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Digital Disorders of Brain Chemistry: Birth to Adolescent

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ABSTRACT

Dopamine, popularly known as the "feel good" neurotransmitter, is released by the brain when you become addicted to your device and use it for extended periods of time leading to poor impulse control and behavioral changes. The current findings of neuroscience research on the potential impacts of digital media use on brain chemistry, cognition, and behavior have recently become a more popular area for study since the development of technology has become very advanced in the last ten years. My initial thoughts were that device usage had a major impact on the brain which was proven to be correct by multiple serious of data and analysis. After extensive research I was proven to be correct and found many reasonings for this outbreak which will be referenced later. This area of research is crucial given the significant amount of time teens spend in front of screens. Regardless of many beneficial features of digital media, this effect has an everlasting impact on our mental health and well being. The processing of psychological indications, the development of language, as well as internet/game dependency have all been linked to neurological effects. However, it is argued that neuroscientists need to include datasets with greater precision in terms of what is done on screens, for how long, and at what age since much of the neuroscientific research performed up to now relies exclusively on self-reported parameters to assess social media usage.

Introduction

What do you do right away after waking up? Do you brush your teeth? Use the restroom? Check the time? The first thing most typical teens do is check social media. Their attention is quickly moved to what their friends texted them last night or what the most recent instagram gossip is as soon as they can think of anything other than just 5 more minutes of sleep. They are unable to focus on anything besides this piece of technology because of their addiction. According to studies, 68% of students said that cell phone buzzing in class was the most prevalent electronic distraction, and 21% of them said that the noise was very distracting. Does it not disturb anyone that children are playing a mental game of tug-of-war with their devices in a place where they are supposed to learn and be educated? The adolescent mind is significantly impacted by this extreme addiction. Although most people react to these diversions in a more mature manner, this toxin can still have an impact on them. What do you do, for instance, if your hand accidentally touches a hot burner or pan? You yank your hand away, blow on it to ease the discomfort, and perhaps mutter. Nevertheless, in other instances, for those who are hooked, a voice in the back of your brain tells you that you can't remove your hand off that stove and that voice is forcing your hand on that stove even if it burns so badly. You are being told that you "need it and cannot live without it." When it's gone, you're left with no direction in life, no longer able to see the point in anything, and no idea of what you're supposed to be doing. Is it to scroll on TikTok endlessly? Is it to respond to each and every Instagram DM? Yet there are other issues with screens that teens are dealing with as well. Social media's wide range of users and viewpoints poses a concern; people break up with each other and destroy relationships over things they post on their stories. Teenagers worry a lot about what other people think of them, whether or

not their peers find them attractive and cool, and whether or not their post received a particular number of likes. Additionally, if they don't feel socially acceptable, they experience feelings of worthlessness and contempt, as if they are a nobody with no potential. Their emotional and mental health have suffered greatly as a result, which increases the risk of several serious mental illnesses. We need to figure out a means to stop this and assist teenagers in using their devices appropriately. But in order to help these young adolescents, we have to understand what is going on in their head. Some research has also proven that females are more likely to get mental illnesses due to their increased presence on social media.

