The Biology of Bad Behavior

FROM THE EARLY 1960S TO THE EARLY 1990S, the United States experienced a terrible crime wave. The number of murders doubled. The rates of rape, robbery, and violent crimes were four times greater than before. Violence crept toward epidemic levels all across the country.

But then, sometime around 1992, the trend began to reverse. Crime decreased, and not just for a year or two. Nearly every year from the early 1990s to the late 2000s, crime dropped across the country. By 2015, the rates of murder, rape, robbery, and violent crimes had each been cut in half from the record highs of the 1980s.

What changed?

It's a complex issue, but many scientists believe the rise and fall of crime in the United States can be attributed not to changes in city planning or law enforcement, but instead to a change in biology. In particular, the bulk of the crime wave that hit the United States can be tied to a single element: lead.

The first tank of leaded gasoline was produced in 1923. Car manufacturers discovered that by adding lead to gasoline, they could improve engine performance and eliminate knocking and pinging, which could cause mechanical damage and maintenance issues. Unfortunately, while lead helped car manufacturers and oil companies make money, it also destroyed the health of the nation.

Lead is unsafe at nearly any level. In adults, exposure can cause brain damage, kidney disease, heart attack, stroke, and cancer. Even in mild doses, it can cause blindness and high blood pressure. But its effects are most harmful to children. When exposed to lead at a young age, children can end up with learning disabilities, lower IQs, and an inclination for aggressive and impulsive behaviors—such as an increased tendency to commit violent crimes.

Leaded gasoline reached peak popularity in the United States in the late '50s. As more cars began to run on it, more lead entered the atmosphere as exhaust. The Agency for Toxic Substances and Disease Registry estimates that "the burning of gasoline has accounted for 90 percent of lead placed in the atmosphere since the 1920s."

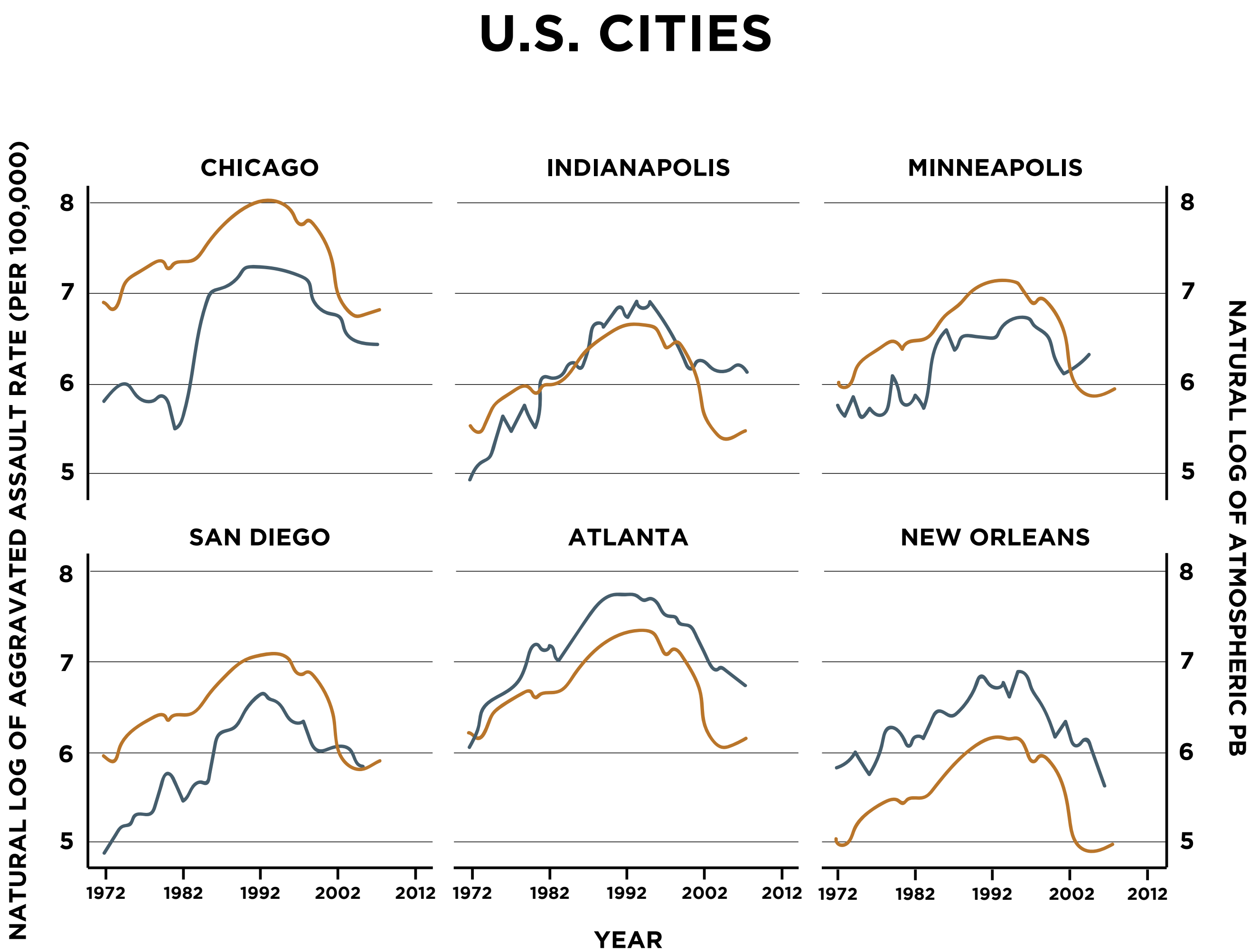
As the use of leaded gasoline became more common, lead levels in neighborhoods around the country jumped hundreds of times higher than normal, and well beyond what was safe. The effects were the worst in densely populated cities where the exhaust from many vehicles accumulated. When the air is littered with lead particles, some of it ends up in your bloodstream.

