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# Screen Time and the Brain

*Digital drugs may be even more insidious and problematic than illicit drugs because we don't have our guard up about them.*

—DR. NICHOLAS KARDARAS

**W**hen my (Arlene's) daughter Lucy was in fifth grade, she made a troubling comment on our way to school. "Mom, that is so sad. Look at that preschooler and her sister. They walked out of their front door holding iPads."

"Why do you think that's a problem?" I asked Lucy.

"Because they can't even walk to the car without their iPad."

Toddlers to teenagers are cradling their devices like permanent pacifiers. Screens are accessed with little effort and yield high reward. But don't be fooled. There is a cost for this cure-all entertainment system and digital soother. Many children become easily distracted. They cry easily, or become argumentative and defiant when pulled away from the screen.

For Michael, a senior in high school, video games were his life. His parents hosted a graduation party to honor Michael at their

## SCREEN KIDS

home. Michael lasted about ten minutes before he retreated to his room alone, shut the door, and began playing video games. No one could coax him out of his room, so within an hour, everyone had left the party.

Michael's brain never learned how to connect with people in social settings. But his brain had vast experience in the world of video games. According to Pew Research, 97 percent of teen boys and 83 percent of girls play games on some kind of device.<sup>1</sup> It turns out Michael is not alone.

Two notable takeaways have emerged from the initial data gleaned from the massive ABCD study of 11,874 children by the National Institutes of Health:

- MRI scans found significant differences in the brains of children who reported using smartphones, tablets, and video games more than seven hours a day
- Children who reported spending more than two hours a day on screens got lower scores on thinking and language tests
- The brain scans showed that kids with a lot of screen time had a premature thinning of the cortex, the outermost layer of the brain which processes information from the five senses. When your child is on screens, he is not exercising his five senses in the real world, and that part of the brain starts to decline. The cortex gets thinner over time, usually around age sixty, but that same thinning is happening much sooner now in kids.<sup>2</sup> This fact alone should send us scrambling to hit the pause button.

## NEW DRUG ON THE BLOCK

Every year, schoolchildren participate in Red Ribbon Week to say no to drugs, and rightly so. But there is a new drug on the block that's legal, rampant, and largely accepted even for our most

vulnerable. Psychiatrist and screen expert Dr. Victoria Dunckley says, “Screen time actually is very much like a drug, in fact it’s like a stimulant, not unlike caffeine, or nicotine, or even cocaine. So it raises arousal levels, it changes brain chemistry.”<sup>3</sup>

In the documentary *Screenagers*, Stanford-trained physician Dr. Delaney Ruston says, “It’s amazing that there’s many studies that look at MRI scans of the brain of kids who play a lot of video games, twenty hours or more of video games a week. And when they compare them to people who are addicted to, say, drugs or alcohol, their brains scans are similar. So, something is really happening on a physiological level. It’s not just psychological.”<sup>4</sup>

You might wonder how video games can be like drugs since no substance is involved. The eyes are the only outward extension of the central nervous system, affecting the brain directly. That’s the gateway. “Smartphone screens light up the same area of the brain as opioids and cannabis. The rewards pathways mediated by dopamine respond to screens in a very similar way to opioids,” says Anna Lembke, assistant professor of psychiatry at the Stanford University Medical Center.<sup>5</sup> So when you hear a parent nervously say, “It’s like my son is on drugs,” that’s much closer to the truth than most of us realize.

Any device with an electronic screen acts like a stimulant, causing the stress hormone cortisol to rise. The more visually appealing and exciting the screen time, the more that stress hormone will rise. Cortisol prepares you to deal with an emergency; it’s a “fight-or-flight” hormone. But your child isn’t a caveman having to escape a predator. He is sedentary, staring at a screen, so there’s this recurring mismatch between high arousal and being inert. Your child is all dressed up with nowhere to go.

