When Brain and Technology Collide—Good and Bad, Happy and Sad

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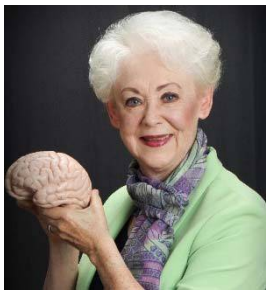
Thankfully, technology is here and here to stay. I, for one, have no desire to return to the 'stone age' or the 'bronze age' or any other 'age' for that matter. Technology, however, can be a valued friend or your brain's worse enemy. Do you want to be a person or a machine?
—Arlene R. Taylor



Technology. According to Wikipedia, the use of the word *technology* has changed significantly over the last 200 years. Before the 20th century, the term was relatively uncommon in English. When utilized, it referred to the study of "useful arts" or was associated with technical education, as in the Massachusetts Institute of Technology that was chartered in 1861.

The 21st Century is not only referred to as *The Age of the Brain* but also as the *Age of Technology*. But what happens when the brain and technology collide? And what does the word *technology*, in today's world, actually encompass? In most dictionaries, the definitions are rather broad. For example, here are three:

- The total knowledge and skills available to any human society for industry, art, science, and etc.
- The branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment.
- All the different and usable technologies developed by a culture or people.

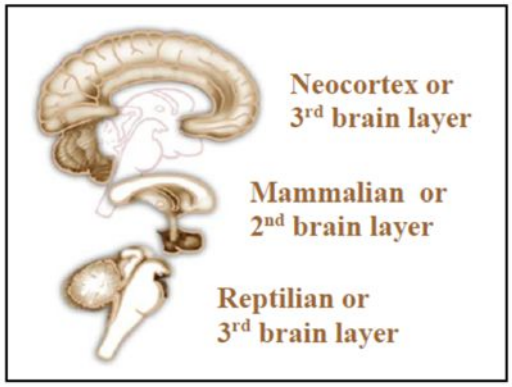
And the definition reportedly crafted in 1937 by the American sociologist, Read Bain, described it like this: Technology includes all tools, machines, utensils, weapons, instruments, housing, clothing, communicating and transporting devices and the skills by which we produce and use them.

Even by that definition, almost every generation has had some type of technology. In the Stone Age simple tools were developed from wood or rocks. That's a form of technology. The Bronze Age brought metal and all the technologies that go with it. These days many people use the term to describe modalities that have been invented in the last hundred years or so, including electronic and wireless systems and digital products considered as a group.

Technology can be our best friend, and technology can also be the biggest party pooper of our lives. It interrupts our own story, interrupts our ability to have a thought or a daydream, to imagine something wonderful, because we're too busy bridging the walk from the cafeteria back to the office on the cell phone.
—Steven Spielberg

In the Brain

For a frame of reference, a quick overview of the brain is appropriate. Your brain is approximately the size of your two fists put together with thumbs parallel. Now imagine that you have a gray glove on your left hand and a white glove on the right hand. The glove on the right hand is lighter in color because the right hemisphere contains more of those long projections from the neurons called axons. The axons are wrapped with a whitish insulating material known as myelin. Think: *fiber optics*. If you have very large hands, or if you have very small hands, not to worry. Generally brain function is more aligned with the number of connections in your brain between and among neurons rather than outright brain size.



There are many ways to describe the brain. For example, it can be described as having three brain layers. Each layer contains distinct functions, although all layers and all systems interact continually at some level. You may want to remember this drawing to help you understand subsequent references to the brain.

Metaphorically, let your wrist represent the reptilian or 1st brain layer. It houses the stress responses including fight-flight, tend-befriend, and conserve-withdraw and dominates when threat is perceived. It primarily processes what is happening right now, in the present tense. Likely it was named the reptilian layer because that's pretty much all the brain a reptile has. A subconscious portion of the brain, this layer contains mechanisms to load and run routine behaviors, especially those that involve motor sequences, such as playing a musical instrument, riding a bike, and other skills involving precise use of muscles. Motor neurons in the reptilian brain load rapid, automatic responses, a skill needed in many video games. Although it doesn't use language per se, it can follow the pictures that are created by thoughts and language. Therefore, the thoughts you think and the words you use to communicate with yourself ('self-talk') and with others are important because they create pictures that the 1st brain layer tries to follow.

Clench your hand into a fist to represent the subconscious mammalian (2nd brain) layer. It is lightning fast, some estimate 80,000 times faster than the 3rd brain layer or neocortex—and it is no slouch! Probably named the mammalian layer because all mammals have it, it processes present and past tenses. Think of it as the sandwich filling. The 2nd brain layer directs immune system functions. It is also the home of emotional impulses and phobias. Because the brain matures from back to front, as you move up toward the front you gain functions. While the reptilian layer is primarily aware of the present tense, the mammalian layer is aware of both present and past tenses.

Place your other hand over your clenched fist. This represents the 3rd brain layer also known as the

neocortex or cerebrum. This portion of the brain contains functions of consciousness so you can think and be aware consciously of what is going on both inside you and in the environment outside. The 3rd brain layer processes all tenses: present, past, and future. The frontal lobes provide executive control over choices made in the environment. Think of it as the board room. The pre-frontal portion of the 3rd brain layer, located directly behind your forehead, contains complex high-level functions that essentially make you human—such as setting goals, planning, making choices, following your conscience, and exercising willpower—functions that help different human beings from other mammals.

Brain Reward System

No doubt you've heard of the brain reward system. The most important reward pathway in the brain is the mesolimbic dopamine system. The 2nd brain layer contains components of the brain reward system. This circuit is a key detector of a rewarding stimulus. Under normal conditions, the circuit controls an individual's responses to natural rewards, such as food, sex, and social interactions, and is therefore an important determinant of motivation and incentive drive. In simple terms, activation of the reward pathway tells the individual to repeat what it just did to get that reward. It also tells the memory centers in the, sometimes referred to as the mesolimbic-dopamine system. It's the system that helps you feel good when you think about rewards in general, those in the past, what's happening in the present, and a reward that may be coming up—hopefully sooner than later.

When you anticipate an enjoyable experience, the brain reward system is triggered. Cells in the substantia nigra of the 1st brain layer release dopamine, which makes its way throughout the brain and helps you feel better. The more exciting the game, the more it triggers the brain reward system. About half of all the dopamine released makes its way to your gastrointestinal system. This can help explain differing sensations in the pit of your stomach based on what is going on at any given time.

Interestingly, cells in the brain reward center also respond to bad or fearful experiences. Eating chocolate as well as falling off a cliff (or just the thought of falling off a cliff) can trigger production of dopamine, which of course can make the heart race and motivate behavior. Researchers have found that essentially all dopamine cells have some response to good or bad experiences, while a fearful event excited about 25 percent of the neurons, spurring more dopamine production. Adrenalin is released when individuals compete (as in videogames) against themselves or others, which gives them a hit of energy. And, as adrenalin rises, so does the feel-good chemical, dopamine. In the male brain, competition also tends to raise testosterone levels, which can contribute to more assertive if not outright aggressive behavior.

The 2nd brain layer contains components of the brain reward system, as well. This circuit is a key detector of a rewarding stimulus. Under normal conditions, the circuit controls an individual's responses to natural rewards, such as food, sex, and social interactions, and is therefore an important determinant of motivation and incentive drive. In simple terms, activation of the reward pathway tells the individual to repeat what it just did to get that reward. It also tells the memory centers in the brain to pay particular attention to all features of that rewarding experience so it can be repeated. The amygdalae, two little brain organs each about the size of an almond, are part of

the 2nd brain layer and particularly important for conditioned forms of learning. They help an organism establish associations between environmental cues and evaluate whether or not that particular experience was rewarding or aversive.

The neocortex or 3rd brain layer provides executive control over your choices, especially in relation to the environment, and whether to seek a reward. In generally, technology does provide rewards to the brain.

Three Areas of Technology

This mini-monograph briefly discusses three broad areas involving recent technologies. It is not intended as an exhaustive treatise on the topic. Rather, it is designed to heighten your awareness of some plusses and minuses related to various forms of technologies and to encourage you to make wise, informed choices, regarding their use.

It is presented in three sections:

B. F. Skinner once said: "The real problem is not whether machines think but whether men do." With that in mind, let the *thinking* begin.

I – Communication Technologies

> ***Words are singularly the most powerful force available to humanity. We can choose to use this force constructively with words of encouragement or destructively using words of despair. Words have energy and power, with the ability to help, to heal, to hinder, to hurt, or to harm.*** Yehuda Berg

Human Communication

In the 21st Century, people use technologies to connect with others. Think for a moment about the technologies you had during childhood. It was pretty slim during my growing-up years. I thought our telephone party-line was quite innovative! There were five telephones on our party line, and each of the five households on our line had a distinct ring. Technically, you were supposed to only answer the telephone when your ring sounded. Sometimes when talking on the party-line, another person would pick up their phone and say, "I need to use the telephone. Please hang up." Usually we would. Other times when you were talking on the telephone, you might hear a faint *click* and you knew someone had carefully picked up their receiver to listen in on your conversation. If you became skilled at lifting the receiver and weren't caught, it was amazing what you might hear.

