Seven and a Half Lessons About the Brain

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Dialogue

Story from me --> temp. checks

Chapter in the book:

> Your brain predicts almost everything you do.

> Neuroscientists like to say that your day-to-day experience is a carefully controlled hallucination, constrained by the world and your body but ultimately constructed by your brain.

How does that work?

> Brains aren't wired for accuracy. They're wired to keep us alive.

> Yes, your brain is wired to initiate your actions before you're aware of them. That is kind of a big deal. After all, in everyday life, you do many things by choice, right? At least it seems that way. For example, you chose to open this book and read these words. But the brain is a predicting organ. It launches your next set of actions based on your past experience and current situation, and it does so outside of your awareness. In other words, your actions are under the control of your memory and your environment.

> Now here's the final nail in the coffin of common sense: All this predicting happens backward from the way we experience it. You and I seem to sense first and act second. You see an enemy and then raise your rifle. But in your brain, sensing actually comes second. Your brain is wired to prepare for action first

Learning is expensive.

> You're always cultivating your past.

> It's impossible to change your past, but right now, with some effort, you can change how your brain will predict in the future. You can invest a little time and energy to learn new ideas. You can curate new experiences. You can try new activities.

> You might not be able to change your behavior in the heat of the moment, but there's a good chance you can change your predictions before the heat of the moment. With practice, you can make some automatic behaviors more likely than others and have more control over your future actions and experiences than you might think.

Pick a controversial issue

What have you changed your mind on?

Reserve

Buddhist saying —> anger is a form of ignorance

Medological deficit

Quotes

You and I do not experience our every thought, every feeling of happiness or anger or awe, every hug we give or receive, every kindness we extend, and every insult we bear as a deposit or withdrawal in our metabolic budgets, but under the hood, that is what's happening. This idea is key to understanding how your brain works and, in turn, how to stay healthy and live a longer and more meaningful life.

So you don't have an inner lizard or an emotional beastbrain. There is no such thing as a limbic system dedicated to emotions. And your misnamed neocortex is not a new part; many other vertebrates grow the same neurons that, in some animals, organize into a cerebral cortex if key stages run for long enough. Anything you read or hear that proclaims the human neocortex, cerebral cortex, or prefrontal cortex to be the root of rationality, or says that the frontal lobe regulates so-called emotional brain areas to keep irrational behavior in check, is simply outdated or woefully incomplete. The triune brain idea and its epic battle between emotion, instinct, and rationality is a modern myth.

If you return home from war to a safer environment but your brain continues to false-alarm, as happens in post-traumatic stress disorder, that behavior could still be considered rational. Your brain is protecting you from threats it believes are present, even though the frequent withdrawals decimate your body budget. The problem is your brain's beliefs; they are not a good fit for your new environment, and your brain hasn't adjusted yet. What we call mental illnesses, then, may be rational body-budgeting for the short term that's out of sync with the immediate environment, the needs of other people, or your own best interests down the road.

The answer to these questions begins with an important insight. Your brain is a network — a collection of parts that are connected to function as a single unit. You are surely familiar with other networks that surround us. The internet is a network of connected devices. An ant- hill is a network of underground locations connected by tunnels. Your social network is a collection of connected people. Your brain, in turn, is a network of 128 billion neurons connected as a single, massive, and flexible structure.

Communication in your brain is a balancing act between speed and cost. Each neuron directly passes information to just a few thousand other neurons and receives information from a few thousand others, give or take, yielding over five hundred trillion neuron-to-neuron connections. That's a really big number, but it would be considerably larger if every neuron spoke directly to every other neuron in the network. Such a structure would re- quire so many more connections that your brain would run out of resources to sustain itself.

So you have a more frugal wiring arrangement that is sort of like the global air-travel system. (Yep, here comes another metaphor.) The air-travel system is a network of about seventeen thousand airports around the world. Whereas your brain carries electrical and chemical signals, this network carries passengers (and, if we're lucky, our luggage). Each airport runs direct flights to some other airports but not to every other airport. If every air- port sent flights to every other, air traffic would increase by billions more flights per year, and the whole system would run out of fuel and pilots and runways and ultimately collapse. Instead, some airports take the burden off the rest by serving as hubs. There's no direct flight from Lincoln, Nebraska, to Rome, Italy, so you first fly from Lincoln to a hub like Newark International Airport in New Jersey, then hop onto a second, longer-distance flight from the hub to Rome. You might even take three flights and pass through two hubs on your journey. The hub system is flexible and scalable, and it forms the back- bone of international travel. It allows all airports to participate globally, even while many of them focus on local flights.

