behaviors that cost us money. We can more readily secure wealth by using inversion to make sure we are not doing the worst things that prevent the accumulation of wealth.

Guarantee a Life of Misery

In one of the more unique graduation speeches ever delivered, Johnny Carson offered the Harvard School some peculiar life advice. While he couldn't tell the graduating class how to be happy, Carson inverted and offered three guaranteed prescriptions for misery:

1. Ingesting chemicals in an effort to alter mood or perception
2. Envy
3. Resentment

Let's briefly explore each.

"Ingesting chemicals to alter mood or perception" refers to the misuse of substances like drugs or alcohol to change one's mental state. If you want to spiral your life out of control, turn to alcohol or other substances for stress relief.

Envy involves feeling discontent or resentful longing aroused by someone else's possessions, qualities, or luck. To ensure a perpetual state of dissatisfaction, constantly compare yourself to others who have more.

Resentment is a failure to let go of anger or bitterness toward someone due to a past slight or injustice. If you want to poison your personal relationships and mental health, hold on tightly to tiny slights.

In a later speech, Charlie Munger added to Carson's prescriptions to ensure a life of misery.

"First," he offered, "be unreliable. Do not faithfully do what you have engaged to do. If you will only master this one habit you will more than counterbalance the combined effect of all your virtues, howsoever great." Being unreliable is a sure way to be excluded and distrusted.

Second on the list was "not learning from others' mistakes." Mastering this habit ensures you make every mistake possible. In the process, you will be surpassed by those who master the best of what other people have figured out.

Finally, Munger offered, "go down and stay down." A surefire way to fail is to quit trying.[11]

One of the theoretical foundations for this type of thinking comes from psychologist Kurt Lewin.[12] In the 1930s, he came up with the idea of "force field analysis," which essentially recognizes that in any situation where change is desired, successful management of that change requires applied inversion. Here is a brief explanation of his process:

1. Identify the problem.
2. Define your objective.
3. Identify the forces that support change toward your objective.
4. Identify the forces that impede change toward the objective.
5. Strategize a solution! This may involve both augmenting, or adding to, the forces in step 3 and reducing or eliminating the forces in step 4.

Even if we are quite logical, most of us stop after step 3. Once we figure out our objective, we focus on the things we need to put in place to make it happen—the new training or education, the messaging and marketing. But Lewin theorized that it can be just as powerful to remove obstacles to change.

The inversion happens between steps 3 and 4. Whatever angle you choose to approach your problem from, you need to then follow up with consideration of the opposite angle. Think about not only what you could do to solve a problem but what you could do to make it worse—and then avoid doing that, or eliminate the conditions that perpetuate it.

This inversion approach was used by Florence Nightingale to help significantly reduce the mortality rate of British soldiers in military hospitals in the mid-nineteenth century. Nightingale is often remembered as the founder of modern nursing, but she was also an excellent statistician and was the first woman elected to the Royal Statistical Society, in 1858.

During the first winter of the Crimean War, 1854–55, the British Army endured a death rate of 23 percent. The next winter that rate had dropped to

2.5 percent.[13] The main reason for the change was a much better understanding of what was actually killing the soldiers, an understanding that rested on the detailed statistics that Florence Nightingale collected. She demonstrated that the leading cause of death by far was poor sanitation. In her famous polar-area chart—a completely new way of presenting data at the time—she captured a visual representation of the statistics that made them easy to understand. Improve the sanitary conditions in the hospitals, she explained, and many soldiers' lives would be saved.

Nightingale's use of statistics helped to identify the real problem of army-hospital deaths. She was able to demonstrate not only what the army could do to improve outcomes but, just as important, what they had to avoid doing to stop making things worse. She reflected on the knowledge that could be derived from statistics and, in another instance of inversion thinking, she advocated for their use as a means of prevention.[14] The question became not so much "how do we fix this problem?" but "how do we stop it from happening in the first place?" Nightingale took the knowledge and experience she gained in Crimea and began gathering statistics not just for British Army field hospitals but for domestic ones as well. She demonstrated that unsanitary conditions in military hospitals were a real problem causing many preventable deaths.[15]

Nightingale's advocacy for statistics ultimately went much further than British military hospitals. But her use of statistics to improve sanitary conditions can be seen as an example of applied inversion. She used them to advocate for both solving problems and the invert, preventing them.

> Hence to fight and conquer in all your battles is not supreme excellence; supreme excellence consists in breaking the enemy's resistance without fighting.
>
> **—SUN TZU**[16]

Conclusion

A lot of advantage is gained simply by avoiding the standard paths to failure.

Inversion is not the way we are taught to think. We are taught to identify what we want and explore things that will move us closer to our objective. However, by spending time identifying things that will ensure we *don't* get what we want, we dramatically increase our odds of success.

