NeuroRegulation

Digital Addiction: Increased Loneliness, Anxiety, and Depression

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Abstract

Digital addiction is defined by the American Society for Addiction Medicine (ASAM) as well as the American Psychiatric Association (APA) as "… a primary, chronic disease of brain reward, motivation, memory, and related circuitry. Dysfunction in these circuits leads to characteristic biological, psychological, social, and spiritual manifestations. This is reflected in an individual pathologically pursuing reward and/or relief by substance use and other behaviors…" with examples such a such as internet gaming or similar behaviors. Symptoms of digital addiction such as increased loneliness (also called "phoneliness"), anxiety, and depression were observed in a sample of university undergraduates who completed a survey about smartphone use during and outside of class. Other observations included observations of "iNeck" (poor) posture as well as how multitasking/semitasking was prevalent in the sample. Implications of continued digital addition are discussed.

Keywords: digital addiction; smartphones; depression; loneliness; multitasking

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Background

"I felt dismissed and slighted when, in the middle of dinner, my friend picked up his phone and quickly glanced at the notification. The message appeared more important than me."

> The host at the dinner party asked us to turn our phone off or leave it at the door. At first, I felt the impulse to check my phone, but during the evening I really connected with the other people.

"I had accidentally left my phone at home and, the whole day long, I kept reaching for it to check email and social media feeds—I felt emotionally lost."

> As I was running on the trail behind UC Berkeley enjoying the expansive view of the San Francisco Bay, another idea for this article popped into my head. Namely, the importance of taking time to reflect and allow neural regeneration. I rushed back to add these concepts to this article.

Classroom Observations

When observing university students sitting in the classroom, we see them alone with their heads down looking at their mobile phone. When students enter a classroom, during class breaks, or after class, they are continually texting, scrolling, clicking, or looking at their smartphone instead of engaging with the people next to them. The same habits exist outside the classroom, whether they are leaning against the walls in the hallways, walking between classes, eating pizzas, or standing on the bus. A term that describes the phenomenon is an "iNeck" posture which has become all too common a body position.

Push Notifications

Notifications from email, Facebook, Instagram, Snapchat, and Twitter can feel so important that we interrupt what we are doing and look at the screen. A few decades ago, some physicians wore portable pagers that notified them of medical emergencies that demanded their attention, albeit on a relatively infrequent basis. Similarly, a notification such as a ringing sound that someone is calling you, or such as an image appearing on a screen from a friend via social media, triggers a cascade of orienting reactions. Should I ignore the notification, or should I interrupt what I am doing to respond? Unfortunately, the auditory or visual notifications activate neurological pathways that are powerful and similar to what would have been triggered by a surprise (Kouider et al., 2015), or even as if we had perceived a danger signal in our environment (e.g., a predatory carnivore) that would threaten our survival, causing us to momentarily "freeze" and orient to the source (Roelofs, 2017). Modern marketing and advertising strategies take advantage of the evolutionarily preserved orienting response that demands attention when, for example, notifications from advertisers as well as from our friends are "pushed" to us in the form of auditory, visual, or vibratory signals called push notifications (Albuquerque et al., 2016; Mikulic, 2016).

In addition, smartphone push notifications provide updates on our social environment which would be necessary for our group's survival; however, too many notifications pushed our way can become distractions from group survival, so the balance between a constant demand to orient towards a notification versus ignoring all notifications requires choices by the users of smartphone technology (Lee, Kwon, & Kim, 2016).

Even when push notifications from friends or advertisers lack content that demands attention, the process of orienting towards almost any form of auditory, visual, and/or vibrational sources of information is automatic. For example, in almost all cases, when you sit next to someone and they focus on a smartphone or computer screen—without being prompted and in many situations against social etiquette—you automatically orient to a visual and/or auditory source after glancing at their screen. Current neuroscience research suggests that with repeated exposure to certain content (e.g., video gaming, pornography) a form of dependency may form making it difficult to "pull away" from the screen. For example, Park and Kim (2015) describe neuronal mechanisms associated with "internet addiction," and Weinstein and Lejoyeux (2015) state:

> Excessive internet game use was shown to be associated with abnormal neurobiological mechanisms in the orbitofrontal cortex (OFC), striatum, and sensory regions, which are implicated in impulse control, reward processing, and somatic representation of previous experiences in a study measuring regional cerebral metabolic rates of glucose in positron emission tomography (PET) in normal and excessive internet game users.

Evolutionary Traps

The changing visual stimulation, especially in the peripheral vision, triggers us to orient to the cause of the visual changes. In the past these peripheral changes would indicate that there is something going on to which we need to pay attention. It could be the tiger shadowing us, or a possible enemy. Now the ongoing visual display changes on the screen hijacks our vigilance that evolved over millions of years for survival. Looking at and being captured by the screen has now become an evolutionary trap (Peper, 2015). A fictional account of the stress generated during texting when there is not an immediate response is superbly described by Aziz Ansari and Eric Klinenberg (2015) in their book *Modern Romance*.

