RESEARCH ARTICLE

ADDICTION BY DESIGN:
Some Dimensions and Challenges of Excessive Social Media Use

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Abstract

Social media addiction is a growing problem throughout the world. It has been characterized as a type of behavioral addiction, which can be measured using standardized criteria based on six general properties of addiction criteria: salience, mood modification, tolerance, withdrawal symptoms, conflict and relapse. Several studies have found a prevalence of approximately 10% for social media addiction in individuals across the globe, indicating that this problem is common and widespread. Deleterious effects of this disorder include depressive symptoms, increased anxiety, and a lowered sense of personal well-being. Social media addiction also has been linked to neuroplastic changes that diminish attention and impede an individual's ability to focus.

There many dimensions of social media that can foster addiction, including the exploitation of evolutionarily old urges to communicate and socialize, as well as intentional design of the user interface to hook users into constant use. There is little doubt that social media companies are financially incentivized to maximize user attentiveness to ads (i.e., ad views and clicks) on their platforms because user attention is the product for which they are paid. These companies maximize user attentiveness in two primary ways: first, by intentionally designing the interface to have properties intended to hold users' attention; and second, by personalizing the content shown to users in order to make it more interesting and engaging for them. Social media addiction likely arises from the vicious cycle involving user attention leading to powerful dopamine-related reinforcement, which then stimulates more attention intended to achieve more reinforcement.

This paper provides an overview of this multifaceted problem of social media addiction, including a brief review of addictions in general, social media addiction in particular, and a discussion of the prevalence and consequences of this addiction. Also discussed is the role social media companies play in addiction by design, along with the critical need to present solutions to social media addiction. These solutions, beginning with redesign of the user interface properties to make them more humane and ethical, are possible, but will not be easy. However, we all must work toward a world in which people use technology for their own well-being rather than for the well-being of those who control the technology.

Keywords: Social media, Addiction, Attention Economy, Intentional Design, Regulation, Therapy

"*Teens told us that they don't like the amount of time they spend on the app* [Instagram] *but feel like they have to be present...They often feel 'addicted' and know that what they're seeing is bad for their mental health but feel unable to stop themselves* (p. 6)."[1]

"*Every time you see it* [phone] *there on the counter, and you just look at it, and you know if you reach over, it just might have something for you, so you play that slot machine to see what you got, right? That's not by accident. That's a design technique* (at 24:53 in video)."[2]

1. Introduction

It is becoming increasingly clear that social media platforms are designed intentionally to maximize their addictive potential.[2] Addiction by design on the part of social media companies is fueled by their "attention economy" business model in which revenue is earned from advertisements shown to platform users.[3] In this model, the more advertisements platform users view, the more revenue those ads generate for the social media company. Under such a "pay per view" economy, social media companies are economically motivated to addict their users such that they will stay on the platforms longer and come back as often as possible.[3]

Social media companies maximize the additive potential of their platforms in three specific ways involving data collection practices, algorithmic content curation, and visual interface design. In terms of data collection, social media platforms collect large amounts of data about user activity enabling them to make very specific predictions about user demographics and preferences.[4] Content selection algorithms built into social media platforms take advantage of predicted user preferences to create personalized feeds for individuals with the most potentially engaging content possible, without giving users control over what they see, or much explanation for why they are seeing it. Finally, the interface itself is meticulously designed to attract and hold the user's attention, using techniques like the infinite scroll and the like button. All of this means that social media companies bear a clear responsibility for the addictive nature of their platforms, for which they should acknowledge an appropriate level of accountability.

In this paper, we will provide an overview of the multifaceted problem of social media addiction, including a brief review of existing explanations for addictions in general, a description of what social media addiction is and how it can be measured, along with a discussion of the prevalence and consequences of this addiction. Most importantly, we will elaborate on the above-noted role social media companies play in contributing to social media addiction by focusing on the economic motivations behind addicting customers and the ways addiction is fostered through intentional design. Finally, we will underscore the critical need to present solutions to social media addiction, arguably one of the most pressing global issues of our time, by examining ways to achieve a humane redesign of the social media industry through the use of interventions intended to change the way social media sites themselves operate, along with interventions focused on helping the victims of social media addiction through various forms of treatment and prevention. A primary contribution of this paper is to bring together in one place heretofore scattered views and sources of information on the problems and solutions related to social media addiction.

2. Behavioral Addictions

2.1 Background and Definition

In the field of addiction research as well as among the general public, there has been a tendency to associate the term "addiction" with psychoactive drugs. As scientists elucidated the psychology and neuroscience of addiction, they eventually discovered that behaviors other than ingesting psychoactive drugs fulfilled the criteria to be classified as addiction. Ultimately, several types of behaviors came to be classified as addiction, creating two categories of addiction: substance and behavioral.[5-6]

Peele and Brodsky[6] popularized the idea that addictions are not limited to drug or substance use. According to this view, individuals can become addicted to certain

non-substance experiences like gambling or video games in the same way that others can become addicted to chemical substances. These so-called behavioral additions can be every bit as compulsive and destructive as substance-based additions.[7] People with behavioral addictions report an urge or craving state prior to initiating the addiction-related behavior, just as do individuals with substance use disorders. Additionally, addictive behaviors often decrease anxiety and result in a positive mood state or "high," analogous to the favorably altered emotional and mental states induced by substance intoxication. With repeated exposure to the object of the addiction, both behavioral and substance disorders deliver less intense highs, as the individual builds tolerance for the neurological reward of the addictive habit. As the individual habituates to the altered mental states induced by the object of the addiction, she acquires a dependence on the object to achieve normal function. If the substance or behavior is not provided, withdrawal symptoms such as mood changes, irritability and anxiety appear.[7] These features are common to both substance and behavioral addictions, and it is because of this similarity that they both fall under the same umbrella classification.

Addiction has been conceptualized in two main ways: as disorders of choice and as mental/brain illnesses.[8] Based on choice theory, addiction is a pattern of irrational, self-defeating choices that prioritize a short-term reward over long-term well-being, ultimately harming the addicted individual. All addictions can be understood as a failure of impulse control and delayed gratification mechanisms. As the addictive activity progressively consumes more of the person's time and attention, other activities and goals are neglected, thereby reducing quality of life. Still, research indicates that many addicts eventually stop their addictive behavior even without professional help.[9] Heyman[8] argued that such remissions are further evidence that additions are disorders of choice rather than disease-based compulsions.

A second conceptualization of addiction is the Brain Disease Model of Addiction (BDMA). This model is strongly supported both by animal and human studies showing specific neural and molecular changes triggered by repeated drug exposure.[10] Based on these neural correlates of substance abuse, researchers guided by the BDMA have developed specific medications for different types of addiction that are effective in reducing substance abuse and some behavioral addictions.[11]

2.2 Factors Giving Rise to Addiction

While originally developed to explain substance addiction, at least two theories have attempted to account for how addiction arises. Drug instrumentalization theory claims that individuals initially use drugs to positively alter their mental states and/or their ability to perform tasks, thereby "instrumentalizing" substances as a way to improve goal-directed performance.[12] In this view, when individuals discover that low or moderate doses of certain drugs can enhance their mental or physical activity, they resort to those substances as a means (i.e., an instrument) to improve mental or physical states. However, for some individuals, what starts as a selective, instrumental use, becomes a more serious problem when they can no longer control how much they consume, especially when increasingly concentrated versions of their substances of choice become available for consumption.[12]

A second, but not mutually exclusive theory regarding the rise of addiction appeals to habit formation through reward conditioning.[13] Since many addictive substances have significant systemic effects on the peripheral and

central nervous system, including effects on brain systems related to pleasure and mood (see Section 2.3), these drugs can act as powerful biological agents akin to the "unconditioned stimuli" used in studies of Pavlovian conditioning.[14] As Pavlov demonstrated, when organisms are repeatedly exposed to unconditioned stimuli, the cues accompanying the intake of these substances (environmental, internal, and behavioral cues) can become "conditioned stimuli" capable of eliciting strong reactions in anticipation of the forthcoming unconditioned event. If the systemic effects of the drug are intensely pleasurable or enhancing in some other way, then the anticipatory reactions evoked by the conditioned stimuli may be unpleasant inasmuch as they represent wanting but not yet having the substance in question. These anticipatory reactions become instrumental to increasing drug exposure. Anticipating, but not having the desired substance, is a form of "craving" that will often precipitate the behaviors needed to obtain the desired substance and its attendant reward. Thus, a habit is formed and a vicious cycle is established in which more exposure to the addictive substance leads to strengthening of cues that evoke the anticipatory triggers for more ingestion of the substance.[13]