Often, we get so fixated on solving a problem in a particular way that we miss simpler, more elegant solutions. Inversion forces us to consider the opposite side of the equation.

Instead of asking, "How do I solve this problem?" inversion asks, "What would guarantee failure?" Instead of asking, "How can I achieve this goal?" it asks, "What is preventing me from achieving it?" By inverting the question, we can gain insights that our normal thought patterns might miss.

The next time you're grappling with a difficult problem or striving toward an ambitious goal, try inverting your thinking. Ask yourself how you could guarantee failure. The answers may surprise you and open up new avenues for possible solutions.

Occam’s Razor

Keep it simple.

Anybody can make the simple complicated. Creativity is making the complicated simple.

—CHARLES MINGUS[1]

Simpler explanations are more likely to be true than complicated ones. This is the essence of Occam's razor, a classic principle of logic and problem solving. Instead of wasting your time trying to disprove complex scenarios, you can make decisions more confidently by basing them on the explanation that has the fewest moving parts.

The more complicated the explanation for something, the more skeptical you should be.

We all jump to overly complex explanations about something. Husband late getting home? What if he's been in a car accident? Son grew a centimeter less than he did last year? What if there's something wrong with him? Your toe hurts? What if you have bone cancer? Although it is possible that any of these worst-case scenarios could be true, without any other correlating factors, it is significantly more likely that your husband got caught up at work, you mismeasured your son, and your shoe is too tight.

We often spend lots of time coming up with very complicated narratives to explain what we see around us. From the behavior of people on the street to physical phenomena, we get caught up in assuming vast icebergs of meaning beyond the tips that we observe. This is a common human tendency, and it serves us well in some situations, such as creating art. However, complexity takes work to unravel, manage, and understand.

Occam's razor is a great tool for avoiding unnecessary complexity by helping you identify and commit to the simplest explanation possible.

Named after the medieval logician William of Ockham, Occam's razor is a general rule by which we select among competing explanations. Ockham wrote that "a plurality is not to be posited without necessity"—essentially, that we should prefer the simplest explanation with the fewest moving parts.[2],[3] Simple explanations are easier to falsify, easier to understand, and generally more likely to be correct. Occam's razor is not an

iron law but a tendency and a mindset you can choose to use: if all else is equal—that is, if two competing models both have equal explanatory power—it's more likely that the simple solution suffices.

Ockham himself did not derive this idea, which had been in use since antiquity. Nor was Ockham the last to note the value of simplicity. The principle was stated in another useful way by the eighteenth-century Scottish philosopher David Hume, in his famous *Enquiry Concerning Human Understanding*. Writing about the truth or untruth of miracles, Hume stated that we should default to skepticism about them.[4]

Why? It wasn't simply that Hume was a buzzkill. He had a specific, Occam-like reason for being cautious about miracles. By definition, a miracle is something that has happened outside of our normal understanding of the way nature works. If the miracle was not outside of our common experience, we wouldn't consider its occurrence miraculous. If there was a simple explanation for the occurrence based on mostly common knowledge, we likely wouldn't pay much attention to it at all.

Therefore, the simplest explanation for a miracle is that the miracle witnesser is not describing the event correctly, or the miracle represents a more common phenomenon that we currently don't properly understand. As scientist and writer Carl Sagan explains in *The Demon-Haunted World*:

> A multitude of aspects of the natural world that were considered miraculous only a few generations ago are now thoroughly understood in terms of physics and chemistry. At least some of the mysteries of today will be comprehensively solved by our descendants. The fact that we cannot now produce a detailed understanding of, say, altered states of consciousness in terms of brain chemistry no more implies the existence of a "spirit world" than a sunflower following the Sun in its course across the sky was evidence of a literal miracle before we knew about phototropism and plant hormones.[5]

The simpler explanation for a miracle is that there are principles of nature being exploited that we do not understand. This is Hume's and Sagan's point.

Dark What?

In the mid-1970s, astronomer Vera Rubin had a very interesting problem. She had a bunch of data piling up about the behavior of galaxies that wasn't explained by contemporary theories.[6],[7],[8]

