The internet has successfully rewired the way our brains work today

By Charles Ng

NGCHARL2

1001720097

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# Abstract

This paper will explore how the internet rewires our brains to form bad habits, and cause us to stick with those bad habits instead of going back to the habits we formed predating the internet. Following on that topic, there will also be examinations and analysis on how the internet causes many users to develop some sort of anxiety or depression, which is sign of our brain structure changing due to the internet. This topic is significant because it is vital for those who are affected to know how deep these effects are on our brains, since anyone that will be affected will likely be using the internet daily and the internet has many daily users who use the internet many hours at a time. Lastly, this paper will look into possible solutions that people can apply if they find that the effects that internet has had are negatively affecting how they function on a day to day basis. Also look at proposed break-up plans that researchers have designed in order to get rid of internet addiction and lessen the effects on our brain. Ultimately, my paper will seek to answer the question of how the internet manages to rewire our brain structure, by exploring how the internet currently affects our brain by looking at scientific papers and why the internet can so easily rewire our brain to form different reading habits than the ones we formed before.

# Introduction

The internet has been slowly obtaining world domination with more people being glued to their screens than ever before. Whether it be for entertainment or work, it is nearly impossible to avoid using the internet on a day to day basis. One of the most impressive characteristics about the internet is the vast amount of information scattered across the interwebs waiting for users to digest and utilize in their lives. We click on articles in order to read information about subjects we have not been informed on yet to gain knowledge to be used for the future. However, is this enormous amount of information actually useful to humans? There is a lot of scientific research that shows the information on the internet is hindering our ability to properly read and digest information. The neural networks in our brain have been showing signs that the internet has changed the way humans read text, favoring a more scanning approach when a user sees text on the internet. Humanity evolved with reading on paper and symbols, not scanning and skimming through and article scrolling up and down to quickly finish “reading” an article to get on with the next activity or article on the internet. Furthermore, when scanning or skimming through text with various links embedded, it becomes increasingly hard for the user not to be distracted and switch trains of thoughts constantly. These distractions coupled with the lack of deep concentrated reading leaves the reader unable to properly understand and interpret the text they read. A UCLA study in 2008 showed that “people with minimal experience, performing Internet searches for even a relatively short period of time can change brain activity patterns”. (UCLA, 2008) This study shows that even using internet even a little bit already changes our brain chemistry, introducing the idea that maybe humans are not evolved to mentally deal with something as powerful as the internet. Furthermore, that study was done a little bit over a decade ago when the internet was not as aesthetically pleasing and the connection was not as nearly as fast as our download speeds today. There is no question that the internet today provides way more stimuli, and is way more instantaneous which may be additional factors to why the internet causes our brain to change so dramatically. A book called “The Shallows: What the Internet Is Doing to Our Brains” by Nicholas Carr argues that google makes us stupid, and uses multiple scientific studies like the UCLA study to back up his argument. An interesting example Carr uses is to consider our memory as a bath tub, and when we try to process information from the internet we end up scanning pages and clicking links to other pages of information, the knowledge we tried to process ends up being diluted droplets from a faucet dropping into our bath tub of memory. There is a coherent stream of information when you read a book but when you use the internet instead we receive multiple droplets of information reaching our bath tub. This is due to articles being riddled with links, pictures, distracting ads and then on the side of the text will be other articles tempting you to click over. Furthermore, if you do click away from the page, your brain would not have properly processed the information and as a result will not retain that information as well as reading a book. (Sehgal, 2016) For this paper, instead of arguing that the internet makes us inherently dumber, it would be more useful to see how the internet has changed how our brain functions on a daily basis and what negative effects may occur as a result. This topic is very much relevant and should be of public interest because kids are being exposed to the internet at a very young age, if internet usage turns out to be extremely harmful for the brain, counter-measures and awareness need to be spread in our society to help arm these young users the tools they need to form a healthy relationship with the internet. There is no question the internet provides us with many helpful tools that may not negatively affect the brain at all such as Google maps, or bus schedules. However, finding out what kind of negative effects it has on our brain will be able to inform us to make better choices on our internet usage in the future. This is very helpful information for a modern society where employees may be required to use the internet to do their job, or for the people who use the internet to stay connected with their peers. It is preferable for those users to at least know what side effects are happening to their brain, rather than them being in the dark about these possible effects that internet usage comes with.