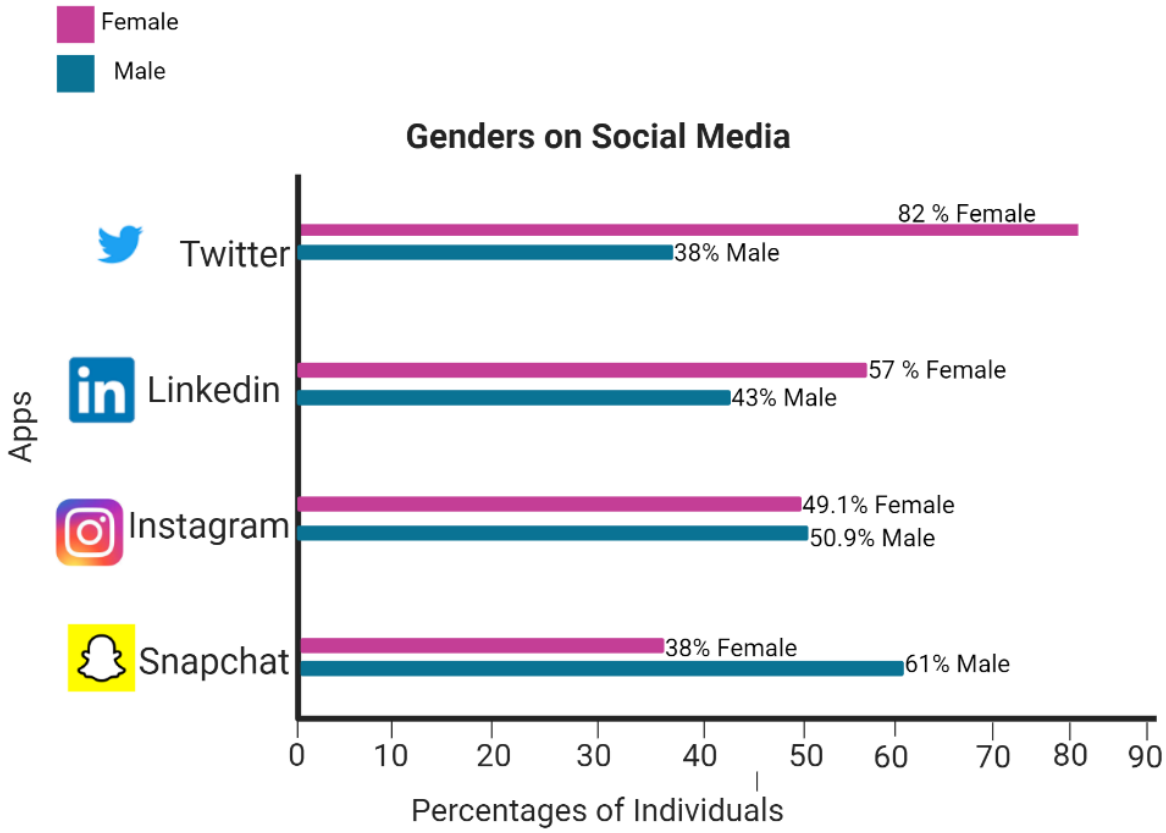


Figure 1. In this diagram the percentages of males and female who use specific social media apps have been displayed, research shows that since females on social media take up more population than men therefore they are more likely to get mental illness. Men don't use social media as much as women so they are less likely to get a mental illness.

Background Info

As teenagers, we are bound to make impulsive and irresponsible decisions most of the time. In our adolescent years, our brain is still developing, in fact it is the last organ to reach full maturity in our body. Specifically, the maturing path for the brain is typically from front to back meaning the first branch to mature is the brainstem and follows through the midbrain. Finally, at 25 years our brain reaches full maturity ending at the frontal lobe. The frontal lobe owns the responsibility of controlling emotions and decision mankind skills and if this is the last to reach full maturity, our impulsive and emotional responses will be increased. Since teens can't responsibly think and make decisions, they are vulnerable to addiction to their devices. In the duration of which our brain is still developing and growing, digital media will influence and mold how the brain thrives. Starting

around age 10, children's brains undergo a fundamental shift that spurs them to seek social rewards, including attention and approval from their peers. Although social media is a large support community, it has also been increasingly linked to mental health problems, including anxiety, depressive symptoms, and body image concerns. We all know mental health is a very common study in the modern day, we all know its important but what do we do to care for it? Communicating with peers is a necessity and crucial part of our day but communicating via text or voice message cuts off your speaking skills and your ability to have a conversation with someone face to face, including grammar and a proper flowing sentence. Also, people who use apps like Instagram, Facebook, or TikTok show higher signs of depression. Starting around age 10, children's brains undergo a fundamental shift that spurs them to seek social rewards, including attention and approval from their peers. Although social media is a large support community, it has also been increasingly linked to mental health problems, including anxiety, depressive symptoms, and body image concerns.