We also had a radio, a large piece of furniture about three feet high. Too bad my parents didn't hang on to it. By now it would have been a genuine antique. My mother always had a lamp sitting on top. Most mornings my father would catch the news on the "wireless," as he called it. I would listen to Fibber McGee and Molly if my parents were out, my ear pressed close to the cloth that covered the speaker. (I certainly couldn't listen to that if they were home.) When they were home, it seemed there was a never-ending stream of chores or practicing or studying to do. Being auditory, I loved Fibber McGee's closet: hearing the door creak open followed by the rush and tumble and clatter of things falling out onto the floor.

Sitting around the radio, our family of four would listen to King George the V read his speech on Christmas mornings. Later, when his daughter Queen Elizabeth II became Queen, we listened to her annual Christmas speech. It was an annual ritual. We also had a small record player. I had maybe four 78-records of Eric B. Hare's wonderful stories from Burma. I nearly wore them out, the records, not the stories. I never tiring of listening to them. My mother had two long-playing records of Irish music that we listened to once a year, every March 17th when St. Patrick's Day rolled around. And that was pretty much it for technologies.

There have been huge, innovative advances since then. Communication technologies are virtually exploding. And unlike many people alive on this planet, today's youth have little or no concept of a world without technologies such as:

- iPhones and smart phones
- iPads and Notebooks
- desktop and laptop computers
- texting and tweeting and twittering and talking
- surfing and searching and emailing and googling
- Facebook and Linked-In, with more cropping up all the time

For many individuals, the majority of most communication—both personally and professionally—has been by cell phone or email. It's very easy to miscommunicate with these mediums, since the recruitment (an increase in the response to a stimulus owing to the activation of additional sensory-system receptors) you can get from face-to-face interactions through body language, emotions, and exhibited feelings is not present. That's the reason for email rules such as this: Avoid typing your message in all caps or you may come across as angry. It is also so easy to say or write something that you would never say or do if the person were actually present in real time. More than one personal (if not corporate) disaster has been triggered by an unfortunate email, written poorly or misdirected.

Speak clearly, if you speak at all: carve every word before you let it fall.
—Oliver Wendell Holmes

Upside

Some ask whether they should embrace these emerging technologies or move back from them. My brain's opinion is that there is neither a yes nor a no answer to that question, which can be a

problem for black-and-white thinkers. Some families say 'yes' to all types of technologies; others say 'no' to almost everything. Refusing to embrace technologies reminds me of reports that some have refused to embrace fuel-powered vehicles and cling to horse-and-buggy transportation. Naturally, there are pros and cons. As with almost everything else in life, you always give something up to get something. I believe the healthy answer lies in the balance between the *yes* and the *no*.

There are many benefits, of course. The upside, if you will. Sending snail-mail back and forth would likely have taken far too long for some communications. I do the majority of work with my nonprofit corporation, (Realizations, Inc,) via technologies: email rather than snail mail, mobile phone instead of a wired office phone. My website (arlenetaylor.org) is filled with age-proofing information, articles, PowerPoints, and brain aerobic exercises—all free and easily available. I use cloud-storage for all my back-up files. Imagine! I store my work and intellectual properties in a *cloud*. It's just too funny and quite marvelous, all at the same time. I have almost instant world-wide communication with anyone else who has a computer or mobile phone and almost instant access to data and state-of-the-art information.

The cell phone has become the adult's transitional object, replacing the toddler's teddy bear for comfort and a sense of belonging. —Margaret Heffernan

Teenage Brains

In life you typically give up something to get something. The human brain is extremely sensitive to the outside world. Therefore, technologies used inappropriately or out of balance can create problems for the brain, especially for the developing brain. According to *Psychology Today*, one important thing to remember is that what a teen does and is exposed to during the teenage years has a large influence on his or her future. Experience and current needs shape the pruning and sprouting process in the brain. As one researcher put it, if teens are spending a great deal of time playing video games, this will shape the brain in such a way that they might become excellent fighter pilots, but a career as an accountant or researcher will be less possible. Being the class clown will help make a good sales person later on, and running for class president will develop the brain skills needed to run a business or take on a management position. Being exposed to drugs, computer sex, or violent movies, also shapes the brain and future of the adolescent, laying down the seeds of addictive behaviors and interpersonal conflict.

The teenage brain is simply not *done* yet. Rather, it is self-absorbed and somewhat ego-centric and narcissistic as in *it's all about me*. Maturing the teenage brain is a learned process designed to move it away from narcissistic behaviors to more balanced and functional adult behaviors. This is a learning process, not an automatic genetic process. An unbalanced use of technologies during adolescent years can interfere with brain maturation. If the teenage brain fails to mature and move to more balanced behaviors, it tends to continue narcissistic behaviors into adulthood. The danger is that the antisocial, narcissistic adult may eventually end up exhibiting sociopathic behaviors.

Many live unbalanced lives for any number of reasons, excessive time spent on social media sites being one. It may be even more problematic for brains that are still developing—and studies suggest that the pre-frontal cortex may not be developed until mid-to-late twenties. As a species,

human brains respond to rewards. But teenage brains respond *strongly* to social rewards. Physiologically, adolescence brings a peak in the brain's sensitivity to dopamine. This neurotransmitter appears to prime and fire reward circuits and aids in learning patterns and making decisions. This helps explain teenage quickness of learning and their extraordinary receptivity to rewards, along with their keen—sometimes melodramatic—reaction to success as well as defeat. Functions of the 2nd brain layer form the basis for relationships. Oxytocin (the bonding chemical) is released when you connect with family and friends through technologies. The teenage brain is very much attuned to oxytocin, which (among other things) makes social connections particular rewarding to the brain. The neural networks and dynamics associated with general reward and social interactions overlap heavily. Engage one and you often engage the other. Engage them during adolescence, and you light a fire!

Many can argue—not many converse. —A. Bronson Alcott

Interpersonal Skills

There has been talk about the decrease in interpersonal skills observed among individuals who spend hours and hours a day using technologies to communicate on a variety of social networking sites. The inappropriate or unbalanced use of technologies can contribute to a lack of good interpersonal skills. According to Lady Greenfield, professor of synaptic pharmacology at Lincoln College, Oxford, and director of the Royal Institution, social networking sites can provide constant reassurance that you are listened to, recognized, and important--coupled with a distancing from the stress of face-to-face and real-life conversation. Real-life interactions are more perilous, occur in real time with no opportunity to think up clever or witty responses, and require a sensitivity to voice tone, body language, and perhaps even to pheromones, those secreted olfactory chemical cues that can trigger a social response in the same species. For many and for all these reasons, screen life can seem more appealing.

In order to develop effective socialization skills, the brain needs real time, real life, and face-to-face experiences such as practice in striking up a conversation with someone you just met and setting them at ease through small talk. When the outside world primarily consists of Facebook, email, Linked-In, texting, tweeting, twittering, and surfing the net, exposure and practice in face-to-face communication is reduced. When you can't see or hear the other person, it becomes easier to be less embarrassed, less inhibited, and less concerned about what other people will think. It becomes easier to reveal things about yourself that you might wish later you had not done and/or to say things to or about other people that you might not do in person.

People who spend three hours per day on Facebook tend to occupy self with self. They tend to use lower brain functions over higher brain functions and to exhibit decreased empathy and compassion. Myelination tends to be stronger in the lower brain layers.

Lady Greenfield warns that social networking sites are changing children's brains and putting attention span in jeopardy, resulting in selfish and attention-deficient young people. If the young brain is exposed from the outset to a world of fast action and reaction, of new screen images instantly flashing up with the press of a key, such rapid interchange might accustom the brain to operate over such timescales. In the real world, when such responses are not immediately

forthcoming, perhaps we will see such behaviors and call them attention-deficit disorder. Because children's experiences on social networking sites largely are devoid of cohesive narrative and long-term significance, Greenfield fears the mid-21st century mind may be characterized by short attention spans, sensationalism, inability to empathize, and a shaky sense of identity.

Teachers at a local high school reportedly were concerned about the lack of conversational skills among some of their students so they got together and cooked up an experiment. While participation was not compulsory, students who did agree to participate would get extra credit in one of their glasses. On a given evening, the participating teenagers were asked to shut down all their devices. The teachers then placed them separately in real-time face-to-face social situations with individuals they did not know. Anecdotally, they had a very difficult time initiating or sustaining a conversation. They had not learned the art of 'small talk,' which is key in many professional careers to say nothing of personal and social interactions. Later, during debriefing, the teenagers were heard to make comments such as: "I don't have any trouble texting and tweeting—but I couldn't think of a thing to say in person." Or "Wow! That was a lot harder than I expected." Or "I'm going to turn off my electronics for at least an hour a day and practice doing some real-time 'small talk.'" And if the experiment motivated even some of the teenagers to hone their conversational skills, the teachers felt it was worth the time and effort required to set up the experiment.

