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Mental Health, Relationships & Cognition

Enslave the liberty of but one human being and the liberties of the world are put in peril.
–William Lloyd Garrison

Beyond its wider cultural and social impacts, we are also affected in more individual and personal ways by the technology in our lives. Because the purpose of this book is not to inventory the positive effects of technology, it will have to suffice to recognize that there are significant favorable impacts born of digital technologies. Apps for improving health, platforms for informed discussion, video communication technology, 3D-printed affordable homes (and 3D printed organs, for that matter), research repositories, drones for medical services delivery. There are countless wonderful uses and applications of technology and the companies and people who build them should be celebrated.

We can recognize technology as an incredible force for good, while, at the same time working to mitigate the ways in which it causes harm. While democracy, misinformation, economic inequality, and job displacement encapsulate some of the most important social concerns in

relation to technology, the impacts on our health, mental health, cognition, and relationships are among the most pressing challenges we face at a more personal level.

First, Do No Harm

While the mental health effects of tech have, quite rightly, captured the attention of journalists and researchers alike, the physical effects of technology have been relatively less prominent in public discourse. The physical impacts of technology may take considerably longer to materialize, but evidence increasingly points to the need for both awareness and caution.

In 2018, researchers from the University of Toledo found that the blue light emitted from devices such as phones, laptops, and tablets triggers the creation of toxic molecules in the eye's retina. Over time, the light, which has a different, shorter wavelength and more energy than other types of light, can cause permanent damage, such as macular degeneration, which leads to blindness.[1] Other studies have focused on the phenomenon of sleep deprivation as a result of technology. The addictive effects of phones in particular, have led both to less sleep and lower quality sleep.[2,3,4] (The health benefits of sleep and the health impacts of insufficient sleep are wide-ranging and well-documented throughout scholarly research.[5])

A more contentious area of research is the relationship between digital technology and cancer. A large-scale study by the U.S. National Toxicology Program (NTP) exposed rats and mice to a radiofrequency (RF) energy similar to that emitted by mobile phones for two years (a period equivalent to 70 years in humans). The study found "clear evidence" for an increased risk of heart tumors and a "possible risk" of increased brain and adrenal gland tumors in the male rats exposed to RF radiation. Interestingly, the female rats showed no increased risk of developing cancer and all the mice of both genders were fine.[6,7] Research on human subjects has, for obvious reasons, been far more limited. While some studies follow large cohorts and track their phone use and rates of cancer, the majority have looked retrospectively at patients with brain tumors

and relied on self-reported phone use to determine correlations between technology and cancer. Throughout these studies, findings have been mixed and the rates and risks of cancer and other impacts remain unclear. A closer look at the history of research around phone radiation and cancer paints a disturbing picture as to why this might be.

In 1993, the Cellular Telecommunications and Internet Association (CTIA) hired epidemiologist George Carlo to investigate the physical risks of cellular phone radiation. At the time, there were neither restrictions nor government safety testing on phones, but a growing number of cases were beginning to be brought against companies alleging the potential harm of mobile devices, particularly an increased risk of cancer. For six years, Carlo acted as chairman of a research initiative called the Wireless Technology Research project (WTR), which carried out over 50 studies and reviewed dozens more. In October 1999, Carlo wrote to CEOs at 32 major tech and telecom companies, including Apple and AT&T, to explain WTR's findings, which included an increased risk of benign tumors, lethal tumors, and genetic damage. In a letter to AT&T CEO Michael Armstrong, Carlo expressed concerns about what he believed to be "an emerging and serious problem concerning wireless phones." In addition to the research findings themselves, Carlo also expressed concern about the disingenuous approach of technology firms in truthfully communicating these risks with their customers.

> Alarmingly, indications are that some segments of the industry have ignored the scientific findings suggesting potential health effects, have repeatedly and falsely claimed that wireless phones are safe for all consumers including children, and have created an illusion of responsible follow up by calling for and supporting more research. The most important measures of consumer protection are missing: complete and honest factual information to allow informed judgment by consumers about assumption of risk; the direct tracking and monitoring of what happens to consumers who use wireless phones; and, the monitoring of changes in the technology that could impact health.… As an industry, you will have to deal with the fallout from all of your choices, good and bad, in the long term. But short term, I would like your help in effectuating an important public health intervention today. The question of wireless phone safety is unclear. Therefore, from a public health perspective, it is critical for consumers to

have the information they need to make an informed judgment about how much of this unknown risk they wish to assume in their use of wireless phones. Informing consumers openly and honestly about what is known and not-known about health risks is not liability laden—it is evidence that your industry is being responsible, and doing all it can to assure safe use of its products. The current popular backlash we are witnessing in the United States today against the tobacco industry is derived in large part from perceived dishonesty on the part of that industry in not being forthright about health effects. I urge you to help your industry not repeat that mistake.[8]

The following day, Tom Wheeler, president of the CTIA, began to discredit Carlo's research findings, releasing his own letter to the same tech CEOs, contradicting WTR's findings, and trashing Carlo in the press. The Wireless Technology Research project ceased operations and George Carlo was pushed out of the organization.

Since Carlo released the results of his research over twenty years ago, tens of thousands of studies have been published on the topic of mobile phones and cancer, which variously support or fail to find evidence for an increased risk of cancer from phone radiation. As Mark Dowie and Mark Hertsgaard report, however, the industry's practice of funding research that fails to correlate mobile phones with negative health outcomes is symptomatic of the industry's self-interest.