## How our brain works

Before we discuss what the effects the internet has done on our brain, we have to understand a bit more about our brains before we can properly gauge what the internet has been doing to human brain. The two main features of the brain to be covered is that the brain is similar to plastic, and that the brain’s memory works just like how a computer utilizes RAM and a hard drive. These two aspects are important because it turns out our brain physically changes when we repeat habits and one of the main reason why the internet is so dangerous is due to its ability to overload our memory. I will first go through the memory aspect of our brains, then transition into our brains being malleable like plastic and combine those two characteristics of our brain to show why the internet is so effective in rewiring our brain.

# Computer memory is very much alike Human memory

An Australian educational psychologist named John Sweller studied how our minds process information for nearly three decades. He explains, “incorporate two very different kinds of memory: short-term and long-term” (Sweller, 1999) which is eerily similar to how computer incorporates memory with having RAM for short-term memory and a hard drive for long-term memory. Furthermore, just like a computer, humans hold our immediate thoughts in our short-term memory, more specifically the human brain has a working memory which is integral in transferring memories from short-term to long-term strikingly similar to how computers function. Moreover, human’s working memory is sizably smaller in capacity compared to the long term memory, however unlike a computer humans can only distinguish when a memory becomes long-term if its recalled up from long-term back to the working memory. (Carr, 2010)

## Information overload:

Books were one of the most popular forms of media before the internet became the big economical phenomenon that attempts to keep us connected today. The medium allows the reader to be engaged, and process the information thoroughly due to the low amount of stimuli and external distractions produced when reading a book. Due to the low stimuli, the brain maintains a meditative state where the brain clears out its working memory, and allows the brain to concentrate on the text for a deeper understanding. During prolonged and undistracted reading sessions, the reader’s working memory will be able to efficiently process information and store it into the long-term memory; furthermore as the reader progresses, they are forced to recall information from previous pages which essentially ferments the information into the long-term memory. (Carr, 2010) Sweller’s research also backs up these claims as he says that the current evidence shows that “we cannot process no more than two to four things at any given time with the actual number be at the lower end rather than the higher end” this research shows that the human brain cannot handle too much information at a single time. (Sweller, 1999) This is the first problem that arises with the internet. In contrast of the low capacity of information our brains can handle at any given moment, the internet is continually blasting us with an insane amount of gratification and information with a few simple clicks; causing our brains are being hit with a lot more information than the threshold Sweller mentioned. Even nearly two decades ago, back when the internet still in a very raw state, Sweller concluded that our human brain likely cannot handle the amount or the speed of information the internet is throwing at us. (Sweller, 1999) With this in mind, it is quite easy to conclude that the flourishing internet we have today is very likely way too much for our human minds to handle with the insane amount of multimedia distractions and the ever growing database of information readily available at any given moment. The problem with too much information going into our brains is that we are unable to process it all, and in order to keep up with the endless stream of gratification and information we do not process the information we read on the internet with as much detail as the understanding we receive from deep reading.

## The studies are telling

An older study by Niederhauser compared two group’s ability to comprehend what they just read; one group used electronic documents with links to other documents, while another group used traditional paper documents. The result is that the traditional document group demonstrated a better ability to retain and critically comprehend the text they had just read, this kind of result holds true for many similar studies that came after the one by Niederhauser. (Niederhauser, 1999) All these studies found that when the hypertext group is presented with links, their cognitive ability is then used to decide whether to click the link or not, when this decision making process occurs our brains ability to store and process information in the working memory is halted in order for our brain to make the decision on whether or not we should click a link. Even if this decision happens within milliseconds, this cognitive load adds up over time due to the sheer amount of distractions pages on the internet contains since time spent on the website is money earned by these companies who depend on online traffic for revenue. In addition, if the user does decide to click on the link, they are brought to a different page distracting them from the main text, causing the brain to switch gears and clear the working memory to make way for new content. Furthermore, the main way we read when we browse the internet is skimming or scanning the page for key parts, which is our brains attempt in trying to fit all the information we are looking at once, so instead of intently reading a sentence on the internet we ignore most of the information on the page and try to find content we deem important enough to pass towards our working memory. To add on to this, the average amount of time spent on a website is 10-20 seconds (Nielsen, 2011) the miniscule amount of time combined with the skimming text technique combines for a very scattered brain, causing the user to jump from webpages that contain a tonne of information, while the user retains very little the content. There are multiple studies and statistics that support the change in our approach to reading text, but is this paradigm shift noticed by the readers themselves? Turns out, people have noticed their reading practices have changed as well, a library science professor named Ziming Liu surveyed over one hundred well-educated people between thirty and fifty years old, and nearly 85% of them reported that they spend much more time skimming research documents than explore topics deeply and extensively. Liu concludes that “the flood of digital text causes people to spend more time reading, but it’s a very different kind of reading… characterized by browsing and scanning, key word spotting, and non-linear reading, while the time spent on in-depth reading and concentrated reading is falling steadily”. (Liu, 2005) Skimming is not inherently bad, there are benefits to being able to skim text and pick out important pieces of information efficiently. However, the problem with the internet today is the novelty is endless which will inevitably overload our working memory, causing us to replace our deep reading abilities with fast skimming and scanning abilities in order to cope with the huge amount of information being passed through our brain. Thus, the internet may not be necessarily making us inherently dumber, but there is definitely a sense of making us more mindless when reading textual content. Regardless if the text is electronic or is a book, the internet is severely hindering our ability to retain information in general.