Downside

Technology provides many benefits to individuals and society but it is not without its down side. Sara Thomée, doctoral student, and colleagues at the University of Gothenburg's Sahlgrenska Academy conducted four studies to evaluate the effects of heavy computer and cell phone by young adults on sleep quality, stress levels, and general mental health. The studies found that young adults who make particularly heavy use of mobile phones and computers run a greater risk of sleep disturbances, stress, and symptoms of mental health.

- Frequent computer use without breaks was found to increase the risk of stress, sleeping problems, and depressive symptoms in women

- Males who use mobile phones / computers extensively without breaks were more likely to develop sleeping problems.

- Regularly using a computer late at night was associated not only with sleep disorders but also with stress and depressive symptoms in both men and women

Adequate sleep is related to cognitive performance and is independently linked with longevity. The artificial light from TV and computer screens and smart phones affects melatonin production and throws off circadian rhythms, preventing deep, restorative sleep.

Nomophobia, an abbreviation for 'no-mobile-phone phobia,' reportedly was coined during a 2010 study by the UK Post Office. The study compared stress levels induced by the average case of nomophobia to be on-par with those of 'wedding day jitters' and trips to the dentist and found that more than one in two nomophobes never switch off their mobile phones.

In her article 'One Patient's Story' published in Scientific American MIND, Carol W. Berman MD indicated that surveys in both the U.S. and the U.K. have shown that about 70 percent of young adults feel so attached to their phone that they admit to feeling anxiety or even panic when they are separated from it." Researchers at the University of Missouri found that study participants solving word puzzles experienced increased heart rate, blood pressure, and anxiety when they were separated from their iPhone and were less successful solving the puzzles. Because of this, The researchers say "these findings suggest that iPhone users should avoid parting with their phones during daily situations that involve a great deal of attention, such as taking tests, sitting in conferences or meetings, or completing important work assignments, as it could result in poorer cognitive performance on those tasks."

Reported symptoms of nomophobia include:

- anxiety
- respiratory alterations
- trembling
- perspiration
- agitation
- disorientation
- tachycardia
- depression
- panic
- fear
- dependence
- rejection
- low self-esteem
- loneliness

Nomophobia may be becoming the new 'normal' (meaning commonly occurring and not necessarily healthy or desirable). For some individuals, nomophobia may escalate into an obsession. (Obsessive Compulsive Disorder or OCD is believed to involve a dysregulation of the neurotransmitter serotonin.) Differentiating between nomophobia and OCD can be tricky. Dr. Carol W. Berman wrote: "For clinicians like me, the true test of whether mental illness is present is the degree to which the individual's daily life is impaired." Personally, I am very attached to my iPhone and do much of the business related to my nonprofit corporation on it. It does not take the place of interpersonal real-time social interactions and other life activities, however, and I am careful to balance the two. For example, I turn off my iPhone when I am having lunch with a friend—callers can leave a message. I do my daily morning walk unaccompanied by my iPhone so that I can devote my whole attention to nature around me and to creative brainstorming. I let the phone go to voicemail when I am creating a new article or a new seminar presentation. And there are no electronics in the bedroom when I sleep—unless I am 'on call' for some reason, which happens infrequently. Developing nomophobia is not one of my goals.

> ***The danger of the Internet is cocooning with the like-minded online, of sending an email or twitter and confusing that with action.*** —Gloria Steinem

Health Issues

The inappropriate or excessive use of technologies has been linked with a variety of health issues. Estimates are that nearly all children from the age of seven have access to a wireless telephone. Amount of usage increases around age twelve. More than eighty percent of all nineteen-year-olds use mobile phones regularly with fewer than two percent of the children and adolescents using a

headset often or always. At Örebro University in Sweden, a study by Fredrik Söderqvist showed that the brain is affected by microwaves from wireless telephones, and he suggests caution in their use. Apparently, even though the Swedish Radiation Safety Authority recommends using a headset, few children do. The study also showed that children and adolescents who regularly use wireless telephones more often self-reported various health symptoms compared to those who did not, including headaches, asthmatic complaints, and impaired concentration.

Then there are the issues with tendinitis. Frequent texting using the thumbs can cause tendons in the hand to thicken abnormally and progress to tendinitis. Study results by researchers in Turkey were published online in the *American Journal of Physical Medicine & Rehabilitation*. Researchers recruited 149 people, ranging from 18 to 40 years old, for the study. About half the participants ranked as frequent texters who used a texting style that involved repeatedly flexing the interphalangeal joint, the joint closest to the thumbnail. The remaining participants sent relatively fewer texts, but also used their thumbs. Researchers found that the tendon in study participants who repeatedly flexed the interphalangeal joint while texting showed significant thickening. No surprise: the greater the number of texts, the thicker the tendon. Frequent texters, defined as sending an average of 1,209 text messages per month, reported greater thumb pain in the dominant texting hand than infrequent texters, who sent an average of 50 text messages per month.

Lifestyle imbalances can suppress the immune system. The overuse of technology-related devices can result in a life that reels into imbalance. The individual can become so interested in the devices or games that he or she misses meals or eats fast food on the fly or even loses sleep. Research by Eve Van Cauter, University of Chicago, has shown that loss of sleep results in chemical changes that deplete the immune system, increases growth of fat rather than muscle, accelerates the aging process and memory impairment, increases the risk for depression, and is linked with bone and cardiovascular tissue damage.

Sleep deprivation is likely another of the health issues, perhaps one of the most serious. Sleep has been independently associated with longevity as well as with cognitive problems. The American Academy of Sleep Medicine has indicated that the prefrontal cortex is always active when you are awake and regenerates itself during sleep. It is very sensitive to sleep deprivation—which can impair its ability to regulate emotional expression. Sleep-deprived individuals are more easily irritated, more likely to be angry, more likely to blame others, and are even more likely to plan revenge. According to studies at the University of Michigan Medical School, sleep deprivation may lead to aggressive or bullying behaviors, delinquency, or even substance abuse. And then there is the link between lack of sleep and driving sleepiness. According to the ‘National Highway Traffic Safety Administration,’ drowsy driving" causes over 100,000 car crashes each year, resulting in about 1,550 deaths.

When people stay up late at night using various forms of technology, there may also be other implications. Brain scans by scientists at Germany's Aachen University showed that night owls (as compared to intermediates or larks) show reduced integrity of white matter (neuronal axons covered with myelin) in several areas of the brain. This is linked to depression, disruptions of normal cognitive function, and eating more unhealthy foods.

Studies by Nan Hee Kim, MD, PhD of Korea University College of Medicine in Ansan found that independent of lifestyle, individuals who went to bed later at night had a higher risk of developing health problems as compared with early-to-bed and early-to-rise individuals. This was true even when both groups got the same amount of sleep overall. Dr. Kim also found different consequences due to lack of sleep for males and females. Males in the study who got insufficient sleep were more likely to have diabetes or sarcopenia, an age-related loss of muscle strength and mobility. Females in the study who got insufficient sleep tended to have more belly fat and an increased risk of metabolic syndrome, which raises their risk of heart disease, stroke, and diabetes.

People who do not have enough sleep and/or sufficient down time each day may experience reduced learning. Experiences and information are encoded in the hippocampus (located in the mammalian layer) and then moved into long-term memory. At the University of San Francisco, rats were given a new learning experience. Directly after, some rats went immediately to another activity while others were given some down time. Rats that immediately went from the new learning experience to another activity showed reduced encoding in long-term memory and reduced learning. Rats that received down time after the new learning experience showed enhanced encoding in long term memory and enhanced learning. The brain needs daily downtime to consolidate learning, to put the pieces together. Of course, this has huge implications for learning and school systems. It is important to schedule time every day to shut off all electronics and give your brain time to consolidate what you are learning and move new information into long-term memory.

The ability to defer gratification is a key component for almost any type of success—people with addictive behaviors tend to be unable to delay gratification. Research participants were given a choice to text now and get a small $ reward or unplug for a while and get a larger $$$$ reward the following week. The results showed that the ability to delay electronic gratification was dependent on the person who was contacting the participant. The larger the rush from the specific person, the more difficult for the participant to delay gratification. Practicing periods of daily *unplugging* can help you learn the skills of delaying gratification.

> ***I'm not addicted to Facebook! I just use it whenever I have time: on time, off time, lunch time, any time, all the time . . .*** —Anonymous

Addictive-Like Behaviors

Used appropriately and in balance, technology offers many benefits. Used inappropriately or out of balance, it can be deleterious. That's likely because many technologies provides chemical brain rewards (e.g., adrenalin-dopamine rush), which helps to keep people using it. When you are hyped about using a variety of devices (or even one device) and are excited about making connections, adrenalin may rise. As adrenalin rises, dopamine rises in response to the adrenalin release: hence, you feel better and more energized. Dopamine is also released when anticipating or doing an enjoyable activity (e.g., tweet, text, twitter; talk by phone; surf the net; email; check Facebook), which helps you feel better. Because technologies can trigger the brain reward system, they can also increase one's risk for developing addictive-like behaviors.