A closer look reveals the industry's sleight of hand. When Henry Lai, a professor of bioengineering at the University of Washington, analysed 326 safety-related studies completed between 1990 and 2006, he discovered that 44% of them found no biological effect from mobile phone radiation and 56% did; scientists apparently were split. But when Lai recategorised the studies according to their funding sources, a different picture emerged: 67% of the independently funded studies found a biological effect, while a mere 28% of the industry-funded studies did. Lai's findings were replicated by a 2007 analysis in *Environmental Health Perspectives*, which concluded that industry-funded studies were two and a half times less likely than independent studies to find health effects.[9]

Dowie and Hertsgaard point to the practical effect this tactic serves: by suggesting evidence is inconclusive, further research is called for, which

postpones the influx of regulations that companies would face if a majority of independent research findings concluded mobile phones increased the risk of certain cancers.

> Central to keeping the scientific argument going is making it appear that not all scientists agree. Towards that end, and again like the tobacco and fossil-fuel industries, the wireless industry has "war-gamed" science, as a Motorola internal memo in 1994 phrased it.[10] War-gaming science involves playing offence as well as defence—funding studies friendly to the industry while attacking studies that raise questions; placing industry-friendly experts on advisory bodies such as the World Health Organisation and seeking to discredit scientists whose views differ from the industry's.[11]

Dowie and Hertsgaard compare the tech industry's funding of sympathetic research to the tobacco and fossil-fuel industries, which have famously funded studies that cast doubt on the risks of smoking and climate change, respectively.[12]

It has taken decades and millions of cases of death and disease to begin to undo the damage done by research funded by special interests. In the same way oil, gas, tobacco, pharma, and sugar industries have positioned themselves in Washington, contradicted independent research, and funded studies that further their interests, tech has followed suit, becoming the most prolific lobbying force in the U.S. and funding research that promotes its interests. In the absence of definitive evidence in either direction, most expert bodies such as the World Health Organization currently classify mobile phones as "possibly carcinogenic."[13] As 5G connectivity becomes the norm and digital assistants and smart home devices become more common, radiation from these devices will grow exponentially, while industry-funded studies continue to cast doubt on their potentially negative health effects.

Mental Health

Perhaps owing to my background, combined with the sheer amount of research available on the subject of mental health and technology, I wrongly assumed this would be the easiest section of this book to write.

Instead, it has proved the hardest. The psychological effects of mobile phones and social media were what drew me to this work nearly ten years ago, and yet, it has become no easier and no less upsetting to see how technology affects our mental health and wellbeing. The eruption of digital technologies into every corner of our lives has upended the social norms that science tells us are good for our health: deep connections, thoughtful communication, strong relationships, and a sense of community. There is strong evidence that internet-based technology, and social media sites in particular, diminish the things that improve our wellbeing while promoting the things that don't.

Over twenty years ago, researchers at Carnegie Mellon conducted a study that suggested spending time online made you lonely, depressed, and antisocial.[14] Since then, thousands of researchers have replicated their results. While there are typically subtle changes to the specific research question or environment, study after study tells us that social media is negatively correlated with wellbeing[15,16,17] and life satisfaction,[18] and is associated with increased levels of negative emotions,[19] loneliness,[20] and depression.[21] These outcomes are not the result of a single mechanism or social tool, but a convergence of significant social changes, propelled by the internet and underpinned by a number of business priorities that exist in conflict with human wellbeing. Increased depression and anxiety, for example, can be, in part, attributed to a change in the type and quality of human connection, an increase in comparison of one's life to others, and the addictive and frenetic quality of social media.

Central to the problem of technology's negative impact on our mental health is its false promise of sociability. Platforms such as Snapchat, Twitter, Facebook, Instagram, and Reddit, which have been globally marketed as a form of social connection and community, are, for many, inherently isolating. Ethan Cross and his colleagues, who have carried out numerous studies on the mental health effects of social networks, concluded that, "[o]n the surface, Facebook provides an invaluable resource for fulfilling the basic human need for social connection. Rather than enhancing well-being, however, these findings suggest that Facebook may undermine it."[22] Social platforms like Facebook would argue that they create opportunities for "meaningful connections," but research has repeatedly demonstrated that this is simply not the way humans work. A

2005 study found that the internet, when used for the purpose of sociability and intimacy, was in fact inversely correlated to quality of life.[23]

The reason for this is, in some ways, pretty straightforward. The more time we spend on our phones and devices, the less time we have available to spend with others in person. The method of contact in our social relationships actually matters a lot, especially when it comes to depression. The authors of one study concluded that in-person interactions should be encouraged as much as possible, as the "[p]robability of having depressive symptoms steadily increased as frequency of in-person [interaction]… decreased."[24] A study in the journal *American Psychologist* found that internet use was correlated with less family communication, smaller social circles, more depressive symptoms, and greater feelings of loneliness,[25] suggesting increased screen time may lead to a decrease in the types of interactions that promote wellbeing. A follow-up study by the same researchers refined these results and found that, four years later, many of the negative social effects had dissipated for some of their cohort but remained high for others. In general, the researchers found, "using the Internet predicted better outcomes for extraverts and those with more social support but worse outcomes for introverts and those with less support."[26]

The importance of in-person connection and communication is true not only of our deeper, more intimate relationships, but our brief social interactions as well. Gillian Sandstrom and Elizabeth Dunn have spent years studying the power of acquaintances and "weak social ties," which include people we may interact with once or repeatedly, for a short period of time, such as our barista, a professor, or a colleague down the hall. Those who increased their number of such interactions reported an elevation of their mood and decreased loneliness, "suggesting that even [in-person] social interactions with the more peripheral members of our social networks contribute to our well-being."[27] Other people, it turns out, are good for our health. While relationships can certainly be forged online (such as on dating apps or in chat rooms), real human connection and intimacy are the domains of offline interactions. Communal dinners, social meet-ups, team sports, classrooms, parties, intimate meals, brunches with friends, nights on the sofa, and shared activities and adventures are all infinitely better for us than scrolling through a newsfeed or communicating in the comments section.

