An Analysis of Recommendation Systems' Effect on Society and the Engineers'

Involvement

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On my honor as a University Student, I have neither given nor received unauthorized aid on this

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INTRODUCTION

Over the last two decades, countless successful social media platforms have popped up and have created a multi-billion dollar industry (Curry, 2023). Due to this, millions of people worldwide have fallen victim to predatory practices employed by these companies to gain the most possible ad revenue from each user. With a customer base as massive as social media, the financial incentive is massive, leading to companies and universities putting incredible amounts of effort into research on how to retain as many users for as long as possible. In fact, between just the top 16 countries, nearly 6000 pieces of literature have been written (Shao et al., 2021). The result of this research and the implementation of its findings is that users' screen time has increased exponentially in the last two decades, and at the same time, a mental health epidemic has begun and political polarization has increased. The correlation between the increase in documented mental health disorders and the use of social media is staggering. Between 2007 and 2017, depression in teenagers increased by 57% (Geiger, 2019). In the same time frame, the percentage of teenagers using social media increased by 46% (Pew Research, 2021). Companies, researchers, and developers alike are aware of the potential harm they are causing and yet make no changes.

One may expect that, due to these statistics and the general knowledge of social media consumption being unhealthy in many ways, there would be a decline in application usage. As is evident by the continuous increase in social media usage (Pew Research, 2021) there is no real urgency or change from the public regarding social media usage and its potential ramifications both for the individual and society. There are occasional stories or documentaries, such as "The Social Dilemma", but no shifts in screen time have occurred and have instead continued in a steady upward trend. This is the opposite reaction of what would be expected. Given any other

addictive and destructive item, there would be immediate and powerful social and political pushes against the creators and distributors of any such product. Part of the issue, however, is the lack of transparency on the part of social media companies, and a lack of education for the general public. Many users don't even know how strictly they're being controlled and manipulated.

To find a link between recommendation systems, political polarization, and the rise in mental health disorders, I have researched both the ethical and technical sides of recommendation systems. Using this research, which is a combination of past literature and extensive research conducted on all sides of recommendation systems, I will attempt to answer what the effects of recommendation systems are on mental health and political polarization. Following this, there will be an analysis surrounding the companies and engineers involved in the creation and implementation of recommendation systems.

THE PREDATORY ASPECT OF SOCIAL MEDIA

As previously mentioned, one of the predatory practices social media companies utilize is recommendation algorithms, which in turn makes social media dangerously addictive. Recommendation algorithms are a simple concept, which is to use machine learning and statistics to take a user's history and data and subsequently predict what the user would like in the future (Keaton, 2023, pg. 2). A base example would be someone who has previously liked romance novels is more likely to enjoy another romance novel, rather than switching genres to something like horror. In theory, recommendation systems could be extremely useful for the efficient and enjoyable use of all websites and applications. However, with the developments made in the last few decades, they have become toxic and extremely powerful, leading to extreme addiction problems among users. A published author of multiple novels surrounding

social media usage, Andrea C Nakaya, outright states this- "Recognition of Internet and social media addiction is worldwide, as is concern over its impact on society and how it should be addressed." (Nakaya, 2014, pg. 10). This problem is exacerbated by the sheer number of users that social media has. According to the University of Maine, over 4.48 billion people in the world use social media– making up nearly 60% of the world's population. With a market this large, social media companies are willing to spend incredible amounts of money to claim a percentage of users. In fact, in 2006, Netflix held a $1,000,000 open competition for users to create the best possible recommendation system (Jackson, 2017). This was just the beginning of the mass spending that would ensue. The urge to get ahead of competitors in this race for user retention is what leads to the willingness of corporations to use tactics that could be considered ethically questionable. While this increase in social media usage has been happening, mental health issues have also been exponentially increasing.