While the two above-noted theories on the origins of addiction were formulated in the context of substance abuse, they also likely apply to behavioral addictions. When addictive behaviors like gambling lead to powerful systemic consequences that influence both body and mind, these behaviors may well become susceptible to the same mechanisms of instrumentalization and anticipatory conditioning that apply to substance abuse.[13]

2.3 Brain Mechanisms and Addiction

Currently, there is extensive evidence indicating that all addictions share a common biological underpinning in the human brain.[15] Drug and behavioral addictions converge on the reward system, and particularly on the mesolimbic dopamine pathway.[15] The mesolimbic dopamine pathway includes the ventral tegmental area (VTA) and the nucleus accumbens (NAc), which together form the VTA-NAc pathway, one of the most important substrates for the acute rewarding effects of all drugs of abuse. Objects of addiction produce dopamine-like effects on the same NAc neurons, revealing shared mechanisms of acute drug action.[16]

Chronic exposure to drugs negatively impacts the VTA-NAc dopamine system. With repeated drug use, the dopamine system is impaired through a homeostatic response to excessive stimulation, leading to tolerance. Baseline levels of dopamine function are reduced, such that normal stimuli become less rewarding; the resulting underactive dopamine system leads to the negative withdrawal symptoms characteristic of addiction.[15] At the same time, the dopamine system is sensitized to anticipatory drug-related environmental cues that might signal impending ingestion of the drug, which as noted in Section 2.2 leads to cravings and may trigger relapse in recovering addicts.[17]

There is support for shared neural substrates between behavioral and drug addictions. There have been findings of cross-sensitization between natural rewards (such as food, internet usage, and sex) and drugs of abuse.[18] Brain imaging scans have revealed similar abnormalities in both types of addiction.[19]

2.4 Criteria for Identifying Addiction

Given the existence of many types of addiction, it is imperative to find their commonalities and to determine standardized criteria to characterize what is and is not

addiction. The Griffiths[5] "Components Model of Addiction" clearly outlines six criteria that can be used to describe any addiction, be it substance-based or behavioral. These criteria are:

- Salience: The object of addiction becomes the most important thing in the individual's mind, and it dominates their thinking, behavior and time. When the addict is not engaging in addiction-related behavior, she is thinking about the next time she will. Salience also refers to the cravings addicts experience constantly, not allowing them to focus on something other than obtaining the drug or performing the action.
- Mood modification: Both substance-based and behavioral addictions are employed by addicts to shift their current mental state to a more desirable one. These mood modifications include "highs," reduced anxiety and stress, greater focus, higher energy levels, and clearer thinking. The mood modification also is highly contextual, as the same addictive substance or behavior can have different effects in different contexts.
- Tolerance: With repeated exposure to the addictive drug or action, the individual becomes desensitized to the mood modification effects. This results in the need for increasing amounts of the addictive target to reach the same "high." In substance addictions, the dosage and frequency of a substance is increased over time to achieve the same effects previously achieved with a smaller dose. In behavioral addictions, like gambling, the size of the bet, the frequency of gambling, and the time spent gambling may increase across sessions to achieve the same effects formerly produced by small bets.
- Withdrawal symptoms: Withdrawal symptoms are psychological and/or physiological reactions to the reduction or discontinuation of the addiction-related activity or substance. These reactions can include negative mood states, anxiety and irritability, intense cravings, lack of focus, headaches, heart racing, loss of appetite, low energy levels, insomnia. The appearance of withdrawal symptoms indicates a level of dependence on the activity or substance.
- Conflict: As addiction-related activity takes increasingly more of the addict's time and attention, the individual suffers interpersonal and intrapsychic conflicts. The focus on short-term pleasure results in consistently self-defeating choices, which in turn leads to long-term damage. The individual's relationships are affected negatively, and his own self-concepts are called into question as the individual experiences a loss of control over the direction his life is taking.
- Relapse: When experiencing addiction, most individuals realize the negative effects that the activity has on their lives and try to take steps to reduce or stop their engagement with the substance/activity. Relapsing means reverting back to old, more extreme patterns of addictive behavior after periods of remission and reduction. A common saying is that it feels "just like the first time" once one returns to the activity after quitting.

According to the Griffiths model,[5] when a certain activity fulfills all six of these criteria, it can be clinically described as an addiction even when the problem consists of an addictive behavior rather than substance abuse.

3. Internet and Social Media Addictions

A collection of potentially problematic behaviors that has received considerable

attention in recent years is related to excessive use of the Internet.[20] The term "Internet addiction"[21] has been applied to inordinate use of online apps for video gaming,[22] online sexually-oriented text (i.e., sexting) exchanges,[23] pornography use,[24] and online gambling.[25] These behaviors are problematic when they become compulsive such that the time and effort individuals spend engaging in them interferes with other daily activities at school or work, jeopardizes interpersonal relations, and impairs psychological health and well-being.[26] Cash et al.[27] indicate that addiction to the Internet for purposes of gaming, sexting, pornography use, or gambling is known to be a prevalent and highly problematic disorder that is under consideration for addition to the latest edition of the *Diagnostic and Statistical Manual of Mental Disorders*.[28]

As Andreassen[29] notes, the Internet also supports another collection of potentially problematic behaviors involving the use of electronic technologies (smartphones, tablets, computers) to access online apps like Facebook, Instagram, Tik Tok, Twitter, SMS texting, and email for various forms of social networking and communication. These behaviors also can rise to the level of an addiction when they conform to the criteria outlined by Griffiths.[5] Andreassen[29] found that many forms of excessive Internet use, including the utilization of social media, were correlated with one another and arguably may be based on common underlying demographic and psychological factors. For the purposes of this report, we will refer to the excessive use of social media apps as *Social Media Addiction* insofar as these behaviors are indicative of the types of problematic activities noted above by Andreassen and Pallesen.[26]

The remainder of this paper will be devoted to elaborating on the aspects of Social Media Addiction shown in Figure 1. First, we will elaborate on the ways to characterize Social Media Addiction shown on the right side of this figure. Then, we will enumerate and discuss some ways to help alleviate this prevalent and pressing problem depicted on the left side.

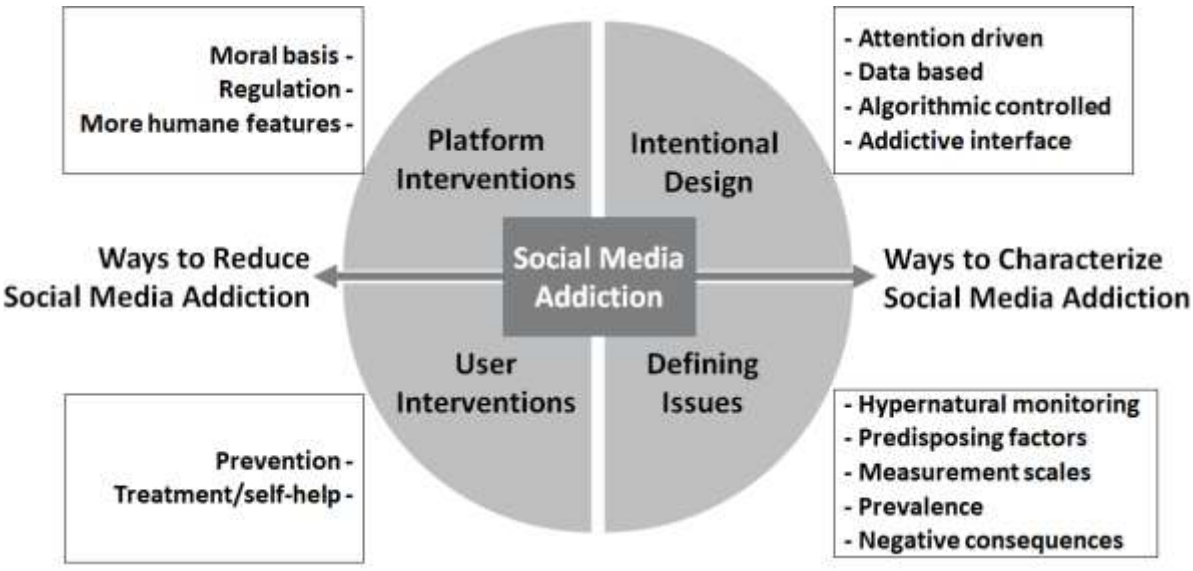

Figure 1: The general organization of the remainder of this paper in terms of characterizing and reducing the problem of social media addiction.