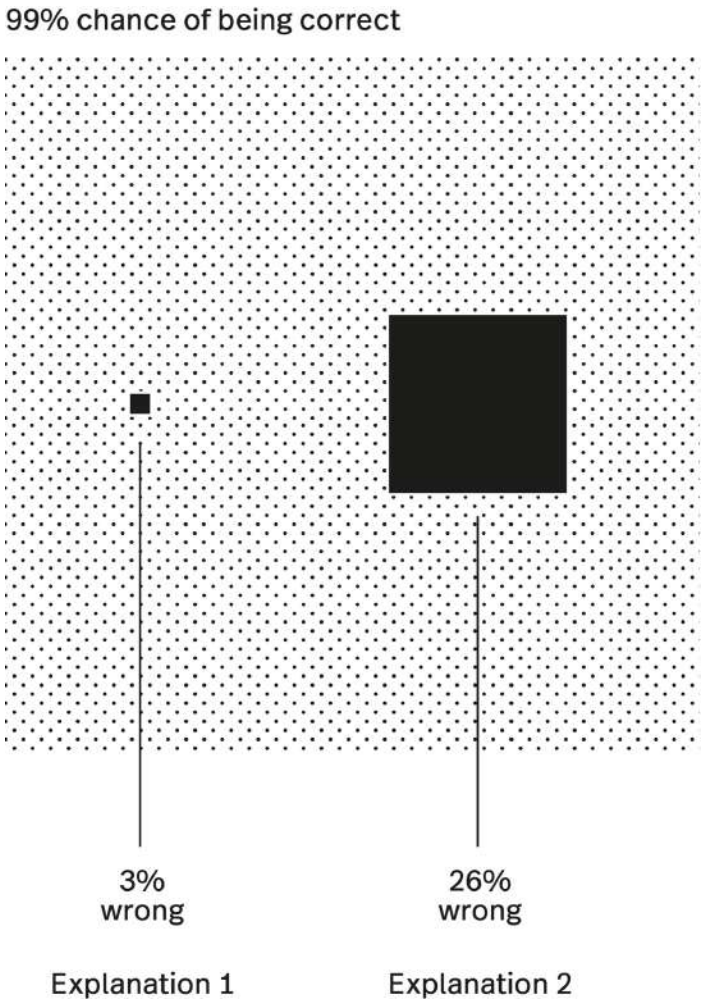
Rubin had been observing the behavior of the Andromeda Galaxy and had noticed something very strange. As explained in an article on Astronomy.com, "The vast spiral seemed to be rotating all wrong. The stuff at the edges was moving just as fast as the stuff near the center, apparently violating Newton's laws of motion (which also govern how the planets move around our Sun)."[9] This didn't make any sense. Gravity should exert less pull on distant objects, which should move slower. But Rubin was observing something entirely different.

One possible explanation was something that had been theorized as far back as 1933, by Swiss astrophysicist Fritz Zwicky, who coined the phrase "dark matter" to describe a mass we couldn't see but that was influencing the behavior of orbits in the galaxies. Dark matter became the simplest explanation for the observed phenomenon, and Vera Rubin has been credited with providing the first evidence of its existence. What is particularly interesting is that, to this day, no one has ever actually discovered dark matter.

Why are more complicated explanations less likely to be true? Let's work it out mathematically. Take two competing explanations, each of which seems equally to explain a given phenomenon. If one of them requires the interaction of three variables, and the other the interaction of thirty variables—all of which *must* have occurred to arrive at the stated conclusion—which of these is more likely to be in error? If each variable has a 99 percent chance of being correct, the first explanation is only 3

percent likely to be wrong. The second, more complex explanation, is about nine times as likely to be wrong, or 26 percent. The simpler explanation is more robust in the face of uncertainty.

Dark matter is an excellent theory with a lot of explanatory power. As Lisa Randall explains in *Dark Matter and the Dinosaurs*, measurements of dark matter so far fit in exactly with what we understand about the universe. Although we can't see it, we can make predictions based on our understanding of it and test those predictions. Randall writes, "It would be even more mysterious to me if the matter we can see with our eyes is all the matter that exists."[10] Dark matter is currently the simplest explanation for certain phenomena we observe in the universe. The great thing about science, however, is that it continually seeks to validate its assumptions.



Carl Sagan wrote that “extraordinary claims require extraordinary proof.”[11] He dedicated much ink to rational investigation of extraordinary claims. He felt most, or nearly all, were susceptible to simpler and more parsimonious explanations. UFOs, paranormal activity, telepathy, and a hundred other seemingly mystifying occurrences could be better explained by the confluence of a few simple real-world variables—and, as Hume suggested, if they couldn’t, it was a lot more likely that we needed to update our understanding of the world than that a miracle had occurred.

And so, dark matter remains, right now, the simplest explanation for the peculiar behavior of galaxies. Scientists, however, continue to try to conclusively discover dark matter and thus to determine if our understanding of the world is correct. If dark matter eventually becomes too complicated an explanation, it could be that the data describes something we don’t yet understand about the universe. We can then apply Occam’s razor to update what is the simplest, and thus most likely, explanation.

Vera Rubin herself, after noting that scientists always felt as though they were ten years away from discovering dark matter, without ever closing the gap, was described by an interviewer as thinking, “The longer that dark matter went undetected…the more likely she thought the solution to the mystery would be a modification to our understanding of gravity.”[12] This claim, demanding a total overhaul of our established theories of gravity, would correspondingly require extraordinary proof!

Simplicity Can Increase Efficiency

With limited time and resources, it is not possible to track down every theory with a plausible explanation of a complex, uncertain event. Without the filter of Occam’s razor, we are stuck chasing down dead ends. We waste time, resources, and energy.

