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Their Brains on Google: How Digital Technologies are Altering the Millennial Generation’s Brain and Impacting Legal Education

Kari Mercer Dalton*

I. INTRODUCTION

I sat at a table at Barnes & Noble and tried to focus on the stack of research in front of me. My eyes scanned the first line of the article, but my mind wandered to my smartphone sitting next to the stack of articles. Its pull was irresistible. Did I get a new work email? Better check. Did someone post something new on Facebook? Better check. What about my personal email account? Surely, I needed to check. I might be missing something if I did not check. After a few clicks, I felt bloated by all the unnecessary information: there was a new CLE class on advocacy; my friend Barb was in Paris, standing in front of the Eiffel Tower at that moment; and Gap was having a 25%-off summer sale. I shook off my new “knowledge” and refocused on my research. I re-read the first line of the article and continued reading for a few minutes. I made it about halfway down the page when my phone dinged, signaling a new text. Better check.

When I went back to my research, I just kept thinking about the pull I felt when technology called. I wondered what this was doing to my ability to read and think deeply. Was I becoming a scatterbrain? Could I only read in short spurts? Could I effectively recall what I was reading and draw meaning from the text? I mentioned this to several peers only to find they were also guilty of this distracted way of reading. Whether it was checking their emails or reading online and bouncing from hyperlink to hyperlink, all recounted similar experiences when it came to their new reading and thinking habits. We all concluded that reading and absorbing a longer article was becoming increasingly more difficult.

If this was happening to me—a “Digital Immigrant”1 in scholarly terms and a “book nerd” according to my brother—and my fellow Digital Immigrant law professors, what was happening to my Digital Native2 students,

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1. Beatriz Rivera & Maribel Huertas, Millennials: Challenges and Implications to Higher Education, NYU Fac. Res. Network, (Nov. 17–18, 2006), http://www.nyu.edu/frn/publications/millennial.student/Challenges%20and%20Implications.html (“The Digital Immigrants are all of us who were born when the computer was not yet personal, the cell phone did not exist, and the best information highway was a well-equipped library.”).
2. Id. Digital Natives are so called “because they are native speakers of technology, fluent in the digital language of computers, video games and the Internet.” Id.
who were raised using technology and never knew a world where information was not accessible twenty-four hours a day?

So, I did an experiment. I gave my negotiations class a lengthy article to read that addressed their questions from class the day before. I told them that I knew if I just handed the article out for them to read outside of class, they would not read it. I gave them ten minutes of class time to peruse the article. As I observed the class, not a single student was able to read for ten consecutive minutes. They all seemed to read a line or two and then stop to check their computers or phones. Then, when I started asking questions about the text, their responses were disjointed and incomplete. They could give me sound bites but did not really know or understand the answer. Several of them even admitted that they Googled the question instead of reading the article—again, only to produce answers that did not show they understood the material.

It was then that I thought to shift my research and write about the influence of the Internet over our brains—particularly over the brains of current law students and how this influence is impacting legal education. As such, this article will provide a simplified version of “Brain Anatomy 101” and offer a rudimentary explanation of how the cells within the brain work. This article will explore neuroscience’s current position—that the brain is plastic—and the breadth of what that means, explaining how the neural circuitry in our brains physically changes in response to our experiences.

The article will then discuss how experiences with digital technologies are physically altering our brains. It will then show that this alteration particularly impacts the Millennial generation, who make up the majority of our current law students. As a result of this physical alteration of our students' brains, current law students are struggling with reading comprehension, concentration, and contemplation, all of which are key lawyering skills. Finally, the article will conclude that we can counteract these changes by balancing our technology time, using our brain in non-technological ways, and teaching reading comprehension skills.

II. HOW THE BRAIN WORKS

The human brain is a complex organ. It weighs about three pounds. The brain consists of three primary vesicles: the hindbrain, the midbrain, and

3. *Id.* "Millennials” describes the latest generation of people born between 1981 and the present, who are also known as Digital Natives. *Id.*

4. *See generally Brain Basics: Know Your Brain*, Nat’l Inst. of Neurological Disorders & Stroke, http://www.ninds.nih.gov/disorders/brain_basics/know_your_brain.htm (last updated Mar. 20, 2013). This article is not intended to be an in-depth discussion of the workings of the brain. Instead, it is meant to provide the reader with an overview.

the forebrain. The hindbrain is made up of the cerebellum, the brain stem, and the upper part of the spinal cord. The hindbrain controls the body’s vital functions and coordinates movement. The midbrain is the upper most part of the brain stem. It controls some reflex actions and is part of the circuit involved in eye movements and other voluntary movements. Finally, the forebrain is made up of the cerebrum, which is split into two hemispheres, and the structures beneath it. The cerebrum is the source of intellectual activity. The surfaces of the cerebrum and the cerebellum are coated with a layer of tissue called the cortex, where information processing takes place.

Many different types of cells compose each of these brain parts. The main cell, most integral to brain functioning, is called a neuron. "All sensations, movements, thoughts, memories and feelings are the result of signals that pass through neurons." Each neuron is made up of a cell body, dendrites, and an axon. (See diagram below.)

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7. Id.
8. Id.
9. Id.
10. Id.
11. Id.
14. Id.
15. Id.
16. Id.; see also JOSEPH E. LE DOUX, SYNAPTIC SELF: HOW OUR BRAINS BECOME WHO WE ARE 2 (2002).
17. LE DOUX, supra note 16, at 40.
The cell body manufactures the molecules that the neuron needs to survive. The dendrites extend from the cell body and receive messages from other nerve cells. The nerve signals then pass from the dendrites to the cell body and then possibly to an axon. The axon is like a messenger that sends nerve signals to other neurons, muscle cells, or other cells through synapses. A synapse is the place where a nerve signal passes from the neuron to another cell.

When the nerve signal reaches the end of the axon, it stimulates the release of a tiny sac. The sac releases chemicals called neurotransmitters into the synapse. The neurotransmitters cross the synapse and attach to the receptors of the next cell. “The receptors can change the properties of the receiving cell.” If the receiving cell is a neuron, the signal can continue on. “It [i]s through the flow of neurotransmitters across synapses that neurons communicate with one another, directing the transmission of electrical signals along complex cellular pathways.” The average neuron makes about a thousand synaptic connections . . . . These synaptic connections tie our neurons together in a “dense mesh of circuits.” The electrochemical interactions taking place in this dense mesh of circuits give rise to our thoughts, memories, and emotions.