3.1 Technology Enables Hypernatural Monitoring of Social Media Apps

Veissiere and Stendel[30] identified a key factor contributing to what we are calling social media addiction. According to these authors, while there is nothing inherently addictive about smartphones themselves, a smartphone in your pocket enables convenient and ready access to all social media and communication apps that are installed on that phone. As a result, many will engage in "hypernatural monitoring" of those apps.[30] This hypernatural (i.e., excessive) monitoring feeds the emergence of a behavioral addiction when the problems described by Andreassen and Pallesen[26] begin to occur and when those behaviors conform to the addiction criteria described above.

As Veissiere and Stendel[30] note, social media use stems from an evolutionarily old human social need to see and be seen by others, to be monitored and judged by peers, as well as to gain information and knowledge from other people. It is known that healthy social relationships activate the dopaminergic reward circuit, just as addictive substances do, whether it is online or in person.[31] For this reason, it is not surprising that social reward can become addictive through the same mechanisms as those previously described in Section 2.2 for other addictions, especially considering the ways in which "hypernatural monitoring" via smartphones and other computer-based technologies can encourage unhealthy expressions of normal, healthy social urges.[30]

Moreover, as we argue in more detail below, social media apps themselves have been intentionally designed to have unhealthy addictive features. Two aspects in particular are relevant here: ubiquitous interactions and notification reinforcement schedules. Ubiquitous interactions contribute to addiction because when the human brain first evolved, social interactions were limited, temporary, and difficult to procure. For these reasons, there was a high reward value in seeking out other members of the species with which to socialize. Nowadays, while we humans still have strong urges for social connection involving the reciprocal sharing of information and emotions, our environment is much different than it used to be. Today, we can engage in a limitless number of conversations with multiple people simultaneously, unconstrained by distance or time. Now, social moments can be created at the touch of a screen, and our ancient urges to communicate lead us to do it over and over again.[30]

In addition to the rich online connectedness social media makes possible, its notification features clearly are based on what is known about the powerful effects of reinforcement schedules.[32] Being notified by a social media platform that we have just received a communication can be a potent reward since it triggers the expectation of a message from a valued family member, friend, or other important contact. Most people look forward to such communications and enjoy them. However, the notification itself does not always signal a valued communication since the actual message or post received could be from someone that annoys us, or might be an unpleasant work-related notice, or just a junk advertisement—but every notification is the same: the screen lights up and the ping sounds, and we cannot help but look. In fact, social media notifications are signals of valued communications being delivered to us on what is called an "intermittent reinforcement schedule." Such schedules are known to be effective ways of creating persistent behavioral habits[32] and surely contribute to "hypernatural monitoring." Not knowing when we will receive the next

notification or what will be behind it keeps most of us on edge even when there are long periods of time between notifications. This anticipation can lead to persistent checking behavior marked by the act of inspecting devices periodically, even when no notifications have been received. Persistent checking of digital devices is not unlike checking the fridge or pantry regularly, even though we haven't been to the store, or pushing the elevator button multiple times, even though it is on the way. Regular digital device checking has the potential of greatly increasing the time we spend on our phones and computers[33] and often leads to opening the social media apps in question, thereby reinforcing the addiction.

As Veissiere and Stendel[30] make clear, social media apps take a perfectly natural prosocial urge and transform it into a hyper-concentrated means of social interaction, where the individual is exposed to more information than they can process, more "friends" than they can sustain, and more opinions and evaluations than they can act upon. As a result, the "hypernatural monitoring" and excessive scrutiny of social media feeds made possible through smartphone and other electronic technologies very likely contributes to the emergence of social media addiction.

3.2 Personal Factors and Social Media Addiction

Many recent studies have investigated the relation of personal characteristics and the emergence of social media addiction.[29] It is clear from this work that some people appear more vulnerable to social media addiction than others. For example, Andreassen et al.[34] showed that demographic factors like age, gender and marital status were related to the incidence of social media addition. In this work, the researchers found that young, single females were more likely to develop social media addition than were individuals from other demographics. Other research[35-36] revealed that each of the so-called "Big Five" personality traits[37-38] were either positively or negatively related to social media addiction. For example, neuroticism, defined as the tendency to experience psychological distress and negative affect, was shown to be positively associated with social media addiction.[35] Distress and anxiety may predispose an individual to seek comfort and safety in a virtual environment where they can be nameless and escape daily life. In addition, extraversion, or the tendency to be outgoing and social,[37] was found to be positively associated with social media addiction.[35-36] Higher levels of extraversion may enhance the personal importance of social interactions, so these individuals may become more vulnerable to the extreme sociality of social media networks.[36] Also, Conscientiousness, characterized by self-discipline and goal-driven behavior, was shown to be negatively associated with social media addiction.[35] Individuals with higher levels of discipline and organization may be less likely to fall into disordered patterns of social media usage that affect their well-being.[29] Finally, Andreassen[29] identified a number of other personal, social, and cultural factors that may predispose individuals to social media addiction.

3.3 Measuring Social Media Addictions

Andreassen[29] highlighted several instruments that have been used to measure social media addiction, including the Bergen Facebook Addiction Scale, the Facebook Dependence Scale, the Bergen Social Media Addiction Scale and the Addictive Tendencies Scale. Perhaps the most widely used measure of social media addiction has been the Bergen Social Media Addiction Scale (BSMAS). This measure, derived from the previous Bergen Facebook Addiction Scale, is grounded theoretically in the Components Model of Addiction,[5] and contains items that address

each of the six common components of addiction described in Section 2.4: salience, mood modification, tolerance, withdrawal, conflict and relapse. The BSMAS has been validated repeatedly, and its concise format makes it easy to administer. The results of the initial study to validate this measure were completely consistent with the literature, indicating that this instrument was effective in measuring social media addiction. The BSMAS has been proven to be effective in capturing the nuanced nature of social media addiction, and has been used not only in its original language but all across the world in translated versions.

3.4 Prevalence of Social Media Usage and Addiction

Social media usage has exploded in recent years. Dean[39] provided statistics on the pervasiveness of social media use globally. According to this report, 3.96 billion people around the world use at least one social media network. On average, each of these people use 8.8 different social media apps, totaling an average time of 2 hours 24 minutes of social media use per day. An earlier study[36] reported that, of all Internet users, one-third of them used social media apps, accounting for 10% of all time spent online. Moreover, these authors reported that in a survey of nearly a thousand teenage users, 55% of the respondents used social media.

A study sponsored by Dscout, Inc,[40] recruited 94 participants and built a supplementary app to track swipes, taps and pinches on the individuals' phone screens. They found that phone usage was primarily dedicated to messaging and social media, which ranked even above internet searches. Additionally, they found that users greatly underestimated their usage. Once confronted with the reality of their excessive use, users expressed some initial surprise followed quickly by resignation. There was no resolve to reduce usage.

In terms of the prevalence of social media addiction among worldwide users, Cheng et al.[41] reported a meta-analysis of 49 studies assessing the incidence of social media addiction, diagnosed using the BFAS/BSMAS. The data reviewed in this study included 34,798 participants, but involved studies that used different addiction classification criteria including very severe only, severe only, and moderate-to-severe only. They found that 5% of respondents were addicted when only a very severe classification was used, 13% were addicted when a more inclusive severe classification was employed, and 25% were addicted when the most inclusive moderate-to-severe classification was considered. While these findings show that addiction prevalence depends on the nature of the criteria used, a prevalence estimate of 25% in the moderate-to-severe category represents a significant number that should be very alarming.