The trend of social media usage and depression rates in the United States are eerily similar, leading to a sentiment in the community of those who study social media that social media causes mental health issues. This general feeling is very simply summarized by Professor Aydin from Georgia State University when he states that the "Increased use of technology and tools like the internet, social media, smartphones, and digital games in daily life may cause addictions with technology that can result in depression" (Aydin, 2021, pg. 2). According to Pew Research Center's writer Geiger, "The total number of teenagers who recently experienced depression increased 59% between 2007 and 2017." (Geiger, 2019, para. 4). Similarly, from 2007 to 2017, social media usage increased from around 42% to around 88%, a total increase of 46% (Pew Research, 2021). A visualization of this trend for varying age groups has been provided on the following page in Figure 1.
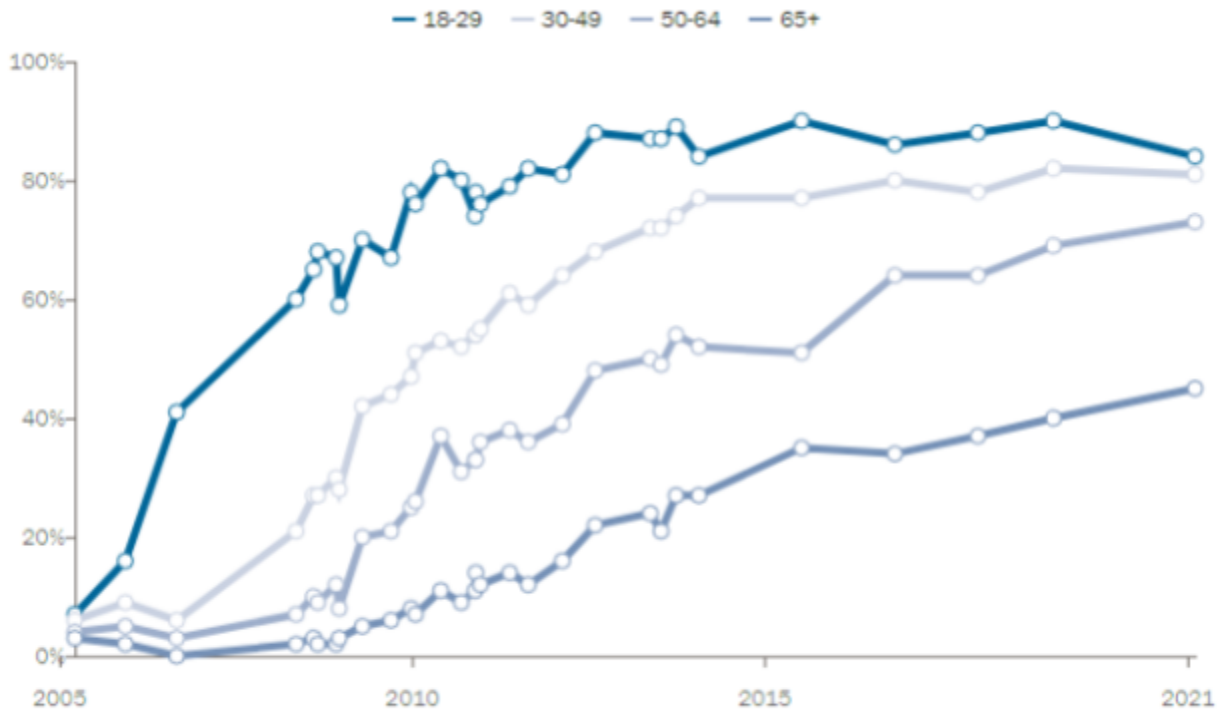
FIGURE 1: SOCIAL MEDIA USAGE BY AGE (PEW RESEARCH, 2021)
Percentage of respondents who use at least one social media application or site, sorted by age group

This increase in social media usage has been no coincidence. As mentioned previously, the applications are designed to be addictive and put the needs of the company above the safety of the users. The issue has become so extreme that psychology has recognized internet addiction as an official mental health problem on its own. Aydin discusses this in his paper Investigation of the effect of social media addiction on adults with depression, where he states that "Symptoms of internet addiction, and hence social media addiction, which is a subcategory of internet addiction, can be listed as the following: an increasing and more frequent use of the internet, lying about the amount and duration of the use, constantly having an engaged mind with the internet and its elements, using the internet to avoid problems, and demonstrating continued usage while knowing the consequences of excessive use of the internet" (Aydin, 2021, pg. 2). Causing this addiction is not a negative side effect in the eyes of corporation though. One expert from "The Social Dilemma," even admits that "These technologies are shaping the way we think, feel, and behave without us even realizing it." (Orlowski, 2020), demonstrating domain experts

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are aware that their users are unaware of the side effects. The goals of corporations are just that–to have a grip on who we are and how we act without users being conscious of it happening. That way users will be more easily manipulated into staying on their application, and generate more ad revenue for the company.