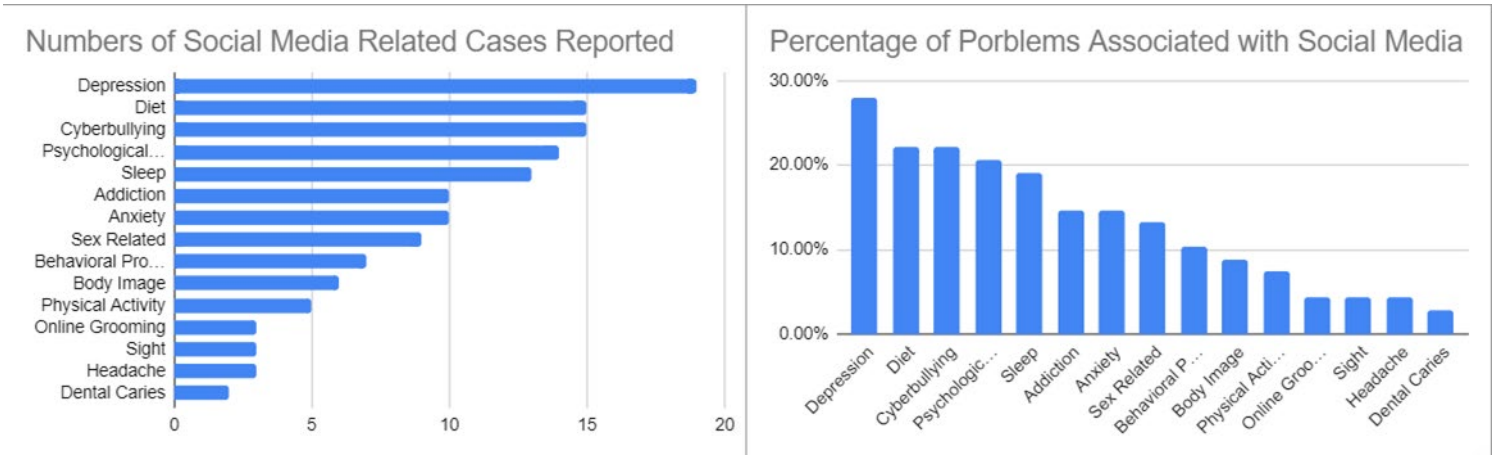


Figure 2.

Problem	Cases Reported	Percent
Depression	19	27.90%
Diet	15	22.10%
Cyberbullying	15	22.10%
Psychological Problems	14	20.60%
Sleep	13	19.10%
Addiction	10	14.70%
Anxiety	10	14.70%
Sex Related	9	13.20%
Behavioral Problems	7	10.30%
Body Image	6	8.80%
Physical Activity	5	7.40%
Online Grooming	3	4.40%
Sight	3	4.40%
Headache	3	4.40%
Dental Caries	2	2.90%

Figure 3.

Elaboration for Figures 2 and 3: Medical issues in children caused by social media. The table below lists the issues that were raised during the scoping review. The majority of the study (27.9%) focused on depression and was covered in 19 papers. Cyberbullying (15), psychological concerns (14), sleep troubles (13), anxiety (10), sex issues (9) and body image distortion (6) were also all topics mentioned in 15 complaints, in addition to diet-related disorders. Additionally included were dental caries (2 articles), headaches (3 reports), sight problems (3 reports), and online grooming (3 reports).

Alterations in Behavior and Mental Health Caused by Games/Social Media

Additionally, the overuse of screens may lead to disrupted sleep patterns, using screens before bedtime may lead to reduced sleep which affects your brain and may cause depression, low self-esteem, and decreased physical and mental exercise. Effects like these may be life threatening and could transform into very severe problems. In a study employing meta-analytic methods, the effects of violent video games on aggressive conduct, aggressive cognition, hostile mood, physiological arousal, empathy/desensitization, and prosocial behavior were investigated. Some of the distinguishing characteristics of this meta-analytic review include more stringent inclusion criteria for methodological quality than in prior meta-analyses, cross-cultural comparisons, longitudinal studies for all outcomes aside from physiological arousal, conservative statistical controls, multiple moderator analyses, and sensitivity analyses. One effect of digital media use to take into account is on motor abilities. Other affects include language, cognition, and visual object perception in the growing brain. In an experiment, a functional MRI was utilized to scan the brains of adults who had played Pokémon extensively as kids in order to investigate this. It was already known that the ventral visual stream's higher visual areas, particularly the ventral temporal lobe, are where object and face recognition occurs. Typical Pokémon figures are a blend of humanized animal characters and a special kind of item that isn't often apparent in human settings. In the

ventral temporal lobe near face-recognition areas, only adults with extensive Pokémon experience during infancy displayed distinct distributed cortical reactivity to Pokémon figures. These results show that, as a matter of principle, the usage of digital media can result in a distinctively useful and durable depiction of digital figures and objects, even decades later. Unexpectedly, the functional topography was the same among all Pokémon players.