The false equation of social media with true connection is compounded by the nature of interactions online. The divisiveness and anger omnipresent on social media are accompanied, in many cases, by threats of violence and bullying. The toxicity of such interactions is, quite obviously, extremely dangerous for our mental health, particularly for children, who may lack the resilience or tools to manage such harassment. Researcher Jean Twenge has suggested that increased engagement in social media use "may account for the increases in depression and suicide"[28] in young people, as studies show that teenagers who spend two or more hours a day online have a significantly increased risk of suicide.[29] Data from both U.S. children's hospitals, which saw the number of suicide-related admissions double,[30] and the National Center for Health Statistics (NCHS), which reported a 24% increase in suicides across the U.S.,[31] support Twenge's hypothesis and findings. Interestingly, the NCHS reported that the pace of the increase was greatest after 2006/07, the same two years Twitter, Facebook, YouTube, and the iPhone were made available to the public (or in YouTube's case, went mainstream). While these correlations may not tell the entire story and should not be mistaken for causation, experts express concern that, taken together, the effects of the internet and social media on our wellbeing are more dangerous than tech companies would like us to believe. Dr. Safiya Umoja Noble, an Associate Professor at UCLA and author of *Algorithms of Oppression: How Search Engines Reinforce Racism*, has argued that lawmakers should take note of the "mounting evidence, that unregulated digital platforms cause serious harm" across a number of mental health categories.[32]

In addition to the depressive effects of social media, the rise and inundation of technology plays a role in our individual and collective anxiety. Breaking news, updates, emails, notifications, and the incessant buzz of messages across a variety of platforms have become increasingly difficult to escape, as has the perceived need to document and catalogue our lives online. Dr. Edward Shorter, a professor at the University of Ontario who lectures on the History of Medicine, argues that social media has "created a universal climate of apprehension,"[33] an argument confirmed by Gallup's 2019 Global Emotions Report, which found U.S. citizens to be among the most stressed out in the world. In *The Age of Anxiety*, Sarah

Dunant and Roy Porter explain that the root of our collective anxiousness stems from an uncertainty about the future, magnified by an unprecedented number of accelerating social changes.

> For many people in the western world the unprecedented expansion of everything from technology through communication to shopping has brought with it not only increased demands of choice (in itself something of an anxiety) but also an expanding potential for feeling out of control.[34]

Dr. Harsh Trivedi, president and CEO of Sheppard Pratt Health System, contends that while technology may not be the only cause of this continuous source of stress, it is certainly responsible for exacerbating it. The "constant noise from the internet and social media," combined with the stream of notifications and alerts we receive all day, Trivedi explains, heightens our alert system, amps up our "anxiety and angst,"[35] and leaves us feeling busy and apprehensive round the clock.

Twenge has a wholly different theory than Shorter and Trivedi about the increase in anxiety, specifically when it comes to young adults. A 2010 study by Twenge and her colleagues found that a shift from intrinsic to more extrinsic goals has mirrored the increase of anxiety and depression among young adults.[36] Where previously intrinsic pursuits, such as strong relationships, community, and competence were more central to young people's life goals, Twenge's team found a pronounced shift to extrinsic goals, such as appearance, social status, and wealth in the young adults they studied. Peter Gray, a psychology professor at Boston College explains that Twenge's findings represent "a general shift toward a culture of materialism, transmitted through television and other media," in which "young people are exposed… to advertisements and other messages implying that happiness depends on good looks, popularity, and material goods."[37] Where intrinsic goals "have to do with one's own development as a person—such as becoming competent in endeavors of one's choosing and developing a meaningful philosophy of life,"[38] extrinsic goals, by contrast, require an audience. And, as luck would have it, we each have an ever-present audience, at all hours, conveniently located in our pocket.

The shift from internal achievements to external attainment mirrors the escalation of our online lives, which has precipitated the rise of personal brands, self-aggrandizing content, and digital personas. Elements of who we are have shifted online to a series of digital representations of ourselves (Instagram account, Twitter handle, LinkedIn profile) that capture only a sliver of our true selves—typically only the most positive and favorable snippets of who we are (or rather, who we want others to believe we are). The psychological consequences of this phenomenon on our identity is a concern for many academics, such as Baroness Susan Greenfield, an Oxford researcher and member of the House of Lords, who studies the neuroscience of consciousness and the impacts of technology on the brain.

> People feel they have to sell themselves, have lots of friends, and offer their constant thoughts all the time, as if they have to have some kind of cyber presence or they won't exist. And that is deeply troubling, because if you see your identity simply as a brand, as someone who has 500 friends, who has eaten chocolate cake, or downloaded this or that, or gives a particularly savage reaction to something to get attention—who are you?[39]

The focus on status and materialism is intimately linked to what we have, what we do, or how we look, Greenfield explains, and thus is dependent on the judgment of others.[40] Allowing our identity to be increasingly defined by external factors, rather than relying on our internal sense of self, creates greater dependence on our audience and the digital markers of social affirmation and approval we get from them.

The anxiety Twenge and Greenfield describe is linked to this mercurial process, wherein our sense of who we are is variously confirmed, invalidated, or ignored by others. The result is a constant comparison between our lives and the lives of others, which may leave us feeling dissatisfied, jealous, elated, depressed, anxious, or validated, depending on the day, the engagement we receive, and our perception of our extrinsic worth.[41] When we see ourselves in comparison to our contemporaries, we experience "status anxiety," a term coined by Alain de Botton, which in turn causes "an assault on [our] feeling of self-worth."[42] Wilkinson and Pickett, who study the psychosocial effects of economic inequality, explain that

status anxiety "increases what psychologists have called the 'social evaluative threat', where social contact becomes increasingly stressful."[43] The results can range from "low self-esteem and a collapse of self-confidence,"[44] to depression, narcissism, and addiction,[45] as more favorable feedback is continually sought. German researchers have dubbed this cycle of sharing and comparing our lives online the "the self-promotion-envy spiral,"[46] where likes, comments, views, and engagement come to define our sense of self-worth. Knowing social media is the world's most effective vehicle for social comparison, that it heightens and amplifies status anxiety, and negatively affects our wellbeing across a variety of measures, why do we keep coming back for more?