Outside of just the immediate repercussions caused to individuals, are greater concerns for society. In my research conducted at the University of Virginia, I found that most recommendation systems use models that "group" users to a certain degree. What this means is that users with similar interests and personalities will continuously see the same kinds of posts among themselves (Keaton, 2023). Social media platforms that use this method of recommendation tend to lead to echo chambers, that, over time, group users more and more tightly with each other, rarely showing content outside of the group's viewpoints. This can lead to a vast amount of misinformation and confirmation bias, as discussed throughout Ferguson's 2021 paper, Does the internet make the world worse? depression, aggression and polarization in the social media age [research paper]. Ferguson states "...social media could allow for individuals to self-select only information that reinforces their personal views which could be undesirable particularly when those views are extreme." (2021, pg. 117). Some of the information mentioned by Ferguson for these potential echo chambers are extremist political positions or data-deficient viewpoints (climate change denialism).

Aside from all of the statistics, research, and expert opinions that seem to align with the common theme that social media inherently causes mental health issues, I could find no study deliberately holds this to be true. Furthermore, even if social media causes depression and other mental health issues in the masses, there is no hard evidence shown that says this is because of recommendation algorithms themselves. Similarly, Ferguson (2021) found that there is no basis

to argue that we are in a time of "unprecedented" political polarization, regardless of what social media and mainstream news platforms may lead you to believe. There are countless other theories as to what has been causing the uptick in mental health issues or general feeling of political unrest, and ultimately it is likely a combination of all of the above, but it is hard to determine who the main perpetrators are with how drastically the world has changed in the past few decades.

DERIVING A RESEARCH APPROACH

To conduct research, one must first have a foundation of how they plan to approach the research required. A framework piece is one such foundation. For me to effectively explore the topic of this paper, I will be using an article written by Neeley and Luegenbiehl– Beyond inevitability: emphasizing the role of intention and ethical responsibility in engineering design. This article discusses the blindness of engineers when coming up with new creations, and how they tend to willingly undermine their invention's impact on the world at large. I chose this source because I believe this situation is exactly what happened with recommendation systems, and continues with each new advancement in the field.

The Problem The Source Addresses

The aforementioned article by Neeley and Luegenbiehl discusses and analyzes an issue in the ethics of engineering commonly known as the "discourse of inevitability". This idea is the notion that engineers tend to ignore the implications of their inventions, under the guise that if they don't create them, someone else will, as "technological development is difficult, if not impossible, to control" (p. 1). The framework at hand is described more concretely in the abstract of the article, explaining how frameworks focused on development tend to lead to this discourse

of inevitability, whereas "one [framework] focusing on the terminology of engineering design enhances perceptions of choice and, consequently, of individual responsibility."

The Analytical Framework it Provides

Within the introduction of the article, Neeley and Luegenbiehl argue that three main ideas must occur to disrupt the discourse of inevitability. These three points are:

1. "Recognizing that robustness of the discourse of inevitability derives from many sources…"

2. "Developing a compelling discourse of design that is, in turn, based on a sound philosophy of engineering and philosophy of engineering." and

3. "Demonstrating that as humans we have choices about the forms of discourse in which we engage and that those choices have significant societal consequences." (p. 2)