Eloquence is the power to translate a truth into language perfectly intelligible to the person to whom you speak. —Ralph Waldo Emerson

Distracted Walking and Driving

There are increasing reports of distracted driving linked with technologies. Several bridges connect the brain hemispheres, two of which are the corpus callosum and the anterior commissure. Both hemispheres are attached to a common brain stem, so they sleep and wake at the same time. Because there appears to be only one integrated attention system, conscious attention cannot be distributed to or divided between two spatially separate brain locations. The brain was not designed for multi-tasking, which decreases concentration, interferes with decision-making, and increases your risk of accidents whether driving or walking.

While driving, your mind is processing destination, route, speed, traffic laws, distances between your car and those around you, when to brake or to speed up, the amount of fuel left in the gas tank—and probably more, depending on where you are driving. Talking on the phone decreases mindful awareness of traffic conditions as your brain processes the conversation. The right cerebral hemisphere cannot watch traffic while the left is texting, tweeting, or decoding speech sounds.

According to National Safety Council (www.itcanwait.com), at least 100,000 vehicle crashes annually in the US are due to texting while driving. That's more than one per hour around the clock. In simulations, drivers consistently underestimated the interference with cognitive processes of talking on the phone. It can take up to *seven* seconds to transfer attention fully from one activity to another. In some countries, legislation is being considered to require teenage drivers to have cell phones turned off completely while the vehicle is moving. A large church put up a signboard on their property designed to catch people's attention and encourage them to refrain from texting while driving. It reads: Honk if you love Jesus. Text while driving if you want to meet Him.

Distracted driving has a cousin: distracting walking. Crossing a street while tweeting, texting, chatting on the phone, playing video games, or listening to music can be dangerous to life and limb. American Emergency Departments have reported a surge in patients injured because they were distracted while crossing a busy street. Approximately 1,150 patients were treated at hospital EDs in the past year due to distracted walking injuries, and they were likely underreported due to failure to disclose use of portable devices at time of injury (Consumer Product Safety Commission). According to the US National Highway Traffic Safety Administration, distracted pedestrian fatalities have risen by 4.2 percent, while injuries have risen by 400 percent over the past seven years.

Life and time are the two best teachers. Life teaches us to make good use of time and time teaches us the value of life. —Anmol Andore

Recommendations

Recommendations around the use of safe, appropriate, and balanced use of technologies include these:

1. Practice unplugging from devices by choice—when focusing on one activity, turn off your phone or iPad, etc.

2. When learning new things, take regular breaks to give your brain the time to consolidate the information (put the pieces together) and move it into long-term memory

3. Keep a balance of differing activities in your daily life. Walk or bike in nature, read books or listen to audiobooks, play games, play/listen/compose music, do puzzles, write stories/poems, or converse face-to-face. According to the American Academy of Pediatrics, a minimum of sixty minutes per day of unstructured free play is essential to children's physical and mental health. If a child is too busy to get this minimum, the child is too busy.

4. Avoid distracted driving and walking.

5. Stop texting, tweeting, twittering, or emailing during classes or in meetings. Concentrate on what is happening in the present moment wherever you are.

6. Engage in conscious breathing, a major component of martial arts, as it helps to increase awareness and oxygenate the brain. (Some hold their breath when using technologies.)

7. Keep your bedroom free from television, iPads, computers, cell phones (unless you are 'on call.' Avoid clocks with visible LED lights. (Note: LEDs can stimulate the brain to wakefulness and interfere with sleep). Shut off all electronics and devices one hour before bedtime.

Bottom Line: In life you usually give up something to get something. Maturity involves evaluating what you will GET versus what you will GIVE UP when making a decision. With some knowledge and forethought you can obtain the benefits technologies offer while preventing them from creating problems for your brain, health, and potential longevity. The brain you save may be your own!

Part II – Gaming Technologies

Video games and computers have become babysitters for kids. —Taylor Kitsch

Gaming Software and Apps

There are hundreds (if not thousands) of software programs and apps so individuals can play games on desktop and laptop computers, iPads, Notebooks, iPhones, smart phones, and even some free-standing electronic devices. Electronic games do have an impact on the brain. As with almost everything else in life, there are pros *and* cons.

If motor skills and repetitive routines are needed to play the game, the reptilian layer is your ticket. Overuse of video games can over-develop the reptilian brain in comparison to other layers of the

brain. Since the 1st brain layer primarily perceives present tense, a gamer might easily forget about everything except what is happening *right now*.

When you anticipate playing an enjoyable videogame, the brain reward system is triggered. Cells in the substantia nigra of the 1st brain layer release dopamine, which makes its way throughout the brain and helps you feel better. The more exciting the game, the more it triggers the brain reward system. Remember that about half of all the dopamine released makes its way to your gastrointestinal system. This can help explain differing sensations in the pit of your stomach based on what is going on at any given time.

Video games have an impact on the mammalian or 2nd brain layer, as well. Since this part of the brain processes present and past tenses, it's easy to get sucked into remembering how much fun it was to play video games the last time and get triggered into doing it again now, in the present. In the process you may end up neglecting other important things (e.g., household tasks, homework, career tasks, relationship building, and honing your spirituality.) Since the mammalian brain is home of emotional impulses, depending on the type of videogame, protective emotions such as anger, fear, and sadness may be triggered, all of which can spill over into personal relationships.

In terms of the neocortex or 3rd brain layer and videogames, the frontal lobes provide executive control over choices made in the environment, including whether to seek a reward. Both electronic games and videogames provide a reward to the brain.

Lost time is never found again. —Benjamin Franklin

Upside

There are some benefits to playing some types of specific games. For example, Jason Moser PhD, Assistant Professor of Psychology at Michigan State University and colleagues recently created a surprising simple yet targeted brain game. Studies revealed that playing the brain game helped participants improve their concentration and be less anxious. This was particular true among participants who had higher levels of anxiety. Dr. Moser has been quoted as saying that there are a plethora of brain-training games on the market, but they are highly controversial and offer no independent scientific proof that they sharpen focus let alone reduce anxiety. Playing this new game that involved identifying a shape in a series of shapes (e.g., a red circle in a series of red diamonds, squares, and triangles) was found to reduce anxiety.

Recent studies related to plasticity of the adult brain indicate that enhancements after action video game play are due to observers being better able to select and use the most reliable information in the brain to help them best handle the specific task required for that video game. Yet, unlike perceptual learning whereby the observer typically learns the best template just for one trained task, this work suggests that action gamers learn to find the best template on the fly as they are faced with new visual stimuli and new environments. According to this view, fast-paced, action-packed games have already been documented to have a potent positive impact on an array of skills, such as perception, visual-motor coordination, spatial cognition, attention, and decision making. This illustrates the powerful effect of action games in reshaping the adult brain.

Adam Chie-Ming Oei and Michael Donald Patterson of Nanyang Technological University, Singapore, designed the first study to compare multiple video games in a single study and show that varied skills can be improved through playing different games. Their research was reported in the open-access journal *PLOS ONE*. Five different games were used. Each non-gamer participant was assigned one game, e.g., Bejeweled, where participants matched three identical objects; or an agent-based virtual life simulation like The Sims; or a game where they had to find hidden objects, as in Hidden Expedition, or an action game. Each participant was asked to play the assigned game on his or her smartphone for an hour a day, five days of the week, for a month. After this month of "training," participants who had played the action game had improved their capacity to track multiple objects in a short span of time. Participants playing games that involved finding hidden objects, matching three objects, and/or honing spatial memory did improve on visual search tasks.

Researchers concluded that:

- Cognitive improvements are not limited to action-game training alone.
- Different games enhance different aspects of cognition.
- Training specific cognitive abilities in a video game improves performance in tasks that share common underlying demands.
- Many video-game related cognitive improvements may not be due to training of general broad cognitive systems such as executive attentional control, but rather due to frequent utilization of specific cognitive processes during game play.

Results from research studies continue to accumulate on the importance of regular challenging stimulation to the brain. For example, Posit Science just released data from the 10-year ACTIVE (Advanced Cognitive Training in Vital Elderly) study. The randomized, controlled trial compared the results of cognitive training exercises in speed, memory, and reasoning between study participants and a control group to determine if brain training might help with healthier aging. The speed training was found to cut long-term dementia risk by 33 percent among those asked to complete 10 hours of training in the first year of the study. (Memory and reasoning training were found not to have any significant effect on dementia risk.) Earlier research had shown that participants in speed training also improved at measures of brain processing speed, in tasks related to independent living, and did better than the control group at measures of mood, confidence, health, and driving. (The speed exercise is exclusively licensed to Posit Science and available as "Double Decision" in BrainHQ.)

> ***I do love video games. But after a while, you feel like you really need to get up and do something.*** —Patrick Chan

Myelin Connection

Just as there can be some social isolation when people spend excessive time on social media sites, a similar phenomenon can occur with videogames**.** Researchers at the University at Buffalo and Mt. Sinai School of Medicine reported in *Nature Neuroscience* online that when animals are

socially isolated for prolonged periods they make less myelin in the region of the brain responsible for complex emotional and cognitive behavior. When the social isolation is reversed, the production of myelin returns to normal. There is some sense that this may apply to the developing human brain. Also, when excessive amounts of time are spent playing videogames, often in isolation, myelin completion may be inconsistent.