The great thing about simplicity is that it can be so powerful. Sometimes unnecessary complexity just papers over the systemic flaws that will eventually choke us. Opting for the simple helps us make decisions based

on how things really are. Here are two short examples of those who got waylaid chasing down complicated solutions when simple ones were most effective.

The ten-acre Ivanhoe Reservoir in Los Angeles provides drinking water for more than six hundred thousand people. Its nearly sixty million gallons of water are disinfected with chlorine, as is common practice.[13] Groundwater often contains elevated levels of a chemical called bromide. When chlorine and bromide mix, then are exposed to sunlight, they create a dangerous carcinogen called bromate.

To avoid poisoning the water supply, the LA Department of Water and Power (DWP) needed a way to shade the water's surface. Brainstorming sessions had yielded only two infeasible solutions: building either a ten-acre tarp or a huge retractable dome over the reservoir. Then a DWP biologist suggested using "bird balls," the floating balls that airports use to keep birds from congregating near runways. They required no construction, no parts, no labor, no maintenance, and cost forty cents each. Three million UV-deflecting black balls were eventually deployed in Ivanhoe and other LA reservoirs, a simple solution to a potentially serious problem.

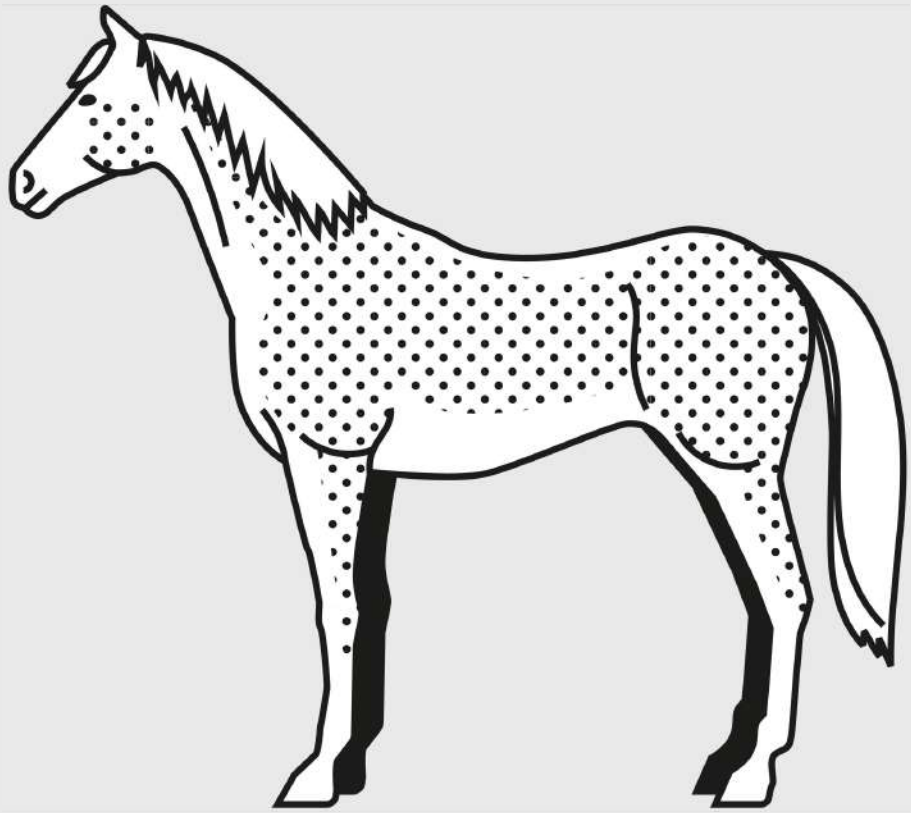
In another life-and-death situation, in 1989, Bengal tigers killed about sixty villagers in India's Ganges Delta.[14] No weapon seemed to work against them, including lacing dummies with live wires to shock the tigers away from attacking human populations.

Then a student at the Science Club of Calcutta noticed that tigers attacked only when they thought they were unseen and recalled that the patterns decorating some species of butterflies, beetles, and caterpillars look like big eyes, ostensibly to trick predators into thinking their prey is also watching them. The result: a human face mask, worn on the back of the head. Remarkably, no one wearing a mask was attacked by a tiger for the next three years; anyone killed by a tiger during that time either had refused to wear the mask or had taken it off while working.

Occam's Razor in the Medical Field

Occam's razor can be quite powerful in the medical field, for both doctors and patients. Let's suppose that a patient shows up at a doctor's office with horrible, flulike symptoms. Are they more likely to have the flu or to have contracted Ebola?