When there is chronic overstimulation like this to the brain, blood flow is rerouted from the front part of the brain (the frontal

lobe) to the deeper part of the brain responsible for vital functions like breathing and swallowing. This switch is significant because the frontal lobe is the most human part of our brain, regulating mood, decision-making, prioritizing, impulse control, empathy and creativity. So when your child is playing a video game and forgets to do chores or even go to the bathroom, it's because the decision-making, self-control part of his brain is turned off. It's not getting any blood. When your daughter yells at you for taking away her tablet, it's because her impulse control and empathy center have gone dark.

It's our job as parents to protect our child's brain. When that frontal lobe is given plenty of blood and physical exercise, your child will grow in self-control, mood management, and wise decision-making. Then when she is older, her brain (with that healthy frontal lobe) will be much better prepared to manage the world of screens.

Add to that the colors in the screen. Why is this important? The blue-and-white tones in a screen signal to your child's brain that it's daytime—even in the middle of the night. For millennia, blue light existed only during the daytime. Now we can see blue light 24/7, which suppresses melatonin, the hormone needed for sleep. As we have noted, school-aged children need nine to eleven hours of sleep. If your child is watching a video or playing a game before bedtime, he's going to have a harder time getting to sleep. His body clock is off. Did you know what Netflix CEO Reed Hastings said was one of his biggest competitors? *Sleep*.<sup>6</sup> What will you get in the morning if your child's sleep is interrupted or delayed by devices? A cranky, tired kid who isn't ready for school. Netflix, 1. Your child, 0.

## **Warning Signs of Too Much Screen Time**

My child is irritable, tearful, depressed, or angry.

My child has a hard time focusing.

My child is forgetful and disorganized.

My child is defiant and impulsive.

My child is not empathetic and has poor social skills.

## **How Screen Time Impacts the Brain**

Thinning cortex

Lower scores on thinking and language tests

Stress hormone cortisol rises

Blue light changes the body clock

Reduced dopamine receptors and transporters

Brain scans of video game players and drug addicts  
look similar

Abnormal processing (decision-making skills impaired)

### **A TALE OF TWO CHEMICALS**

Bella, five, pushes a button on the remote control and sees a new image that makes her laugh. As Bella watches a cartoon, the neurotransmitter dopamine carries a signal of pleasure to the pleasure center of the brain. As children go for more pleasure by watching more videos or playing more games, they are pushing the dopamine level in their brain higher and higher. But as the brain's pleasure sys-

tem is overused, the feeling of pleasure is diminished. The thirty minutes of video gaming that used to thrill a child now doesn't produce the same joy. So she seeks to play for longer, or to find a more stimulating game. She's looking for that fresh hit of dopamine.

Pleasure, in the right amounts, is a very good thing, but in excess, it's detrimental to your child. Just compare the difference between taking a family vacation to Disneyland to living at the theme park for a year.

Pleasure *can* be overdone. How? Here's what the scientists say. When dopamine is released from one neuron to the next, it excites that next neuron. That's what it's designed to do. But as Dr. Robert Lustig, professor emeritus of pediatrics at University of California, San Francisco says, "Neurons like to be tickled, not bludgeoned. They like to stimulate, then they like to come to rest. Chronic overstimulation of any neuron anywhere in the brain . . . will lead to neuronal cell death." Excessive dopamine kills neurons. The neurons don't "want" to die, so they have a self-defense mechanism. They downregulate the number of receptors, so it's harder for the dopamine to find a receptor with which to bind. This means the more dopamine your child produces, the more receptors go down. "Next time you need a bigger hit to get the same rush, because there are fewer receptors. And then . . . you need a bigger hit, and a bigger hit, until finally . . . the neurons actually do start to die . . . and those neurons ain't coming back. They don't regrow." says Dr. Lustig.<sup>7</sup>