Later in the article, the authors discuss a speaker, William McDonough, and how he believes that design is a showcase of the intention of the designer. He goes on to discuss how financial success and a progressive social agenda can be a difficult mix to achieve for companies, however, this is a strong opportunity for "individual and collective empowerment, especially for engineers" (p. 5). Figure two shows how the discourse of inevitability stands today, versus how it should be:
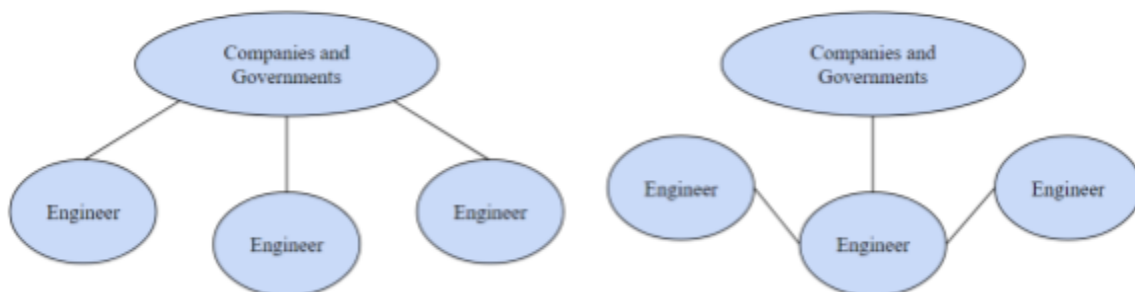
FIGURE 2: PROPOSED ACTOR RELATIONSHIP WITHIN LAW OF INEVITABILITY (CREATED BY AUTHOR)
Visualization showing before and after of proposed actor network between engineers and their superiors

The framework however also introduces another group of people, the people who use these inventions. In the third point mentioned above, Neeley and Luegenbiehl state that " as humans, we have choices about the forms of discourse in which we engage and that those choices have significant societal consequences" (p. 2). While this statement may have initially been geared towards the idea that engineers have free will, and can deny creations that would be harmful to society, I believe that the point goes further than this. I believe that other engineers, doctors, psychologists, and hundreds of other professionals should hold engineers and creators accountable. These groups should do this by calling out harmful creations the moment they arise, and in turn, everyday people should refuse to use them. In the context of my STS project, this would be users refusing to use platforms that use addictive recommendation systems.

Framework Strengths and Limitations

The strength of the proposed framework and its branches is that it would, in theory, help to invent only products that would be morally and ethically sound for the consumer. In general, the world would become a "better" place. It would push away from the complete power that governments and other financial bodies have, and place the power in the hands of the creators, and distributors. The main issue with this proposition is that it is largely unrealistic. Engineers in general want to do good and prefer that their creations are not harmful to the world. However, ultimately, enough money and the will to be remembered will eventually overtake at least a small handful of the population. What this means is that, in the end, we do end up back to the discourse of inevitability. In a perfect world, the framework stands, but with eight billion people, each acting individually or under a company focused solely on quarterly revenue, it will be near impossible to employ.

Research Approach Conclusion

Although I may have discussed the clear limitations of the framework in the previous section, I still believe it is an important lesson and one that can be applied to my STS research essay. Even if the discourse of inevitability is in and of itself, inevitable, we as a society of engineers and creators should still individually do our best to create only good. If the initial creators of the recommendation systems had waited, tested more, and worked alongside psychologists and other professionals, they may have been able to come up with a way to help the world in terms of efficiency like their goal was, while not creating the beginning of a mental health epidemic in terms of attention span, depression, anxiety, and addiction. (846)

FINDINGS AND NEXT STEPS

As was discussed in the problem definition section of this paper, there is no real way to determine how predominant recommendation systems are in the mental health epidemic of the early 21st century. Other factors could be a change in the frequency of individuals being diagnosed with mental health disorders by medical professionals, financial issues such as the housing collapse of 2008, or even just a shift in the self-reporting of mental health issues. Additionally, it was found by Ferguson that the political polarization of the states is no worse than in pre-machine learning times, and that, regardless of what we may think, our current political landscape is relatively normal.

What can be deduced, however, is the intentions of the engineers and researchers when creating these algorithms. My technical research in the field has led me to better understand the goals of recommendation systems, and they truly are to hook the user– to make them addicted. The end goal of getting users addicted is so blatant, that in "The Social Dilemma", there is a quote given by Yale Professor in Mathematics and Statistics, Edward Tufte, that "There are only

two industries that call their customers 'users': illegal drugs and software." This can be interpreted as a shot at the social media industry, and how companies are almost mocking those that use their applications.