This is a problem best solved by a concept we explored in the chapter on probabilistic thinking, called Bayesian updating. It's a way of using general background knowledge in solving specific problems with new information. We know that, generally, the flu is far more common than Ebola, so when a good doctor encounters a patient with what looks like the flu, the simplest explanation is almost certainly the correct one. A diagnosis of Ebola means a call to the Centers for Disease Control and a quarantine—an expensive and panic-inducing mistake if the patient just has the flu. Thus, medical students are taught to heed the saying, "When you hear hoofbeats, think horses, not zebras."



For patients, Occam's razor is a good counter to hypochondria. Based on the same principles, you factor in the current state of your health to an evaluation of your current symptoms. Knowing that the simplest explanation is most likely to be true can help us avoid unnecessary panic and stress.

A Few Caveats

One important counter to Occam's razor is the difficult truth that some things are simply not that simple. The regular recurrence of fraudulent human enterprises like pyramid schemes and Ponzi schemes is not a miracle, but neither is it obvious. No simple explanation suffices, exactly. Such cons are a result of a complex set of behaviors, some happening almost by accident or luck, and some carefully designed with the intent to deceive. It isn't a bit easy to spot the development of a fraud; if it was, they'd be stamped out early. Yet, to this day, frauds frequently grow to epic proportions before they are discovered.

Alternatively, consider the achievement of human flight. It too might seem like a miracle to our fourteenth-century friar, but it isn't—it's a natural consequence of applied physics. Still, it took a long time for humans to figure out because it's not simple at all. In fact, the invention of powered human flight is highly counterintuitive, requiring an understanding of airflow, lift, drag, and combustion, among other difficult concepts. Only a precise combination of the right factors will do. You can't know just enough to get the aircraft off the ground, you need to keep it in the air!

Simple as we wish things were, irreducible complexity, like simplicity, is a part of our reality. Therefore, we can't use Occam's razor to create artificial simplicity. If something cannot be broken down any further, we must deal with it as it is.

How do you know something is as simple as it can be? Think of computer code. Code can sometimes be excessively complex. In trying to simplify it, we would have to make sure it can still perform the functions we need it to. This is one way to understand simplicity: an explanation can be simplified only to the extent that it can still provide an accurate understanding.

Occam's Razor in Leadership

When Louis Gerstner took over IBM in the early 1990s, during one of the worst periods of struggle in its history, many business pundits called for a statement of his vision. What rabbit would Gerstner pull out of his hat to save Big Blue?

It seemed a logical enough demand—wouldn't a technology company that had fallen behind need a grand vision of brilliant technological leadership to regain its place among the leaders in American innovation? As Gerstner put it, "The IBM organization, so full of brilliant, insightful people, would have loved to receive a bold recipe for success—the more sophisticated, the more complicated the recipe, the better everyone would have liked it."

Smartly, Gerstner realized that the simple approach was most likely to be the effective one. His famous reply was that "the last thing IBM needs right now is a vision." What IBM actually needed to do was to serve its customers, compete for business in the here and now, and focus on businesses that were already profitable. It needed simple, tough-minded business execution. By the end of the 1990s, Gerstner had provided exactly that, bringing IBM back from the brink without any brilliant visions or massive technological overhauls.[15]

Conclusion

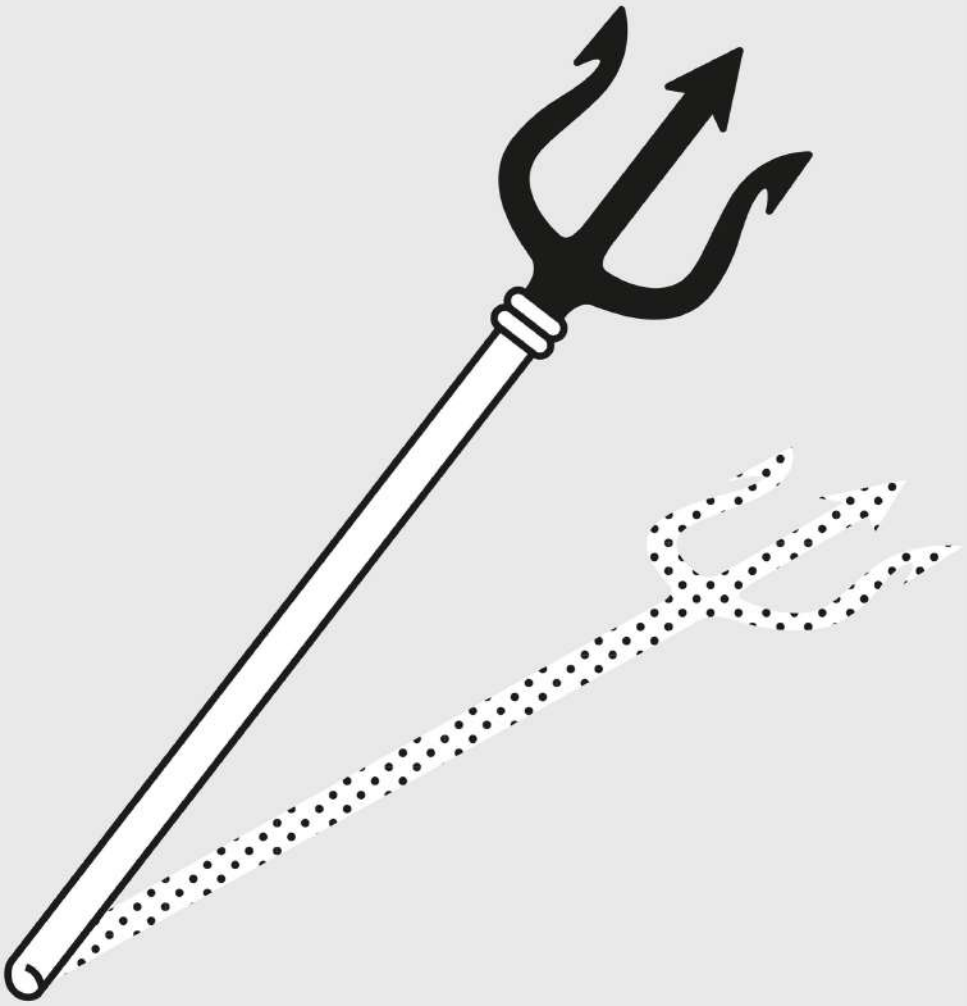
Occam’s razor is the intellectual equivalent of “keep it simple.”