## Some counter points:

Some good counter arguments to the above points is, why not just simply avoid the internet all together if you want to keep your deep reading abilities? Well, it is simply not that easy to avoid the internet cold turkey in this day and age, there is no denying the internet provides many benefits to society like maps or food ordering services for example. In addition, most typical office work consists of utilizing the internet in some form, making it nearly impossible to avoid it especially if the internet is tied to your main source of income. Furthermore, the wealth of knowledge uploaded on the internet is staggering, and unlike our ancestors we have access to this information at any given time. Avoiding the internet means we would lose access to the biggest library of information mankind has ever seen in all of its existence, putting internet avoiders at a distinct disadvantage. Internet users these days no longer need the ability to retain pieces of information in our long-term memory, if we can simply pull out a device connected to the internet and search it up faster than our brain can piece together the knowledge we required. Some may argue that trading our ability to read deeply for the quantity of knowledge at our fingertips is worth it, however I would counter that being unable to properly process that knowledge with quality makes the trade unfavorable. Furthermore, the fact that society is trading away their ability to be concentrated to read and fully understand some text means that even if important article is posted, we will rather stick with reading the headline which is actually causing a rising problem of fake news in our society today. Another good counter argument is: why don’t we simply choose to consciously stop scanning text and switch back to deep reading? Unfortunately, it turns out that our brains are not very good at removing habits once built since our brain is not good at detecting whether the habit is good or not, and once developed new habits our brain will favour keep reusing those new synapses and cast away the old ones for more space.

# Our brains are basically plastic:

When plastic materials are heated to a certain temperature through a specific heating process, the plastic can be poured into a variety of moulds and shapes and once cooled and solidified it retains its shape from the mould. (The Warren, 2019) It turns out that our brains functions very similarly, we can create habits from repeating the same action over and over, and our brain will create synapses to connect different brain cells in order to make that action happen more efficiently for the brain, these synapses will be moulded onto our brain for future use when we want to repeat the action. Furthermore, these habits locks us into rigid behaviours once the synapses link together with the new circuitry, our brain wants to keep using those circuits to keep them activated in order to keep these new routines to be even more efficient. (Doidge, 2016) Furthermore, just as our brain can create new synapses and link neurons, we can as easily lose those mental skills we previously learned as our brain tries to create new space for other skills that our brain uses more often. (Doidge, 2016) This means deep reading is not a skill like riding a bicycle where you will always know how to, it is more akin to a skill like knowing how to play a piano piece, as you practice the piece more you will get better at playing with a higher degree of accuracy, but once you stop practicing and try to play it out of the blue, your brain will have already gotten rid of those mental links used for the piano piece before and not be able to perform as well. This shows that our brain does not want to simply change back to the old state of deep reading after creating and using the synapses formed to scan web pages and text, it would take a long process in order to undo these habits and would not be an overnight change. Moreover, from the many applications that the internet offers, many of them provide us with instant gratification with pretty visuals or funny videos causing the amount of dopamine generated in our brains to spike. These applications would make it even harder for our brain to disconnect from the internet since our brain will feel withdraw symptoms similar to drug addictions. (Schwartz and Begley, 2013) There are other studies that show that dopamine drops in the brain may be related to depression or other symptoms such as anxiety or suicidal thoughts. (Cadman, 2018)