This point of view from the industry is morally wrong, and what should come from the current social media giants is that they learn and improve– but they aren't. As I have stated above, in conjunction with my ethical research on recommendation systems, I have also worked on a technical state-of-the-art report on recommendation systems. This research has led me to read hundreds of research papers about modern-day algorithms such as Monolith, the system employed by TikTok, or the algorithm used by YouTube throughout the 2010s that helped the website explode in popularity. The general trend I have found is that the algorithms used by companies are becoming increasingly sophisticated, and doing so at an alarming rate. Multiple new research papers are released every week solving different problems with old models, making them more efficient at their end goal of addicting users. As shown on the following page in Figure 3, nearly 50% of young adults use social media "almost constantly" as of 2021.

The obvious yet flawed solution to the growing disease that is social media addiction, is laws and regulations imposed by the federal government. The use of the government to put laws in place about the types and sophistication of the models used by companies, however, is unrealistic for several reasons. Perhaps a better approach to implementing laws would be to first, begin a formal campaign to bring awareness to the technologies being used, and then garner political support for laws and regulations to be put in place. If people were entirely aware of how out of control the problem had become, perhaps they would stop using the platforms, and companies would be forced to change their methods. The court of public opinion in the modern day is perhaps one of the most powerful methods for change as companies are so invested in
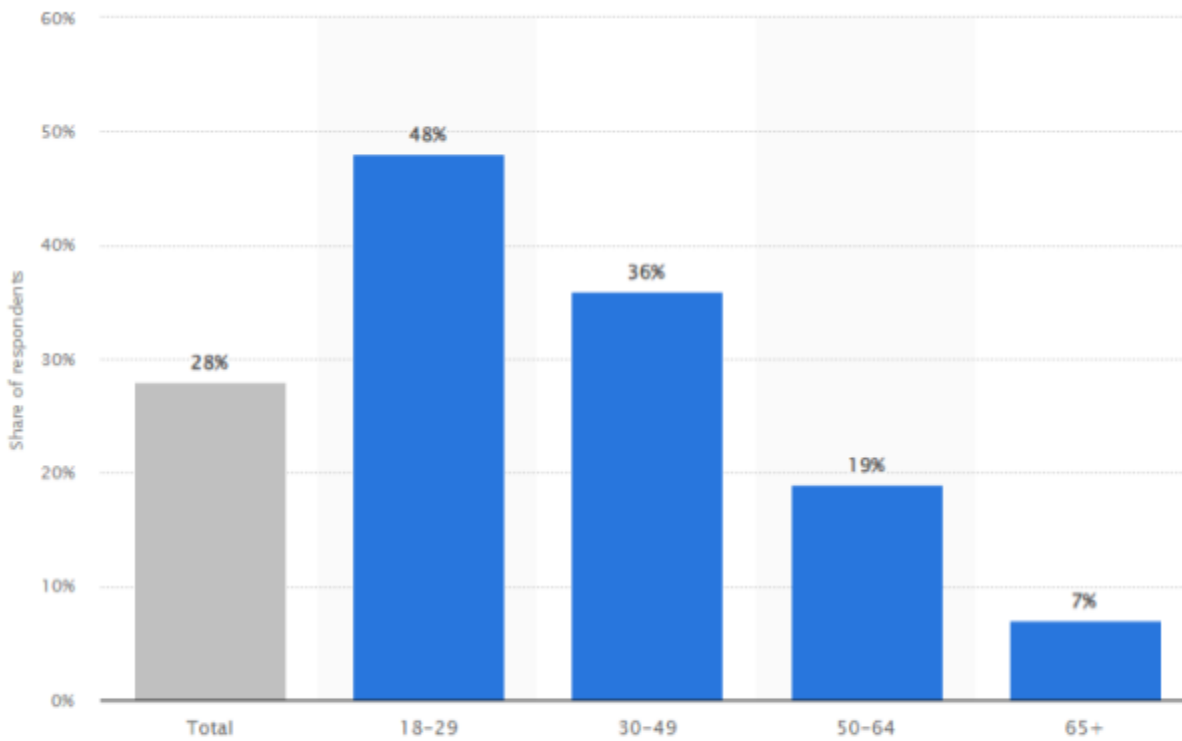
FIGURE 3: SOCIAL MEDIA USAGE BY AGE (PETROSYAN, 2023)
Bar chart showing percentage of individuals in an age group that use social media "almost constantly"
(exact amount undefined by source)

financial gain, that they will do whatever it takes to maintain users and a stream of revenue. Even if users didn't stop using the platforms, the threat of policies being implemented from public support could be enough for companies to do more self-regulation than they currently do, as what the government would ban would likely be more strict.