Taken together, the data reviewed above reveal the sheer size presented by the problem of social media addiction. Over half of the world's population uses social media for an average of over two hours every day. People in general underestimate the time they spend on the platforms, but even when confronted with the truth they do not seek to change. The prevalence of social media addiction across severity tiers indicates that potentially there are hundreds of millions of people in the world engaged in excessive and possibly harmful social media usage.

3.5 Negative Consequences of Social Media Addiction

Andreassen[29] identified a number of deleterious effects of social media addiction ranging from heightened interpersonal conflicts and disturbed sleep to reduced life satisfaction and impaired study or work performance. Here we will focus only on two categories of negative consequences that seem particularly alarming.

3.5.1 Consequences for Mental Health

Many studies have evaluated the effect of social media addiction on different indicators of mental health. The general consensus in the literature is that social media addiction as measured with the BSMAS or BFAS is positively correlated with depression and anxiety.[29] A meta-analysis of eight studies examining the relationship between problematic smartphone usage (based on problematic social media usage) and depression found a consistently significant correlation between the two.[42] To explain this correlation, one study proposed a model in which depression was mediated by social comparison, with the results confirming their hypothesis.[43] In this model, social media was conceptualized as a medium whereby individuals are exposed to endless content from their peers, leading to constant social comparison. Excessive social comparison of any kind was understood to have a negative effect on mental health, with upward social comparisons (comparing oneself to a superior peer) having the most negative effects. Since people generally show their best selves on social media, they project a false image that leads most social media users to engage in constant upward social comparisons. Such comparisons might help to explain the relationship between spending more time on social media and showing more depressive symptoms.[43]

In a recent review of unpublished documents compiled by Facebook researchers, the Wall Street Journal revealed that Facebook has known about the negative effects of social media use on teen-aged girls for some time.[1] The journalistic reporters examined documents showing that Facebook had done a "teen mental health deep dive" in various studies with very disturbing results. These reporters noted that Facebook's Instagram platform may be one of the worst offenders with respect to the mental health of teens, especially girls. Describing internal Facebook research documents related to Instagram, they concluded: "The features that Instagram identifies as most harmful to teens appear to be at the platform's core. The tendency to share only the best moments, a pressure to look perfect and an addictive product can send teens spiraling toward eating disorders, an unhealthy sense of their own bodies and depression (p. 2)."[1]

Sohn et al.[42] also conducted a meta-analysis on the relationship between problematic smartphone usage and anxiety, with six out of the seven eligible studies showing significant positive correlations. The hypothesis behind this relationship was that the above-noted intermittent variable rewards of social media seem to create a state of constant alertness in users even when they are not using social media or receiving any notifications.[44] Additionally, the volume of content to which every user is exposed across all of the social networks he monitors generates an information overload.[45] There is an unconscious expectation that someone will respond or that an email will arrive, which keeps the user thinking about things that she cannot control. This can lead to higher levels of anxiety, especially when social media use is excessive and random.[42]

3.5.2 Consequences for Cognition (Attention)

An excellent review of the research regarding the general effects of Internet use on cognition reveals several important ways in which excessive Internet and social media use can negatively impact human cognitive abilities.[46] One negative consequence in particular may be especially germane to social media use: diminished attentional capacities that derive from the strategies adopted by excessive social media users in an effort to cope with the vast amount of content on these platforms to which they regularly expose themselves.

For content creators, the internet is a sink or swim environment. Either your video

or other posts are impactful and engaging, gaining you likes and comments, or your content is lackluster, disappearing before it is widely viewed. This creates a powerful filtering process on the Internet and on social media such that any content that does not grab attention is quickly forgotten amidst mass content generation, whereas effective posts and attention-grabbing media are noticed, shared and emulated. As a result, maximum attention-grabbing content spreads rapidly.[47] Such a selection process poses major challenges for the attentional capabilities of users, forcing many into a debilitating media multitasking habit.

The media multitasking habit essentially becomes a coping strategy that develops out of necessity, and is sustained due to the reinforcement it generates, given the large amount engaging content available on the Internet and social media. To process as much content as possible, thereby maximizing dopamine-related rewards, many users resort to a multitasking strategy in which they scan different content selections only superficially, rather than focusing on them in detail. These users may have several different apps open at once, jumping back and forth between them quickly in an effort to process, shallowly, as many content pieces as possible. Effectively, this strategy trains a user's attentional process to attend to as many things as possible at once, with only a minimal understanding of any one. In one study, for example, it was found that such a multitasking strategy resulted in 75% of all on-screen being viewed for less than one minute, as users quickly moved to the next screen and then the next.[48]

While this multitasking approach can maximize cognitive throughput, it does so at a cost. For example, one study found, ironically, that heavy multitaskers performed worse in task-switching tasks than their non-multitasking counterparts.[46] Another study using fMRI imaging techniques found greater activation in frequent multitaskers, compared to non-multitaskers, of brain regions involved in helping to managing distractions, the right prefrontal cortex (PFC). Despite greater PFC activity for multitaskers, they performed more poorly in tasks involving distractors than did non-multitaskers.[46] These results suggest that multitaskers are more susceptible to distraction, and less able to maintain focused concentration, than are non-multitaskers.[46] We believe these outcomes likely characterize many heavy Internet and social media users as a consequence of the way they have trained their attentional processes in order to maximize the social media content they can "consume."

4. Addiction by Design

As noted in Section 3.4, the addictive quality of social media networks has been well established in the literature. In trying to mitigate the impact of social media addiction on society, the role that social media companies play in designing products that are intentionally addictive should be explored. Motivated by a business model that demands ever-increasing user engagement, social media companies seek to extract as much of their users' attention as possible, disregarding potential negative ramifications. This user engagement business model has given rise to another business model, the attention economy.

4.1 The Attention Economy

An attention economy is a business model in which revenue comes from advertisements that are shown to users as they engage with the platforms. If users spend more time on the platforms, more advertisements are shown, and more revenue is generated. This relationship (user engagement = advertisements = revenue) becomes the motivation for intentionally making social media more addictive. This mindset is evidenced by the main goal of the purveyors of social media: maximize user engagement.[3]

Due to the nature of the product offered by social media companies, human attention from users is essential to their success. In attention-based economies, and specifically for social media companies, the platforms themselves are free and any revenue comes from the advertisements shown to social media users. In other words, social media users not only consume the content on the app, but also the paid advertisements from sponsors (i.e., brands). In turn, the social media companies are paid by the brand companies for collecting and delivering all verified user "views" and "clicks" on their ads. Therefore, social media companies are motivated to maximize user attentiveness to ads (i.e., ad views and clicks) on their platforms. If we consider that the user's attention is truly the product for which social media companies are being paid, then maximizing user attentiveness entails finding ways to increase time spent viewing ads from sponsors on their platforms. Two primary ways to accomplish this goal, discussed in more detail below, are, first, by intentionally designing the interface to have properties intended to hold users' attention and, second, by curating the content shown to users in order to make it more interesting and engaging for them. Both of these techniques render the platform more addictive to users. Content curation involves targeting advertisements to people who are more likely to buy the product being shown, which is aided greatly by collecting and analyzing usage data to uncover user traits and preferences.[4]

4.2 Data-driven Predictions About Users

Once users create an Internet account with a so-called "Big Tech" company (e.g., Google, Amazon, Facebook), they establish digital footprints containing a fair amount of information about themselves and their online behaviors.[49-50] This footprint can include personal information such as name, gender, age, physical address, driver's license, and even social security number, depending on which Big Tech accounts they have created and what info the account creation process requires.[50] In addition, by virtue of going online with a browser or an app, information is available about a user's history of web browsing, sites visited, current location provided by the IP address and/or GPS sensor on their device. Purchase history, email and message history, and information provided about personal preferences or attitudes provided through online surveys also may be available. Companies who have this information may sell or give it to third parties, depending on their data privacy agreements.[50] Even though users can opt-out of having companies sell their data (an option of which many are unaware), there is still plenty of information available online about any particular individual that could be used to profile and predict their personal interests and purchase preferences.[49-50]

Social media companies have their own information about the behavior their users exhibit on their platforms enabling them to make many inferences about individuals, even without other user digital footprints that may be available from third parties. Social media companies, like Facebook, have developed online data collection and recording methods they use to infer, with a fair degree of accuracy, the personal, attitudinal, and purchase preference tendencies of their users. As mentioned previously, to fulfill their economic goals, social media platforms strive to deliver personalized advertisements to each user so as to maximize the views and clicks they can report to ad companies who pay them for such information. To do this, social media companies need to predict what ads a user will find most interesting, what demographic she belongs to, if he is in a relationship or not, along with the user's sexual orientation, personality traits, etc.