The visual stream for Pokémon figures in the ventral region. Furthermore, it is unclear whether these findings simply demonstrate the brain's remarkable capacity for plasticity in developing new representations for novel classes of objects in the higher visual areas or whether the development of extensive object representations from digital media use may have detrimental effects on face recognition and processing due to competition for cortical space. In this regard, it is interesting that research on young adults' empathy have found a link between time spent using digital media and a decrease in their cognitive empathy for other people. It is still unclear if this is because of a lack of understanding of how other people could think (theory of mind), issues with facial recognition, or a lack of social interaction with peers (as a result of spending too much time online). It should be noted that several research found no link between empathy and time spent online.

Causing a Lag in the Learning and Functioning Process

Everything all comes back to the mental health of an an individual, their ability to learn, stay happy, and healthy. What makes these tasks possible is the synapses in one's brain. In Figure 2 above, you can see synapses, but what do they do and how do they help us learn? Positive and negative (brains may be vulnerable to negative things such as addiction, substances, digital media) When a child’s brain is under developments, a process called Myelinations takes place. Myelination is a wrapping process in which insulate connections take 25 years to complete. Many axons typically stay untainted throughout one's lifetime because myelination of the axons is not strictly necessary for neural function. Examples include a significant portion of the corpus callosum's axons and many autonomic nerves, particularly sympathetic ones. Nevertheless, myelination significantly accelerates the rate of conduction, and insufficient myelination can lead to synaptic blockages. In the central nervous system (CNS), oligodendrocytes, specialized glial cells derived from the neuroepithelium, and Schwann cells, derived from neural crest, generate the myelin sheaths of axons. At the spinal and cranial nerve roots, the change from oligodendrocytes to Schwann cells that produce continuous myelin sheaths is visible. The frontal lobe has less connectivity because the wrapping process works from back to front meaning the frontal lobe has less connectivity which explains behavioral issues within teens.

Moving on, magnetic resonance technology can be used to detect and measure important chemical contents within the brain. To be visible in an MRI image, a chemical must respond in a unique way to magnetization and energy stimulation, and it must be present in relatively high concentrations. Synapses are the tiny gap between neurons which send signals to the other neuron. How they work is when the nerve impulse reaches the dendrites at the end of the axon, chemical messengers called neurotransmitters are released. These chemicals diffuse across the synapse (the gap between the two neurons). The chemicals bind with receptor molecules on the membrane of the second neuron.

Figure 4:

The Reward System

When it comes to the reward system, synapses constitute its essential functional element. It Each cell in the reward circuit communicates electrical and chemical signals when it is turned on.