18. Id.
20. Id. The axon is the conducting region of the neuron. It transmits nerve impulses away from the cell body. Id. at 391.
21. Id.
22. Id. at 406.
23. Id. at 391.
24. Id. Neurotransmitters are the language of the nervous system. They are the means by which each neuron communicates with others to process and send messages to the rest of the body. Id. at 413.
25. See generally MARIEB & HOEHN, supra note 19, at 413–14.
26. Id.
27. Id. at 413.
29. Id.
30. Id.; see also SMALL & VORGAN, supra note 5 (“In the average brain, the number of synaptic connection sites has been estimated at 1,000,000,000,000,000, or a million times a billion.”).
31. See CARR, supra note 28.
For hundreds of years, scientists and doctors thought the human brain did not change during adulthood.\textsuperscript{32} They theorized that our neurons connected as we developed in childhood,\textsuperscript{33} and then our neurons and their circuits became fixed as we reached maturity.\textsuperscript{34} The only change believed to occur in our brains during adulthood "was a slow process of decay as the body aged."\textsuperscript{35} However, even in the late 19th century, there were some researchers who theorized that the human brain was "plastic."\textsuperscript{36} These researchers believed that neural circuits formed throughout life and old ones could grow stronger, weaker, or die out.\textsuperscript{37} Despite some then-existing evidence of plasticity, however, the majority of doctors, scientists, and psychiatrists maintained the adult human brain was "fixed" and incapable of changing.\textsuperscript{38} They regarded the brain as a hard-wired machine, asserting that neural paths once laid could not be widened, narrowed, or rerouted.\textsuperscript{39} This position remained the scientific standard until the 1970s and 1980s.\textsuperscript{40}

Since the 1980s, brain science has continued to develop and has created more substantial evidence that the brain is indeed "plastic" and capable of

\textsuperscript{32} Id. at 20–21.

\textsuperscript{33} See Nat’l Research Council, How People Learn, Brain, Mind, Experience and School: Expanded Edition 116 (John D. Bransford et al. eds., 2d ed. 2000). At birth, the human brain only has a small portion of the synapse connections that it will eventually have. Id.

\textsuperscript{34} Carr, supra note 28; see also Sharon Begley, Train Your Mind, Change Your Brain 31 (Ballentine Books 2007) (arguing that scientists once believed that the brain establishes most of its fundamental system connections like the visual cortex, the auditory cortex and somatosensory cortex in the first years of life).

\textsuperscript{35} Carr, supra note 28, at 21.

\textsuperscript{36} Id.; see also Begley, supra note 34, at 5 (noting that Sigmund Freud and William James, the father of experimental psychology, were early believers in the brain’s plasticity. In 1890, James hinted at it when he said that the nervous tissue seemed endowed with plasticity, meaning "a structure weak enough to yield to an influence.")); J.Z. Young, Doubt and Certainty in Science: A Biologist’s Reflection on the Brain 36 (Oxford Univ. Press 1951) (noting that British biologist J.Z. Young was another early researcher who thought the brain was plastic).

\textsuperscript{37} Carr, supra note 28, at 21; see also Young, supra note 36 ("There is evidence that the cells of our brains literally develop and grow bigger with use, and atrophy or waste away with disuse.").

\textsuperscript{38} Begley, supra note 34, at 31. "So convinced were neuroscientists that the adult brain is essentially fixed that they largely ignored the handful of studies suggesting that the brain is actually malleable and shaped by experience." Id. at 5.

\textsuperscript{39} Carr, supra note 28, at 22.

\textsuperscript{40} Jeffrey M. Schwartz & Sharon Begley, The Mind and the Brain: Neuroplasticity and the Power of Mental Force 130 (1st ed. 2003).
This plasticity refers to changes in neural pathways and synapses, which are a result of changes in behavior, environment, neural processes, and bodily injury. Specifically, when we perform a task or experience a sensation, neurons in our brain are activated. If the neurons are close together, they join together through the synaptic neurotransmitters. If we repeat the task or experience, the synaptic link between neurons grows stronger. The repeated experience can be either physical or mental. This phenomenon supports the phrase used by Canadian psychologist Donald Hebb: "Cells that fire together wire together."

Neuroscientists T. Graham Brown and Charles Sherrington did an experiment with monkeys proving that repeated behaviors change neural patterns. They investigated why the brain map of one monkey differed from


42. See Carr, supra note 28, at 26.

43. Id. at 27.

44. Id.

45. Id.

46. See Alvaro Pascual-Leone et al., Modulation of Muscle Responses Evoked by Transcranial Magnetic Stimulation During the Acquisition of New Fine Motor Skills, 74 J. NEUROPHYSIOLOGY 1037, 1037–45 (1995). Pascual-Leone's piano experiment where he found people who actually played the piano keys versus who just thought about playing the piano keys experienced the same physical changes to their brain. Id.

47. LeDoux, supra note 16, at 79; see also Small & Vorgan, supra note 5, at 8–9 (asserting that in explaining how the brain develops and determining what the brain is capable of, we should not rely totally on the structure of the neural patterns. While genetics play a role, genes are not totally responsible for the development. "The relatively modest number of human genes—estimated at twenty thousand—is tiny compared with the billions of synapses that eventually develop in our brains. Thus, the amount of information in an individual's genetic code would be insufficient to map out the billions of complex neural connections in the brain without additional environmental input.").

48. Nat'l Research Council, supra note 33, at 115 ("Neuroscientists study the anatomy, physiology, chemistry, and molecular biology of the nervous system.").

49. See generally Begley, supra note 34, at 28.

50. See Laura Stephens Khoshbin & Shahram Khoshbin, Imaging the Mind, Minding the Image: A Historical Introduction to Brain Imagining and the Law, 33 AM. J.L. & MED. 171, 177 (2007). Brain mapping is the result of using com-
Their Brains on Google

the brain map of another.\(^{51}\) During their experiment, they learned that the repeated, habitual movements of the monkeys changed the neurons in the monkeys' motor cortexes.\(^{52}\) If the monkey habitually held fruit with its thumb and pinkie, the clusters of neurons in the motor cortex that moved those two fingers would lie together because those fingers were repeatedly, regularly flexed together.\(^{53}\) Alternately, the other monkey, who held the fruit with its thumb and forefinger, had a brain map where the neurons that control thumb and forefinger movement were closer together.\(^{54}\) Thus, the monkeys' brain maps were different because the repeated behaviors strengthened neural patterns and altered the structure of their brains.\(^{55}\)

There is evidence that neural links can also weaken or dissolve if they are not called upon.\(^{56}\) For example, Biologist Eric Kandel performed an experiment with sea slugs that showed existing synaptic connections can weaken as new behaviors are learned.\(^{57}\) In a sea slug's gills, 90% of the sensory neurons are connected to motor neurons.\(^{58}\) Kandel lightly touched the sea slug's gill and it recoiled.\(^{59}\) He then repeatedly touched the sea slug's gill and observed that the recoil reflex steadily diminished.\(^{60}\) Kandel noted that after forty touches, the sea slug became habituated to the touch and the gill was no longer withdrawn.\(^{61}\) As a result of this habituation, only 10% of the sensory neurons remained connected to motor neurons.\(^{62}\) Kandel analo-

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\(^{51}\) \textit{Begley, supra} note 34, at 28 (asserting that brain maps are individual as fingerprints).

\(^{52}\) \textit{Id.}

\(^{53}\) \textit{See id.}

\(^{54}\) \textit{Id.} at 28–29 (“[D]ancers who repeatedly practice particular foot extensions should have larger clusters of neurons responsible for moving the foot muscles than people who do little more than place one foot ploddingly in front of the other”).