When you map the rates of violent crime in a given city with the rise in lead levels, they overlap almost perfectly. The following chart shows the assault rate (in blue) and the levels of lead in the air (gold) for six cities in the United States from 1972 to 2012. When lead goes up, crime goes up. When lead goes down, crime goes down.

The correlation between lead levels and crime rates is one of the strongest you can find in studies of public health. In fact, the link between lead and crime is so robust that it can be mapped on a state-by-state, city-by-city, and even neighborhood-by-neighborhood level. When comparing two communities in the same city, researchers found the one that switched to unleaded gasoline earlier saw a drop in violent crime sooner as well.

In New Orleans, researchers estimate that 85 percent of the variance in aggravated assault rates could be predicted by the lead levels in the neighborhood twenty-two years earlier. When children who were born into high levels of lead exposure reached their early twenties, they were more likely to engage in criminal activity. This terrifying fact played out on a nationwide scale. The production of leaded gasoline peaked in 1958. Exactly twenty-two years later, in 1980, the murder rate in the United States reached an all-time high.

Of course, no single factor can predict all of human behavior, and lead certainly isn't the only cause of criminal behavior. You are not destined to a life of violence if you have been exposed to lead. However, individuals who suffer from mental illness, struggle with



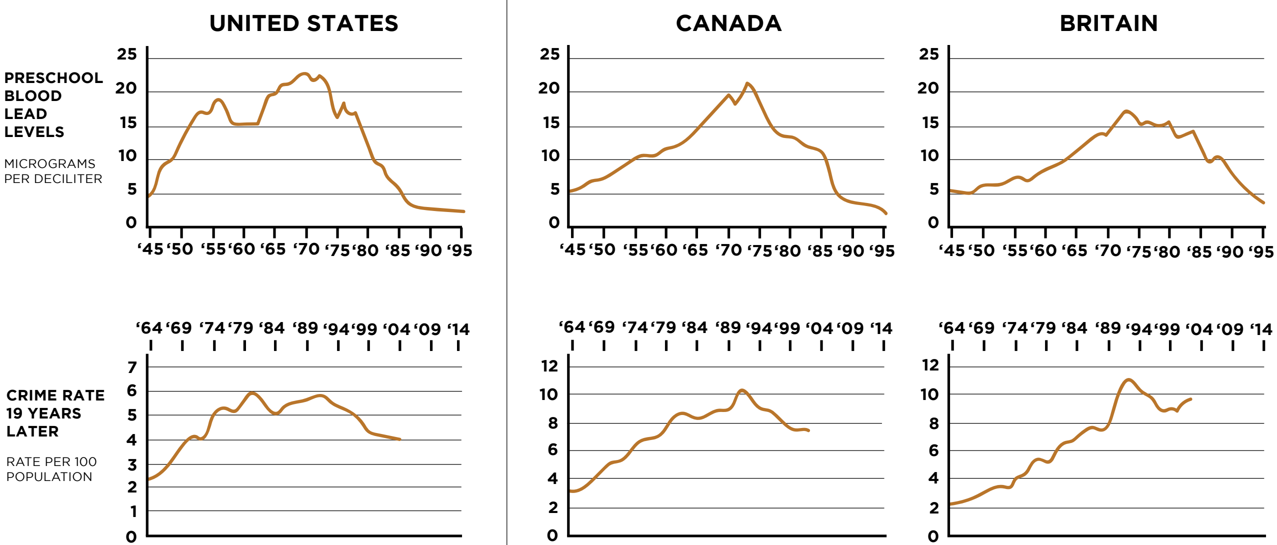
Note that the annual estimated metric tons of air Pb is shifted forward by 22 years for each metropolitan area in order to display the relationship between childhood lead exposure and the aggravated assault rate years later. The year 1972, for instance, corresponds to the observed aggravated assault rate in 1972, and the metric tons of air Pb from vehicle traffic observed in 1950. Source: Figure 2, "The urban rise and fall of air lead (Pb) and the latent surge and retreat of societal violence," Mielke and Zahran (2012).