## Rise of anxiety:

After becoming so efficient at browsing the internet, when it comes time for us to disconnect, it may become difficult for some people to stay away due to the level of dopamine dropping from non-usage. Other than the massive library of information, another huge draw to the internet is the social aspect, articles have a comment section displaying’s other people’s reaction or outrage, pictures posted on social media have other people validating how pretty or handsome the user looks and there are multiple messaging apps that keep people connected every second of the day. The reason why this is very powerful is because human brains releases dopamine when we have successful social interactions (Haynes, 2018) this rewards beneficial behavior for human survival, in the past it was for humans to come together to gather food or hunt. Although we are not physically communicating with one another over the internet, simple comments or even likes provide us with positive social stimuli and activate the same pathways in our brain. (Haynes, 2018) Furthermore, even when we are not actively trying to socialize our brain will want to quickly check our phone for notifications to see if there are any awaiting social interactions to be resolved, giving our brain another hit of dopamine that it desired. Although wanting to stay connected with your friends and family is not inherently a bad thing, what is disturbing is the fact that our brains become so needy of these dopamine hits, that it may affect our focus in normal day life outside of the internet. Coupled with the fact that it is super easy to open our phone and check our messages in order to reward ourselves, that our brain will become accustomed to these social interactions and try to check social media or messaging apps as often as it can because the low amount of physical effort can result in a very high reward of dopamine. Furthermore, it turns out dopamine deficiency may lead to depression which causes unfavorable changes in the physical structure and chemical activities of the brain. The disturbing fact is that depression and suicide rates are steadily rising in our youths today, a scary trend that is strongly linked to the uprising of the internet. (Neighmond , 2019) Due to social media, young impressionable kids are easily vulnerable to the peer status and approval gratification that comes with social media. Social media targets a human’s fear of missing out by always constantly keeping users updated about their friends and changing content every time the user refreshes the page, this kind of variable reward system keeps users addicted because they need something new to get a hit of the desired dopamine. The fear of missing out coupled with the fact that they are also susceptible to the constant distractions from the various notifications social media hammers us with and the fact that younger users of the internet possess an even more malleable brain than an adult developed brain means that they will be forming bad habits with the internet early, and will take an even longer time to fix those habits if they choose so. Although it would be nearly offensive to say mental health issues means society as a collective is getting dumber, it is still true that the internet brings upon a lot of anxiety to people and we need to inform and educate younger kids who are getting their access to the developed internet at even earlier ages.

# Combining what we know so far

We have covered a lot of points, so now let us connect all the dots laid out. Our brains are malleable and are subject to change physically and mentally if one decides to stick with a new habit and repeatedly performing that habit. Moreover, our brain likes to keep habits so it will prefer to utilize the newly connected circuits in favour of previous connected circuits, and will even clear those synapses out for space for new habits to form if those circuits are not being utilized anymore. Due to the information overload the internet provides, our brain’s working memory is unable to handle deep reading of the massive amount of information being processed and will resort to scanning for key words instead of deep immersive reading to process all the information. Combined with the fact that our brain likes to keep new habits, many people that utilize the internet and have stopped reading paperback books might find it hard to access that deep concentration to decipher text and understand its meaning. While this may not inherently make us dumber, it does show that many people will not be control their attention and be more scatter brained when compared to the people that lived before the internet. Whether or not this new favoring of scanning text makes us dumb or not is subjective, however we can conclude many people today are more easily distracted while reading, thus a rewiring of our brain caused by the effects of the internet. Another rewiring of our brains caused by the internet is the rising anxiety levels in our society today, caused by the upbringing of the online social media and ease of access to instant gratification from the internet. Anxiety leads to depression causing chemical imbalance in the brain, and in extreme cases may even lead to suicide. These effects need to be carefully examined as we need to protect and educate the younger generation who are going to be raised with the internet connected to their lives the day they are born. (Side anecdote: I have seen babies in strollers holding their parents phones watching a kids show in the market place, and have seen other kids as young as 3 be able to navigate the ipad even faster than their parents) It is known that simply avoiding the internet is nearly impossible due to many jobs and livelihoods being intertwined with the internet today, so instead we should look at some possible solutions to resist the negative effects of the internet.

