Service Operation Management: Internal Web Application and API for Service Development and Production Support
(Technical project)

How Engagement and Attention Engineering in Facebook and Instagram has Contributed to Social Media Addiction Among Users in Generation Z
(STS project)
A
A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

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October 27, 2022

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

The introduction of social media in the 21st century has had many benefits for society in communication, entertainment, education, and many other areas, but when does its usage become problematic? Meta's largest platforms, Facebook and Instagram, have become deeply ingrained in the daily lives of their billions of users across the globe. Users may spend hours active on these platforms as a result of engagement and attention engineering tactics employed by both the platforms themselves, and the companies or individuals that leverage them to gain brand visibility or market a product. This can be partially attributed to Facebook's business model, which depends on users' constant engagement and interaction in order to gain advertisement revenue and generate monetizable data (Burt, 2019). Social media marketing has become increasingly important to other smaller businesses who aim to increase customer engagement with their company profiles on platforms like Instagram and emotionally engaging content (Lee, 2018 pp. 5105-5106). This has created a problem where the platforms themselves and business profiles are constantly engineering for more engagement and longer sustained attention of casual users. This creates strong potential for addiction, where users have very little understanding of the ways in which that addiction is being encouraged by Meta itself.

Understanding addiction in general is important for framing this problem. Anna Lembke, Professor and Medical Director of Addiction Medicine at Stanford University, weighs in on the relationship between pleasure and pain, dopamine pathways in the brain, and addiction in modern society in her book *Dopamine Nation*. She defines addiction as "the continued and compulsive consumption of a substance or behavior despite its harm to self and/or others" (Lembke, 2021, p. 20). Use of social media platforms, like Facebook and Instagram, can be abused to the point of addiction under this definition. Regarding social media addiction, it is

described as a failure to control problematic usage that leads to negative effects on a user's personal life (Ryan et al., 2014, p. 133). As Generation Z includes people born after 1997 and they are the first to have Internet technology readily available throughout their upbringing (Dimock, 2019), whether or not they have been disproportionately affected by the addictive potential of social media is worthy of investigation. Addiction to both Facebook and Instagram have been examined with a focus on uses and gratifications theory, primarily in an effort to show that there are uses and gratifications that underlie these platforms (Foroughi et al., 2022; Ryan et al., 2014). This theory and associated model involve the investigation of active audiences and their relationship to media (Katz et al., 1973). Aspects of media like interactivity, demassification, and asynchrony have been introduced or enhanced with the growth of the internet in the 21st century and have increased the active role that users play (Ruggiero, 2000, pp. 15-17), thus requiring novel approaches to researching the sociological and psychological effects.

Internet and social media addiction is not a new concept by any means, and in fact has been studied for over 15 years although it is excluded from the most recent version of *The Diagnostic and Statistical Manual of Mental Disorders* (Ryan et al., 2014, p. 133). Previous work has had a focus on psychosocial influences. There has been lots of emphasis on the evidence and existence of this addiction through psychological and social studies, but little on the causes. This paper aims to pin down some root causes of addiction as well as potential solutions and strategies to mitigate problematic social media usage. One facet of this problem is the involvement of machine learning and artificial intelligence. Facebook pushes massive amounts of user data through machine learning pipelines in order to create artificially intelligent algorithms. They have a variety of services and thus require a variety of complex and specific

models (Hazelwood et al., 2018). The artificial intelligence that permeates Meta's social media platforms and its iterative nature can allow biases and manipulation of those who configure their underlying models to impact end users. The goal of these algorithms is to convert massive, convoluted datasets into valuable knowledge for Meta to further develop Facebook or Instagram. One paper cites an argument that the use of AI in social media by extremely popular and powerful platforms can create a slew of problems including but not limited to redlining, targeting, and favoring certain demographics of users (Bechmann & Bowker, 2019, p. 2). Based on the business models of Facebook and Instagram, then, it is worth considering how AI algorithms that optimize advertisement clicks and active time on the platform can lead to addiction, especially for the generation that grew up in the midst of the social media revolution – Generation Z.

The present thesis will also include a technical report, unrelated to the previously described STS research paper. That technical report details a system that was developed during a summer 2022 software engineering internship with a used car retailer and financer. At the retailer, there are systems and other software tools that are developed internally, as well as software development tools and technologies that are external and require purchase of a license for use. Since the company has over 70 product teams working on different software and using different tools, efforts to keep track of them and remember how to use them could become quite convoluted. While both the internal and external tools are well documented, that documentation is usually stored in a GitHub repository (internal) or on a website (external). Finding the tools and reviewing documentation to properly use them wastes valuable time that could be better spent programming and debugging. This led to the design and subsequent development of a service development and production support toolkit in the form of both an API and web

application interface. An API, or application programming interface, is a piece of software that allows multiple software systems to communicate with one another using standard guidelines and the retailer has become increasingly reliant on them as the technological infrastructure has become more complex and distributed. The web application allows a user to interact with the API through an elegant user interface. This system reduced time spent on tedious and repetitive tasks and created a centralized hub for various finance-related software services, effectively increasing the agility and efficiency of finance-area product teams. While the two separate papers present in this thesis are not connected in subject matter, they both draw attention to the way that the overall software architecture of modern companies is structured. The service development and production support toolkit is an example of one of these smaller systems that fit into a company's suite of internal services, while the platforms, Facebook and Instagram, that are the subject of the present research are composed of a variety of these sorts of smaller services that contain different functionalities.