The Science of Addiction

Have you ever wondered why digital notifications are red? Or why a dot dot dot appears while your mom is crafting her latest emoji-heavy text message? (Just kidding, mom, you know I love these.) Or why you get a little thrill of anticipation when you check your Instagram after posting a cool photo? Each of these design techniques and many others like them—Snapchat's score, Bumble's 24-hour response window, push notifications—are all built to maximize engagement. And no one is more engaged than someone who is addicted.

Technology author and journalist Simon Parkin has described Facebook as an empire built on a molecule, in reference to the dopamine high that social media relies on to keep its captives—I mean, customers—coming back for more.[47] In order to appreciate how well dopamine works in this capacity, it's helpful to understand the science behind it all.

Dopamine is little molecule (is there another kind?) known as a neurotransmitter. We have lots of neurotransmitters, which are like the messengers of the nervous system, each of which has a different job. Dopamine functions to serve as an indicator of reward and pleasure, which, from an evolutionary perspective, is incredibly adaptive. Dopamine helps motivate us to set and achieve goals and reminds us to eat, drink, and reproduce. When we get a hit of dopamine, we're flooded with pleasurable sensations that reinforce whatever behavior caused them

(for example, having an orgasm, completing a marathon, or finishing a degree or project). Dopamine is the most addictive molecule running around our system, and while it can help make us more productive, organized, and motivated, it can also lead to anxiety, reward-seeking behavior, and—especially—addiction. Over time, we can become hooked on the little hits of dopamine we receive and, consequently, less able to control our impulses to indulge in them.

In addition to dopamine, it's useful to understand a few of the other chemicals that influence our mood and behaviors: endorphins, serotonin, oxytocin, and cortisol. Endorphins help us to rise above perceptions of pain or danger, like when we push through the final set of a workout or run away from a bear. Serotonin is the chemical that gives us feelings of recognition, contentment, and confidence, particularly within a group. Simon Sinek calls serotonin the "leadership chemical," as it encourages acting on behalf of or with others and creates group cohesion. Oxytocin is the feeling of true love, trust, and safety. A good example is the love and protection a mom shows her child, but it can also be the intimacy of any strong relationship. Finally, cortisol is released in response to stress.

Unsurprisingly, perhaps, dopamine is the chemical of choice of both social media and the tech industry more broadly. The exploitation of reward-seeking dopamine-driven psychological processes is the single biggest reason we have collectively become so consumed with technology. Many early investors, founders, and former employees at Facebook, such as Sean Parker, Chamath Palihapitiya, Antonio García Martínez, Justin Rosenstein, and Sandy Parakilas, now publicly condemn the addictive nature and mental health effects of the attention economy they helped build at the company. While many cite their own immaturity[48] or ignorance, others, such as former Facebook exec Chamath Palihapitiya and former Facebook president Sean Parker, have acknowledged that they knowingly and purposefully exploited human psychology for the purposes of growth, engagement, and profit.

> How do we consume as much of your time and conscious attention as possible? That means that we needed to sort of give you a little dopamine hit every once in a while because someone liked or commented on a photo or a post or whatever and that's gonna get you to contribute more content …

> It's a social validation feedback loop … It's exactly the kind of thing that a hacker like myself would come up with, because you're exploiting a vulnerability in human psychology … The inventors… understood this, consciously, and we did it anyway.[49]

The fact that we continually anticipate mini "rewards" from our phones and social media platforms (not only likes and comments, but emails, follows, or any other type of engagement) keeps us coming back for more in anticipation of what might be there.

The dopamine-fueled feedback loop Parker describes relies heavily on triggers and variable rewards. These concepts are taught, not on the dark web or in the back alleys of tech campuses, but in the heart of Silicon Valley, at Stanford's Persuasive Technology Lab. The lab, which is run by behavioral psychologist B.J. Fogg, boasts of its capacity to program "machines designed to change humans,"[50] and employs Fogg's own model to teach students how to build persuasive design into technology, such as digital machines, video games, and apps. Fogg's model has three components: motivation, ability, and trigger. *Motivation* is the drive to use a product, which Fogg explains is rooted in the need for sensation, anticipation, or belonging. *Ability* relates to how easy or "user-friendly" the product is: in other words, it has to be easy enough to use in order for it to stick. *Trigger* refers to what keeps you coming back for more, which could be a signal indicating someone is typing a message, a reward for increased time spent on a platform, or notifications that remind you something is waiting that needs to be checked or actioned. Thousands of students have taken Fogg's class, among them some of Silicon Valley's most prominent engineers and founders, including Nir Eyal, Ed Baker, Kevin Systrom, Mike Krieger, and countless others who would go on to work at Facebook, Google, Uber, and some of the Bay Area's most prestigious companies. In one of his classes, students practiced putting Fogg's model to work; in just over two months, the result was a series of apps with over 16 million users, which generated $1,000,000 in advertising revenue.[51]

The key to designing for addiction lies in offering variable rewards that eventually become so engrained they become second-nature to our daily functioning. Nir Eyal, an expert of persuasive design and habits, explains

that in order to achieve this, tech companies employ the Hook Model. The Hook Model "goes beyond reinforcing behaviour" and instead "creates habits, spurring users to act on their own, without the need for expensive external stimuli like advertising."