When faced with competing explanations or solutions, Occam’s razor suggests that the correct explanation is most likely the simplest one, the one that makes the fewest assumptions.

This doesn’t mean the simplest theory is always true, only that it should be preferred until proven otherwise. Sometimes, the truth is complex, and the simplest explanation doesn’t account for all the facts.

The key to wielding this powerful model is understanding when it works for you and when it works against you. A theory that is too simple will fail to capture reality, and one that is too complex will collapse under its own weight.

Hanlon’s Razor



Don’t assume the worst.

I need to listen well so that I hear what is not said.

—THULI MADONSELA [1]

Hard to trace in its origin, Hanlon's razor states that we should not attribute to malice that which is more easily explained by stupidity. In a complex world, using this model helps us avoid paranoia and ideology. By not generally assuming that bad results are the fault of a bad actor, we look for options instead of missing opportunities. This model reminds us that people do make mistakes and demands that we ask if there is another reasonable explanation for the events that have occurred. The explanation most likely to be right is the one that contains the least amount of intent.

Assuming the worst intent is a habit that crops up all over our lives. Consider road rage, a growing problem in a world that is becoming short on patience and time. When someone cuts you off, to assume malice is to assume the other person has done a lot of risky work. In order for someone to deliberately get in your way, they have to notice you, gauge the speed of your car, consider where you are headed, and swerve in at exactly the right time to cause you to slam on the brakes, yet not cause an accident. That is some effort. The simpler, and thus more likely, explanation is that they didn't see you. It was a mistake. There was no intent. So why would you assume the former? Why do our minds make these kinds of connections when logic says otherwise?

The famous Linda problem, demonstrated by the psychologists Daniel Kahneman and Amos Tversky in a 1982 paper, is an illuminating example of how our minds work and why we need Hanlon's razor.[2] It went like this:

> Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

Which is more probable?

1. Linda is a bank teller.
2. Linda is a bank teller and is active in the feminist movement.

The majority of respondents chose option 2. Why? The wording used to describe her suggests Linda is a feminist. But Linda could only be a bank teller, or a feminist *and* a bank teller. So naturally, the majority of students concluded she was both. They didn't know anything about what she did, but because they were led to believe she had to be a feminist, they couldn't reject that option, even though the math of statistics makes it more likely that a single condition is true instead of multiple conditions. In other words, every feminist bank teller is a bank teller, but not every bank teller is a feminist.

Thus, Kahneman and Tversky showed that students would, with vivid enough wording, assume it more likely that a liberal-leaning woman was both a feminist *and* a bank teller rather than simply a bank teller. They called it the "conjunction fallacy."

With this experiment, and a host of others, Kahneman and Tversky exposed a sort of tic in our mental machinery: We're deeply affected by vivid, available evidence, to such a degree that we're willing to make judgments that violate simple logic. We overconclude based on the available information; we have no trouble packaging in unrelated factors if they happen to occur in proximity to what we already believe.

The Linda problem was later criticized as the psychologists setting up their test subjects for failure—if the problem was stated in a different way, subjects did not always make the error. But this, of course, was Kahneman and Tversky's point: If we present the evidence in a certain light, the brain malfunctions. It doesn't weigh out the variables in a rational way.

What does this have to do with Hanlon's razor? When we see something happen that we don't like and that seems wrong, we assume it's intentional. But it's more likely that it's completely unintentional. Assuming someone is

doing wrong and doing it purposefully is like assuming Linda is more likely to be a bank teller *and* a feminist. Most people doing wrong are not bad people trying to be malicious.