Computational scientists have shown how it is possible to make such predictions,

with a high degree of specificity and accuracy, by analyzing relatively simple information that Facebook routinely collects and records on their app: Facebook likes. Using over 54 thousand volunteers, who turned over their Facebook likes related to known content, along with their demographic, political, and personality test results, Kosinski et al.[51] were able to predict an individual's age, political leanings, race, gender and sexual orientations with a high degree of accuracy (75%, 85%, 95%, 93%, and 88% respectively) based only on user likes. Also, they predicted the personality trait of "Openness" from likes at close to the test-retest reliability of the personality test itself. Following up on the predictability of personality traits, using a similar methodology, Youyou et al.[52] demonstrated that an individual's personality traits, as actually measured by a standardized personality test, could be predicted more accurately by a user's Facebook likes than by judgements made by a user's Facebook friends using a separate personality questionnaire tool. Taken together, these two studies show that data about what social media content users "like" has great predictive power about their personal characteristics and preferences, data that can be used to present users with advertisements they are more likely to find interesting and engaging.

4.3 Algorithmic Content Curation

As noted in Section 4.1, the impetus for social media companies to make their platforms more addictive is the attention-economy business model driving their revenues. Given the predictive power of the user data they collect (e.g., likes), these companies have developed adaptive algorithms that sift through and analyze a user's data to output a personalized feed of posts from friends, groups and brands that are most likely to keep that user engaged in the site for longer periods of time. It is important to note here that social media companies like Facebook are paid by advertisers to target certain types of viewers with certain demographics and or purchasing histories.[53] Personalized feeds are the primary way to ensure that ads are targeted to desired audience groups. As noted by Cooper[54] "While we don't know all the details of how the Facebook algorithm decides what to show people (and what not to show people) we do know that—like all social media recommendation algorithms—one of its goals is to keep people scrolling, so that they see more ads (p. 2-3)."

The best understood of the social media recommendation algorithms is Facebook's "EdgeRank," which was employed from about 2009-2011.[55] Edgerank, like all such algorithms, sifts through a very large number of possible posts from other owners (i.e., friends, brands, news) that could be shown to a particular user in his or her news feed in order to rank and select those that actually will be shown to that person. EdgeRank used what are called "edges" to accomplish this goal. Edges refer to any action any friend of the user takes on Facebook (e.g., a new post, a comment on a post, a like, a tag of a photo, a status update, etc.) or posts from brands or news that are relevant to the user's demographic profile or group.[56] Since the average user may have 300 or more friends,[57] along with hundreds or thousands of potentially relevant brands, an enormous number of edges must be sorted through to populate a user's news feed every time he logs into the platform from any device. Edgerank assigns a quantitative score to each possible post from an owner that might be shown to a user based on a weighted combination of the predicted importance of the owner's post to the user, the affinity (i.e., closeness of relation) between the user and the owner, and the time since the owner's post was originally created/made. The resulting Edgerank score for every owner's post then is compared to scores for all the other possible posts to determine which are included in the actual

news feed for that user at that login.[54, 56]

Social media recommendation algorithms are not static, but rather are updated or changed on a regular basis by the development staff of the companies in question. [54, 56] Cooper[54] identified a timeline of the changes in Facebook's algorithm from first introduction of the news feed (2006) to present. According to this timeline, the first Facebook recommendation algorithm (Edgerank) appeared in 2009 and their algorithms have continued to evolve since then. Although Edgerank appears to have been phased out in 2011,[55] it was replaced by a machine learning algorithm that itself changed notably each year or starting in 2016.[54] Today, as Cooper[54] notes, Facebook's machine learning algorithm has moved on from the three broad categories of ranking factors used by Edgerank to using "...thousands of ranking signals. Everything from the speed of a user's internet connection to whether they prefer to engage by liking or commenting (p. 11)."

It is interesting to note here that algorithm changes such as those Facebook has made in recent years are not without risk. While changes in algorithms are ostensibly intended to improve their effectiveness, unintended consequences can arise. For example, as Cooper[54] indicated, a change made by Facebook to its algorithm in 2018 to favor posts from family, friends, and groups over those from organizations and businesses, which was intended to "spark conversations and meaningful interactions," actually drew criticism from advertisers since that change potentially reduced the chances users would see paid ads. Also, this change drew criticism from those who believed that favoring the spread of posts from family and friends contributed to the spread of politics-based "misinformation," thereby increasing online anger and divisiveness, rather than enhancing meaningful interactions.[58-59] The latter criticism prompted Facebook to make a further change to the algorithm in 2020 to add a weighting factor based on the "credibility and quality" of posts to combat the spread of misinformation.[54]

Social media recommendation algorithms are ways in which these platforms curate their content in an effort to manage what users see, thereby increasing their exposure to engaging information and potentially interesting buying opportunities. All of this contributes to users spending more time on social media platforms and potentially becoming more and more "hooked" on what they experience when using social media.

4.4 Addictive Interface Design

To further "hook" their users, social media platform developers have employed principles of behavioral and cognitive psychology to design their user interfaces in such a way that they capture and maximize a user's attention and behavior. The principles involved here have been described by various authors.[60-61, 32] Eyal and Hoover[60] outlined a "Hooked Model" that can be used to design user interfaces to take advantage of the "dopamine cycle" shown in Figure 2. As we noted earlier in this paper, Dopamine is a neurotransmitter in the brain and is an integral part of the reward system in animals and humans.[62] Dopamine, released in response to exposure to addictive targets (either behaviors or substances), serves as a powerful reward with mood-altering properties. The Dopamine cycle depicted in Figure 2, begins on the left side with a state of desire, referred to here as "wanting,"[13] which is akin to a type of craving for stimulation that either arises from boredom or from habit formation in which organisms have learned that certain actions will lead to certain rewards.[32, 63] Wanting leads to "seeking" behaviors intended to find sources of stimulation or to procure previously encountered rewards. Seeking leads organisms to "anticipate" the rewards that are being sought. Nahai[32] characterized such anticipation as a kind of fantasy of the desired

reward that often is more stimulating than the actual reward itself. "Triggers" represent specific signals that rewards may be coming or are near, which prompt additional behaviors related to the receipt or consumption of the "reward." The most addictive cycles happen when the desired rewards do not always occur and indeed are somewhat unpredictable.[61] Whether or not a reward actually occurs, organisms usually are not fully satisfied by one reward. As Nahai[32] put it, "we seek more than we are satisfied," since the anticipated reward often is more potent than the received reward, especially when actual rewards are unpredictable. This ensures that wanting and seeking continue, fueling the next cycle in the series.