> The Hook Model is at the heart of many of today's most habit-forming technologies. Social media, online games, and even good ol' email utilize the Hook Model to compel us to use them. At the heart of the Hook Model is a powerful cognitive quirk described by B.F. Skinner in the 1950s, called a variable schedule of rewards. Skinner observed that lab mice responded most voraciously to random rewards. The mice would press a lever and sometimes they'd get a small treat, other times a large treat, and other times nothing at all. Unlike the mice that received the same treat every time, the mice that received variable rewards seemed to press the lever compulsively. Humans, like the mice in Skinner's box, crave predictability and struggle to find patterns, even when none exist. Variability is the brain's cognitive nemesis and our minds make deduction of cause and effect a priority over other functions like self-control and moderation.[52]

The anticipation of an unknown reward, then, like a potentially important email or a pull-to-refresh newsfeed, is likely to draw us in on a much deeper, more reactive level. This is particularly true when rewards are combined with a little bit of cortisol, which is released when we hear or see a notification. This creates just enough stress for us to experience what neuroscientist Ramsay Brown, co-founder of Dopamine Labs, describes as an "emotional need to go resolve it, to get the red away."[53] Eventually, as Jory McKay explains, the habits associated with variable rewards and triggers become internalized, and we act instinctively, without thought.

> It's not just these notifications that drive our app and phone usage. After being triggered to use a product enough times, the trigger becomes internalized. All of a sudden, we don't need a reminder to check Facebook, but instead are driven by some emotional cue (like loneliness or a need for connection).[54]

The true genius of social media is to connect variable rewards with our most deeply held psychological needs: social validation, love, and belonging.

Facebook, Twitter, and Instagram have recognized and capitalized on these desires: we may very well check our phones hundreds of times per day in anticipation of feeling connected, seen, and praised.

Happiness vs. Pleasure

The modern world has gone to great lengths to convince us that what we seek is pleasure. (Or perhaps, more accurately, that pleasure is happiness.) The dopamine-filled experiences and objectives that advertising promotes in our culture are predominantly extrinsic goals, which center on consumerist, material, and wealth-focused aims. Buying something, drinking something, smoking something, playing something, scrolling through something, buying more somethings. All associated with dopamine. Unfortunately, while dopamine can give us a lovely little short-lived high, it is not related in any way to either contentment or happiness. Samantha Lee and Hilary Brueck provide a helpful breakdown of the key differences between dopamine and serotonin.

> [D]opamine, associated with reward and motivation, is very different from serotonin, associated with contentment and true happiness. You can't get contentment from an app or from a purchase, but you *can* click or buy your way to a whole lot of reward and pleasure.[55]

Dopamine is addictive, short-term, visceral (meaning it's felt in the body), self-perpetuating, and is generally a solitary experience. Perhaps the most important feature of dopamine is that it always makes us want more dopamine. Serotonin, by contrast, is non-addictive, long-term, ethereal (meaning it's experienced in the mind, not the body), is generally a shared experience, inspires leadership and generosity, and is associated with contentment. Serotonin also has five times the number of receptors in the brain, which scientists think may be the reason it is responsible for a wider variety of experiences.[56] Not having enough of this important chemical in our system can lead to depression.

In his book *Sapiens*, Yuval Harari argues that "[m]ost current ideologies and political programmes are based on rather flimsy ideas concerning

the real source of human happiness,"[57] namely, the erroneous idea that happiness is correlated with economic prosperity and wealth.[58] Instead, Harari explains, strong families, supportive communities, and contentment with what we have are the strongest indicators of human happiness.[59] Rather than helping members of society grow and nurture true sources of contentment, like family, community, and self-actualization, Harari contends that the modern world instead cultivates unrealistic expectations of material wealth and possessions, which it constantly attempts to convince us will generate happiness. "If happiness is determined by expectations," Harari argues, "then two pillars of our society— mass media and the advertising industry—may unwittingly be depleting the globe's reservoirs of contentment."[60]

Johann Hari, author of *Lost Connections: Uncovering the Real Causes of Depression—and the Unexpected Solutions*, makes a similar case to Harari's. Hari believes mounting cultural anxiety and depression are the result of the way we live our lives in the modern world. Unhappiness and depression, he believes, "are caused, to an extent, by the same thing: disconnection from the things we need to be happy."[61] What at first sounds like a fairly obvious statement gets infinitely more interesting when we consider what science tells us it takes to be happy—"the need to belong in a group, the need to be valued by other people, the need to feel like we're good at something, and the need to feel like our future is secure"[62]—and contrast this to the world tech companies are shaping, in which we feel more isolated, unsure of ourselves, and insecure about the future. Hari's recommendations for a happier and more fulfilling life include thinking more about others and less about ourselves, making genuine connections in order to feel less isolated, and avoiding materialism, consumerism, advertising, and social media. Hari also suggests recognizing and aligning ourselves with our intrinsic values—the things we find truly meaningful and are passionate about—rather than the extrinsic values imposed on us by the expectations of others or society.[63]

Hari and Harari's arguments on happiness don't just make logical sense, they stand up scientifically as well. Wilkinson and Pickett have found that those who are most engaged with and reliant on consumer culture "are the least happy, the most insecure and often suffer poor mental health,"[64] while Twenge's research suggests that "screen activities are

linked to less happiness" and "nonscreen activities are linked to more happiness."[65] The Health Foundation summarizes the most essential elements of health as follows:

> a healthy person is someone with the opportunity for meaningful work, secure housing, stable relationships, high self-esteem and healthy behaviours…. People who are more socially connected to family, friends or their community are happier and live longer, healthier lives with fewer physical and mental health problems than people who are less well connected.[66]

Emotionally, this includes a well-connected and positive family life, "supportive relationships," the ability to "develop intellectual, social and emotional skills," and "take part in community life," each of which protect health and wellbeing.[67] The displacement of the true foundations of human happiness with watered-down, modern material alternatives is a moral failing, both on the part of the technology companies who propagate advertising and consumer culture and the hypercapitalist economic system that encourages them to do so.