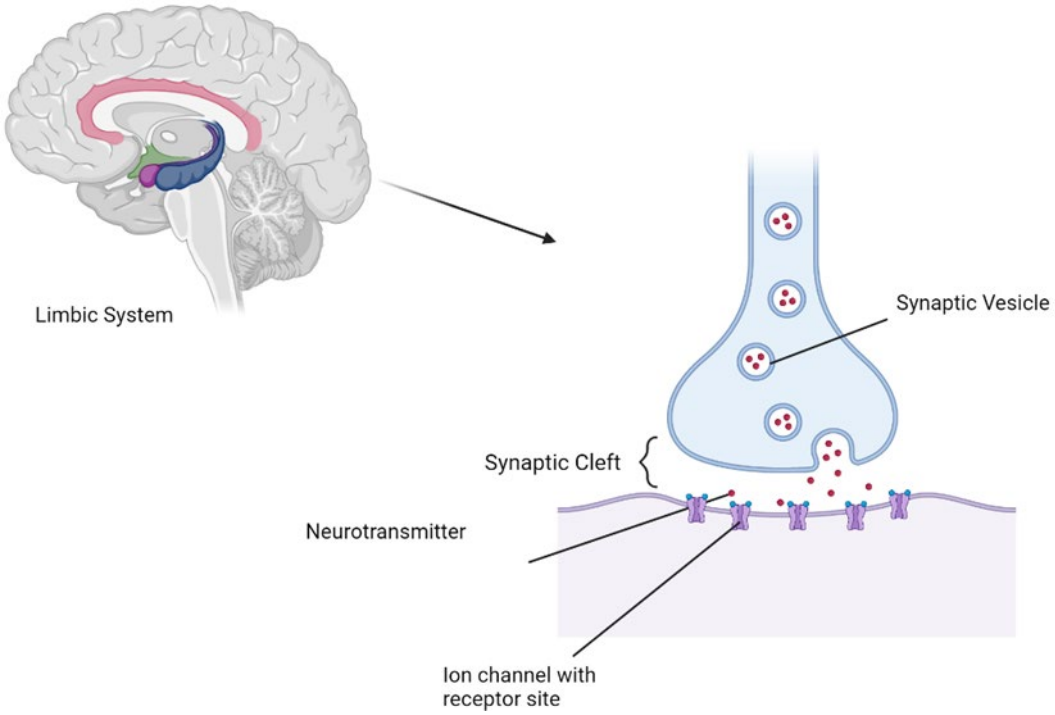
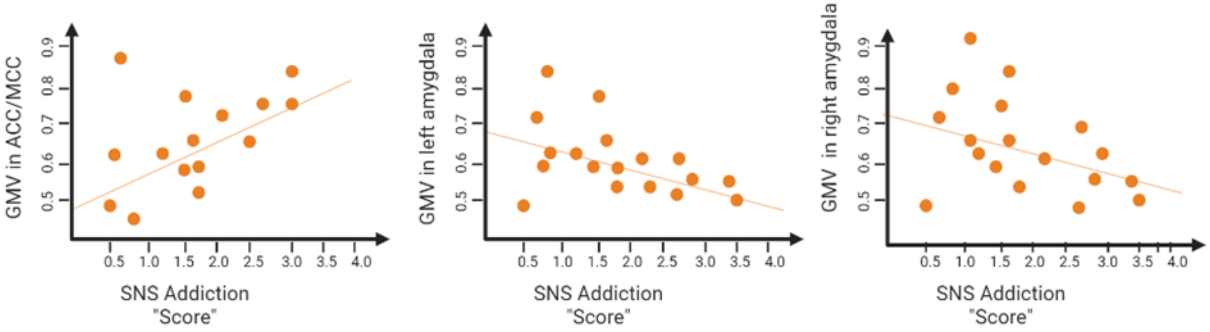


Figure 4. The synapse is the microscopic space between the sending and receiving cells. Dopamine neurons release the neurotransmitter dopamine in the reward circuit. Dopamine receptors are proteins on the surface of the receiving cell that the released dopamine molecules connect with as they cross the synapse. Dopamine binds to the dopamine receptor's surface, which allows proteins connected to the receptor's interior to transmit the signal to other parts of the cell.

Some dopamine molecules can be released again after returning to the transmitting cell via dopamine transporters. The pre-synaptic cell releases more dopamine in a quick burst when a reward is encountered. The excess will then be promptly eliminated by dopamine transporters. The brain learns and adjusts to a complicated reality thanks to dopamine spikes brought on by natural rewards. Drugs and digital media, on the other hand, have the power to disrupt this process, leading to undesirable habits and outcomes. For instance, methamphetamine enters the brain quickly when someone first consumes it. Meth works similarly to cocaine in blocking the re-entry of dopamine into the pre-synaptic cell at low doses. Contrary to cocaine, however, higher doses of meth can enhance the release of dopamine from the cell, resulting in significantly more dopamine being trapped in the synapse where it cannot be removed because of meth's inhibition of the transporters. Meth is extremely addictive because the amount of dopamine that stays in the synapse for such extended periods of time activates the post-synaptic cell to dangerously high levels and causes the user to feel strong emotions of bliss. Similar to this, social media use is highly comparable; studies have shown that the MRI scans of drug addicts and those of social media users are very identical. Drug misuse can be more severe in comparison, but the similar mechanism occurs in the brain when using social media. Additionally, the usage of screens and drugs, in other words addiction can cause dopamine buildup in synapses.