According to Thom Hartmann, author of *The Edison Gene,* the level of cortisol in the body tends to diminish in the presence of positive emotions and achievement. Appropriate social interaction and shared play provide both positive emotions and achievement, while TV and video games provide little of either.

> ***Look carefully then how you walk, not as unwise but as wise, making the best use of the time.*** —Ephesians 5:15-17 ESV

Time Side

One common problem with video games is their consumption of the gamer's time. Studies indicate that it takes about 10,000 hours of practice to become world class in a specific type of skill. It doesn't take many years to achieve 10,000 hours of video-game playing. For most people, that skill will do little to help them finish school, enhance relationships with family members and close friends, get a good job or hone a career and become successful doing it to the extent they can support themselves and their family.

Video games impact each brain in different ways and those effects relate not only to its content but also to the person playing the game. Video games with excellent qualities do exist. The ones that are good for you is an individual matter. However, the more video games you play, the more your coping skills may be reduced. Games can also exasperate attention deficit problems and addictive behavior in children as well as adolescents and adults. Violent video games have been shown to stimulate aggressive behaviors and may increase aggressiveness in children and young adults.

As mentioned earlier, a person caught in a compulsion to play video games may experience negative consequences both personally (relationships) and professionally (school/work). Study results suggest that video game addiction is a problem among adolescents, particularly among males. Addiction is associated with adjustment problems (such as school performance) in addition to aggressive attitudes and behaviors. Compulsive internet use seems to produce the same type of tolerance and withdrawal as other addictions. You can develop a tolerance that pushes you to spend greater amounts of time online or to access more stimulating material. Websites need not be sexual in nature to become addictive. Any distinction between physical and psychological addictions is impractical and probably irrelevant, since humans are wholistic beings. In addition, whether you label this behavior as compulsion *or* addiction is of little relevance.

Regarding a computer game, you can always just play it again; everything you do is reversible. The emphasis is on the thrill of the moment. This creates a marked preference for the here-and-now, where the immediacy of an experience trumps any regard for the consequences. In fact, this type of activity—and its disregard for consequence—can be compared with the thrill of

compulsive gambling or compulsive eating. The sheer compulsion of reliable and almost immediate reward is being linked to the brain reward system that may also play a part in drug addiction. People should not underestimate the 'pleasure' of interacting with a screen nor puzzle over why it seems so appealing to young people.

Time is thought to primarily be a left-hemisphere function. When you are in the right cerebral hemisphere and involved with creative images, sounds, and rewards, your brain is less aware of time. Several hours can slip by as if in just a few minutes, which is one reason gamers sometimes get into difficulty with losing sleep, forgetting appointments, and doing poorly at school or at work—to say nothing of at home.

> ***We cannot and will not ban the creation of violent video games. But, we can prevent the distribution of these disturbing games to children, where their effects can be negative.*** —Herb Kohl

Criteria

My brain thoroughly enjoys some electronic games. I have several on my iPhone as well as my iPad and laptop. I tend to play electronic games when I have to wait at the airport or in line at the grocery store or while getting my car lubed or siting in the dental or medical waiting room, etc. I especially enjoy Whirly Word, which I believe has increased my vocabulary. Another favorite is Blitz, a game that has improved my ability to quickly recognize colors and shapes and align them. Break the Ice is an electronic game that has enhanced my abilities to solve problems and to persist in discovering the preferred solution. Mine do not include 'Angry Birds' as I have no desire to be around angry birds or do them in.

Personally, I do not enjoy jig-saw puzzles when pieces are fragmented all over the table, but I love solving jig-saw puzzles on-line. That helps my brain quickly recognize shapes and fit them into the big picture. Matching Mahjong pictures is also a good exercise for my brain and has helped hone my visual sense. And although there are mixed reviews about how mental stimulation affects health and longevity, I believe there is sufficient evidence to prompt me to use electronic games to challenge my brain. I aim for thirty minutes each day, and I can do this almost anywhere. I choose games to play based on at least four criteria:

1. A law of the brain states that when information comes to the brain in at least two senses and with some emotion, it tends to bypass conscious choice and has a high risk for going directly into long-term memory. Many videogames and other electronic games involve the senses of both sight and sound and typically include some type of emotion. Sometimes the emotion is happiness, but more often anger, fear, and/or even sadness, killing, or bullying.

   I choose to carefully select what I risk moving directly into long-term memory. Whatever goes into long-term memory may return as a trigger for thoughts and behaviors. You sometimes see this phenomenon exhibited in the so-called copy-cat crimes. Some heinous crime will be splashed all over the news and half a dozen reports of a similar crime will pop up later in other areas of the country or world.

2. Affirmation is the programming language of the brain. Add that to the brain principle of congruence and you can see that I am concerned about games that do not portray information and images that are true, noble, right, pure, lovely, admirable, excellent, and praiseworthy. This has become my guideline for selecting games, electronic as well as videogames. I choose to avoid games where the protective emotions of anger, fear, and sadness are triggered. Or when the object is to kill something or someone. Or games that demean race, culture, ethnicity, gender, and age. Or a host of other less-than-desirable topics. What I see and hear matters to my brain.

3. By *watching*, your brain becomes changed. Certain neurons (known as 'mirror' neurons) have been identified in the pre-frontal cortex (and may be elsewhere in the brain, as well). The brain's fascinating mirror neurons fire and activate, both when you personally perform an action AND when you watch another's behavior. It's like they are looking into a mirror and reflecting back what they observe. Depending on what you watch, this can be desirable or undesirable. Mirror neurons make no judgment regarding desirable versus undesirable behaviors. They simply are quick to mirror and mimic what you watch, including the behaviors of the people with whom you hang out.

   Studies estimate that within a space of three years you are at risk for picking up the behaviors of the people with whom you regularly associate. The same result can happen regarding videogames played on a regular basis. Does the over-riding theme match the spirit with which you live life or what to live life? If yes, well and good. If not, I cannot afford to expose my brain to that content.

   The good news, of course, is that watching desirable and positive skills and behaviors can speed up your learning process. Even watching yourself doing the new behavior in your mind's eye can speed learning. Researchers used brain imaging techniques to evaluate brains during both actual and virtual rehearsal. One group did real hand-on piano practice of a specific selection of music for two hours a day for an entire week. Brains showed that the brain's motor cortex was reshaped. The second group looked at the selection of music and spent two hours a day for an entire week imagining they were playing the music—practicing in their mind's eye. At the end of seven days, brain scans showed that the virtual rehearsal resulted in similar reshaping of the brain.

4. Long-term success rarely occurs by accident—rather by a process of ongoing conscious and deliberate choices. You can increase your likelihood of success by using positive-picture rehearsal consistently. When you do something once, the brain begins to lay down a neuron highway (a piece of software, if you will) in case you want to do that same thing again. And if so, your brain will already have a head start and you will probably do whatever you are doing more easily the second time. That speaks to the critical importance of making conscious choices about what you will do once. Some people have been hooked after one drink or one cigarette or one episode of cocaine, and so on.

   People already do actual rehearsal, often without realizing it. For example, I went on a cruise to Alaska with family members some years ago and the very first activity on the ship, with

required participation, was a life-boat drill. Each passenger donned a life jacket and found the way to the assigned muster station. The crew explained the process that would occur should it become necessary to evacuate the ship. The passengers did everything except actually climb into the lifeboats. Should the alarm sound, the passengers would already have some sense of where to find the lifejackets, how to put them on, and which muster station was their appointed gathering place. When the ship was merely docked in port, the crew actually lowered the lifeboats and went through an actual life-safety drill.

Airlines go through a similar exercise using virtual rehearsal. More individuals are probably familiar with that routine. The airline attendant asks passengers to direct their attention to the video, which outlines the safety features on that airline and provides instructions on how to evacuate safely. Survivors of plane crashes tell stories about how they believe they survived by recalling the safety instructions and implementing them quickly.

PET (Positron Emission Tomography) scan studies were used to record patterns in the brain as participants actually handled a three-dimensional wire grid and again later during recollection of the event only. The activity patterns in the brain were the same whether the experience was actual or virtual. As such, I choose only those games that are likely to create positive patterns and impressions in my brain.

Video games offer violent messages, and even the sports video games include taunting and teasing. —Geoffrey Canada

Addictive-Like Behaviors

Since the human brain is designed to develop habits, it can be at risk for exhibiting addictive behaviors involving gaming. The brain can become to almost anything and definitely can become addicted to the rush of hormones and chemicals that are triggered by technologies: gamers may feel as if something is missing unless they are constantly involved with their games of choice. Their risk of addiction rises to the extent that technologies constitute the most exciting thing in their lives and whether or not they are willing to disconnect for periods of time every day. Testosterone (in males) tends to rise when they play games and compete. The higher level of testosterone tend to increase their level of assertiveness.