Tech's failure to promote happiness centers on its elevation of the individual, a concept woven deeply into both Silicon Valley's psychology and the internet itself. The industry's libertarian ideals promote the importance of personal satisfaction, personal opinions, and personal happiness, which as Jessi Hempel observes, "elevates individuals while deprecating institutions."[68] The primacy of individual needs is embedded not only in the mantras of individual tech companies (Broadcast yourself!, Give everyone a voice!, Tweet til your fingers fall off! Post pictures of every meal you eat!), but in the very DNA of the industry, which promotes messages of individualism and self-interest. The priorities adopted by many prominent tech companies aren't that surprising when we consider the origins of one of most dominant moral philosophies that guides the industry: objectivism. In a Vanity Fair article on Silicon Valley's obsession with Ayn Rand's theory of objectivism, Nick Bilton writes:

> [Steve] Jobs's co-founder, Steve Wozniak, has suggested that *Atlas Shrugged* was one of Jobs's "guides in life." For a time, [Travis] Kalanick's Twitter avatar featured the cover of *The Fountainhead*. Peter Thiel, whose

dissatisfaction with a Gawker story led him to underwrite a lawsuit that eventually killed off the site, and who made the outré decision to publicly support Donald Trump, is also a self-described Rand devotee. At their core, Rand's philosophies suggest that it's O.K. to be selfish, greedy, and self-interested, especially in business, and that a win-at-all-costs mentality is just the price of changing the norms of society. As one start-up founder recently told me, "They should retitle her books *It's O.K. to Be a Sociopath!*" And yet most tech entrepreneurs and engineers appear to live by one of Rand's defining mantras: The question isn't who is going to let me; it's who is going to stop me.[69]

The theory of objectivism posits that a moral life is centered on pursuing one's own happiness and individual success. (According to Rand, the system most consistent with her vision of morality, in which individual rights were respected above all else, was laissez-faire capitalism.) The prominence of such ideas in Silicon Valley is intimately tied not only to a troubling lack of concern for civic and social institutions, but a denigration of the very ingredients of true happiness: relationships, service, and human connection.

The Input-Output Problem

The sheer amount of information on the internet is enough to do your head in. Mitch Kapor, co-founder of the Electronic Frontier Foundation, has compared getting information on the internet to "taking a drink from a fire hydrant." We have, at a rather impressive speed, compiled the world's available information in a single place, to which we all have equal access. We have failed, however, not only to provision how we would identify, promote, or remove information based on its basis in fact and reality, but also to consider what so much information would do to us emotionally and mentally. In providing every type and flavor of information we could have asked for, the internet has also thrown in the cognitive equivalents of soda, cocaine, and arsenic, alongside genuine, accurate knowledge, with no indication of which is which and no plan to help us manage it. In addition to the mental health effects of technology, we are now beginning to witness a variety of cognitive impacts with equally dire consequences.

Larry Rosen, a professor of psychology at California State University, Dominguez Hills and co-author of *The Distracted Mind: Ancient Brains in a High-Tech World*, has spent his career studying the psychological impacts of technology. Rosen is particularly interested in the addictive qualities of tech and the effects these have on us cognitively, emotionally, and physically. According to Rosen's research, the effects of technology range from lack of sleep and increased anxiety, to less focus and a diminished capacity to tolerate boredom. Rosen's latest book argues that this is due, in part, to what he calls the "information foraging model," or the tendency of the human mind to seek out information. We're programmed "to maximize exposure and consumption of new information,"[70] Rosen explains, but often "don't have the metacognition to realize it's not good for us."[71] This leaves us constantly on alert, suffering from heightened cortisol levels, and feeling increasingly overstimulated, anxious, and distracted.

Both the pace of change and the amount of information we receive is problematic for our brains, which are not in any way adapted for a digital world that "produces as much information in two days as it did in all of pre-digital history."[72] Feeling the need to take in, classify, and understand the reams of information we are inundated with becomes not only impossible, it actually leaves us at risk of understanding less, rather than more.

> [T]oday our knowledge is increasing at breakneck speed, and theoretically we should understand the world better and better. But the very opposite is happening. Our newfound knowledge leads to faster economic, social and political changes; in an attempt to understand what is happening, we accelerate the accumulation of knowledge, which leads only to faster and greater upheavals. Consequently we are less and less able to make sense of the present or forecast the future.[73]

Harari equates this to a new form of information suppression, in which there is simply so much for us to process that we cannot reasonably make sense of it all.

> Humans are relinquishing authority to the free market, to crowd wisdom and to external algorithms partly because we cannot deal with the deluge of data. In the past, censorship worked by blocking the flow of information. In the twenty-first century censorship works by flooding people with

irrelevant information. We just don't know what to pay attention to, and often spend our time investigating and debating side issues. In ancient times having power meant having access to data. Today having power means knowing what to ignore.[74]

The capacity to shut off the flow of information and selectively determine what is worthy of our attention is hugely at odds with our more innate information-gathering instincts, described by Rosen. Information discretion is both a critical and necessary modern skill, which, if it was taught, we might apply to our news diet, advertising intake, and political conversations.

 Such mammoth flows of information require a quick turnaround. That is, once we take in information, we must act quickly in order to process it and move on to the next item of interest. Susan Greenfield suggests that this dynamic has led to a phenomenon in which we go immediately from input (information) to output (response) without any meaningful cognitive or emotional processing in between. Examples include reading articles (or worse, article headlines) and re-posting them without verifying their accuracy; forming snap decisions without stopping to consider multiple perspectives; and the endless marvel of otherwise sane people screaming into the void of Twitter. The lack of time and consideration we allow ourselves when it comes to processing information not only has cultural implications, such as increased hostility online and a more polarized, less informed electorate, but, as Greenfield explains, impinges upon our individuality and intellectual autonomy.