Dopamine is wonderful in moderation, but dangerous in excess. Dopamine excites, but there's a different chemical, which inhibits: serotonin. Instead of exciting the next neuron, serotonin puts the next neuron to rest. This chemical is all about well-being, and it cannot be overdone, overused, or worn out. The brain uses serotonin to regulate mood, emotions, sleep schedule, and appe-

tite. Serotonin is closely related to happiness, and most antidepressant drugs work by increasing serotonin levels. You can boost the level of serotonin in your child's brain by exercise and proper nutrition. But can you see how screen time fights against these two pillars of health as kids live a sedentary life, eating junk food? To increase serotonin levels in your child, aim for sixty minutes of exercise every day and a diet rich in nutrients, protein, and complex carbohydrates such as apples, carrots, and sweet potatoes. Other foods that raise serotonin levels are chicken, eggs, cheese, turkey, salmon, spinach, beans, seeds, and nuts.<sup>8</sup>

### **I'M AFRAID MY CHILD IS ADDICTED**

If you've ever uttered the words "My child is addicted," you are not alone. One study asked a thousand students in ten countries to stop using technology and media for just one day. At the end of that twenty-four-hour period, many of the students repeatedly used the word "addiction." One student said, "I was itching, like a crackhead, because I could not use my phone." Others could not complete the one-day technology fast. Most said they missed their phone because it was their source of connection and comfort.<sup>9</sup> Many teenagers agreed with the statement "If I lose my cell-phone, I lose half my brain."<sup>10</sup>

The *Diagnostic and Statistical Manual of Mental Health Disorders* (DSM), published by the American Psychiatric Association, recommends further research of Internet Gaming Disorder. Symptoms of Internet Gaming Disorder include:

- Gaming preoccupation
- Symptoms of withdrawal when gaming not available
- Tolerance (spending more time to achieve the same high)

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- Loss of other interests
- Unsuccessful attempts to control use
- Use of gaming to lessen negative moods<sup>11</sup>

In China, Taiwan, and South Korea, Internet Addiction Disorder continues to climb, with as many as 30 percent of teens in these countries considered addicted.<sup>12</sup> In South Korea, most teenagers participate in gaming centers. Sitting in rows of small cubbies and computers, teens and young adults settle in for long periods of time to play multiplayer computer games for a small hourly fee. Teens and students in their twenties often play through the night and then go to school or work exhausted.

In extreme cases, computer addiction has turned deadly. A twenty-eight-year-old man in Korea played for fifty hours, taking just a few breaks. After he collapsed in a “PC bang” (internet café), he was rushed to the hospital where he died shortly after, presumably of heart failure because of exhaustion.<sup>13</sup>

### **Kids Who Are Addicted to Gaming . . .**

Sneak around to use screens  
Exhibit changes in behavior  
Are only in a good mood when gaming  
Increase their use over time  
Freak out when forced to unplug  
Choose gaming over family activities and school

Kids fall into three categories of gamers: casual, at risk, and addicted.<sup>14</sup> Casual players leave a game easily for another activity. At-risk gamers have more trouble, and addicts play every single

day. Puzzle games such as Tetris or Solitaire are not nearly as addicting as first person shooter games. Even more addicting than the shooter games are the MMORPGs (Massively Multiplayer Online Role-Playing Game) in which a very large number of players interact with each other within a virtual game world. Be aware of the risk of addiction inherent in the games your child is choosing. Not all games are created equal.

Melanie Hemepe, BSN and founder of ScreenStrong, remembers the day Adam, her freshman son in college, confessed, “Mom, I’ve been in bed for a week. I haven’t left my dorm. *World of Warcraft* did something to me.”<sup>15</sup> Like so many parents, Melanie Hemepe had hoped her highly academic son would outgrow playing video games once he went to college. But the truth was his addiction grew exponentially worse. If a child’s video game habit is a problem in high school, it will likely grow out of control in college. The struggle with an elementary school child or younger will be even worse. *Now* is the time to rescue a child from a dead-end future of gaming.