Human beings tend to become dependent on electronic gaming for the same reason they become dependent on other addictive behaviors, such as gambling, sex, food, tobacco, alcohol, or recreational drugs. Individuals with gaming addictions often perceive their lives as very stressful and are more likely to be diagnosed with ADHD, anxiety, and depression. Even without exhibiting addictive behaviors, many gamers lose vital sleep, miss out on developing solid personal relationships and fail to hone requisite social skills, and/or do poorly in school. And, brain rewards aside, if you experience frustration or stress with technologies both adrenalin and cortisol are released. Remember: as adrenalin increases, so does the level of dopamine. Together they give the brain a reward.

A group of German scientists surveyed 1217 fourth-grade students and then repeated the survey five years later. The results showed that problems in socializing, which might make gamers especially vulnerable to video game addiction, included these:

- Low parental support
- Divorce or separation of parents
- Lack of successful experiences in real life
- Poor grades, repeating a grade
- School phobias or truancy from classes
- High video gaming by parents

A longitudinal study involving over 3,000 students in Singapore found that, after two years, greater amounts of gaming, lower social competence, and greater impulsivity seemed to act as risk factors for becoming players to become pathological gamers. Furthermore, depression, anxiety, social phobias, and lower school performance appeared to be outcomes of pathological gaming.

According to Romeo Vitelli, PhD, most strategies aimed at preventing video game abuse involve having parents take greater responsibility over what their children are doing. This does not appear to be very effective. Neither does restricting time spent playing games and taking away X-boxes and other gaming devices—except possibly for children under the age of ten. It likely is much more effective to identify and focus on solving the social problems that make gaming so very attractive and so 'must have' to some individuals.

A person caught in a compulsion to play video games may experience negative consequences both personally (relationships) and professionally (school or work). Physically there may be symptoms of carpal tunnel, headaches, dry eyes, backaches, weight issues, and depression. It may be a two-way street, as well. The lack of rewarding personal social interactions resulting from the excessive or pathological use of video games may deteriorate existing relationships. This may help explain the increase in feelings of loneliness reported by adolescent gamers.

> ***Know the true value of time; snatch, seize, and enjoy every moment of it. No idleness, no laziness, no procrastination: never put off till tomorrow what you can do today.*** —Philip Stanhope, 4th Earl of Chesterfield

Recommendations

Dr. Daniel Amen has recommended to parents that children spend no more than 30 minutes a day playing video games. This is because (according to brain imaging studies) video games impact the same area of the brain as cocaine and methamphetamine. When you play video games, your brain really likes it because the process increases the amount of dopamine being released in the brain. When you try to take those games away from kids, they get really upset. In fact, some even go through withdrawal symptoms. According to Dr. Amen, playing video games releases so much dopamine there isn't enough available for the little things in life. Other activities and relationships that would normally make children happy leave them feeling nothing at all.

Electronic and videogames are here to stay. Selected carefully and used in balance, they can improve some of the functions that reside inside your brain. Selected carelessly or used out of balance or to compensate for an unhappy and unfulfilling life, they can negatively impact your brain. Remember, with some knowledge and forethought you can obtain the benefits technologies offer while preventing them from creating problems for your brain.

Your brain contains the ability to choose, so use that function wisely. The rest of your life—in terms of health, longevity, and overall success—depends on those choices. Clearly, taking care of your brain is not a game!

Part III – Television and Movie Technologies

> ***My conclusion is that the majority of television shows provide a steady stream of low energy most of the time. So I devote a significant amount of time and efforts to support non-commercial public television and help replace the message of negativity, hopelessness, violence, profanity, and disrespect with the higher principles that match up with the principle of intension. Children in America see 12,000 simulated murders in their living room before their fourteenth birthday. I suggest you reduce your exposure to the very low energy of commercial and cable television.*** —Wayne Dyer PhD

Chicken or Egg

Television and movies—regardless of differences of opinion about which actually came first, TV or movies—do have an impact on the brain. Black and white silent films hit this planet in the 1890s and quickly morphed into talkies that soon expanded into Technicolor. Then the world got Cinerama in 1952. I must have been about age eleven when my uncle took our family to the Grauman's Chinese Theatre in Los Angeles. When it opened in 1927, it was touted as the most spectacular theatre opening in motion picture *history.* The Cinerama movie playing, *Around the World in 80 Days,* was the most amazing thing I'd ever seen; I still remember the train ride!

Then the world got Cinema Scope in 1953 and Vista Vision in 1954. And on into wide-screen movies, followed by IMAX. In 1971 the first permanent IMAX projection system was installed in the Cinesphere at Ontario Place in Toronto, Ontario, Canada, where it remains in operation to this day. China, with 25 IMAX theaters, is the second largest market for IMAX after the United States. IMAX 3-D followed in 1986 and then 4-D started popping up all over.

Around the same time, the groundwork for what would become the invention of television was laid by many individuals in the late 19th century. Constantin Perskyj is credited with coining the word *television* in a paper read to the International Electricity Congress at the International World Fair in Paris on August 25, 1900. In 1928 the world saw its first television station, W2XB, broadcasting from the General Electric facility in Schenectady, New York. Rather rapidly television, too, went from black and white to color to digital.

Close to 100 years later in this 21st Century, estimates are that most households in industrialized countries have at least one TV, to say nothing of other electronic devices on which one can watch TV programming, movies, videos, YouTube, TED talks, DVDs, and so on. And they do impact the brain. The last estimate I saw for the United States was that television is on for about seven (7) hours per day in the average home.

> ***The first step toward maintaining autonomy in any programmed environment is to be aware that there's programming going on. It's as simple as understanding the commercials are there to help sell things. And that TV shows are there to sell commercials, and so on.*** —Douglas Rushkoff

Tim Jennings MD, author of *The God-Shaped Brain,* has pointed out that television watching changes the way the brain develops and functions. It over develops the limbic system (mammalian layer) and decreases the development of the pre-frontal cortex. This is similar to observations that have been made on the outcomes to the brain of playing video games.

> ***All television is educational television. The question is: what is it teaching?***
> —Nicholas Johnson

The Time Side of TV and Movies

How much times is spent watching television and movies? And how much time is too much time? Those are difficult questions. Have you noticed on news reports how many millions of dollars a new movie takes in on any given weekend? That'll give you some idea of how many people went to see it.

Television and movies are multi-billion dollar industries. And controversy continues to rage about whether the human brain should, or should not, be watching. It appears that some viewing time is better than either none or too much. But the amount of time does matters. Some of the same downsides of videogames also apply to television and movies. Spending large amounts of time watching television and viewing movies on a regular basis often reduces physical exercise. Lack of exercise not only can trigger weight gain but the individual also fails to realize the stress-reducing effects of exercise. Studies by Richard Dahl, University of Pittsburgh Medical Center, found that the average child spends three hours per day watching television, i.e., twenty-one hours a week. By contrast, the child spends about thirty hours a week in school.

Researchers at the University College London, Department of Epidemiology and Public Health, examined the cross-sectional association between psychological distress, television and screen entertainment time, and physical activity levels among a representative sample of children from the 2003 Scottish Health Survey. They found that higher levels of television and screen entertainment time and low physical activity levels interact to increase psychological distress in young children. Total difficulties scores (after adjustment for age, gender, area deprivation level, single-parent status, medical conditions, and various dietary intake indicators) show that the combination of high television and screen entertainment time and low physical activity was associated with the highest Strengths and Difficulties Questionnaire score. Higher television and

screen entertainment exposure alone (greater than 2.7 hours/day) resulted in a 24 percent increase in the Strengths and Difficulties Questionnaire score in comparison with lower television and screen entertainment exposure (less than 1.6 hours/day), although when combined with low physical activity this resulted in a 46 percent increase.

According to the A.C. Nielsen Company the average American watches more than four hours of TV each day. That figures out at twenty-eight hours of viewing per week or two whole months of nonstop TV-watching per year. During a lifespan of sixty-five years, the average person will have spent nine of those years glued to the tube. Remember, in the United States estimates are that ninety-nine percent of households have at least one television and two-thirds of households have three or more—and that doesn't even address other electronic modalities on which television programming can be viewed.

> ***… In terms of binge-watching your favorite TV shows, it has been estimated that the brain has the storage capacity of three million hours of shows! Another way to look at it is that ONE human brain can store more than 2.5 times the amount that Netflix has on all of their servers!*** —Daniel G. Amen, MD

Obesity

Several thousand studies have looked at the impact of television on children and their brains. Studies have linked the amount of television viewing time to obesity in many age ranges. Children who watched more than one hour of television per day were more likely to be at unhealthy weights compared with those who watched less. Children who watched one to two hours of television a day were forth-three percent more likely to be overweight and forty-seven percent more likely to be obese compared to children who watched less than an hour per day.

Although the American Academy of Pediatrics (AAP) recommends that children watch less than two hours of TV daily, the appropriate guidelines most conducive to a healthy weight status remain unknown. Mark DeBoer, MD, associate professor of pediatrics at the University of Virginia in Charlottesville, has been quoted as saying that given the overwhelming evidence connecting the amount of time viewing TV and unhealthy weight, pediatricians and parents should attempt to restrict childhood TV viewing. Of course, it takes thought and consistent awareness to plan activities for children that take its place and, for many adults, it's just easier to plunk the kids in front of the TV as the adults do their own thing.