Brain Anatomy Alterations Related to Social Networking Site (SNS) Addiction

The most straightforward and simple approach to elucidating whether digital media use has a profound effect on the human brain is to explore whether the use of fingertips on touchscreens changes cortical activity in the motor or the somatosensory cortex. This was already known that cortical space assigned to the tactile receptors on fingertips is influenced by how often the hand is used.14 Indeed, the results were remarkable, as only touchscreen users showed an increase in the cortical potentials from the thumb and also for the index fingertips. These responses were statistically highly significantly correlated to the intensity of use. For the thumb, the size of cortical representation was correlated even with the day-to-day fluctuations in touchscreen use. These results clearly demonstrate that repetitive use of touchscreens can reshape somatosensory processing in fingertips, and they also indicate that such representation in the thumb can change within a short time frame (days), depending on use. MRI scans and inquiry presents relationships between GMV (gray- mattervolume) and SNS (social-networking site) addiction score. Three images are shown to illustrate the representation of connectivity-wise-based anatomy (VBM): (A) rendered brain; (B) coronal view; and (C) sagittal view. The SNS addiction score was positively connected with GMV in the anterior/mid cingulate cortex (ACC/MCC, displayed as yellow area) and negatively correlated with GMV in the bilateral amygdala. Imaging is shown in radiological view, where the viewer's left is the right. (D-F) Scatter plots depict the relationship between GMV and SNS addiction score in the ACC/MCC, left amygdala, and right amygdala in. Adapted from He Q, Turel O, and Bechara A (ref. 57). Addiction to social networking sites (SNS) is related with changes in brain structure.



Similarities Between a Drug Addict and Device Addict

Recently, I have discovered that the MRI scan of a drug addict is very similar if not identical to the MRI scan of an individual who is glued to their devices. Before deeper analysis, how does an MRI scan work? An MRI scan is a type of scan that uses strong magnetic fields and radio waves to produce detailed images of the inside of the body. MRI scans allow us to analyze the brain and provide information about the brain's interior structure and also display abnormalities in tissues by using a magnetic field temporarily realigns water molecules in your body. Radio waves cause these aligned atoms to produce faint signals, which are used to create cross-sectional MRI images. The reward system is huge part of causing addiction because it makes teenagers want more and more.

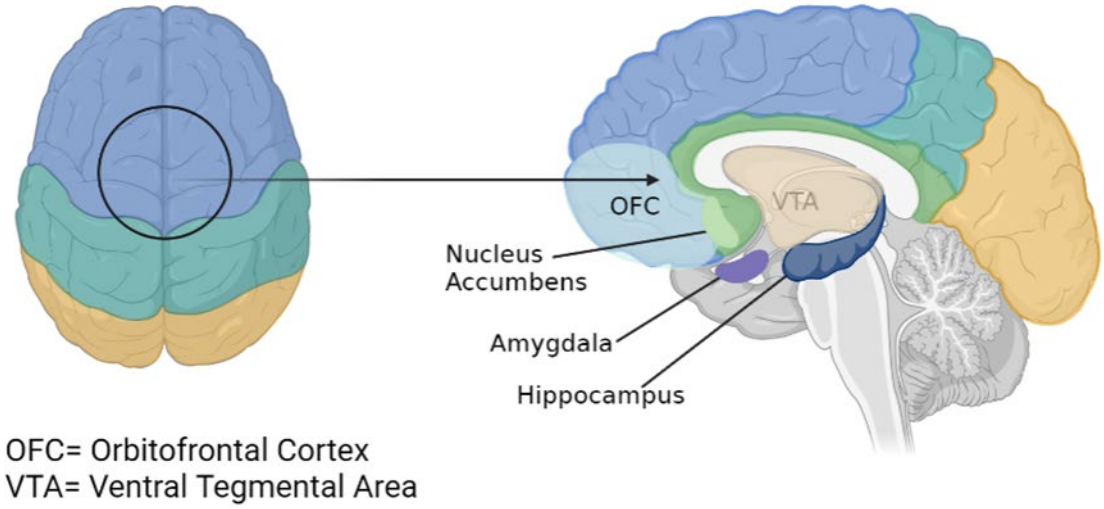


Figure 6. The primary center for planning and thought is the prefrontal cortex. The VTA and nucleus accumbens make up the majority of the brain's reward system. Adults have more active reward centers than adolescents do, and vice versa. The VTA, NAc, amygdala, and hippocampus are important limbic system organs that work together to coordinate desires, emotions, and memories.