\(^{55}\) \textit{Id.} at 29–30.

\(^{56}\) \textit{Carr, supra} note 28, at 27. “Synapses can undergo large and enduring changes in strength after only a relatively small amount of training.” \textit{Id.} (quoting \textit{Eric R. Kandel, In Search of Memory: The Emergence of a New Science of Mind} 198–207 (2006)).


\(^{58}\) \textit{Carr, supra} note 28, at 28.

\(^{59}\) \textit{Kandel, supra} note 57, at 200–01.

\(^{60}\) \textit{Id.}

\(^{61}\) \textit{Carr, supra} note 28, at 28.

\(^{62}\) \textit{Id.}
tions can change based upon experiences. Furthermore, the actions people take can shrink different regions of their brain because the brain devotes more cortical real estate to functions which are used more frequently, and the brain will allow the more frequently used areas to occupy areas that are used less frequently. For example, a violinist’s brain will devote more cortical real estate to the space in the brain that controls the digits of the fingering hand than will the brain of a person who does not play the violin.

Even parts of the brain that are associated with a particular function are plastic. For example, when someone goes blind the part of the brain responsible for processing visual stimuli does not “go dark” but is instead taken over by circuits used for audio processing. The brain’s real estate that was occupied by the weakened or dissolved link is taken up by the new repetitive experience.

In addition to repeated experiences, your attention impacts neuroplasticity. It is attention that “pumps up neuronal activity.” It is as if attention works like a gate and regulates the input of neural information. Mike Merzenich, a neuroscientist and pioneer of neuroplasticity, conducted an experiment on monkeys where he placed a tapping device on their fingers and played sounds through headsets. One set of monkeys was taught to pay attention to the tapping and ignore the sound while the other set was taught the opposite. The brain scans revealed that the neurons in the part of the brain responsible for the fingers did not change in the monkeys who paid attention to the sound, and the brains of the monkeys who paid attention to

63. KANDEL, supra note 57, at 201.
64. BEGLEY, supra note 34, at 8.
65. Id.
66. Id.
67. See CARR, supra note 28, at 29. The same has been seen in folks who lose their hearing. Id.
68. BEGLEY, supra note 34, at 42-44. Mortimer Mishkin and Tim Pons, neuroscientist at the National Institute of Mental Health, showed that the brain of a Silver Spring monkey, whose arm had been deprived of sensory input due to a severed nerve twelve years ago, had been rewired. Specifically, their experiment showed that the face zone of the somatosensory cortex in the monkey had taken over the hand/arm zone that had been severed. The “hand” region of the monkey’s brain had been invaded by neurons from the face area, and the territory the brain zoned for receiving feelings from the face had grown ten to fourteen millimeters.
69. Id. at 156–60.
70. Id. at 158.
71. Id. at 160.
72. Id. at 158–59.
73. BEGLEY, supra note 34, at 158.
the tapping showed that the cortical area devoted to fingers increased two to threefold.\textsuperscript{74} This shows that “the pattern of activity of neurons in sensory areas can be altered by patterns of attention.”\textsuperscript{75} So, experience and attention are needed to make physical changes in the structure of the brain.

Once a change in the brain has occurred, the new neural connection holds onto the change.\textsuperscript{76} In fact, “we long to keep it activated.”\textsuperscript{77} However, that does not mean we cannot once again redirect our neural paths and re-build skills we have lost.\textsuperscript{78}

Neuroplasticity is constantly occurring.\textsuperscript{79} This constant neural flux is the normal, default state of the brain.\textsuperscript{80} “[O]ur brains are constantly changing in response to our experiences and our behavior, reworking their circuitry with ‘each sensory input, motor act, association, reward signal, action plan, or [shift of] awareness.’”\textsuperscript{81} Dr. Gary Small, Director of the Memory and Aging Research Centre at the University of California, Los Angeles, agrees that the stimulation to which we expose our brains is critical to how our brains work.\textsuperscript{82} So, our brains are plastic and constantly breaking old connections and forming new ones in response to our experiences, which helps to show that the adult brain “retains much of the plasticity of the developing brain.”\textsuperscript{83} “Like sand on a beach, the brain bears the footprints of the decisions we have made, the skills we have learned, [and] the actions we have taken.”\textsuperscript{84}

\textbf{III. How the Internet Is Altering Our Brains}

The brain is very sensitive to any kind of stimulation.\textsuperscript{85} “Through what we do and how we do it . . . . we alter the chemical flows in our synapses and change our brains . . . . Any repeated experiences influence our synapses . . . .”\textsuperscript{86} Technologies, specifically the Internet, provide users re-

\begin{itemize}
  \item \textsuperscript{74} Id. at 159.
  \item \textsuperscript{75} Id.
  \item \textsuperscript{76} \textit{Carr}, supra note 28, at 34.
  \item \textsuperscript{77} Id. (quoting \textit{Norman Doidge, The Brain that Changes Itself} 108 (2007)).
  \item \textsuperscript{78} Id. at 35.
  \item \textsuperscript{79} Mark Hallett, \textit{Neuroplasticity and Rehabilitation}, 42 J. Rehabilitation Res. \& Dev. Center, July 2005, at xvii, xxviii.
  \item \textsuperscript{80} \textit{Carr}, supra note 28, at 31.
  \item \textsuperscript{81} Id. (quoting Pascual-Leone, supra note 41).
  \item \textsuperscript{82} \textit{Small} \& \textit{Vorgan}, supra note 5, at 9.
  \item \textsuperscript{83} \textit{Begley}, supra note 34, at 8.
  \item \textsuperscript{84} Begley, supra note 41.
  \item \textsuperscript{86} \textit{Carr}, supra note 28, at 49.
\end{itemize}
peatable experiences that are virtually impossible to resist.87 We are drawn to them and pay attention to them.88 In fact, “[i]f, knowing what we know today about the brain’s plasticity, you were to set out to invent a medium that would rewire our mental circuits as quickly and thoroughly as possible, you would probably end up designing something that looks and works a lot like the [I]nternet.”89 As Nora Volkow, Director of the National Institute of Drug Abuse and one of the world’s leading brain scientists has said, “Technology is rewiring our brains.”90 Moreover, the rewiring is occurring at an “unprecedented pace.”91

Dr. Small conducted an experiment to understand the Internet’s effects on the brain.92 In his experiment, he compared MRI imagery of the brains of both experienced and newcomer web users while using Google.93 Initial MRI scans of the two user groups showed two different types of brain images for the experienced users and newcomers.94 The experienced users showed activity in the dorsolateral prefrontal cortex while the newcomers showed hardly any activity in that area of the brain.95 Both sets of users were then asked to use the Internet, specifically Google, for an hour each day for the next five days to complete a specific task.96 Their brains were then scanned again, and the results showed that the mental activity in both users had become virtually identical.97 So, after only five days of an hour-a-day use of Google, the newcomers’ brain images were “rewired” to look like the brain images of the experienced users.98 In other words, online activities caused measurable and rapid alteration to the brain’s neural circuitry.