Your brain network is organized in much the same way. Its neurons are grouped into clusters that are like airports. Most of the connections in and out of a cluster are local, so, like an airport, the cluster serves mostly local traffic. In addition, some clusters serve

as hubs for communication. They are densely connected to many other clusters, and some of their axons reach far across the brain and act as long-distance connections. Brain hubs, like airport hubs, make a complicated system efficient. They allow most neurons to participate globally even as they focus more locally. Hubs form the backbone of communication throughout the brain.

Brains of higher complexity can remember more. A brain doesn't store memories like files in a computer — it reconstructs them on demand with electricity and swirling chemicals. We call this process remembering but it's really assembling. A complex brain can assemble many more memories than either Meatloaf Brain or Pocketknife Brain could. And each time you have the same memory, your brain may have assembled it with a differ- ent collection of neurons. (That's degeneracy.)

But don't take my word for it. Instead, think of the last time you were thirsty and drank a glass of water. Within seconds after draining the last drops, you probably felt less thirsty. This event might seem ordinary, but water actually takes about twenty minutes to reach your blood- stream. Water can't possibly quench your thirst in a few seconds. So what relieved your thirst? Prediction. As your brain plans and executes the actions that allow you to drink and swallow, it simultaneously anticipates the sensory consequences of gulping water, causing you to feel less thirsty long before the water has any direct effect on your blood.

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Here's an example. All of us have had a nervous feel- ing before a test, but for some people, this anxiety is crippling. Based on their past experiences of taking tests, their brains predict and launch a hammering heartbeat and sweaty hands and they're unable to complete the test. If this happens enough, they fail courses or even drop out of school. But here's the thing: a hammering heartbeat is not necessarily anxiety. Research shows that students can learn to experience their physical sensations not as anxiety but as energized determination, and when they do, they perform better on tests. That determination seeds their brains to predict differently in the future so they can get their butterflies flying in formation. If they practice this skill enough, they can pass a test, perhaps pass their courses, and even graduate, which has a huge impact on their future earning potential.

It's also possible to change predictions to cultivate empathy for other people and act differently in the future. An organization called Seeds of Peace tries to change pre- dictions by bringing together young people from cultures that are in serious conflict, like Palestinians and Israelis, and Indians and Pakistanis. The teens participate in activities

like soccer, canoeing, and leadership training, and they can talk about the animosity between their cultures in a supportive environment. By creating new experiences, these teens are changing their future predictions in the hopes of building bridges between the cultures and, ultimately, creating a more peaceful world.

You can try something similar on a smaller scale. Today, many of us feel like we live in a highly polarized world, where people with opposing opinions cannot even be civil to each other. If you want things to be different, I offer you a challenge. Pick a controversial political issue that you feel strongly about. In the United States, that might be abortion, guns, religion, the police, climate change, reparations for slavery, or perhaps a local issue that's important to you. Spend five minutes per day deliberately considering the issue from the perspective of those you disagree with, not to have an argument with them in your head, but to understand how someone who's just as smart as you can believe the opposite of what you do.

I'm not asking you to change your mind. I'm also not saying this challenge is easy. It requires a withdrawal from your body budget, and it might feel pretty unpleasant or even pointless. But when you try, really try, to embody someone else's point of view, you can change your future predictions about the people who hold those differ- ent views. If you can honestly say, "I absolutely disagree with those people, but I can understand why they believe what they do," you're one step closer to a less polarized world. This is not magical liberal academic rubbish. It's a strategy that comes from basic science about your predicting brain.

My point here is that you might not be able to change your behavior in the heat of the moment, but there's a good chance you can change your predictions before the heat of the moment. With practice, you can make some automatic behaviors more likely than others and have more control over your future actions and experiences than you might think.