Social media use represents a good example of the dopamine cycle in action. People who have used a social media platform know that they can find interesting information or communications from friends and family there. This awareness becomes a kind of wanting that leads to scrolling through news feeds (seeking) in anticipation that they will encounter a desired reward. Specific triggers, such as notifications, may signal that potentially interesting posts are available. The actual post may or may not be rewarding so its value is unpredictable. Even if interesting, the craving for more (wanting) continues, which leads to more scrolling (seeking) and anticipating. Hence the cycle continues, over and over, to the point where 79% of smartphone users check their phone as soon as they wake up and a third of all users say they would rather forfeit physical intimacy than give up their smartphones.[60]

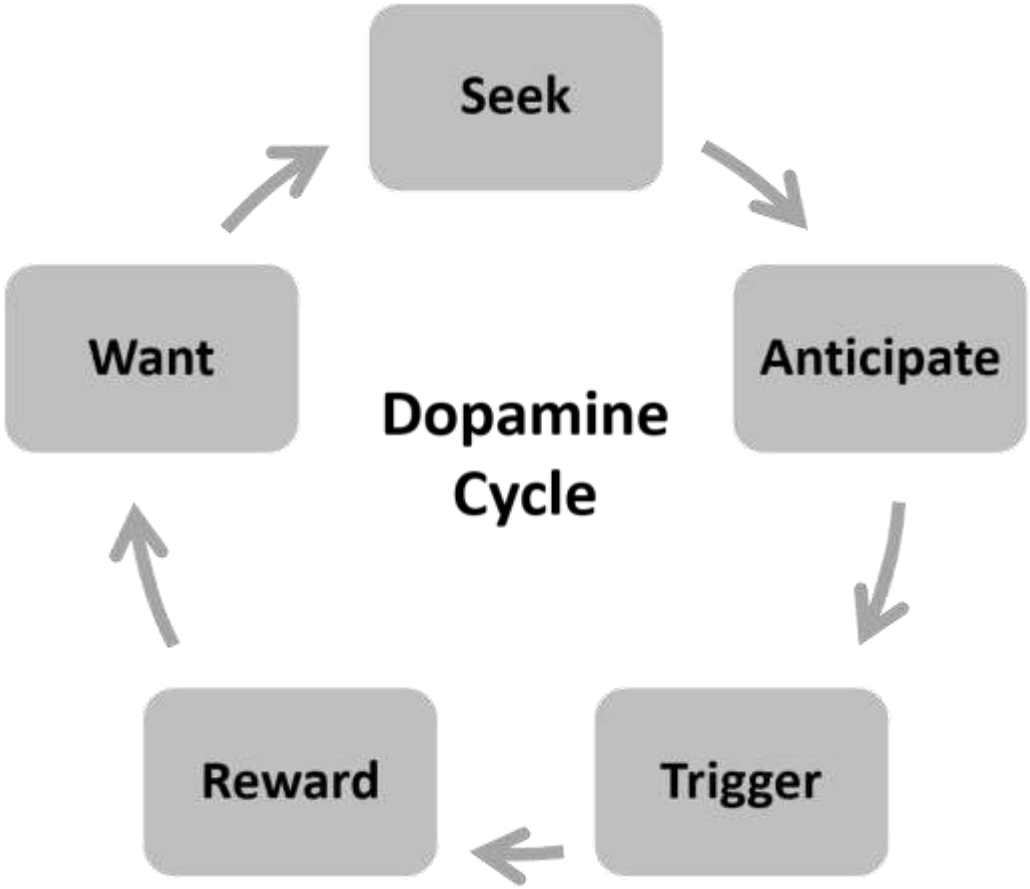

Figure 2: The Dopamine Cycle involved in behavioral addictions that can be used to design addictive properties of user interfaces.

Table 1 shows some of the addictive interface design features of several popular social media platforms (Facebook, Whatsapp, Gmail). We have categorized each feature in terms of its possible relation to the specific steps in the Dopamine Cycle, and we have provided purposes and possible user reactions for each feature.

Table 1: Some potentially addictive properties of several social media platform user interfaces in relation to the steps of the Dopamine Cycle.

Feature	Dopamine Cycle Step	Purpose	Possible User Reaction
Ellipsis (…)	Want, Anticipate, Trigger	In anticipation of a text reply, the user is kept waiting, getting the anticipatory arousal effect of an expected reward.	"Oh, I see a reply is coming — I can't put my phone down until I see it!"
Like button	Trigger, Reward	Acts as a social approval metric, it harnesses the need for social comparison and validation to become a coveted reward	"My posts usually have 100 likes. How many do yours have?"
Sharing button	Seek, Reward	It enlists a user's friends in the task of keeping them online. Capitalizing on the draw of social interaction, it becomes a measure of friendship status	"You never look at any of the posts I share with you! Are you even my friend?"
Infinite feed (scrolling down)	Want, Seek, Anticipate	Removing natural stopping cues that cause the user to stop and reflect before continuing (e.g. natural stopping points at the end of a chapter in a book). This feature encourages mindless scrolling without end.	"Where did the last hour go? I just wanted to check Instagram for five minutes."
Photo Tagging	Seek, Reward	Similar to sharing. Apart from post sharing, though, it also harnesses the need for self-evaluation ("how do I look in this picture they shared of me?") to bring the user back to the app.	"Oh no, he just tagged me on a photo of last night's party. I have to look at it now —I probably look horrible!"
"Read" message icon (e.g. blue double tick on whatsapp)	Trigger, Reward	Exploits the drive towards social reciprocity to pressure people into answering a given message, because the other person knows it has been read.	"If she keeps leaving you on read, you should break up with her. If she cared about you, she would never leave you hanging."
Red notifications	Want, Anticipate, Trigger	The color red increases the anticipation of something noteworthy happening, and it gets more responses than any other color of notifications. They also are harder to ignore than any other color.	"I hate these annoying red bubbles on Whatsapp. I'm just going to go and check my messages so they go away."
Push notifications	Trigger, Seek	The app moves beyond its passive role when the user opens it, to send reminders and alerts on the phone while the app itself is closed. This creates anticipation of a new rewarding interaction, and boosts engagement by bringing people back to the app	"Somebody just commented on my post! I have to see what they said"

In-app alerts:	Trigger, Seek, Anticipate	The app sends alerts to users while they are on the app, to keep providing content that holds their attention and keeps them from leaving.	"New people on Instagram… oh, she's here now? I'll send her a friend request and ask her how she's doing."
Pull-to-refresh feature	Anticipate, Seek	In most apps, users can drag the screen down and release it to refresh their feeds and see more recent content. This action is similar and analogous to pulling the lever on a slot machine, and it preys on the human attraction to unpredictability.	"I have no idea why I keep refreshing my feed. I know nothing new will appear every five seconds, but it feels exciting for some reason."
Loading screen	Anticipate	The wait time before content is actually shown generates anticipation before the reward is provided.	"Come on… load! I want to see what he said!"
Streaks/daily login rewards	Reward	Using Snapchat as a case study, streaks (which are counters of how many consecutive days of uninterrupted interaction with a particular friend a user has had) can come to serve as status symbols. Their ultimate goal is to force the user to maintain daily engagement to keep this status.	"You have streaks with only one person? Most of us here have streaks with five or more people…"
Emails reminders about unread notifications	Want, Trigger, Anticipate	Similar to push notifications, email reminders are ways in which apps can reach outside of the user's own intentional engagement, and send alerts and reminders that would bring them back to the app.	"Oh wow, he made 10 new friends on LinkedIn this week? I should probably go back and make some of my own —I don't want to be left behind."

5. Strategies to Reduce Social Media Addiction

Just as social media provides countless benefits, it also has costs. As research unveils more and more pervasive negative effects of excessive social media use, and people become more aware of these effects, it becomes imperative to address these growing concerns. Eliminating social media altogether is an unlikely option, since it has penetrated almost every aspect of our lives and is now necessary for most lifestyles. The task at hand, then, is to find ways to reinvent social media: how can we keep the benefits of social media, but make it healthier?

To mitigate the negative effects of social media, there are platform interventions and user interventions that could be made. The former interventions seek to change the platforms themselves, through design changes or external regulations. The latter interventions address how a user's mental health can be restored when they are already suffering from social media addiction, and they address preventative measures that can be deployed in schools, workplaces and households, seeking to enable humans to be more resilient to the potential harms of social media.

5.1 Platform Interventions

5.1.1 A Moral Case for Platform Interventions

Many argue that intervening in social media companies is not justified. Common arguments in this vein suggest that the problem is overblown or that people simply have no right to intervene in free markets. For this reason, before discussing possible platform interventions themselves, it is useful to consider a moral argument in favor of their implementation.

Bhargava and Velazaquez[3] made a three-point argument addressing why deliberate efforts

to make social media addictive are unethical, and why steps should be taken to reverse the current situation. First, they argued that the harms of social media, through social media addiction, are not justified by the benefits the platforms provide. As we outlined in an earlier section, the detrimental effects of social media addiction are many, from poor school/work performance to depression and diminished attention span. Additionally, Bhargava and Velazaquez argued that the beneficial aspects of social media could be delivered without making the platform addictive. If the addictive nature of social media platforms only benefits the companies owning them, then users have nothing to lose and much to gain by reducing the addictive features of those platforms.