87. Harris, supra note 85. “The [I]nternet lures us. Our brains become addicted to it.” Id.
88. Id.
89. Id. (quoting Carr, supra note 28).
91. Small & Vorgan, supra note 5, at 12.
92. Harris, supra note 85; see also Small & Vorgan, supra note 5.
94. Harris, supra note 85.
95. Id.
96. Id.
97. Id.
98. Id.; see also Small & Vorgan, supra note 5, at 14–17 (providing an in-depth discussion of the experiment).
The Internet is able to rewire our brains because it delivers a steady stream of inputs to our visual, somatosensory, and auditory cortices. The Internet simultaneously engages all of our senses, except for taste and smell. The constant sensory and cognitive stimuli of the Internet alter the brain circuits, especially of Millennials, because it is repetitive, intense, interactive, and addictive. As discussed above, there are physiological effects of repetition on neurons and synapses. The constant use of technologies such as smartphones, computers, search engines, and the like "stimulate brain cell alteration and neurotransmitter release, gradually strengthening new neural pathways in our brains while weakening old ones."

Many neuroscientists believe that the constant exposure to high levels of technology is altering the neural connections and stunting frontal lobe development in younger generations. The frontal lobe is the higher order reasoning center of the brain, where working memory is located. For example, studies show that excessive computer gaming leads to suppressed functions in the frontal lobes in favor of stimulating lower order brain centers controlling movement and vision. Additionally, it shows a decrease in working memory.

The research of John Sweller, an educational psychologist who studies how the mind processes information, shows that the Internet impacts our ability to think deeply. Specifically, it has been found that the Internet

100. Id.
101. Id.
102. Id. at 184–86.
103. Id. at 120 (quoting Small & Vorgan, supra note 5).
105. Chapman, supra note 104.
106. Affleck, supra note 104 (citing Mickey Dodson, Video Games & Brain Development, eHow, http://ehow.com/about_6324252_videogames_brain_development.htm#ixzz2RTVrsqqQ (last visited Nov. 4, 2013)).
108. Carr, supra note 28, at 123 (citing John Sweller, Instructional Design in Technical Areas 4 (1999)).
impacts the neural connections involved in memory. Long-term memory is the seat of understanding because it uses facts and bits of information to form patterns of knowledge, or schemas; it does not simply store facts. These patterns of knowledge, or schemas, which we acquire over time, are what give rise to our intellectual prowess. As such, our brains need to transfer information from working memory to long-term memory in order to weave our thoughts into complex ideas. "The depth of our intelligence hinges on our ability to transfer information from working memory to long-term memory and weave it into conceptual schemas." However, the passageway from working memory to long-term memory is not always easy. Unlike the long-term memory portion of our brain, where there is almost unlimited capacity, our working memory can hold only a small amount of information at a time. So, transferring information from working to long-term memory is like "filling a bathtub with a thimble." Further, a break in attention can sweep information from our short-term memory. The information flowing into our working memory is called cognitive load. When cognitive load exceeds the brain's ability to process and store it, we cannot retain the information or draw connections with other memories. The Internet causes cognitive overload because it is providing information through too many "faucets," and our "thimble" is overflowing as we rush from "faucets to thimble."
Their Brains on Google

cet” to “faucet.”120 We are not able to transfer all the information to our long-term memory, and the information that is transferred becomes jumbled.121 This overflow of information prevents our brains from forming strong neural connections that give depth to our thinking when we are distracted.122

Moreover, when we surf the Internet and expose our brains to the stimuli it provides, we evaluate links and make navigational choices, tasks which require decision making.123 This process of pausing to evaluate whether to move to the next link alters neural connections and distracts the brain from the work of interpreting text.124 Our mental resources move from reading words to making judgments, which impedes comprehension and retention.125

Scholars from the University College London suggest we “are in the midst of a sea of change in the way we read and think.”126 The exposure to digital technologies makes us read in a “skimming” way that can be characterized as “power browsing.”127 This different way of reading leads to a different kind of thinking.128 Maryanne Wolf argues this new form of reading puts efficiency and immediacy above all else, and we are weakening our ability to read deeply, which in turn weakens our ability to interpret text and

120. Chapman, supra note 104 (“This information overload leads to more multitasking and forces us to push our brain to do things it was not built to do.”).


122. Id.

123. Carr, supra note 28, at 122.

124. Id.

125. Compare Steven Johnson, Everything Bad is Good for You: How Today’s Popular Culture is Actually Making Us Smarter 19 (2005) (This Internet stimuli is more intense than the stimuli your brain receives when it reads. Some argue that this stimulation is good for the brain.), with Carr, supra note 28, at 122 (conversely arguing that the firing of more neurons is not necessarily better when it comes to the brain and deep thinking).

126. Nicholas Carr, Is Google Making Us Stupid? What the Internet is Doing to our Brains, ATLANTIC (July 1, 2008, 12:00 PM), http://www.theatlantic.com/magazine/archive/2008/07/is-google-making-us-stupid/306868/ [hereinafter Carr (2008)]. This is not unusual because our past shows that there have been changes with other tools of progress. Prior to 15th century, intelligence was based on memory. Then the written word and books came along, making the work of remembering less critical. Id.

127. Id.

128. Maryanne Wolf, Proust and the Squid: The Story and Science of the Reading Brain 5 (2008); Carr (2008), supra note 126 (asserting that deep reading is indistinguishable from deep thinking).
make rich mental connections. Nicholas Carr agrees, "[W]hen we go online, we enter an environment that promotes cursory reading, hurried and distracted thinking and superficial learning." In a *Science* Magazine article, developmental psychologist Patricia Greenfield reported that media technologies influence our cognitive abilities. We have "new weaknesses in higher-order cognitive processes, including abstract vocabulary, mindfulness, reflection, inductive problem solving, critical thinking, and imagination." At Stanford University’s Communication Between Humans and Interactive Media Lab, researchers performed an experiment that showed exposure to digital media impacts cognition. In the experiment, researchers gave a cognitive test to forty-nine people who did a lot of media multitasking and fifty-two people who did not. The heavy multitaskers all performed worse on the cognitive test, showing less control over working memory and less ability to concentrate. This new neural pattern, caused by the extensive exposure to technologies, is causing fragmented attention.

129. Carr (2008), *supra* note 126. Wolf also argues that reading is not instinctive for humans—that it is a learned behavior. So, this new media is teaching our brain differently. As evidence, she showed that the mental circuitry of those that read Chinese are different than the mental circuitry of those that use an alphabet. Thus, arguably the mental circuitry of those that read online is different than those that read print.

130. Patricia M. Greenfield, *Technology and Informal Education: What Is Taught, What Is Learned*, 322 SCIENCE 69 (2009); *Carr*, *supra* note 28, at 115–16. Of interest, Larry Page, one of Google’s founders, has said that Google is “really trying to build artificial intelligence and to do it on a large scale.” Carr (2008), *supra* note 126. This suggest that “intelligence is the output of a mechanical process, a series of discrete steps that can be isolated, measured, and optimized.” *Id.* Meaning, concentration and contemplation are not needed and are only slowing down. See *id.* Moreover, from an advertising and financial perspective, the more we move from link to link, the better for Google and its advertisers. *Id.* So, “[t]he last thing these companies want is to encourage leisurely reading or slow, concentrated thought.” *Id.*

131. *See* Carr (2010), *supra* note 121.