Children are not the only Americans suffering from weight problems. An estimated two out of three Americans over the age of twenty are obese According to an *American Journal of Public Health* study, an adult who watches three hours of TV a day is far more likely to be obese than an adult who watches under one hour.

Dr. Amir Soas, of Case Western Reserve University Medical School in Cleveland, encourages people in general—not just children and young people—to cut back on TV, because 'when you watch television, your brain goes into neutral.' This is believed so significant that Case Western plans to study whether people who contract Alzheimer's watched more TV throughout life than brain-healthy seniors.

Certainly too much sitting can be a problem, whether from watching TV or from working on a computer. There is an obesity pandemic worldwide, and too much sitting is believed to be a contributor—along with inadequate amounts of movement and exercise. You've heard the old saying "Use it or lose it"? Now it's "Move it or lose it."

Again, children who watch more than one hour of television per day are more likely to be at unhealthy weights compared with those who watch less. This means being overweight and obese is starting much earlier than in the past. Lin Yang, PhD, a researcher at the Washington University School of Medicine in St. Louis, Missouri, has estimated that this present American generation is the first that will have a shorter life expectancy than the previous generation. Obesity is one of the biggest contributors to this shortened life expectancy since it alone drives many of the chronic health conditions. Living longer with good levels of mental, emotional, physical, and spiritual function is *my* goal.

Along with the increased risk for gaining weight, studies have shown that individuals who watch more than four hours of TV on a daily basis tend to be irritable, depressed, restless, and bored. They also have problems concentrating, remembering, and sleeping. This is unhelpful to relationships. Period. But it may also have huge implications for the unemployed.

The study that found a correlation between watching more than one hour of television per day and unhealthy weights in childhood did not review computer use as a separate factor. Anecdotally, however, some believe there is a difference between watching entertainment (TV and movies) on a computer versus playing interactive games, putting jig-saw puzzles together on the screen, and using educational software for learning. Excessive sitting would likely still be a problem but it appears that computer use can be more or less problematic depending on the user's purpose and the program's content.

Generally, television and movies are thought to involve passive mental picturing: the brain is simply processing what other brains have created. This is very different from the active mental picturing involved in creative processes, such as activities needed for brainstorming and problem solving. This leads some to recommend that children should not watch TV until after age two or three. But as mentioned earlier, the same recommendations are not applied to computers when they are used to actively create, play games, process information, and learn—because active mental picturing is good for the brain. It can enhance creativity and help to hone skills of problem solving. Some have estimated that a good internet search on a topic of interest can be a challenging to an older brain as reading a book. Therefore, there are recommendations that every adult over the age of fifty-five would be wise to learn to use a computer as an anti-aging strategy.

According to William H. Deitz, MD, pediatrician and prominent obesity expert at Tufts University School of Medicine, the easiest way to reduce inactivity is to turn off the TV. He says that almost anything else uses more energy than watching TV.

> ***Allowing your kids to watch TV doesn't have to mean they have no choice but to see commercials for junk food and alcohol.*** —Charlie Ergen

Ubiquitous

In the past, television offerings were watched on, well, a television. Now television programming and movies can be viewed on any number of technological devices. There is an upside. In the last few years, advances in technologies offer instant access via TV, computer, iPad, or smart phone (and others) to global news and information from around the world and in almost any location. You can manage your finances on line, check on the security of your home, move your stocks and bonds around, complete entire educational degrees, write and publish books and more. This has revolutionized life worldwide in the 21st Century.

When I was lecturing in South Korea, I could access the Internet while riding on the underground, in public restrooms, in almost every restaurant and store, or in most public places. Free! The good news is that increased availability means that anyone whose job involves a great deal of computer access can work from home or almost anywhere. I can write articles, stories, scripts, and books on the plane while flying to my next appointment, simplifying my life greatly.

Public television provides documentaries, educational programs, animal and nature programs, musical presentations, and so on. I like to watch some of the summer and winter Olympic events. Others like to watch political debates or sports, golf, tennis, racing, football and soccer, basketball and hockey, boxing—you-name-it. To say nothing of the shopping channels and the food networks, and the entertainment provided through game shows, movies, TV program serials and reruns, reality shows, vocal and dancing competitions, Miss America along with the Bachelor and Bachelorette. Of course, entertainment is definitely in the eye of the viewer. Personally, I am not interested in watching programs that follow what I perceive to be dysfunctional family systems. Some think they are very funny (and they may be), but viewing that dysfunction would impact my brain—likely in negative ways.

It's easy to get sucked in, however, because television is very engaging, especially to the brain's right cerebral hemisphere. Like computers, it uses several attributes (images, backlit screens, and speed) that not only engage the right cerebral hemisphere but tend to generate emotional involvement. This is in contrast to words (especially words employed in business communications) that involve primarily the left cerebral hemisphere.

Richard Restak, MD, author of *Mozart's Brain and the Fighter Pilot,* writes that television images, especially when part of the background, tend to capture your attention despite your best efforts to stay focused on real life around you. Staring at a monitor can induce a form of hypnotic trance. This can occur to some extent while watching TV as well, although the hypnotic effect is probably heightened when sitting very close, as with a computer monitor. Entering this trance-like state may contribute to the distortion of time experienced by many users and contribute to keeping them hooked hour after hour . . . after hour.

Remember: when information comes to the brain in two sensory systems plus an emotion, the content is likely to bypass conscious choice and go directly into long-term memory. That makes careful selection of content very important. According to Doc Childre and Howard Martin in their book *The HeartMath Solution*, studies in quantum physics (quantum nonlocality) showed that when you hear something on television or in a move that impacts your thoughts and moods, you

remain connected to that information. Perhaps this may have something to do with the copycat crimes that often pop up around the country or world, after a particularly grizzly murder or unique event has been splashed all over the news.

Experiments by Phil Merikle of the University of Waterloo in Ontario, Canada, found that unconsciously perceived information leads to automatic reactions that cannot be controlled by a perceiver. This would include subliminal messages and pictures flashed too quickly to consciously register them. According to Merikle, images and scripts from moving images can actually become physically materialized in your brain, changing its biological structure and impacting your health. Some who have watched horror movies or other very scary presentations on television sometimes wake up screaming from a horrible nightmare. What you watch—especially what goes directly into long-term memory—can serve as a trigger for fears, phobias, nightmares, and even your choices and behaviors. It can also impact your shopping patterns.

For example, studies have shown an increase in the purchase of foods and beverages that were advertised during half-time at sports events. That's the reason companies pour billions of dollars into commercials. And estimates are that the average TV-watcher will have seen two million commercials by the time he or she reaches age sixty-five. Marketing is often geared to children in the hope that when shopping alone or with their parents, they will be drawn to the products they recognize from seeing them on television. Food products and fast-food restaurants rank number one among television advertisements to children. If the food industry can get young people hooked on products during childhood, they are more likely to continue purchasing them in adulthood. More than two decades ago, studies showed that there were an average of two-hundred junk food ads in four hours of children's Saturday morning cartoons. Heaven only knows how many are crammed in now.

> ***The question for me was, could TV actually teach? I knew it could, because I knew three-year-olds who sang beer commercials!*** —Joan Ganz Cooney

Addictive-Like Behaviors

According to Dr. Kenneth Guiffre: Television involves no active mental processes and no physical activity (e.g., you passively watch someone else actively processing). Some estimates are that the average person watches three to four hours of TV daily. He says that even a nap with its restorative powers is better for your brain than a TV show. Research by Herbert Krugman concludes that watching television tends to shift people into a passive and receptive state, characterized by alpha waves emanating in the brain. Of course, as with videogames and other technologies, it is possible to become dependent or habituated to television and movies. According to Rutgers University psychologist and TV-Free America board member Robert Kubey, millions are so hooked on television that they fit the criteria for substance abuse as defined in the official psychiatric manual. Heavy TV viewers were found to exhibit five dependency symptoms—two more than necessary to arrive at a clinical diagnosis of substance abuse. They include:

- Using television and movies as a sedative
- Feeling miserable when prevented from watching
- Indiscriminate viewing

- Feeling a loss of control while viewing
- Feeling angry with oneself for watching too much
- An inability to stop watching

TV, movies, and screen entertainment can be so mesmerizing, so ubiquitous, so relatively inexpensive and easily available, that I doubt many people really think much about content. What you are *watching* on television and in movies, can change your brain. And you do choose what you watch. One person said recently, "I don't really choose what I watch. I just look at whatever comes on next." Failing to choose consciously is still a choice.