Second, Bhargava and Velazaquez[3] argued that the nature of social media addiction adds insult to injury by involving users in the same process that gets them addicted. Basically, users themselves provide the data for the algorithms to generate increasingly addictive content. At the very least, social media companies should better inform their users of how their data is being exploited to keep them "hooked." It is interesting to note here that social media companies may have taken steps to protect some of their users, while at the same time continuing to exploit others. Horowitz[64] reported that internal Facebook documents show that a little-known program called "XCheck" exempts certain high profile users, like celebrities, from the usual rules and sanctions that apply to other users. These exemptions allegedly made it possible for some users to make posts that would be censured if made by others.

Third, Bhargava and Velazaquez[3] strongly argued that social media companies exploit users to advance self-serving ends by taking advantage of user vulnerabilities. We have described these user vulnerabilities earlier, following Veissiere and Stendel,[30] as evolutionarily ancient desires or cravings to engage with others, combined with the effectiveness of social media to serve these ancient needs. Clearly, addicted users are more profitable to social media companies than those who are not addicted, so promoting addiction among users advances the companies' profit goals. The demeaning nature of having users help to create their own addiction is extremely disrespectful and, along with the exploitation it implies, calls loudly for change.

5.1.2 Toward a More Ethical User Interface Design

If social media companies have intentionally designed their user interfaces to have addictive properties, as we have argued above, then it follows that one important platform intervention would be to redesign these interfaces to be more ethical and less addictive. Somos[65] identified some key changes to the typical interfaces found on social media platforms that could be made to mitigate their addictive properties. These proposed changes directly address some of the addictive interface features we identified in Table 1. Below is a summary of the suggestions made by Somos[65], along with our own thoughts, regarding changes to social media interfaces needed help users avoid becoming "hooked." We have included possible user reactions similar to those presented in Table 1:

- "Time spent" indicator on Facebook and other apps. Part of being hooked is spending too much time using apps. To address this problem, interfaces could be redesigned to add an always-visible time counter on the interface screen. If clicked, this counter could display more detailed statistics (current and historical) about time spent scrolling and browsing in the app. Also, users should be able to set their own limits on session lengths and then receive alerts when they reach those limits. Possible user reaction: "Oh my, look at how much time it's already been since I started scrolling! I have to get back to homework. Next time I'll set a 1-hour limit for this app."
- Newsfeed filtering in Facebook. Users

should have more control over their news feeds. Multiple feeds could be available — brand pages, news/entertainment, only friends, close friends vs. all friends — allowing users to choose what content they want at the moment. Possible user reaction: "That high school reunion was wild! I want to quickly check what my friends posted about it before I go to sleep. I need to show only posts from my friends!"

- Killing the infinite scroll in Facebook and other apps. Another hooked strategy is the bottomless cup of endless scrolling. To address this problem, a "load more" button could be placed at the bottom of the feed, after a certain number of posts have been viewed. This button could tell you how many more posts remain, and could also show how many posts the individual already has scrolled through at that point. Possible user reaction: "Yeah, the 600 posts I've already seen is probably enough. I can come back later for more."
- Why I see what I see. To combat mindless viewing of Facebook posts, each one that appears in a user's feed could include the reason why it was selected (e.g., because a friend liked this...). Moreover, an option to stop suggesting that type of content or suggesting for that reason could be provided. Possible user reaction: "I should take a look at this post since my friend liked it. I generally agree with her," or "I don't want to see any more posts related to this reason."
- Raising saved item prominence. Users now can save posts to view later, but these options are buried in the interface. To give users more control over what they see and further combat endless scrolling, a "saved posts" option could be put next to news feeds to increase accessibility of intentionally saved content. Thumbnails with short titles could appear under a "saved posts" tab. Possible user reaction: "This is an interesting post. Need to do something else now, but I'll save it and look at it later."
- Notification grouping/muting. Notifications are important triggers that hook users who need more control over these triggers. They should be given an option to choose which type of notifications to receive at a given time (i.e., all, only friends, only close friends, news/entertainment, promotions, etc.). Also, Users should be allowed to mute notifications for set periods of time (e.g. from 9am to 5pm), including a feature to bundle notifications and get them all at once. Possible user reaction: "I check social media every day at 5:30pm, when I'm on the subway on my way back home. It's awesome that I can get all of my daily alerts at once at that time. This way I can focus better at work!"
- Do not disturb. Users should be able to control their availability for chats, notifications and posts on all social media apps beyond such a feature that might be available in the device OS. A "do not disturb" schedule should be available for chat notifications, so users can set their online status according to what is needed to focus better on their commitments. Possible user reaction: "It's not that I don't care about text messages, but I can't be looking at them when I'm on a deadline. If something is that urgent, people can always call me."

5.1.3 Encouraging Platform Interventions

Changes to social media platforms such as those noted above are needed to make them less addictive and disrespectful to users. However, as previously mentioned, these platforms are run according to attention-based business models, where the addictive potential of the sites is directly tied to their profitability. For this reason, it is unlikely that social media companies will regulate their own practices or implement design changes without external pressure. Such external pressure can be manifested through consumer opinion and/or government intervention.

Consumer opinion is likely the most

effective tool to influence healthier social media design. A recent Edelman Trust Barometer Special Report[66] revealed that barely 43% of people globally trust social media to "do what is right", while only 41% trust the information they receive on social media platforms. These numbers show social media is developing an increasingly negative reputation. In fact, the same special report showed that 40% of people have deleted at least one of their social media accounts because they didn't trust the company's handling of their personal information.

Since social media companies rely on user engagement to gain revenue from advertisers, both users and advertisers have the power to demand changes to reduce the addictive potential of social media platforms. Earlier we described how feedback from users and advertisers promoted changes in Facebook's recommendation algorithms, sometimes with unintended consequences. Social media companies need their users, so they must listen to user input and adapt to such feedback if they want to survive. Unfortunately, however, change by this means often is slow and depends on information becoming readily available to the public about how certain platform features actually work and how they negatively affect users.

Government intervention, in contrast, works by establishing broadly applicable standards that regulate what is and is not permissible. Such regulation is most likely to emerge in an effort to control or limit what kinds of data platforms can collect and what they can do with it, as well as how platforms can manipulate and control what information users can see. In the United States, large tech company CEOs have been repeatedly called to testify in congressional hearings, answering increasingly specific questions from lawmakers who are set on changing the social media industry. Many legislators have proposed bills to modify the existing law, and this trend is only increasing. Topics frequently brought up include data privacy, protection of children from social media addiction, misinformation and hate speech.[67]

The increasing movement toward government oversight of social media companies, as well as increasing public knowledge about the negative consequences of social media use, signal an emerging opportunity for reform. Current public opinion momentum should be leveraged to educate consumers about the risks of social media use, to advocate for more oversight initiatives, and to pressure lawmakers into acting in the public interest by introducing stricter regulations.

Regulation Examples. With the aim of illustrating what social media regulation might look like, two examples of recent governmental oversight legislation are presented below:

- In 2018, the European Union enacted a General Data Protection Regulation (GDPR) bill,[68-69] which proposed laws to protect the privacy of data on social media platforms, as well as to offer individuals more control over their personal data. This bill proposed that any entity accessing or collecting personal data must put in place appropriate technical and organizational measures to ensure adherence to basic data protection principles. Also, the bill required that data controllers follow specific and stringent guidelines to disclose the details of their data collection practices.
- The US Congress recently introduced the Platform Accountability and Consumer Transparency (PACT) Act,[70] a bill intended to increase transparency in platforms' content moderation policies, requiring they disclose these practices to users, as well as requiring quarterly reports on the moderated content. It also made a distinction between the different capacities to moderate content between large companies and smaller companies. As of this writing, the bill has been referred to committee.[71]

In addition to these legislation examples, other areas of platform operation in need of potential oversight attention are based on some of the more problematic aspects of social media we

have note above, including:

- Attention-economy-based profit models. What kinds of regulation and additional consumer protections are needed when companies profit from keeping users on their sites as much as possible while also creating platform features to promote increased use?
- Data collection practices. Along with the above noted proposals related to user data privacy, do limits need to be placed on the kinds of data social media platforms can collect and record, along with limits on selling and distribution of data to third parties?
- Transparency in algorithms. Social media companies benefit from user ignorance about the algorithms used to generate personalized news feeds for their users. Do we need stricter controls to ensure more transparency and public disclosure about these algorithms?