132. *Id.* (internal quotations omitted).

133. *Id.*

134. *Id.*


Additionally, when the brain is constantly stimulated, the learning process is prevented.\textsuperscript{137} In other words, when you keep your brain stimulated with digital technologies, you are foregoing the “downtime” that is needed to help your brain learn and retain information better.\textsuperscript{138} The imaging studies of human brains show that the major cross sections of the brain are active during downtime, suggesting rest periods are critical in allowing the brain to synthesize information and make connections.\textsuperscript{139} According to Loren Frank, assistant professor at the University of California, San Francisco, downtime allows the brain to solidify experiences and turn them into persistent memories.\textsuperscript{140}

This constant stimulation causes the users to place their brains in a heightened state of stress, which also leads to less time for reflection, contemplation, and decision making.\textsuperscript{141} Overstimulation gives rise to “cursory reading, hurried and distracted thinking, and superficial learning.”\textsuperscript{142} The neural circuits involved in human interaction and communication also become weakened.\textsuperscript{143} Others also argue the “use of the [I]nternet, cellphones and other digital technologies can cause us to become more impatient, impulsive, forgetful and even more narcissistic.”\textsuperscript{144} One writer argues that “tweet by tweet” we are unlearning complexity, acuity, patience, wisdom, and inti-


\textsuperscript{138} \textit{Id.} Scientist at University of California, San Francisco, performed an experiment with rats to establish that downtime is necessary for the brain to create persistent memory. They exposed rats to a new experience?they let them explore an unfamiliar area. When the rats explored the new areas, the rats’ brains showed new patterns of activity. However, the new patterns of activity only became a persistent memory when the rats took a break from the exploration. \textit{Id.}


\textsuperscript{140} Richtel (Aug. 2010), \textit{supra} note 137; Richtel (Nov. 2010), \textit{supra} note 139 (Dr. Rich of Harvard Medical School says, “Downtime is to the brain what sleep is to the body.”).

\textsuperscript{141} SMALL & VORGAN, \textit{supra} note 5, at 18.

\textsuperscript{142} Harris, \textit{supra} note 85 (quoting CARR, \textit{supra} note 28).

\textsuperscript{143} SMALL & VORGAN, \textit{supra} note 5, at 21.

Even more alarming is digital media's influence over the brain continues even after we are not using the technology.146

Some folks argue that the influence of digital technologies does provide some benefits.147 One obvious benefit is the unprecedented amount of information that is now readily accessible online. Research that once took us days in the periodical rooms of a library now can be done in minutes.148 Adam Gazzaley, Professor of Neurology and Director of Neuroscience Imaging Center at the University of California, San Francisco, states “mobile technology can be harnessed to improve our minds.”149 However, he admits the cognitive science field is still in its infancy.150 Others argue that certain video games can create children with better reasoning skills.151 Dr. Small also admits that the use of digital technologies can sharpen some cognitive abilities like learning to react quicker to visual stimuli.152 Others even argue that a new form of intelligence is coming and that those with “Internet brain” will be the only ones who can compete with this new intelligence.153

The debate over new mediums is not new.154 Throughout history, whenever a new medium is introduced, it has become the subject of much debate.155 For example, when people first started using the written word, some


146. Carr (2010), supra note 121.

147. Carr (2008), supra note 126.

148. Id.


150. Id.

151. Samuel Greengard, Are We Losing Our Ability to Think Critically?, 25 COMM. OF ACM at 18–19, available at http://cacm.acm.org/magazines/2009/7/32082-are-we-losing-our-ability-to-think-critically (suggesting that the video games Sim City, Civilization, Railroad Tycoon, and Age of Mythology teach decision making and analytical skills). See also SMALL & VORGAN, supra note 5, at 21 (Paul Kearney, a neuroscientist at Unitec in New Zealand, argues that some computer games can improve cognitive ability and multitasking).

152. SMALL & VORGAN, supra note 5, at 20.


154. CARR, supra note 28, at 46–47.

155. Id.
argued that the dependency on the written word would alter a person’s mind by substituting written word for inner memories. It was also argued that the written word would make us shallower thinkers, “preventing us from achieving the intellectual depth that leads to wisdom and true happiness.”

“Those who rely on reading for their knowledge will seem to know much, while for the most part they know nothing.”

Now, the Internet is the latest medium to become subject to debate and, in this debate, all we truly know is that mediums influence how we think and act. “[M]ediums mold what we see and how we see it.” “Eventually, if we use [a certain medium] enough, it changes who we are, as individuals and as a society.” Therefore, be aware of the positives of the Internet and cognizant of the fact there is scientific evidence that technology is altering our brains by changing neural patterns, which in turn is impacting our reading comprehension and contemplation skills. There is a possibility that the Internet is creating fractured, unimaginative thinkers.

156. Id. at 54.

157. Id. at 54–55.

158. Id. at 54 (internal quotations omitted); see also Jonah Lehrer, Our Cluttered Minds, N.Y. TIMES, June 3, 2010, at BR22, available at http://www.nytimes.com/2010/06/06/books/review/Lehrer-t.html?_r=2&scp=1&sq=internet%20destroying%20mind&st=cse (reviewing Carr, supra note 31) (mentioning how Socrates in the Phaedrus stated that the invention of the book would create forgetfulness in the soul).

159. Carr, supra note 28, at 3.

160. Id.

161. Id.

162. Carr (2008), supra note 126; Affleck, supra note 104; Richtel (Nov. 2010), supra note 139.

163. Affleck, supra note 104; Carr (2008), supra note 126. Again, it is possible that the concern over the alteration of our brains is not warranted because it is possible that we cannot “recognize the superiority of this networked thinking process because we are measuring it against our old linear thought process.” Carr, supra note 28, at 8.
IV. THE MILLENNIAL GENERATION;164 THEIR USE OF DIGITAL TECHNOLOGIES AND THE ALTERATION OF THEIR BRAINS

The Millennials are “digital natives.”165 This group makes up the majority of the students in the law school classroom.166 They were raised using technology and are characterized by their increased use and familiarity with communications, media, and digital technologies.167 They have used laptops, iPods, the Internet, cell phones, iPads, tablets, digital music players, video cameras, video game technologies, and other forms of technology from an early age.168 In fact, by age five, the majority of Millennials were already using a computer.169 Not only do they have an aptitude for this technology, they are drawn to it and desire to stay connected to it twenty-four hours a day, seven days a week.170

Millennials spend less than 5,000 hours reading before college, “over 10,000 hours playing video games, over 200,000 emails and instant messages sent and received . . . [and] over 20,000 hours watching TV . . . .”171 In fact, they send and receive messages every few minutes of their waking day and

164. This generation is also known as Generation Y, Generation Next, Net Generation, Echo Boomers, iGeneration, and Nintendo Digital Generation. NEIL HOWE & WILLIAM STRAUSS, MILLENNIALS RISING: THE NEXT GREAT GENERATION 6 (2000); Rivera & Huertas, supra note 1.