> What is the real you if all you are is an output machine that's responding to inputs? It's so important to have something that goes on in the middle between the input and the output. It saddens me and worries me.[75]

When we attempt to tackle unrealistic amounts of information, we fail to give ourselves the time we truly need to process, make sense, and derive knowledge or wisdom from it. Understanding the difference between information, knowledge, and wisdom is paramount to appreciating the importance of how technology impacts our cognitive processes. Where previously individuals were able to "distil data into information, information

into knowledge, and knowledge into wisdom," Harari states, "humans can no longer cope with the immense flows of data, hence they cannot distil data into information, let alone into knowledge or wisdom."[76] Instead, we have collectively shifted our emphasis to observations and perceptions, which do not necessarily constitute either knowledge or wisdom.[77]

Researchers who study digital addiction outline the consequences of sustained technology use, which include decreased focus and impaired cognitive ability.

> Being plugged in and connected limits the time for reflection and regeneration. Unprogrammed time allows new ideas and concepts to emerge, giving time to assess your own and other people's actions from a distant perspective. It offers the pause that refreshes and allows time for neural regeneration. Our nervous system, just like our muscular system, grows when there is enough time to regenerate after being stressed. Ongoing stress or stimulation without time to regenerate leads to illness and neural death.[78]

The relationship between excessive screen time and neural degeneration has also been demonstrated in childhood development studies, which show that more screen time is associated with poorer cognitive performance and a decrease in kids hitting development milestones.[79] These statistics have also been born out in U.K. figures on early childhood reading and speaking skills, which show that over a quarter of four- and five-year-olds starting primary school do not meet literacy levels and are unable to communicate in full sentences. Information overload also impacts the capacity for sustained attention in both adults and children. According to Gloria Mark, a researcher at the University of California, Irvine, our ability to stay focused on a task decreased from 3 minutes in 2004 to 1 minute 15 seconds in 2012.[80]

The idea that we are increasingly less adept at deep and considered thought is recognized both within and outside of Silicon Valley. In her book, *How to Break Up with Your Phone*, Catherine Price examines the ways in which the use of technology rewires our brains, such that "they are less organised for deep thought."[81] This correlation is directly related to the time we spend consuming disparate, low-quality information,

which both decreases the quality of information we take in and leaves us less time for high-quality, evidenced-based facts and arguments. Writer Charles Chu points out that in the time we currently dedicate to social media, the average person sacrifices reading between 200–300 books each year, a habit research suggests improves the quality of white matter in our brains, where information is processed,[82] and also builds skills such as patience, perseverance, and emotional intelligence. One employee at a popular San Francisco company put it to me a slightly different way over coffee: "we're constantly consuming, constantly reading, constantly—there's no reflection. It's like mind control."

Relationships

There is a beautiful study, called the Harvard Study on Adult Development, that has focused on a single question over the past 80 years: what makes human beings happy and healthy? Starting in 1938, the study has followed three cohorts over the course of their lifetimes, making it one of the world's longest research projects on adult development in human history. The single most significant finding of the study has been, in the words of its current director, Robert Waldinger, that "good relationships keep us happier and healthier. Period."[83] While other factors, such as genetics, smoking, and drinking influence our health, the single biggest predictor of longevity and happiness is the quality of our close relationships.

I have a unique ability to reference this study in nearly any context, perhaps because its implications relate to topics that mean a lot to me, or perhaps because I just like its conclusion: that the people in one's life matter more than anything else, and that our satisfaction with our relationships will, in the end, be the marker of whether we consider our life happy and well-lived. Susan Pinker, a psychologist and author of *The Village Effect: How Face-to-Face Contact Can Make Us Healthier and Happier*, had similar findings after researching the habits and culture of Sardinia, a place with more centenarians (people over 100-years-old) than anywhere in the world. Pinker discovered that the key to longevity in Sardinia is highly correlated to the close relationships and regular face-

to-face interactions they enjoy.[84] Countless other studies have reported similar findings around the connection between our health and our relationships. As social beings, the benefits of deep supportive relationships are paramount, not only when it comes to happiness, longevity, and life satisfaction, but to everyday mental health as well.[85,86,87,88]

What allows us, then, to develop the deep, meaningful, connected relationships that are so good for our longevity, life satisfaction, and mental wellbeing? And is our hyper-connected digital world enabling the connection we need, or changing our interactions in a way we need to think about and provision solutions for? Answering the first question is relatively easy, if slightly more difficult to practice. In order to have mature, psychologically healthy relationships, psychologists point to a variety of factors that influence the health of our interactions. Dr. John Gottman, executive director of the Relationship Research Institute, explains that characteristics like open communication, emotional intelligence, authenticity, intimacy, respect, trust, the ability to listen, the ability to be present, a tolerance for individual differences, and a caring, appreciative approach to others are central to the health of our relationships.[89] To answer the second question, we must determine if the technology in our lives enables or hinders these markers of healthy relationships.

The way technology affects our relationships is a big question, which many researchers have spent many years trying to answer. So far, the answer is a resounding… it's complicated. There are certainly social and relational benefits to social media specifically and technology more broadly—the diversity of our networks, for instance, increases substantially when we have the opportunity to connect to everyone else on the internet. Old friends, family who live across the country, and people with similar interests around the globe are only a click or two away. Research has shown increased social media use is positively correlated with the size of our network and number of interactions we have.[90] While the merits of social media and technology are appreciable, the drawbacks also come in heavy. The most commonly cited outcomes of increasing our use of digital technologies include a decrease in the depth of our connections, increased loneliness, and the divisive properties of technology when used in the company of others.