Consider a radical intervention such as an extended reset period without entertainment screens. It takes time for the hormones to shift back to normal, but as a child begins to sleep more deeply, the brain readjusts and the healing process begins. Adam did drop out of college due to excessive gaming and not finishing classes, but thankfully his story has a happy ending. He served for five years in the military (boot camp digital detox included), got back on track, and returned to complete his college career. Adam’s struggle not only motivated Melanie to establish a game-free home for her younger sons but has also inspired many families to choose this option for their children. Learn more about solutions to reduce screen overuse in Melanie’s book, *The Screen Strong Solution: How to Free Your Child from Addictive Screen Habits*.

THE BRAIN THROUGH THE AGES

The human brain triples in size between birth and age two, which is the largest expansion the brain will experience. Your baby comes equipped with a hundred billion neurons, and in the first three years of life, those neurons are actively building connections to each other, paving permanent roads in the brain.

When our (Arlene's) family purchased a home in new construction, there were no paved roads, only dirt roads. Today, almost twenty years later, plenty of paved roads in our area lead to supermarkets and stores, schools and houses of worship, all accessible from our house. But imagine if the dirt roads had never been paved. Talk about buyer's remorse! We would have lived on the dirt road leading to nowhere.

Your child's brain is like that new home, surrounded by dirt roads. What your child experiences in the first three years of life profoundly shapes the way he or she will think, feel, behave, and learn in adulthood. Those dirt roads are neural pathways connecting one neuron to the next. As your child sees, feels, tastes, smells, and hears, dirt roads are getting paved in her brain. But if the neurons aren't used, they are pruned and removed for efficiency.

In 1970, the average child started watching television at age four. But today the average child starts watching at four months. Screen time too early threatens this vibrant network of billions of connected neurons, the paved roads in the brain. Researchers have found the more television a child watches before age three, the more likely they are to have attention problems at age seven. For each daily hour they watch before age three, their chances of having attention problems increases by about 10 percent.<sup>16</sup>

Most programming for kids relies on rapid image changes to sustain attention. This preconditions a child's brain to expect high levels of stimulation, which leads to inattention later in life. There's

a paved road in the brain that leads to fast-paced video games, but no road exists to prompt a child to sit still while reading a book or listening to a story. If you have a young child, it's imperative that you postpone and limit screens so your child's brain can fully develop with billions of healthy connected neurons. If your little one is more connected to an iPad than a caregiver, neurons that assist with language development or emotional stability will be pruned away from lack of use.

Perhaps you have an older child and you are afraid it is too late. It's not—your young adult's brain will continue the maturation process until age twenty-five. You still have time to positively nurture that good brain!

The second spurt of synapse formation happens in the brain just before puberty (roughly age eleven in girls, twelve in boys). Then another "pruning back" of neurons occurs in adolescence.<sup>17</sup>

Dr. Jay Giedd from the National Institute of Mental Health says, "Our leading hypothesis . . . is the 'use it or lose it' principle. If a teen is doing music or sports or academics, those are the cells and connections that will be hard-wired. If they're lying on the couch or playing video games or [watching] MTV, those are the cells and connections that are going [to] survive."<sup>18</sup> What types of brain cells and connections will be shaping your child's future?

### **WHAT IF MY CHILD IS LEFT BEHIND?**

Dr. Gary Small, head of UCLA's memory and aging research center, conducted a very interesting experiment to demonstrate how people's brains change in response to internet use. He took a dozen experienced online users and a dozen nonusers and scanned their brains as they performed searches on Google. The computer-savvy group showed broad brain activity in the left front

part of the brain associated with quick decision-making and peripheral vision, while the novices showed little if any activity in this area. The novices were then instructed to spend just one hour a day, over a five-day period, searching the internet. Following that period, the test was repeated. The new scans showed the novice group now had the same brain activity as the computer-savvy group when searching Google. In only five hours of internet use, this group had rewired their brains.<sup>19</sup>

Parents who are concerned their young children will be left behind if they don't board the technology plane can take comfort in this experiment. It doesn't take the brain a long time to learn how to use technology. If you had your child on the internet for five hours like the group in the experiment, no doubt they would quickly become proficient in web searches, instant messaging, video games, and photo filters.