Digital Addiction Pathways

Besides automatically responding to the novel stimuli, our neural reward pathways are activated when we respond to the stimulus, click, and scroll and are rewarded by text, videos, etc. The rewards from our scrolling, clicking, and surfing are intermittent. This provides the intermittent rewards which activate reward circuits in the brain and lead to behaviors that would be labeled internet addiction. The American Society for Addiction Medicine (ASAM) as well as the American Psychiatric Association (APA) have updated their definitions of addiction to include not only exposure to and dependency on a variety of substances but also exposure to and dependency on a variety of behaviors such as video gaming (Love, Laier, Brand, Hatch, & Hajela, 2015). In a way similar to dependency formation on content such as video gaming or pornography, push notifications (e.g., texts, social network services [SNS] alerts, social media service [SMS] messages) from friends and/or advertisers may lead to developing "smartphone dependency" (SPD) behavior or addiction (Enez et

al., 2016; Gola et al., 2017; Jeong, Kim, Yum, & Hwang, 2016; Kühn & Gallinat, 2014). As a result, many people preemptively check their phone or automatically respond to push notifications from social network services such as Twitter and Facebook (SNS/SMS) during their waking hours (Grinols & Rajesh, 2014; Hu, Long, Lyu, Zhou, & Chen, 2017; Jeong et al., 2016). In social situations, constant phone interruptions cause those involved to feel slighted and snubbed (Chun et al., 2017; Vaghefi & Lapointe, 2014).

Symptoms of Digital Addiction

In our research students who use their phone the most report experiencing significantly higher levels of isolation/loneliness, depression, and anxiety than those who use their phone the least, as shown in Figure 1.

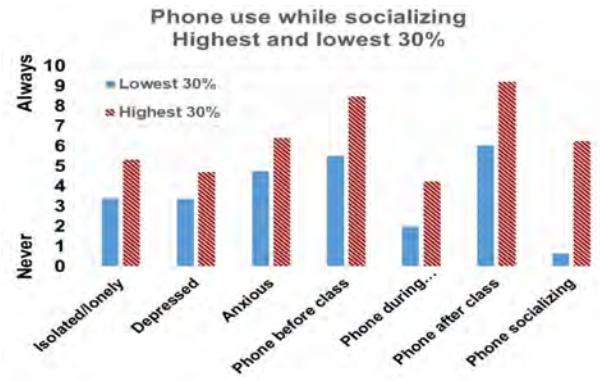

Figure 1. Self-report of isolation, depression, and anxiety which is significantly higher in students who use their phone the most as compared to those who use their phone the least.

Being "on call" by vigilantly and continuously checking the phone for anticipated, forthcoming content also contributes to multitasking, which subsequently interrupts attention and performance (Grinols & Rajesh, 2014; Jarmon, 2008). Many students no longer focus on one task at hand; instead, they are multitasking and interrupted by social media, music, and surfing the web (Lim & Shim, 2016).

Multitasking/Semitasking

In our recent survey of 135 university students who participated as part of an in-class pedagogy improvement evaluation, almost all reported that they multitask even though it would be better to focus on the required task and only shift focus after the task is done as is shown in Figure 2. Unfortunately, multitasking may more accurately be described as "semitasking" or doing twice as much half as well. Examples of multitasking have been described by Lim and Shim (2016) as falling into a few categories such as: non-media multitasking (e.g., eating while talking), cross-media multitasking (e.g., watching TV while texting), and single-device multitasking (e.g., playing an internet game while texting). The types of multitasking or semitasking of greatest interest in this article are cross-media or single-device examples.

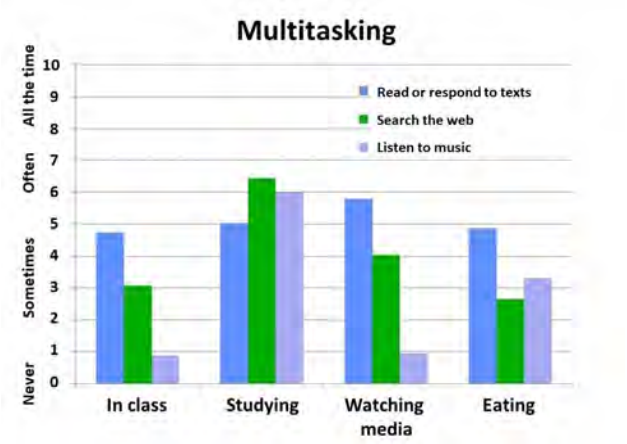

Figure 2. Self-report of multitasking.