Teddy Wayne, a journalist and award-winning author, refers to the first of these problems as the issue of friendship "thickness." Wayne argues that while the quantity of our interactions has increased over the past decade, the quality of those interactions has diminished. This is because, while "[s]ocial media and smartphones spread affection around more easily," the quality and depth—or thickness—of those interactions tend to be less pronounced.[91] Many researchers, psychologists, and social media experts agree with Wayne's estimation, citing the difficulty of connecting in a deep or meaningful way in a digital environment. The predominance of digital interaction in our lives—from emails, texts, group chats, and Messenger, to Whatsapp, chat rooms, comment sections, and tweets—has shifted a good proportion of our interactions with others online, to a space where both the behavioral norms and the health benefits of social interactions do not necessarily apply. A 2003 study on the differences between online and in-person interactions found that those assigned to a face-to-face group had a more meaningful conversation, "felt more satisfied with the experience and experienced a higher degree of closeness and self-disclosure with their partner,"[92] than those in a control group who did not meet in person. Another study performed two separate experiments, both of which confirmed that communicating via technology "can have negative effects on closeness, connection, and conversation quality. These results demonstrate that the presence of mobile phones can interfere with human relationships, an effect that is most clear when individuals are discussing personally meaningful topics."[93]

The increase in the quantity of our interactions is perhaps most notable in the world of dating and romantic relationships. The rise of dating apps like Tinder, Grindr, Bumble, and their many spin-offs has had a curious effect on the love lives of young people in particular, who are free to swipe their way through hundreds of romantic matches in a matter of minutes. As with other online relationships, our dating circles have expanded exponentially, meaning we are more likely to meet people we otherwise wouldn't in our day-to-day lives. The downsides of our increased choice, however, are palpable to many, who cite the lack of romance, manners, and empathy on dating apps; the gamification of relationships; and the rise of acts such as "benching," "ghosting," "submarining," and "breadcrumbing."[94] Others are quick to point out the mental health

impacts of these and other elements of online dating. In a 2019 BBC documentary, one man described how the app he used had, over time, become a barometer of his self-esteem and a form of validation, which resulted in an addiction to the platform. Another described his perception of what seemed an endless availability of potential mates, which he believed discouraged him from committing to one partner. The experiences these daters describe have become familiar to many, according to London-based psychotherapist Denise Dunne, who notes that while dating apps provide an effective way to meet lots of different people, the price of that convenience can be considerable. Apps like Tinder are instinctively compelling; swiping not only fuels a dopamine-driven feedback loop, but also has the capacity to sooth anxiety. Given the visual, transient aesthetic of most dating apps, there is also a tendency, Dunne explains, for increased focus on less substantive qualities, like looks and snappy bios, and a flattening or wholesale abandonment of social etiquette.[95]

*   *   *

If online interaction was merely a supplement to our existing relationships, interactions, and conversations, its widespread use and our increased reliance on it might be less problematic. The more time we devote to online interactions, however, the less we tend to spend engaged in face-to-face conversations. Researchers Norman Nie and Lutz Erbring found that

> [T]he more time people spend using the Internet, the more they lose contact with their social environment. This effect is noticeable even with just 2–5 Internet hours per week, and it rises substantially for those spending more than 10 hours per week.[96]

Nie and Erbring's findings were released at a time when 10 hours a week online was considered substantial. Today, according to the 2019 Digital Trends report, the average person worldwide spends 6 hours and 42 minutes per day,[97] or 47 hours per week online, nearly five times what Nie and Erbring's study considered substantial use. Countless studies point to

the fact that social media makes us lonely,[98] while others have found that, more generally, time spent at home on internet activities "is positively related to loneliness and negatively related to life satisfaction."[99]

As we are encouraged to spend an increasing amount of our time online, our mental health continues to decline. While there is nothing wrong with spending time alone, the effects of moving our relationships and conversations to a digital environment come at a profound cost to our individual and collective mental health. Human beings are social creatures who have evolved to spend time together; as we continue to divert our interactions from face-to-face to online environments, our friendships flatten, our conversations become less deeply engaged, and our relationships become mere connections. The General Social Survey, which measures American society across a vast number of measures, reported that between 1985 and 2004, the average number of confidants, or extremely close friendships, dropped from 2.94 to 2.08, while the number of people reporting there was no one they felt they could discuss important issues with tripled.[100] The depletion of close relationships in the U.S., decreased social interaction, and increased isolation have deep consequences: numerous studies have linked isolation and loneliness to both physical and mental ill-health,[101,102,103,104] while others have found that a lack of social relationships influence the risk of mortality.[105] Former U.S. Surgeon General Vivek Murphy has warned that technology is contributing to what he calls a "loneliness epidemic,"[106] wherein 40 percent of American adults report feeling alone and without someone they can turn to in times of need.

The effects of technology on our social relationships extend beyond the use of phones and devices when we're alone. In one study, 70 percent of couples said that their cell phones had interfered in their interactions with their partners.[107] A separate survey of American adults found that 82 percent believed using their phone during a social gathering damaged the quality of the interaction, but in the same cohort, 89 percent admitted to using their phone during their last social activity.[108] The presence of a phone, even if it is not used or touched, has the capacity to diminish the quality of an interaction, according to researchers. A 2014 study at Virginia Tech observed conversations among 100 pairs of participants, half of whom had a phone on the table. The presence of the phone, which was untouched and unused for the duration of the experiment, decreased

not only the perceived quality of the conversation, but also the level of empathy experienced among participants.[109] The presence of technology can also impact our friendliness towards strangers; a 2019 study found that, when participants were carrying a smartphone, they were significantly less likely to smile at others.[110]

The importance of our psychosocial needs and the role technology plays in shaping our new relational paradigms cannot be overstated. As we mediate our connections through quick, crafted messages, emojis, and a multitude of screens, the ways we connect with each other have shifted dramatically in an exceptionally short period of time. Our new methods of communication, however, are not in line with the evolution of human connection and relationships, which are predicated on our ability to be present, both physically and emotionally, in our interpersonal interactions. The more we prioritize online communication, the more likely we are to sacrifice face-to-face interactions, increase rates of loneliness and depression, and diminish both the number and quality of our relationships. We would benefit from recognizing that devices can be highly divisive; that tech-free face-to-face interactions are central to our health, wellbeing, and the quality of our relationships; and that we collectively must take steps to redress the imbalance that technology has caused in our relational and social lives.

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