5.2 User-based Interventions

Addressing the problem of social media addiction requires more than just platform changes. Interventions aimed directly at users also are needed both at individual and societal levels. One type of user-based intervention is intended to serve as a preventative measure implemented in the workplace and at schools, with the goal of reducing the likelihood of individuals becoming addicted in the first place. A second type of user-based intervention focuses on treatment and self-management for individuals who at the very least are struggling to manage their social network usage and at worst are suffering from severe addiction.

5.2.1 Prevention Strategies

In the workplace, the TeamLease World of Work Report[72] found that employees spent an average of over two hours on social media per workday, potentially reducing their work productivity by about 13%. Three proposed areas of focus to reduce the detrimental effects of workplace social media usage were presented by Herlle and Astray-Caneda.[73] First, they recommended the exposition of clear social media usage expectations during orientation for new hires. Employees, they stated, want to fulfill company expectations, but will struggle to do so if these expectations are not clearly communicated. Second, they highlighted the effectiveness of visual aids, image-based posters and signs, reminding employees of appropriate behavior in the workplace with respect to social media. Third, the study underscored the importance of employee recognition programs, which can motivate workers to adopt more aspirational mindsets and more productive behaviors with respect to creating a company culture of self-improvement.

In schools, Blazer[74] identified reduced face-to-face communication and distraction from school work as potential risks of social media usage in that venue. The author indicated that excessive social media use in schools could result in students who become worse at having real conversations, who have their attention spans reduced, and who might develop more self-centered personalities. Additionally, she highlighted the role of social networks such as Facebook as disruptors of classwork. One suggestion to combat these negative effects was training for staff members, so they can appropriately respond to social media usage challenges. Additionally, Blazer[74] recommended that schools seek to steer their students' usage of social media towards more education-based social networking sites that will benefit teachers and students in their educational goals.

5.2.2 Treatment and Self-management Strategies

Recently, several mental health interventions and self-help programs to assist individuals in managing social media addictions have emerged. Pharmacological treatments are being tested and even work-related policies are being implemented to mitigate the negative effects of this addiction. One effective mental health intervention, developed by Hou et al.,[75] was grounded in Cognitive Behavioral Therapy

(CBT). It was tested and found to have a significant positive impact on the mental health of diagnosed social-media addicted college students in a Chinese university. The intervention consisted of two stages. Stage 1 involved a 30-minute CBT-based cognitive reconstruction session, where experimental group participants reflected on their social media use and potential future practices, and received some strategies to follow these practices. They also printed out a list containing the strategies and pasted it on their desk to keep as a reminder, and additionally used the list as a lock screen on their phones. These individuals continued life as usual keeping the reminders with them for a week before the next stage. For Stage 2, participants kept a daily record of thoughts, emotions and behaviors related to social media use for a week. They reflected on their time of usage, the nature of the usage, and thought about possible future strategies to employ in managing their social media engagement. All participants completed a survey before and after the intervention, and the responses were then used to assess the change in their mental health as a response to the intervention. The study found that every single indicator of mental health (including but not limited to anxiety, depression, and quality of sleep) improved in the experimental group, while not finding these improvements in the control group.

Another intervention approach is motivational interviewing, a method proven effective for behavioral addictions.[76] This method emphasizes the importance of the practitioner's participation, as the one who leads the patient through the process of changing long-standing beliefs about their behavior. In the case of social media addiction, the practitioner solicits the addicts' thoughts about the value of social media, the different ways time can be spent, and the negative consequences of excessive social media usage. The goal in reflecting on these matters is slowly to encourage the addict to embrace new ways of thinking, with the ultimate purpose of creating and sticking to an actionable plan to quit the addiction.

Self-help smartphone applications also have been developed to assist with curbing the amount of time users spend scrolling. These apps employ features such as including reminders to stay on task, providing detailed usage statistics with an "addiction score", blocking notifications from certain apps for certain periods of time, allowing users to set their own rules for usage and then holding them accountable. The most extreme control exerted by these self-help apps involves simply locking a user out of their social media apps once the quota of time spent is reached.[77] These self-help apps can serve as good enforcers for social media usage management plans, both for addicts and non-addicts.

Drug therapies also have been tested for Internet and video-game addiction, though not specifically for social media addiction. In randomized clinical trials, three psychoactive drugs have been found to significantly decrease Internet addiction in participants.[29] Bupropion, a norepinephrine and dopamine reuptake inhibitor used to treat depression and seasonal affective disorder, produced a significant reduction in Internet video-game addiction.[78-79] Methylphenidate, a norepinephrine and dopamine reuptake inhibitor used to treat Attention-Deficit/Hyperactivity Disorder (ADHD) and narcolepsy, had significant positive effects on participants with co-occurring ADHD and Internet-based video game addiction.[80-81] Escitalopram, a serotonin reuptake inhibitor used to treat depression, was found to bring previously excessive Internet usage back to normal levels.[82-83] It remains to be seen whether or not these drug treatments will be effective specifically for social media addiction.

6. Conclusions

There has been extensive research into social media addiction and its relationship to indicators of mental health, with findings revealing numerous negative effects on mood and emotional stability stemming from

compulsive engagement with social media apps. Other effects of excessive social media use, such as reductions in attentional capacities, also have been established. Social media addiction is widespread across age cohorts, and it seems to be growing with the increasing availability of portable internet devices. It is imperative to start considering ways to mitigate the impact of social media addiction, since the prevalence of social media is increasing dramatically across the globe. The actionable solutions that are addressed in this paper include user-based interventions and platform-based intervention. User-based interventions include prevention and intervention, and platform-based approaches include regulation and redesign.

Strategies for the prevention of social media addiction can and should be implemented in schools, workplaces and households. In schools, the use of technology in general, and social media in particular, should be regulated and controlled. In workplaces, policies limiting social media usage, if not other forms of internet use, likely will increase productivity and reduce distractions. At home, parents need to work with children on educational initiatives to better understand the threats and benefits of social media, and need to agree on policies that will bring healthier approaches to technology use into the home.

Mental health programs have been developed and are proving to be effective in treating the negative outcomes of social media addiction and other addictions related to Internet use. Future research needs to address the longitudinal value of these new therapies, to see if their positive effects remain long after the initial study. Self-help applications should continue to be developed, as they can become effective tools to enhance self-awareness and self-control.

Moreover, governmental agencies should become more active in regulating social media companies in the future. Policies should be developed that address the pernicious economic benefits to social media from their attention economy models. Data collection practices from social media companies should be scrutinized and regulated, to ensure user privacy and respect users' dignity. Content curation should be more transparent, and policymakers can introduce bills that require greater disclosure on the part of social media companies.

Redesigning social media is a major undertaking. The pressure to achieve this redesign will need to come from consumers and legislators who want social media companies to respect user dignity, rather than continuing to take advantage of them. The many dimensions of social media that can foster addiction, including the exploitation of evolutionarily old urges to communicate and socialize, as well as the user interface properties designed to hook users into constant use, need to be reimagined in the spirit of creating a more humane and ethical platform. We all need to work toward a world in which people use technology for their own well-being rather than for the well-being of those who control the technology.

Finally, it should be noted that although this paper is focused on social media addiction, excessive use of social media may be linked to other problematic internet addictions for some people. For example, the unattainable beauty standards often reflected in social media posts may drive certain individuals to seek instant gratification and dopaminergic reward though excessive use of pornography. One study[84] found that approximately 200,000 Americans were classified as "porn addicts," and another 40 million Americans regularly visited porn sites, with 93% being boys and 62% of girls under age 18. Today, many consider pornography to be a public health crisis,[85] and its use among adults increases the marital infidelity rate by more than 300%.[86] The constellation of addictions related to internet use, aided greatly by the convenience of smartphone technology, is one of the major societal concerns of our day and must be met on multiple fronts with significant ongoing legislative, research, and treatment efforts.

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