Internship Project: API and Web Application

The technical paper will detail a finance-area product team at a used car retailer and financer based out of Richmond, Virginia that decided to improve access and usability for various elusive, confusing, and time-consuming functionalities for service development and production support. The present system falls under the category of information technology service management (ITSM), which Atlassian (2022) describes as any method that a technology team uses to deliver their software services to end users. ITSM systems have become increasingly important to companies, especially for increasing the efficiency of software development teams. As an intern for the company, I achieved this using a custom API and web application that combined said functionalities into a centralized suite of tools. The project, titled

Service Operation Management (SOM), was built first as an ASP.NET API and later integrated with an ASP.NET web application. As Gino (2021) describes, modern software development has become very reliant on APIs, and as such the retailer utilizes APIs in many of their systems and processes. Using React and an internal design library, my mentor and I developed a usable and functional user interface so these tools could be readily available for software developers in the finance area. According to Galik (2021), React has essentially automated the rendering process so that less time is spent debugging complex programs, and more time can be spent focusing on the minute details that set a UI apart. In making this choice for frontend development, the retailer joins the likes of companies like Netflix, Airbnb, Dropbox, and Reddit in using React. The functionality of the tools in the SOM comes from both custom company systems and Microsoft Azure, and it has effectively increased the agility and efficiency of the team that developed it. Plans include adding more tools, building out the administration system for customization purposes, as well as rolling the system out to other finance product teams and possibly even teams outside of the finance area.

How Engagement and Attention Engineering has Contributed to Addiction

In the science, technology, and society research paper I will examine the addictive effects of Meta's Facebook and Instagram platforms on members of Generation Z as a result of engagement and attention engineering practices, and investigate how society might remedy the negative social impacts it has had to protect future generations. In understanding this problem, one must consider all potentially contributing factors. Technical contributors include algorithms, artificial intelligence, and design components that influence user interaction. Economic contributors include the Facebook and Instagram business model and revenue streams, and the company ideologies that translate from executives and managers into the work done by

engineering, marketing, and sales focused employees at Meta. Social contributors include the effects of advertisement and business account activity on social media platforms, as well as the activity and interaction that takes place between personal account users. For this problem in particular, there is value in employing Actor Network Theory (ANT) to examine how these platforms are composed of many human and nonhuman actors, and how activity can actually be imposed on users by the platforms. Extensive use of machine learning within the platforms has introduced an ever-expanding and incomprehensible actor to the equation – artificial intelligence – which will further complicate the root of the problem, giving cause for my evaluation of its influence on the platforms as actor networks. Cressman wrote in a summary of ANT, "We act as we do, not by some idealistic notion of free choice, but because our actions are bounded by technologies that delegate how and what we can do within a sociotechnical network" (2009, p. 10). Facebook and Instagram are great examples of this idea, as user actions are bounded by the platforms' form, function, and even the social norms of their use that have been formed over the past decade. The boundaries are created both intentionally and unintentionally by the aforementioned contributing factors, such as the business model and various recommendation algorithms. We can evaluate how Facebook or Instagram as technologies prescribe behavior onto their users, how users and other actors subscribe or de-inscribe to those behaviors or the role that platforms impose on them, and what pre-inscriptions exist both in software and human nature that may lead to unhealthy use of the platforms. Each of these concepts are defined in Latour's (1992) explanation of ANT. Prescription is defined as "the behavior imposed back onto the human by nonhuman delegates" (Latour, 1992, p. 232), and in my case the nonhuman delegates are the social media platforms. Subscription and de-inscription are defined as the actors' acceptance or rejection of their prescribed roles in the actor network, respectively (Latour, 1992,

p. 257). Pre-inscription is defined as all of the preexisting factors that influence actors' behavior before any prescription happens, and can be leveraged by engineers when developing a technology. An example of a pre-inscription in my case would be humanity's innate desire to socialize with others, creating the potential for success of social media platforms.