# Possible solutions:

“According to data from Moment, a time-tracking app with nearly five million users, the average person spends four hours a day interacting with his or her phone.” (Price, 2018) This is not adding onto the possible time spent on the internet due to the nature of a person’s occupation, thus the time spent purely on the internet is much higher than what is calculated by Moment. The amount of time being spent by the average person in our society on the internet is quite alarming, and makes it that much harder to disconnect because we have built a habit of spending a lot time on our phones every day. These solutions I am about to propose are not about disconnecting completely with the internet, these solutions are more about creating a healthy relationship with technology that keeps the internet beneficiary without putting our mental health on the line by having our brain rewire itself in undesirable ways. (Price, 2018)

## Pay attention

Our attention has become sources of revenue for these tech giants who strive to optimize their applications to keep users glued to their screens, instead of letting our brains scatter across the internet we should think more deeply and pay more attention to every piece of text we are reading on the internet. When deep reading, we eliminate external stimuli causing our brain to solely focus on the text in the moment in order to properly digest the information. By forcing ourselves to pay closer attention to what we are currently doing on the internet will slowly rewire our brain from the jumpy, text scanning habits into better deep immersive reading habits. (Price, 2018)

## Use our brain against itself

Like we covered before our brains are very malleable akin to plastic, so why not utilize this characteristic of the brain against itself. Whenever our brain feels the need for the hit of dopamine, capture that exact moment and fight against the wiring of our brains. We should utilize this moment to question deeply if we want to continue the negative rewiring of our brain that the internet causes and keep these internal thoughts as a cue for future reference in order battle the need to check our email, or look at notifications on the phone. By developing new simple habits that may hinder internet usage, we can build upon small victories that will lead us to our goal of not succumbing to our brain’s need for dopamine and stay in control. Furthermore, whenever we read an article make a personal rule to not jump through any links on the page until fully reading the entire article from top to bottom. This will also aid in helping the brain rewire itself into wanting to deep read and be immersed in the information more often allowing for a greater understanding of the text instead of wasting the time scanning and thoroughly understanding the material.

## Digital wellbeing

Our phones and computers today has many apps that help track your time on the platforms. This may help give a picture of how much internet usage you do in a day, and from that gather how much abuse the internet will be doing to your brain. Many of these apps are built into phones these days, which help track your time and lets you set limits to certain apps you find more distracting than others. Most likely after setting time limits on distracting apps our brain will want to quickly turn off the limiter and go back to sucking up the dopamine hits, when this happens it becomes a matter of willpower of fighting against the strongly formed circuits of the bad habits. When the bad habits want to reoccur we must search deep within ourselves and ask our self how much we want to stay away from the negative effects of the internet. Keep in mind, every time you open social media apps, those companies win again and gather your attention to sell it to the highest bidder to sell you more distractions, a never ending loop that we must break by starting with our own choices and decisions we make when using the internet. (Price, 2018)

# Conclusion:

Our brain has a working memory which allows us to transfer information from our short term memory into the long, which happens to have a very small capacity. The internet attacks that aspect by providing us with an insane amount of stimuli, information and gratification causing us to favor scanning pages for key information instead of deep reading. Once these scanning habits are formed, if a user of the internet does not participate in any deep immersive reading, the brain will rather become more efficient at scanning than reading with intent to digest information, causing our brains to be better at scanning text but worse at actually interpreting the text and understanding what was read. Furthermore, the nearly endless amount of novelty the internet provides us causes many people to suffer from dopamine withdrawals when away from the internet causing them to be addicted to the internet, or develop some form of anxiety or depression due to the brain chemicals trying to find a way to cope with the sudden dopamine hits combined the sudden lack of dopamine when away from the internet. Due to how our brains are malleable, these bad habits and negative effects the brain has suffered through the usage of the internet will take a lot of effort to change and rewire it. Going cold turkey may not be an available option if the internet is a source of livelihood so better solutions usually incorporate forming a better and healthy relationship with the internet instead of completely disconnecting. Ultimately, the internet may not necessarily make us dumber; however it does cause many negative effects and strains the brain often even when the user is not actively on the internet. These effects may cause a lower productivity, or a bad mood to surface during our daily lives and it is clear that we need to arm our younger generations with the knowledge and techniques to form healthy relations with the internet rather than letting them fall into the same traps that our current internet users have fallen into.

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