166. Id.

167. Id. at 167-68. They grew up when the Internet caused great change to all traditional media. It is this exposure to the Internet that shaped this generation. Id.


feel anxious and nervous about being out of the loop if they do not. They are now spending more than eight hours a day exposing their brains to digital technologies. Tweeting, texting, Facebook, YouTube, Google, and Wikipedia are not great new innovations, but simply part of everyday life. There are even interactive experiences that can (and do) go everywhere with them now due to powerful new smartphones, tablets, and other technologies.

Millennials expect information to be both accessible and rapidly obtained. They use technology seamlessly and constantly. They maximize the multi-purpose functions of most electronic devices. It is not uncommon to see Millennials assembled behind a computer screen, operating four or five open windows, simultaneously texting, instant messaging, listening to music on their iPod, downloading the latest tunes using file-sharing software, uploading videos and photographs for their friends to comment on, and maybe even participating in a teleconference. They prefer these interactive media as learning tools and turn to YouTube and other video, audio, and interactive media instead of printed materials. In fact, the use of books, magazines, and newspapers is on the decline, while “YouTube logs an average of two billion views per day,” presumably as a direct effect of the ease and comfort with which the Millennials communicate through video.

Moreover, Millennials automatically go to the Internet to conduct research. They depend upon Google and other search engines rather than the

172. CARR, supra note 28, at 118.
173. SMALL & VORGAN, supra note 5, at 29. “An estimated 20 percent of this younger generation meets the clinical criteria for pathological [I]nternet use.” Id. at 30
174. Bohl, supra note 169, at 780 (“[A] survey of Gen X Y attitudes toward the [I]nternet found that instead of agreeing that it was ‘life enhancing technology,’ they tended to simply think of it as ‘life.’ ”).
175. Dalton, supra note 165, at 173.
176. Id. at 172.
177. Id. at 173.
178. Id.
179. Id.
181. CARR, supra note 28, at 87.
library. Additionally, due to their high use of the Internet and technology, Millennials do not look to instructions or manuals; instead, they experiment until they get it right. They prefer to piece together information from a variety of sources. They also do not strive to retain information because information is not hard for them to acquire—it is only a keystroke away. Thus, technology is now the conduit for most of the information that flows through the eyes and ears of Millennials and into their brains. Digital technologies exert a broad influence over all of their communications and thoughts.

As a result, the Millennials are constantly scrolling and clicking, exposing themselves to stimuli. They crave this stimulation. The scrolling and clicking that they do on a web page involves physical actions and sensory stimuli that are different than those involved in holding and turning the pages of a book. These differences are altering the neural pathways and resulting in changes to the physical landscape of the brain. Simply, Millennials’ exposure to technology is causing their neural circuits to rewire as a result of the brain’s ability to be “plastic.” Plasticity applies to young and old brains, but young brains are more plastic. This is evidenced by the fact that young brains more readily master new skills, such as learning a language. Exposure to technology has profound structural and functional effects on young, plastic minds. Younger brains also are more easily susceptible to the changes the digital technologies are making to the brain because they are habituated to distraction and to switching focus.


184. Cooney, supra note 180, at 505, 506.

185. Id. at 505.

186. Dalton, supra note 165, at 176.

187. Id.

188. See id.

189. SMALL & VORGAN, supra note 5, at 24.

190. CARR, supra note 28, at 90.

191. See generally BEGLEY, supra note 34, at 76 (The reason the young brain is “more” plastic is because it has a redundancy of neural connections).

192. SMALL & VORGAN, supra note 5, at 8.

193. Id.

194. Richtel (Nov. 2010), supra note 139.
Given the plasticity and the repeated technological experiences that the Millennials have had, particular parts of their brains are larger and more highly developed. However, this same brain plasticity, accompanied by high Internet exposure, has resulted in many Digital Natives with weakened frontal lobes. The neural circuitry, and in turn the brain regions that are usually associated with traditional learning methods, are less developed in Digital Natives. “Children raised with the computers think differently from the rest of us. They develop hypertext minds. They leap around. It’s as though their cognitive structures were parallel not sequential.” Their brains now expect to take in information the way the Internet distributes it. Moreover, their brains become accustomed to switching tasks, resulting in reduced attention spans. As a result, they are reading at a superficial level, are distracted thinkers, exhibit diminished concentration, and only gain a shallow understanding of material.

V. THE RESULTING DEFICIENCY IN SKILLS AND ITS IMPACT ON LEGAL EDUCATION

As a result of the exposure to digital technologies and the resulting physical changes to the brain, Millennials are reading at a superficial level with little concentration or contemplation. They are searching for key terms and skimming the text surrounding the key terms instead of reading line by line. They are bouncing from article to article, barely reading more than a page per article. They are power browsing, which focuses on immediacy of information and efficiency. Power browsing weakens deep reading and impairs understanding. This type of online browsing demands the reader to consider and process hypertext links, and such browsing increases the

196. SMALL & VORGAN, supra note 5, at 186.
197. Id. at 26.
198. Prensky, supra note 171, at 4 (internal quotations omitted).
199. See Carr, supra note 28, at 90.
200. Rightel (Nov. 2010), supra note 139.
201. Nicholas Carr argues that our knowledge is becoming fragmented by the use of the Internet, specifically search engines. He further argues, “We don’t see the forest when we search the Web . . . . We don’t even see the trees. We see twigs and leaves.” Lehrer, supra note 158.
203. See Carr, supra note 28, at 90.
204. Id.
205. See id.
reader’s cognitive load thereby weakening the ability to comprehend and retain what is being read. Erping Zhu, a researcher at the University of Michigan, performed an experiment that studied the influence of hyperlinks on comprehension. Her experiment concluded that comprehension declined as the number of links increased due to the cognitive overload that resulted from having to consider the hyperlinks. Diana DeStefano and Jo-Anne LeFevre performed an experiment that similarly concluded that the increased demands of decision making and visual processing in hypertext impair reading performance. Other research also showed that “people who read linear text comprehend more, remember more and learn more than those who read text peppered with links.”