With such vividness of information, and the associated emotional response, comes a sort of malfunctioning in our minds when we're trying to diagnose the causes of a bad situation. That's why we need Hanlon's razor as an important remedy. Failing to prioritize stupidity over malice causes things like paranoia. Always assuming malice puts you at the center of everyone else's world. This is an incredibly self-centered and impractical approach to life. In reality, for every act of malice, there is almost certainly far more ignorance, stupidity, and laziness at work.

> One is tempted to define man as a rational animal who always loses his temper when he is called upon to act in accordance with the dictates of reason.
>
> **—OSCAR WILDE**[3]

The End of an Empire

In 408 AD, Honorius was the emperor of the Western Roman Empire. He assumed malicious intentions on the part of his best general, Stilicho, and had him executed. According to some historians, this execution may have been a key factor in the collapse of the empire.[4],[5]

Why? Stilicho was an exceptional military general who won many campaigns for Rome. He was also very loyal to the empire. He was not, however, perfect. Like all people, he made some decisions with negative outcomes. One of these was persuading the Roman Senate to accede to the demands of Alaric, leader of the Visigoths. Alaric had attacked the empire multiple times and was no favorite in Rome. The Senate didn't want to give in to his threats and wanted to fight him.

Stilicho counseled against this. Perhaps he had a relationship with Alaric and thought he could convince him to join forces and push back

against the other invaders Rome was dealing with. Regardless of his reasoning, this action of Stilicho's compromised his reputation.

Honorius was thus persuaded of the undesirability of having Stilicho around. Instead of defending him, or giving him the benefit of the doubt on the issue, Honorius assumed malicious intent behind Stilicho's actions—that he wanted the throne for himself and so was making decisions to shore up his power. Honorius ordered the general's arrest and likely supported his execution.

Without Stilicho to influence the relationship with the Visigoths, the empire became a military disaster. Alaric sacked Rome two years later, the first barbarian to capture the city in nearly eight centuries. Rome was thus compromised, a huge contributing factor to the collapse of the Western Roman Empire.

Hanlon's razor, when practiced diligently as a counter to confirmation bias, empowers us, giving us far more realistic and effective options for remedying bad situations. When we assume someone is out to get us, our very natural instinct is to take action to defend ourselves. It's harder to take advantage of, or even see, opportunities while in this defensive mode, because our priority is saving ourselves—which tends to reduce our vision to dealing with the perceived threat instead of examining the bigger picture.

The Man Who Saved the World

On October 27, 1962, Vasili Arkhipov stayed calm, didn't assume malice, and saved the world. Seriously.

This was the height of the Cuban missile crisis. Tensions were high between the United States and the Soviet Union. The world felt on the verge of nuclear war—a catastrophic outcome for all.

American destroyers and Soviet subs were in a standoff in the waters off Cuba. Although they were technically in international waters, the Americans had informed the Soviets that they would be dropping blank depth charges to force the Soviet submarines to surface. The problem was,

Soviet HQ had failed to pass this information along, so the subs in the area were ignorant of the planned American action.[6]

Arkhipov was an officer aboard Soviet sub B-59—a sub that, unbeknownst to the Americans, was carrying a nuclear weapon. When the depth charges began to detonate above them, the Soviets onboard B-59 assumed the worst. Convinced that war had broken out, the captain of the sub wanted to arm and deploy the nuclear-tipped torpedo.

This would have been an unprecedented disaster. It would have significantly changed the world as we know it, with both the geopolitical and nuclear fallout affecting us for decades. Luckily for us, the launch of the torpedo required all three senior officers onboard to agree, and Arkhipov didn't. Instead of assuming malice, he stayed calm and insisted on surfacing to contact Moscow.

Although the explosions around the submarine could have been malicious, Arkhipov realized that to assume so would put the lives of billions in peril. Far better to suppose mistakes and ignorance and on that basis make the decision not to launch. In doing so, Arkhipov saved the entire world.

The sub surfaced and returned to Moscow. Arkhipov wasn't hailed as a hero until the record was declassified, forty years later, and documents revealed just how close the world had come to nuclear war.

As useful as Hanlon's razor can be, however, it is important not to overthink this model. Hanlon's razor is meant to help us perceive stupidity, or error, and their inadvertent consequences. It says that of all possible motives behind an action, the ones that require the least amount of energy to execute (such as ignorance or laziness) are more likely to be at work than ones that require active malice.

Conclusion

Hanlon's razor is a mental safeguard against the temptation to label behavior as malicious when incompetence is the most common response.

It’s a reminder that people are not out to get you and it’s best to assume good faith and resist the urge to assign sinister motives without overwhelming evidence.