anger and impulsivity, or are surrounded by negative social factors are already at risk. Blend these influences together with lead poisoning and your odds aren't great.

The connection between lead and crime provides one example of how our cravings and desires are influenced by our biology, but there are many others. Consider John B. Macklemore, the primary subject of the audio documentary S-Town. As a restorer of antique clocks, Macklemore spent many hours performing fire gilding, an ancient process used to apply a thin coating of gold to surfaces. Fire gilding is rarely performed today because a fire gilder consumes an unsafe amount of elemental mercury during the process.

Macklemore ultimately committed suicide after likely suffering from erethism or "Mad

U.S., CANADA, AND BRITAIN



Crimes counted in the U.S. chart are murder, rape, aggravated assault, burglary, and theft – what experts call “index crimes.”

Crimes in Canada and Britain charts are murder, rape, aggravated assault, burglary, threats and assaults without injury, as well as thefts that fall below the U.S. threshold for an index crime. The crime rates – and scales – in these charts are higher than in the U.S. chart because they include more types of crime.

Sources: Rick Nevin (National Center for Healthy Housing) and The Washington Post.

Hatter” disease, which is caused by mercury poisoning. It’s impossible to say whether his death was a direct result of increased mercury levels, but like the link between lead and crime, it is not unreasonable to believe the consumption of mercury altered his biology and his behavior changed as a result.

Then there is the story of Charles Whitman, who had been an Eagle Scout, had a high IQ score of 139, and was studying for his mechanical engineering degree at the University of Texas when he began to exhibit strange behavior.

After experiencing overwhelming violent impulses, Whitman wrote in a letter, “I do not really understand myself these days. I am supposed to be an average, reasonable, and intelligent young man. However, lately (I cannot recall when it started) I have been a victim of many unusual and irrational thoughts. These thoughts constantly recur, and it requires a tremendous mental effort to concentrate on useful and progressive tasks.”

Shortly after writing those words, Whitman killed both his mother and his wife while they slept. A few hours later, he proceeded to the University of Texas and climbed up to the 28th floor of the UT Tower that looked down over campus. He pulled out a rifle and proceeded to kill seventeen people and wound another thirty before being killed by police officers. The autopsy revealed that Whitman had been suffering from a brain tumor, which may have pressed on his amygdala—the portion of the brain responsible for fear and emotional reactions.

These are extreme examples, of course, but the influence of biology on behavior is not limited to one-time actions like carrying out a crime or committing suicide. Altering the chemistry and biology of the brain can lead to a dramatic change in our habitual behaviors as well.

Consider the interesting case of treating Parkinson's disease. Parkinson's destroys some of the brain regions that produce dopamine, which means people suffering from the disease are dopamine deficient. To counteract this loss, many Parkinson's patients are given dopamine-replacement drugs.

Finding the right dosage can be challenging and, when the resulting levels of dopamine are too high, patients experience relentless urges and compulsions. Some people find themselves suddenly developing an addiction to gambling, pornography, or shopping. For most patients, these behaviors are completely out of character.

Even in healthy individuals, subtle changes in biology can lead to differences in habit. The natural process of aging influences dopamine production. Dopamine peaks around age twenty, declines gradually through your early thirties, and falls quickly as you enter your forties and beyond. Your dopamine levels can drop by about 25 percent over your lifetime.

As a result, feelings of desire and motivation tend to decline over time. For some people, life begins to feel less urgent as they age. For others, the gradual decline of dopamine can lead to the fading of addictive behaviors. Many addicts even experience a tapering of their addictive urges as they grow older, and some lose their cravings altogether. Similarly, the desire to explore tends to drop over time. Some experts believe the desire for novelty goes down by half between the ages of twenty and sixty.

Our desires are regulated by our biology.

Ultimately, every behavior is biological in origin. The state that you call "motivation" or "craving" is nothing more than the release of dopamine and other chemicals. The state that you call "pleasure" or "satisfaction" is simply the firing of the reward system throughout the brain. Naturally, if these biological and chemical interactions change, so do our behaviors.