This solution though has its problems, as it requires the users of social media to be willing to break their addiction. Additionally, a shift in public opinion requires the technical aspects of the systems to be translated into layman's terms to be understood by all users, which can be extremely difficult given the underlying topics and mathematics. This proposed solution has already been attempted on small scales, such as with "The Social Dilemma", a Netflix documentary released in 2020, and while it garnered millions of views, there was not even a dent created in social media usage following the release of the film.

The reason for the complete inaction on the part of users is explored by South Korean-born Philosopher Byung-Chul Han. Han, most notably the author of "The Burnout Society," and professor at the Berlin University in Germany, believes that we live in a society similar to that of "Brave New World,". In his interview with El País (2021), Han describes how in the world of "Brave New World," citizens are controlled by a happiness-inducing drug called 'soma'. He relates this to our current situation with social media. Han continues, by stating that our current structure in society allows for an exploitation of freedom, seducing individuals into a state of being content with their free entertainment (in the form of social media). Byung-Chul Han is right. As it stands, even the individuals who are acutely aware of how largely they are being taken advantage of by social media simply don't care. They are captivated by the constant influx of new, interesting content. And for any users that do not understand what is going on from a technical perspective, they are trapped in a sort of digital panopticon. They are completely unaware of how and when they are being tracked and manipulated. Unfortunately, as the situation stands, corporations feel no pressure to change their methods– either from society or the government, and users themselves for one reason or another feel no urgency in quitting their daily dose of free entertainment. This means that the responsibility falls to the creators of the complex algorithms, engineers.

Most engineers attempt to abide by a code of ethics throughout their professional careers, however, this has not worked, and I believe a change in mindset should occur. This change in mindset should be one of the ethics of care. One such framework is proposed by Joan Tronto, who is a modern-day philosopher with a focus on care ethics. In her paper, "Partiality Based on Relational Responsibilities: Another Approach to Global Ethics," (2012) Tronto discusses her framework for ethics of care. This framework includes four primary elements, including

attentiveness, responsibility, competence, and responsiveness. While discussing the element of responsibility, Tronto mentions that she believes there should be an overt distinction between care given due to a sense of obligation versus that of responsibility. As it stands, the engineers creating the backends for social media are abiding care to the societies they work under due to responsibility in their codes of ethics. Unfortunately, this is not enough, and in turn, engineers are putting their careers and aspirations above the general welfare. A shift into an ethics of care based on obligation, however, would cease the advancement of recommendation systems, and perhaps even have them wiped from the planet. Engineers should avoid thinking about the quarterly reports for the companies they work for and instead think about their families and friends who are being mentally ruined by the very algorithms they design.

CONCLUSION

The intersection between recommendation algorithms and their effects on mental health is incredibly difficult to establish. As has been mentioned throughout, there is little to no scientific evidence that supports any correlation between the two. Despite this, experts believe there is a significant relationship between social media usage and mental health issues. Conversely, significant research has shown that we are by no means in "unprecedented times" in terms of political polarization, and our current political situation is well within normal fluctuation given historical events.

We then turn our eyes to the engineers and researchers who are taking part in creating recommendation algorithms, while knowing exactly what kind of consequences may be happening because of their work. There was a discussion around how, morally, the discourse of inevitability was no excuse to continue development, and developers should protest the continued improvement of models. Engineers should abide by an ethics of care based on

obligation, and thus advocate going back to simpler models, and using recommendation systems only when it is of direct benefit to an application's user. Additionally, there was discourse surrounding the role that users themselves play in the actor network, and how they are in part responsible for their education and subsequent decisions surrounding their participation in social media. Finally, we discussed potential solutions moving forward, being a campaign of public education on the topic, hopefully leading to political discourse on the topic of the algorithms that lay at the root of the social media epidemic.

What needs to be understood, however, is that although recommendations currently are a toxic method to captivate users' attention for the sheer purpose of ad revenue, there is space for productive systems. With government restrictions, a more informed society, and the close attention of engineers, machine learning can be an incredibly powerful tool to help the betterment of society, along with making the lives of users easier, without the negative consequences.

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