This isn’t to say that genuine malice doesn’t exist. Of course it does. But in most interactions, stupidity is a far more common explanation than malevolence. People make mistakes. They forget things. They speak without thinking. They prioritize short-term wins over long-term wins. They act on incomplete information. They fall prey to bias and prejudice. From the outside, these actions might appear like deliberate attacks, but the reality is far more mundane.

The real power of Hanlon’s razor lies in the way it shifts our perspective. When we assume stupidity rather than malice, we respond differently. Instead of getting defensive or lashing out, we approach the situation with empathy and clarity.

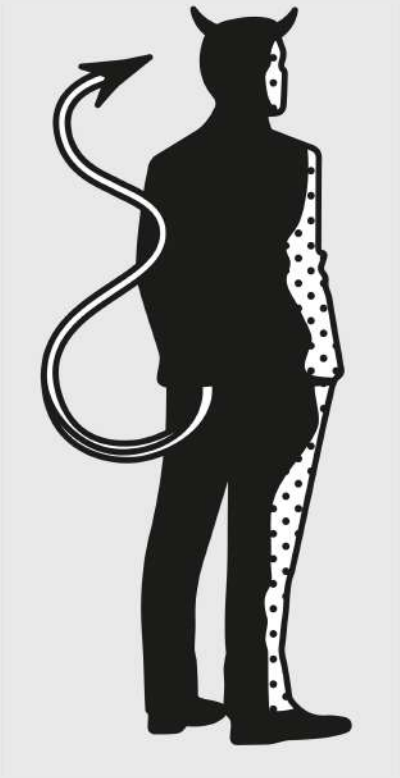
For most of the daily frustrations and confusions, Hanlon’s razor is a powerful reminder to approach problems with a spirit of generosity. It’s a way to reduce the drama and stress in our lives, and to find practical solutions instead of descending into blame and recrimination.

The Devil Fallacy

In one of its best-known appearances, Robert Heinlein's character Doc Graves describes the Devil Fallacy in the 1941 sci-fi story "Logic of Empire," as he explains the theory to another character:

I would say you've fallen into the commonest fallacy of all in dealing with social and economic subjects—the "devil" theory. You have attributed conditions to villainy that simply result from stupidity…. You think bankers are scoundrels. They are not. Nor are company officials, nor patrons, nor the governing classes back on earth. Men are constrained by necessity and build up rationalizations to account for their acts.[7]

Hanlon's razor is a great tool for overcoming this fallacy, one we all fall into at one time or another.



Afterthoughts and Acknowledgments

Afterthoughts

Many of you are no doubt wondering why I choose to partner with Portfolio and rerelease these books. The answer isn’t complicated. First, I wanted to spend less time on the nuts and bolts of running a publishing business (which includes creating, designing, printing, managing inventory, managing relationships, and increasingly complicated tax reporting requirements) and more time on the podcast, newsletter, and helping people become the best version of themselves. Second, I like and trust the team at Portfolio, led by Niki Papadopoulos.

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Shane

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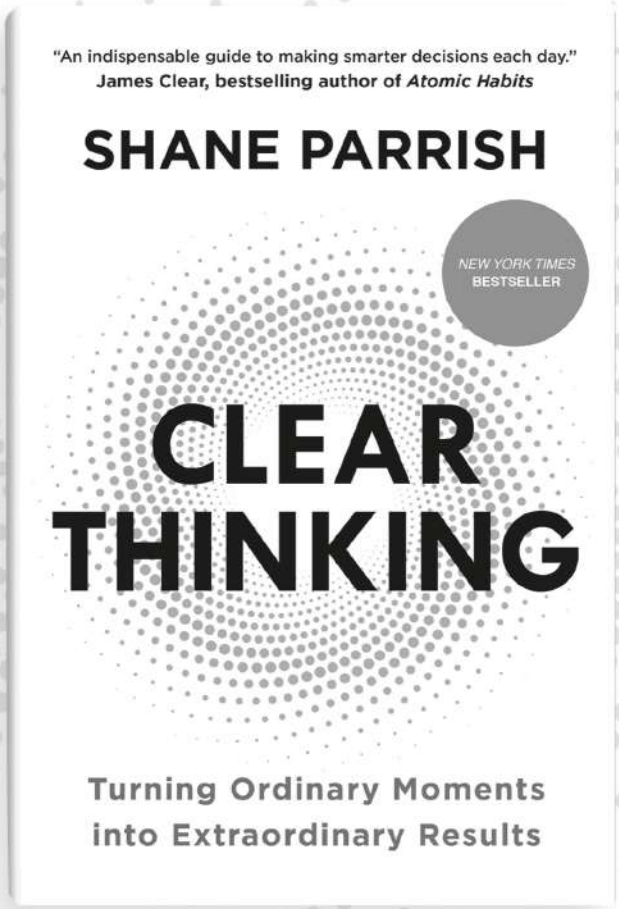

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