Because of the change in the way Millennials are reading, literary reading has declined by 28% in 18 to 34 year olds since 1982. PSAT scores in reading and writing are dropping; critical reading skills scores have dropped 3.3% and writing skills scores have dropped 6.9%. Other studies show the decline in basic reading skills over the past two decades as well. Jane Healy, an educational psychologist, has documented that reading, writing, and attention spans are on the decline. Teachers note loss of reading flu-

206. Id. at 126.
207. See generally Erping Zhu, Hypermedia Interface Design: The Effects of Number of Links and Granularity of Nodes, 8 J. EDUC. MULTIMEDIA & HYPERMEDIA 331, 331–58 (1999).
208. See id.
209. Carr, supra note 28, at 129 (identifying DeStefano and LeFevre as psychologists with the Centre for Applied Cognitive Research at Canada’s Carleton University).
211. Carr, supra note 28, at 127.
214. Affleck, supra note 104.
215. Id. (citing Robert Shaw, The Epidemic (1st ed. 2003)).
ency and comprehension skills.216 Even law professors have specifically noted a decline in their students reading skills.217

This type of reading and lack of concentration and contemplation is impacting legal education because these are core lawyering skills,218 and the Millennials are inadequately developing these skills.219 Studies show that as a result of combining reading with other media activities, such as computer or television, nearly two-thirds of all Millennials are reading superficially and lack active reading habits.220 This type of reading, and the resulting minimization of comprehension and contemplation, is causing Millennial students to lack the ability to critically evaluate information.221 They believe gathering a high volume of information will provide the answer.222 They do not recognize that “the ability to deal with complex and often ambiguous information will be more important than simply knowing a lot of facts or having an accumulation of knowledge.”223 A reduction, or lack of development, of critical reading skills, which is an essential tool of a lawyer, is interfering with their ability to conduct case analysis, statute analysis, synthesis, and application.224 Gathering facts with integrity, writing with clarity, thinking with purpose and consistency, and speaking persuasively are also tools of a lawyer that are dependent upon these same reading skills.225 Given their weaker reading skills and their lack of ability to concentrate and contemplate ideas, Millenni-
als are struggling with these skills as well.\textsuperscript{226} For example, Millennials will copy portions of a case and paste them into another document without completely reading the case or considering the context of the copied portion.

This type of reading also alters the way Millennial students understand and conduct research because it obscured them of the law’s structure and legal context.\textsuperscript{227} The Millennials, because of the way they read, are not conducting research in a linear way, and as a result, it is harder for them as legal researchers to determine the legal context surrounding an issue and to draw comparisons to other legal principles.\textsuperscript{228} Because they read in this hyperlink fashion, an understanding of the division of sources between cases, statutes, and secondary sources is not obvious to them, and it leads to a misunderstanding of the structure of the law and an inability to research the law conceptually. Thus, a lack of cognitive process in reading has a big impact on legal education because critical reading is central to the concept of critical thinking, yet another key component to lawyering.\textsuperscript{229}

Along with the reading struggles, Millennials also tussle with grammar and syntax.\textsuperscript{230} This is occurring because Millennials have been conditioned through texting, tweeting, and instant messaging to write in a short, abbreviated form, often with no attention to proper spelling or grammar. This conditioning impacts negatively on a law student’s ability to write well-constructed legal documents, client letters, memos, and briefs. Grammatical knowledge also impacts one’s ability to understand the relationship concepts within a sentence and can lead to errors in legal documents.\textsuperscript{231}

VI. WHAT DO WE DO?

“The brain can right itself if we’re aware of these issues.”\textsuperscript{232} So, we do not have to become techno-zombies. Some researchers and scientists “have shown that we can intentionally alter brain wiring and reinvigorate some of these dwindling neural pathways, even while the newly evolved technology

\textsuperscript{226} See Carr (2008), supra note 127, at 90.

\textsuperscript{227} See Barbara Bintliff, Context and Legal Research, 99 Law Libr. J. 249, 259–62 (2007) (suggesting the Internet dismantles the structure of the law because the Internet retrieves content in its own way).


\textsuperscript{229} Curtis & Karp (2005), supra note 217, at 295.

\textsuperscript{230} Affleck, supra note 104 (citing C. Moritz, Was’ Up Wif English?, Joburg’s Child, July 2006).


\textsuperscript{232} Harris, supra note 85 (quoting psychiatrist, Dr. Gary Small). The brain has the capacity to grow, change and repair throughout life. Chapman, supra note 104.
circuits bring our brains to extraordinary levels of potential." As proof that our brains can be "unwired," Dr. Small and UCLA Research conducted an experiment where they took a group of research subjects and modified their technology and exercise habits. Particularly, they limited their use of technology, conducted cardiovascular conditioning, memory exercises, relaxation techniques, and fed them a healthy diet. "After just two weeks, [they] found significant improvements in memory scores, as well as dramatic changes on their PET scans, demonstrating increased mental efficiency in the front part of the brain, which controls short-term memory and complex reasoning."

The study results indicate that we can help our brains better adapt to this constant influx of stimulation. We can start by taking control of our neural circuitry by making informed choices about the quantity and quality of our brain's exposure to digital technology. We can balance online and offline time. We can and should flex the brain muscle in non-technological ways. As law professors, we need to make our students aware of the fact that they need to unplug and use their brains in other ways. We need to explain to students that while technology has many benefits, it is altering their brains and impacting their reading comprehension, concentration, and contemplation skills and that, as a critical part of maintaining those skills, they should exercise their brain in non-technological ways. By doing this, they will be able to minimize exposure to digital stimuli and slow negative alterations of their neural pathways.

More particularly, we should explain to students how their brains work in general and then make the students aware of the limits of their working memory. We can explain to students that they can maximize their learning by trying to work within their working memory's cognitive load. One of the ways for students to work within their cognitive load is to reduce distrac-

233. SMALL & VORGAN, supra note 5, at 21.
234. Id. at 122.
235. Id.
236. Id. at 122–123.
237. Id. at 4.
238. Id. at 22.
239. Harris, supra note 85; see also Chapman, supra note 104 ("To maintain your brain health, shut off your cell phone, turn off the computer and limit your use of technology to certain hours of the day.").
240. SMALL & VORGAN, supra note 5, at 120.
242. Id. at 45–46.
Encourage students to put away the technologies when trying to learn new, complex, legal concepts in class. We can also encourage them to read class assignments and study at home with their cell phones, iPods, and other digital devices turned off. We should encourage book reading versus online reading so that all reading is not taking place online. As professors, we can minimize distractions in our lectures and PowerPoint presentations to ease our students' cognitive load. Studies show that distractions in presentation style can substantially impair learning. Minimize or eliminate use of irrelevant sounds, music, and animation in PowerPoints. Also, reduce visual distractions by simplifying the PowerPoints and using the same style throughout the PowerPoint, i.e., by using a minimal number of colors, the same font, simple templates, and unobtrusive transitions.

One of the other ways for students to work within their cognitive load is to relate new information to data already stored in their long-term memory. Encourage students to relate new topics to material previously covered. Also, as we teach materials, professors should draw connections between material previously taught and mastered by the students.

Because of the new neural pathways that have been formed as a result of the constant exposure to digital technologies, professors need to improve Millennial students' reading abilities. Professors must take an interest in teaching reading skills, despite the fact that law professors often feel that reading is a skill students should have already acquired. In order to improve students reading skills, which are deficient because of the new neural pathways, we should teach law students how to critically read both in printed and electronic text. This means we need to teach students how to evaluate, draw inferences, and arrive at conclusions based on evidence while they read. We can accomplish this by teaching our students the following:

243. Id.

244. Id. at 56–57.

245. Id. at 56 (asserting that sounds reduce students' retention of relevant material and reduce ability to apply concepts to new situations); see generally Richard E. Mayer & Roxana Moreno, A Coherence Effect in Multimedia Learning: The Case for Minimizing Irrelevant Sounds in the Design of Multimedia Instructional Messages, 92 J. EDUC. PSYCHOL. 117 (2000).