Engagement engineering and attention engineering have heavily influenced the way in which user interactions occur on Facebook and Instagram. These two forms of engineering users have shaped the design and functionality of these platforms, and thus influences all of the aforementioned factors that may contribute to a user's addiction. Engineering for engagement involves any strategies that those involved in the platform's development use to encourage a user to engage with their platform in some way; that engagement comes in the form of a user liking, commenting on, or sharing a post, among other things. In order to understand attention engineering, one must first understand attention. According to Hartman-Caverly, "Attention refers to conscious behaviors involved in processing information from intentionally selected sources" (2019, p. 25). She goes on to state the involvement of dopamine and serotonin reward systems in attention, as well as its common categorization as either transitory or sustained. Attention engineering, then, involves the strategies used by Facebook or Instagram developers to grab and sustain the attention of users in order to keep them active on the platform. The relationship between attention, social engagement, and different neurotransmitters in the brain creates the potential for addiction.

Meta's use of different strategies to hold a user's attention or provoke certain actions invites the concept of configuring the user for discussion in conjunction with ANT. On configuring the user Woolgar wrote, "For along with negotiations over who the user might be, comes a set of design (and other) activities which attempt to define and delimit the user's

possible actions. Consequently, it is better to say that by setting parameters for the user's actions, the evolving machine effectively attempts to configure the user" (1990, p. 61). There is much value in using this configuration perspective to evaluate Instagram and Facebook, as there are both design and engineering activities that could influence the level of addiction in a configured user who lacks technical understanding or interface design education. Woolgar's use of the term "evolving machine" becomes even more relevant to the present research due to the involvement of machine learning models, which are quite literally evolving based on a continuous input-output loop with active users. In alignment with this perspective, I will review the evaluation of gambling tactics and gambling addiction to identify similar patterns on social media that can lead to problematic use. It is worth investigating how Meta's platforms configure the user in a similar way that casinos or digital gambling platforms do in an effort to control behaviors related to the learning mechanisms and reward systems in the human brain. For example, how the "imperfect prediction of reward" and "fickle nature of the payouts" in gambling may compare to the receipt of responses to one's social media posts (Brevers & Noël, 2013, p. 2). Looking at the founders, engineers, and users as separate actors, the configuration of users by those founders and engineers is a uniquely important relationship within Facebook and Instagram as actor-networks. This creates an opportunity to discuss Woolgar's framework for configuring the user within my greater analysis with ANT.

Research Question and Methods

The question being investigated through this research is: how has engineering for engagement and attention in Meta's Facebook and Instagram platforms contributed to addiction in users from Generation Z? The primary methods used in the present research in an attempt to answer this question are literature review and discourse analysis. The literature review involves

academic research literature on the topics of addiction and dopamine, attention and engagement engineering practices, and social media usage among Generation Z specifically. Moreover, recent literature and studies relating to addiction, artificial intelligence, and engagement methods, and mitigation strategies in the context of social media specifically, primarily with focus on Facebook or Instagram. These resources were found through academic databases pertaining to psychology, media studies, and engineering. I will also analyze the Meta privacy policy to discover how user data may be leveraged to retain user attention and provoke engagement. This policy covers both Facebook and Instagram, in addition to a plethora of other platforms and technologies that Meta owns and operates (Meta, 2022), which indicates that similar strategies may be employed across both platforms. I will use a discourse analysis approach to examine current discussion relating to Meta's business model and the revenue streams of Facebook and Instagram, as well as the ever-growing social media marketing industry in an effort to see how they factor into motivations for attention and engagement engineering and contribute to the overall problem. Related resources were found through narrow internet searches.

Conclusion

The technical project, Service Operation Management, has had positive impacts for the finance area team that developed it, but also has the potential to provide similar benefits to other teams across the organization. These include creating a centralized hub of related tools that can be customized based on specific product team needs. The centralization and development of these tools increases the agility of software development teams and eliminates the need for tedious and repetitive steps required to produce similar results using the methods that it has replaced. As for the research paper, the anticipated findings of this research and analysis are that

the engineering practices of Meta on its Facebook and Instagram platforms have caused social media addiction among Generation Z. The anticipated factors that are most influential to that end are psychological manipulation of users, social pressure due to the platforms' widespread adoption, and the disconnect between the interests of Meta and their users. I expect to find that users in Generation Z are disproportionately affected by addiction to these platforms as a result of society's increased reliance on these technologies from the early 2000s to the present day. The primary goal of my research is to educate and inform policymakers in an effort to produce legislation encouraging or enforcing ethical engineering practices in the development of new and existing social media platforms. Current policymakers are not particularly technologically literate, and are far older than members of Generation Z who comprise the majority of these platforms' active users. Other potential outcomes from this research include increased awareness in users and engineers regarding this problem, potential solutions and strategies to mitigate the addictive effects of popular social media platforms, and an increase or method shift in research on this subject. Review of existing mitigation strategies like the creation of impulsivity barriers, psychoeducation, and active self-monitoring, among other things (Macenski et al., 2021, p. 413) in modern context gives way for their extension or the development of new solutions. A long-term effect could be a shift in engineering practices by social technology engineers and companies that addresses the ethics of existing practices and makes the mental well-being of users a priority.

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