In chapter seven, The Secret to Self-Control, I pointed out that breaking a bad habit is nearly impossible because once the neurological pathway has been established, the brain will default to the habit whenever the appropriate situation arises. Thus, one of the best ways to avoid bad habits is to reduce exposure to the cues that trigger them.

However, there is one exception to this rule. As humankind unravels the links between biology and behavior, scientists are discovering that altering the structure of the brain not only ignites our cravings for bad behaviors, but can also eliminate them entirely.

HOW TO BREAK "UNBREAKABLE" HABITS

In 2012, Luca Rossi walked into the Villa Maria Clinic in Padua, Italy, to receive treatment for cocaine addiction. Rossi had been struggling with his addiction for years, but he didn't fit the stereotypical profile. He was a thirty-five-year-old physician with a successful career and plans for a family. Yet at the peak of his addiction, Rossi was spending $3,500 a month on cocaine.

He had already tried antidepressants, anti-anxiety drugs, and psychotherapy. Nothing helped. On this day, however, he was receiving a new type of treatment known as transcranial magnetic stimulation (TMS). TMS had been used to treat depression for years, and it had recently been found to be effective in cocaine-addicted rats.

In many addicts, the region of the brain responsible for inhibition is quiet and inactive when compared to healthy individuals. Physicians believe TMS can activate this region and increase the brain's ability to regulate desire. The machine contains a coil of wires that create a magnetic field near the patient's head. The electromagnetic waves can be directed at different brain regions to produce electrical impulses in that area. It is as if the magnetic waves "turn on" the neurons in that region. During a thirty-minute session, a patient might receive 10,000 to 20,000 electrical pulses. It is completely painless.

Early results seem promising. When Rossi walked out from his first treatment he said, "It was magnificent. I felt as if I had never taken drugs in my life." Another man described his life after TMS as "a complete change. I feel a vitality and desire to live that I had not felt for a long time." The inhibition centers of his brain were fully activated for the first time in years. The treatment had, almost magically, erased his cravings.

Other scientists are using pharmaceuticals to make bad habits unattractive. The drug baclofen, which was originally developed for muscle spasms, has also shown promise in treating alcohol addiction. The drug interacts with some of the same regions in the brain as alcohol and it may reduce cravings to drink and lessen withdrawal symptoms. Some alcoholics even find that taking the drug regulates desire well enough that they can enjoy a drink or two without going on a binge.

Similarly, physicians have begun prescribing buprenorphine to treat opioid addiction. The drug activates the receptors in the brain responsible for pleasure—the same ones stimulated by heroin and other opioids—so addicts have less reason to get high. This type of "opioid replacement therapy" means addicts are still dependent on a drug—in this case, buprenorphine—but they are not high or impaired. The brain gets the pleasure it craves while achieving a new level of homeostasis. This type of drug substitution has been proven to reduce the risk of death from opioid addiction.

Addiction is a complex problem, and effective treatments will surely come in a wide range of forms. Drugs like baclofen and treatments like TMS don't work for everyone, but no matter what future therapies end up looking like, it is becoming clear that addiction is not so much a moral failing as it is a biological condition. Altering our biology is one way to unlearn bad habits and rewire the neural networks of the brain. When you change the brain, you also change desire. In the future, perhaps we will be able to harness the benefits of these technologies with even greater precision and fewer drawbacks.

As you would expect, businesses outside of the medical industry are also capitalizing on the link between biology and behavior. Some companies now conduct consumer research by using functional magnetic resonance imaging (fMRI) to track blood flow in a target customer's brain as they are shown various products. The offers that elicit the maximum response are believed to be the ones consumers will find most attractive.

In a few years, these techniques will probably seem rudimentary and outdated. As technology continues to advance, pinpointing the most attractive offers will become the norm. In the future, companies might be able to precisely measure your emotions or motivational states. Imagine if a streaming service knew when you were feeling sad and suggested an uplifting movie, or an online retailer could tell that you were fatigued and offered the perfect impulse purchase. A version of this reality already exists: some vending machines will automatically increase the price of soda when it is hot outside. Some websites use algorithms to adjust prices based on the time of day, location, and purchase history of the user. The goal of these efforts is to create the most relevant and personal offer possible. The more personalized a cue is, the more attractive it becomes—and they know it.

What happens when this process gets too good? Imagine knowing exactly what portions of the brain to stimulate to make you want to practice the violin or cook dinner or have sex. Today, we can choose how to respond to our desires, but we often cannot choose our desires themselves. But in the future, for better or worse, perhaps we will.

This is a bonus chapter from Atomic Habits