246. Merritt (2008), supra note 241, at 56–57. "In one survey, 91% of students opposed the use of PowerPoint's sound effects in class; similarly, almost three-quarters of the students disliked animation." Id. at 57 (citing Wim Blokzijl & Roos Naeff, The Instructor as Stagehand: Dutch Student Responses to PowerPoint, 67 BUS. COMM. Q. 70, 73 (2004)).


248. Curtis &. Karp (2005), supra note 217, at 304. Critical reading is a skill that can be taught. Id.

249. Id. at 294. Critical reading is creating meaning within the text. See id. at 296.
(1) recall prior knowledge and mentally connect new information with that knowledge as they read; (2) monitor and repair comprehension by rereading and skipping ahead; (3) analyze text to determine important ideas before, during and after reading; (4) summarize and synthesize to check comprehension; (5) draw inferences from prior knowledge and text to fill in the gaps; and (6) ask and answer questions while reading to check comprehension, clarify ideas and focus attention.250

We can teach this by breaking down critical reading into three subparts—pre-reading, active reading, and post-reading—and by explaining those parts.251 Pre-reading is an awareness of the purpose for reading followed by a preview of the material.252 This is accomplished easily in both the print and electronic world.253 First, inform students that they need to be aware of their purpose for reading the information, so that they can focus on the relevant aspects.254 Next, have them preview the text, whether it is by flipping to the Table of Contents or by scanning hyperlinks on a digital device without clicking on them.255 This allows students to gather the needed background information while avoiding issues with the actual reading of the material.

Active reading is an actual interactive process with reading by highlighting, annotating, or taking notes.256 This process causes the readers to think about the material they are reading and not just pass their eyes over words.257 Active reading is harder to accomplish in the digital world because you cannot take a highlighter or pen directly to the paper.258 So, students need to learn how to use various computer functions to engage with the material if they read digitally. For example, they should use a variety of techniques available on the computer such as, highlighting, using flashing text,
altering fonts, enclosing text in boxes, etc. Active reading skills are important because reading a case is not simply pulling information from the text; it is a matter of interpreting and creating meaning within the text.

Lastly, post-reading is meant to reinforce and cement concepts learned. In both the paper and digital world, questions should be asked that elicit more than just a summation of the material read. In the digital world, professors can insert questions directly into the text. In the print world, the student and professor should pose questions about the material.

A way for professors to help students understand the concept of critical reading is not only to discuss critical reading, and what it is, but also to model it for students. The professor can talk about why they are reading a particular case. It has been shown that what is discussed prior to the text being read can influence the students' understanding of the material. Then, the professor can offer a framework to review an opinion, by annotating and highlighting an opinion to share with the students. Once the modeling is complete, the student can then model the behavior by highlighting and annotating a new, simple opinion. The professor can follow that up by debriefing and posing questions that cause the students to self-reflect on the material read. When students run into questions on the next assignment, professors can refer the students back to their critical reading skills to help them solve their questions. Professors need to continually reinforce critical reading throughout the students' legal education.

Also, since the structure of the brain changes whenever a person pays attention to a certain experience, students should also be able to learn to focus and control their attention. Scientists recognize that attention training is important given that it can be a gateway to plasticity. Explain to students...
that they need to develop the skills to resist the urge to see what their friends are doing on the latest, digital, social media site. Students need to train themselves to sit and focus on their work uninterrupted. For example, students should practice reading an article in its entirety without going to a hyperlink or conducting another activity. Students should practice taking notes about the reading without checking their text messages, listening to their iPods, or surfing YouTube.

We should encourage our students to allow their brain to have true “downtime.” The brain needs downtime to process information. Students can give their brains downtime by restricting all technology before sleep or by engaging in mindfulness or meditation exercises each day. This will help students make lasting connections to the new material learned that day.

Limiting exposure to digital technologies or balancing technological time versus non-technological time, using critical reading skills, learning to minimize distractions, and allowing downtime, all can help activate the portion of the brain being deteriorated by the exposure to constant digital information, which will improve reading comprehension, concentration and contemplation.

VII. CONCLUSION

This article has explained the basics of how the brain is structured and functions. It has shown that science now believes the human brain to be plastic and capable of change—that is it not hard wired from birth. The brain forms new neural connections when it is exposed to new experiences, especially repeated experiences. It also has shown that digital technologies are experiences that alter the brain. “The current explosion of digital technology not only is changing the way we live and communicate but is rapidly and profoundly altering our brains.” Specifically, the Internet is constantly stimulating our brains which in turns alter the neural patterns.

From MRI images, scientists and neurobiologists can see the Internet is altering the frontal lobes of our brains and impacting working memory, which in turn is impacting our abilities to think deeply and to concentrate. We are trading the calm, focused, undistractable, linear mind for a “new kind of mind that wants and needs to take in and dole out information in short, disjointed often overlapping bursts—the faster, the better.”

Millennials are making up the bulk of our law school students, and Millennials have an unprecedented exposure to the stimuli involved in the digital technologies. As a result, Millennials' brains are physically different, which

269. Chapman, supra note 104.
270. SMALL & VORGAN, supra note 5, at 142.
271. CARR, supra note 28, at 120.
272. See Chapman, supra note 104.
273. CARR, supra note 28, at 10.
is causing the students to struggle with reading comprehension, concentration, and contemplation. "The division of attention demanded by multimedia further strains our cognitive abilities, diminishing our learning and weakening our understanding."274 Without these skills, legal education is being impacted. Students are not reading sufficiently and, thus, fail to fully gain an understanding of the law. Poor reading skills are also negatively impacting students' research skills, thus further inhibiting their ability to comprehend the structure and context of the law. This article concluded that despite these physical changes to the Millennial students' brains, changing the brain is possible. As professors, we have to make concerted efforts to teach students about technology and what it is doing to their brains. We have to direct students towards non-technological time and we have to teach reading skills.

In conclusion, the influx of information that we, and even more particularly the Millennials, receive when we go online overloads our working memory and makes it harder for us to concentrate on one thing. Our brains struggle to sufficiently store the great influx of available into long term memory, and students struggle to form the schemas needed for true knowledge. And because of the brain’s plasticity and its ability to alter our neural pathways, the more we use the Internet, the more we reshape our neural pathways and train our brain to process information quickly but without attention—to be distracted. As a result, students are finding it harder to focus, concentrate, and remember, even when away from our computers. This is causing students to become more dependent upon the Internet, creating a self-perpetuating cycle. Nicholas Carr well summarizes the problem when he says, "[A]s our use of the Web makes it harder for us to lock information into our biological memory, we’re forced to rely more and more on the Net’s capacious and easily searchable artificial memory, even if it makes us shallower thinkers."275 So, that is the Millennials’ (and our) brains on Google.

Has the way you THINK changed?

274. *Id.* at 129.

275. *Id.* at 194.