> ***One generation's metaphors become another generation's realities. A generation without violence needs violent metaphors to exercise the animals in the brain—the instinctual equipment that is languishing unused in the cerebral storehouse. So in the 1970s and 1980s, bands like AC/DC wrote songs like "shoot to kill." These songs entertain a generation to which real bloodshed is mere fantasy. But the next generation imprints on the metaphors and turns them into realities. So in the 90s we have mass shootings by kids who take the previous generation's fantasies as blueprints for action.*** —Howard Bloom

Violence Link

Mark Ruffalo has been quoted as saying: 'Commercials that are geared towards kids—I think they should just, like, wipe them out.' I'm reasonably certain he was talking about the commercials, not the kids (smile). However, I appreciate his point of view. Commercials are often presented at a higher decibel level that the programming on either side of it, which tends to get one's attention due to the change in volume. And the jingles are often catchy, to say nothing of the music. And yes, along with Joan Ganz Cooney, I too have heard very small children repeating jingles and singing songs from any number of commercials. And their parents sometimes seemed very proud of the children and were encouraging them to 'perform.' Scary!

Remember, mirror neurons in the pre-frontal cortex activate—or fire up!—when you watch another's behavior. As the mirror neurons watch the images on TV and movies, the watcher can just slip what he sees or hears into a behavior. Remember: mirror neurons make no judgement about whether what they see is desirable or undesirable. They simply are quick to mirror and mimic watch. Because of this, some think that one generation's metaphors become the next generation's actions. In other words, when the violence on television escalates, the next generation's violent behaviors will do the same.

Indeed the level and amount and intensity of violence portrayed in movies and television programming seems to be escalating. Remember mirror neurons? When you watch violence, your mirror neurons fire as if it were happening to you or as if you were doing the violence. Some people then just move the internal pictures to actions. Some of the harmful effects of viewing violence no doubt come from the tendency to bypass the filtering functions of the frontal lobes. Studies of abuse have shown that it isn't just the target of the abuse who is negatively impacted; everyone who witnesses that abuse is, in effect, abused as well.

The violence continues to be a concern for many. An Oklahoma State website estimates that the average American child has seen about 200,000 violent acts on TV by age 18 and has witnessed about 16,000 murders.

Richard Restak, MD, author of *The New Brain,* wrote that watching pictures of a disaster or traumatic event has a more powerful effect on one's mental stability than reading about it. He indicates there are at least three potentially negative effects to children from viewing violence on TV. These are:

- Desensitization to pain and suffering
- More fearful of world around them
- Increased tendency to behave in aggressive or harmful ways toward others

Dr. Restak also points out that thinking aggressive thoughts can alter both blood flow to the brain and one's control over angry impulses. Adolescents and young adults who watched more than seven hours of television per week were more likely to commit an aggressive or violent act in later years. Restak also has pointed out that viewing violent images on TV, in movies and videos, or in person can activate the orbitofrontal cortex and increase the risk of an acute attack of disabling symptoms in children and adults who suffer from mental illness. Constant exposure to visual depictions of conflict, violence, and suffering can create dysfunctional circuits in brain areas that mediate emotion. The results may include PTSD. The orbitofrontal cortex is in intimate contact with the mammalian layer including the amygdalae and other limbic system components. Indeed, Robert E. Ornstein, PhD, author of *Multimind,* has stated that adults who view a lot of violent television have a lower physiological response to violent scenes than those who watch less violence.

> ***The marvels—of film, radio, and television—are marvels of one-way communication, which is not communication at all.*** —Milton Mayer

Attention, Emotions, Learning

Prolonged exposure to rapid image changes (like on a TV show designed for an infant) during critical periods of brain development may precondition the mind to expect high levels of stimulation. This may then make the pace of *real life* less able to sustain a child's attention. The more hours a child views rapid-fire television, the more likely he or she will have attention challenges later in life.

Cognitive stimulation (reading books or going to a museum) reduces the likelihood for attention challenges later in life. The more frenetic or violent the TV show, the more likely your child will have attention challenges later in life. Television shows that move at a typical pace may be far better for all children.

Disney likely hit the nail on the head when he said: "Of all of our inventions for mass communication, pictures still speak the most universally understood language." And that universally understood language involves one's emotions and feelings. Television and movies have an impact on a person's emotions, as well. The brain wants congruence; it wants everything

to match. When what you watch portrayed on the screen, trigger emotion, especially the protective emotions of anger, fear, and sadness, the brain tends to search its memory banks for incidents in the past that match the emotion being observed. So if a brain is already angry and is watching anger portrayed, the person may become even angrier. The same with fear, which can lead to the development of phobias and focus the brain's attention toward lower brain areas—a natural phenomenon known as *downshifting*. And if the brain is sad and depressed, watching sadness portrayed or events that are sad, can exacerbate the sadness. Watching a violent movie or watching violence on the news tends to make you feel more angry, aggressive, negative, and/or powerless.

Beyond emotions per se, there are also learning implications. According to Jane M. Healy, PhD, author of *Endangered Minds*, studies show that television viewing and videos have the potential to affect both the brain itself and related learning abilities. Both modalities tend to under-develop several brain areas and/or connections between them, including functions of the prefrontal lobes. You may recall that this portion of the brain contains executive functions that include morality, decision making, and willpower.

Psychologists at the University of Virginia tested four-year-old children immediately after they had watched nine minutes of *SpongeBob Square Pants* and found that their executive functions related to paying attention, solving problems, and moderating behavior had been severely compromised when compared to four-year-olds who had either watched nine minutes of *Caillou*, (a slower-paced, realistic public television show) or had spent nine minutes drawing. Lead investigator, Angeline Lillard, suggests that parents consider these findings when making decisions about what to allow their young children to watch on TV—if they watch television at all. Since executive function is extremely important to a child's success in school and in everyday life, she recommends that parents use creative learning activities (such as drawing, using building blocks and board games, and playing outdoors) to help their children develop sound behaviors and learning skills.

> ***It's absolutely inevitable that eventually, all or at least most of our entertainment will be in 3D.*** —James Cameron

3-D Phenomenon

Personally, I really enjoy 3-D, especially animal travelogues and documentaries shown on a giant-sized IMAX screen. But the 3-D format can play tricks on your brain and even mimic symptoms of motion sickness in some individuals. It also has to do with how your eyes work—together. According to Dr. James J. Salz, spokesman for the American Academy of Ophthalmology and clinical professor of ophthalmology at the University of Southern California in Los Angeles, in order to see 3-D easily and well, your eyes have to be working together as a team with equally clear images in both eyes to allow for fusion of the two images.

The brain apparently isn't very excited about conflicting signals. When you go to a realistic 3-D movie, there is a conflict between what your eyes are seeing and what your vestibular system is sensing. For example, your eyes are telling you that you're flying through the air while your vestibular system is saying, 'No, you're just sitting here.' This can give you a false sense of

movement, which in sensitive people can lead to a sense of motion sickness, likely due to the extra strain of trying to keep their eyes in alignment. Estimates are that about five percent of the population is unable to perceive 3-D at all. An estimated thirty percent of moviegoers have a weak fusional mechanism so their eyes have to work harder to watch 3-D. They are more likely to get headaches and eye fatigue while watching 3-D. And some people have reported difficulty watching 3-D movies and some have to stop watching altogether because they experienced nausea and motion sickness.

> ***Technology is permeating every single thing we do... And to the extent that we can better expose our young people to all the different ways that technology can be used, not just for video games or toys, we're planning for the future.***
>
> —Marc Morial

Recommendations

For technology health, consider adopting these recommendations:

1. Turn television off during meal times, keep it out of the bedroom, and never use it as a babysitter.

2. Set clear guidelines for watching television. (Some recommend that children watch television and movies only after age two or three and that this be limited to one hour a day of high-quality content.) View whatever is positive and educational and avoid watching scenes of violence or dysfunctional novelty as in most sitcoms. These can increase brain arousal, negatively impact the brain, and interfere with sleep.

3. Monitor what your children view on television and the amount of time they watch. Discuss programs being watched, including the type of sports event or theme of the story and whether you agree with the content of the program, language used, etc. Children will learn what to value from you.

4. Keep technology out of the bedroom including iPads, computers, televisions, and mobile phones (unless you must be on-call for some reason). Turn all electronic technology off at least an hour prior to bedtime to allow the brain some down time before it goes to sleep. People who have a television in the bedroom and fall asleep while viewing or leave it on all night—a light that makes noise—experience interference with natural melatonin production that can result in more waking during lighter stages of sleep.

5. Playing games outdoors and with friends, helping with household chores, or reading a good book can help children be less dependent on television to fill their time. Role model what you want your children to do, e.g., avoid having the TV running in the background for sound or company.

6. Make informed choices about technology and select what can benefit your life positively. Enjoy the benefits and stay up on research in case you need to course correct.

7. Be aware of potential eyestrain. Watching television in a room that is too dark or within four feet of the screen can be harmful and contribute to eyestrain.

Around the World in 80 Days? Forget about 80 days. Today's technologies can pretty much take you *around the world in 80 seconds!*

There is much to see, many ways to see it, and important choices to make. Movies and television might be "big business" but so is taking care of your brain. You'll rarely go wrong if what you watch and listen to and think about is done always with your brain in mind.

> ***First you make your habits—then your habits make you. The beginning of a habit is like an invisible thread. Each time you repeat the act, you strengthen the strand. With each repetition you add another filament until the strand becomes a great cable. The great cable binds you irrevocably to each thought and action.***
>
> —Anonymous