But what about the opposite scenario? If your child grows up with screens throughout preschool and elementary school, can she take that wired brain and produce the concentration required during a classroom lecture? Can her brain readily produce empathy for a friend, or read a long passage with comprehension? These skills are much harder to pick up in a short period of time.

With increased screen use, the neural circuits that control the more traditional learning methods used for reading, writing, and sustained concentration are neglected. Nicholas Carr writes, "The world of the screen, as we're already coming to understand, is a very different place from the world of the page. A new intellectual ethic is taking hold. The pathways in our brains are once again being rerouted."<sup>20</sup>

Jeremy, eleven, doesn't bother to learn his vocabulary words because he knows spell-check can fix the words and texting doesn't require spelling. As Oxford neuroscientist Dr. Susan Greenfield

says, “Unfortunately, the new digital world is a toxic environment for the developing minds of young people. Rather than making digital natives superlearners, it has stunted their mental growth.”<sup>21</sup>

Traditional book readers show more activity in brain regions associated with language, memory and visual processing than in the prefrontal regions tied with decision-making and problem solving. However, internet users show extensive activity across those areas when they scan web pages. Deep reading is difficult online because the brain must evaluate links, decide where to navigate, and process distractions like advertisements. All of this pulls the brain from understanding the text at hand. Our brains online are busy making decisions and navigating through distractions, but they are not engaged in focused learning.

## **HOW TO STRENGTHEN YOUR CHILD’S BRAIN**

Your child’s brain is capable of learning math, reading, foreign languages, music, and much more. As a parent, you can build your child’s brain by practicing these habits at home:

**Downtime.** After a good physical workout, muscles need rest to recover, right? The same is true for the brain. It’s not that the brain gets tired, but it needs time in between tasks to process and consolidate the information it is learning. This free “brain time” for kids is often crowded out by screen time. Your child’s brain needs to be idle from time to time. When she says, “I’m bored,” that’s actually good for her brain.

**Physical exercise.** Exercise affects your child’s growing brain in many positive ways. It increases heart rate (which pumps more oxygen to the brain), reduces cortisol (the stress hormone), and burns off adrenaline. Physical activity releases brain chemicals that are natural stress fighters.

**Unstructured play.** Have your kids negotiate the rules and learn to play with others without any adult direction. It can be rough-and-tumble play or setting up a schoolhouse together. These activities build new circuits in the prefrontal cortex to help navigate complex social interactions.

**Sleep.** Certain stages of sleep are needed to cement what your child learned during the day. That learning doesn't take place if your child is sleep-deprived. The following day, if your child is sleepy, he is unable to focus and pay attention to new material. It's a vicious cycle, but thankfully it can be remedied with a few sleep strategies. Set a consistent bedtime for your child, and make his room dark, quiet, and comfortable. Don't have any screens in the bedroom. Turn off electronic devices one hour before bedtime to avoid stimulating adrenaline and preventing sleep.

**Eat healthy foods.** The brain uses about 20 percent of the body's calories. It needs good fuel to maintain concentration throughout the day. Serve your child nutrient-rich foods and foods with omega-3 like salmon, tuna, soybeans, and nuts. Berries, whole grains, avocados, and broccoli are other power foods for the brain.

As long as your child lives under your roof, you can make healthy adjustments starting today. Neurosurgeon Ben Carson said, "Don't let anyone turn you into a slave. You're a slave if you let the media tell you that sports and entertainment are more important than developing your brain."<sup>22</sup> Your child and his billion-plus brain cells are waiting to be nourished, developed, and paved—not by screens but by you as a parent.