Skepticism About Corporate Motives

Why have we become so addicted that we feel the urgency to check our phones day and night even when there are no notifications? The screen is the first focus of attention when we wake up and the last one before sleep. We cannot even wait to finish a meal or talk to a friend before checking the screen for possible updates. For the technology that is associated with addictive behavior, we can thank the major tech companies who have hired the smartest and brightest engineers, programmers, and scientists to develop software and hardware to capture our attention. They condition us to be addicted to increase corporate profit: more eyeballs, more clicks, more money. For a detailed analysis of how tech companies created our addiction, see Michael Schulson's (2015) essay "User Behaviour: Websites and apps are designed for compulsion, even addiction. Should the net be regulated like drugs or casinos?"

Avoid blaming children or adults who claim lack of self-control. The addictive nature of smartphone interactions was predominantly created by tech companies in their quest to capture market share by exploiting our natural, evolutionary survival responses to orient and attend to a change in our visual and auditory world that builds on an "evolutionary trap." The behavioral addiction of smartphone use begins forming neurological connections in the brain in ways similar to how opioid addiction is experienced by people taking Oxycontin for pain relief—gradually. An obvious skeptical question would be: "Are addictive substances or addictive behaviors created, encouraged, or reinforced by corporations more so in their ongoing quest to increase profits than to benefit the users of their products?"

Future Considerations and Concerns About Digital Addiction

There is cause for worry about the long-term harm of internet addiction as well as smartphone addiction, since overuse or abuse of behavioral technologies may have a worse effect than opioid addiction (Swingle, 2016). For example, because internet or smartphone addiction can lead to reduced social connections and emotional regulation, as well as increased attention-deficit disorders and distractibility or decreased self-initiative (proactive versus reactive behavior) there will likely be compromises to health and well-being (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Swingle, 2016). For example, in a meta-analysis by Holt et al. (2015), actual social isolation along with perceived feelings of loneliness increased mortality by 30%. Furthermore, Cacioppo, Cacioppo, Capitanio, and Cole (2015) have summarized the neuroendocrine effects of social isolation and perceived loneliness on specific brain systems, suggesting that perceived loneliness associated with smartphone addiction can have negative impacts on physical health. Similarly, Pittman (2017) suggests the term "phoneliness" to refer specifically to the types of perceived loneliness associated with smartphone addiction behaviors.

Being plugged in and connected limits the time for reflection and regeneration. Unprogrammed time allows new ideas and concepts to emerge, giving time to assess your own and other people's actions from a distant perspective. It offers the pause that refreshes and allows time for neural regeneration. Our nervous system, just like our muscular system, grows when there is enough time to regenerate after being stressed. Ongoing stress or stimulation without time to regenerate leads to illness and neural death. The phenomena can be seen in the development of rat brains.

Neuroanatomist Professor Marion Diamond showed that rats who were brought up in an impoverished environment and had very little stimulation possessed a thinner cortex and less dendritic connections than rats brought up in an enriched environment (Diamond et al., 1975; Rosenzweig, 1966). More importantly, an excessively enriched environment was associated to a reduction of neurogenesis and synaptic plasticity (Joëls et al., 2004). The more hours of television a child between age 1 and 3 watched was directly correlated with associated attentional problems at age 7 (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004), indicating that excessive stimulation during brain development may be harmful.

Strategies to Address Digital Addiction

From a biological perspective, health is the alternation between activity and regeneration. If you do not allow the system time to regenerate, neural degeneration may occur. Even though it is very challenging to break the addiction, it is possible. Mobilize your health and disconnect to allow regeneration. Take charge, regain social connections, and develop proactive attention.

1. Recognize that you have been manipulated into addiction by the tech companies, which have covertly conditioned you to react to notifications and have created the desire to check frequently for updates.

2. Become proactive by limiting interruptions when you work and play.

    - Turn off of notifications of your apps so that they do not interrupt your work.
    - Schedule time to look and respond to email, Facebook, Twitter, Instagram, or Snapchat and notify your colleagues that you will only respond to messages and information during prescheduled time periods such as 11 a.m.–12 p.m. or 3–4 p.m.
    - Schedule uninterrupted time when you are most alert. For most people this is morning time. Do your creative concentrated work first and then answer social media during times when your attention and concentration has decreased.

- Turn off your digital devices during social events (e.g., dinner or talking to friends, coworkers, and family).
- Make an active choice to be present with friends and family.
- Make a game out of avoiding smartphone use. For example, when going out to dinner, have everyone place their phone in the middle of the table and make an agreement that the first person who touches their smartphone before dinner ends will pay for the entire meal.
- Create unstructured time without stimulation to allow the opportunity for self-reflection and regeneration. As journalist Daniel A. Gross (2014) points out, "Freedom from noise and goal-directed tasks, it appears, unites the quiet without and within, allowing our conscious workspace to do its thing, to weave ourselves into the world, to discover where we fit in. That's the power of silence."

There is a simple aphorism that says: "Pay attention to shift intention," suggesting that training related to better intentional behaviors may allow breaking the cycle of smartphone addiction associated with falling into the evolutionary trap of "mindless attention."

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