It is now commonly acknowledged that neurons in the human cortex, hippocampus, and subcortical regions are highly flexible, meaning that changes in neuronal activity patterns, such as those brought on by rigorous training, can alter both synaptic form and function. Activity-dependent synaptic plasticity modulates the shape and quantity of synaptic connections as well as the effectiveness of synaptic transmission (functional plasticity).According to a 1949 hypothesis, synaptic plasticity provides the framework for the postnatal brain to adapt in response to experience and is the cellular implementation for learning and memory processes. This type of plasticity, known as activity-dependent synaptic plasticity, affects connections between neurons at the network level. When pre- and postsynaptic neurons exhibit simultaneous activity, synaptic strength changes, which alters the input/output characteristic of neuronal assemblies. These can only be remembered if they are engaged simultaneously once more. The fact that the synaptic response to a specific brain activity of a certain intensity is improved is crucial. This suggests that every routine human action, such as using digital media, social networks, or just the internet, will leave a trace on the brain depending on the activity itself, or whether it takes precedence over other activities, whether for the good, the bad, or the ugly side of human cognitive function. In this regard, cellular synaptic plasticity and multitasking mode are related. Inputs are arbitrarily strengthened when three inputs are activated and impinge on the same neuronal population within a constrained time window (+w). The strongest inputs are not always the ones that are strengthened. This indicates that if the input to a neural network in a certain brain area exceeds its processing capacity, the storage of pertinent information may be jeopardized.

Solutions/ Remedies that will Help

In the future, we should strive to help our incoming generations deal with these problems, but how? Some specialists may suggest setting healthy boundaries and limits on screens. Some examples include eating breakfast before using your devices to start the day mindfully, charging your devices in a different room to avoid screen time before bed, avoiding using your phone or computer as an alarm clock, limiting or disabling notifications in your phone settings, and even downloading health apps that track your screen time. Maybe even

finding some hobbies or activities you enjoy and can express yourself with like reading a book or signing up for an exercise class. For example, string instrument players have more cortical neurons of the somatosensory cortex allotted to the fingers they use in playing the instrument.15 This so-called "cortical plasticity of sensory representation" is not limited to musicians; for example, it also occurs with often-repeated grasp movements.16 As repeated finger movements occur with use of touchscreen smartphones, An experiment was conducted in which people used electroencephalography (EEG) to measure cortical potentials resulting from touching tips of the thumb, middle, or index fingers of touchscreen phone users and control subjects who used only non-touch-sensitive mobile phones. Even forms of art help calm the mind like painting or sketching. Another suggestion may be some mindfulness or yoga, this helps calm the mind and focus on one thing at a time.The type of yoga you do can help improve many areas of mental/ physical related health struggles. Slow, repetitive movements, such as through yoga and tai chi, that focus on your breath can be equally effective in relaxing your mind and body. Meditating doesn't require reserving a large chunk of your time. Simply saving a few minutes per day has been proven to reduce distractions and increase focus.

Conclusion

The broad section of social media considered, the brain is a very delicate and influenced part of our body; the consequences that digital media may have on it are alarming, and we are now aware of the dangers of it. Social media is a new study that is rapidly growing and gaining popularity. Thus, there are many unexplored and unexpected constructive answers associated with it. Lately, studies have found that using social media platforms can have a detrimental effect on the psychological health of its users. However, the extent to which the use of social media impacts the public is yet to be determined. This systematic review has found that social media envy can affect the level of anxiety and depression in individuals. In addition, other potential causes of anxiety and depression have been identified, which require further exploration. The importance of such findings is to facilitate further research on social media and mental health. In addition, the information obtained from this study can be helpful not only to medical professionals but also to social science research. The findings of this study suggest that potential causal factors from social media can be considered when cooperating with patients who have been diagnosed with anxiety or depression. Also, if the results from this study were used to explore more relationships with another construct, this could potentially enhance the findings to reduce anxiety and depression rates and prevent suicide rates from occurring.

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