

The Effects of Misinformation on Society and its Future Implications

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Calvin Min

Spring 2023

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

Advisor

Bryn E. Seabrook, Department of Engineering and Society

Introduction

“In the arms race between those who want to falsify information and those who want to product accurate information, the former will always have the advantage.” David Conrad, a current Chief Technology Officer, describes the inherent advantage misinformation has in comparison to its counterpart. Additionally, with the help of social media, misinformation can use these platforms as catalysts to affect more victims (Anderson & Rainie, 2022).

Misinformation is false or inaccurate information that is deliberately made to deceive a party.

With social media becoming mainstream in the past decade, an alarming amount of misinformation has surfaced on platforms like Twitter and Facebook. A study at MIT found that social media apps, such as Twitter, are seventy percent more likely to share misinformation (Brown, 2020). This alarming number has directly affected major current events like the 2016 presidential election and COVID-19, creating an inherent division within the United States.

Unfortunately, the repercussions America faces from misinformation stem from a sense of irony.

Misinformation is not a new term, as it has existed for decades as has been used many times in the past (Soll et al., 2016). However, even with the familiarity of misinformation, the rise of the Information Age has made society America feel like it is combating a wicked problem. With the help of the Actor-Network theory and Wicked problem framing, this paper answers how misinformation from social media has affected society and what are its future implications.

Research Question and Methods

This paper focuses primarily on answering the following question: how has misinformation from social media affected society, and what are its future implications? To answer the research question, the analysis utilizes two historical case studies. The two case studies are analyzed in chronological order to emphasize the growth of misinformation from the

mid-2010s to 2020. The first case study investigates the 2016 presidential election, using Hunt Allcott and Matthew Gentzkow's journal as the primary source (Allcott & Gentzkow, 2017). The second case study analyzes qualitative research from Brazil that examines misinformation on social networks during the pandemic (Biancovilli et al., 2021). After the analysis of the two case studies, the paper will examine the future of misinformation in the post-covid era. Subsequently, the analysis will end with limitations in the research and the next steps to evaluate misinformation in social media.

Background Information

In 2016, the presidential election between real estate baron, Donald J. Trump and former First Lady of the United States, Hillary D. Clinton, revealed one of the most polarized countries America has seen in the past century. Since social media became the forefront of campaigns in 2016, it is often brought up that misinformation directly affected the election's outcome. Even with the heightened use of technology, there was no malicious activity regarding vote counts. But, a study from Ohio State University found that fake news played a significant role in depressing Clinton's support on voting day (Blake, 2021). After the election, Mark Zuckerberg (co-founder of Facebook), admitted that 126 million Americans were shown fake political news stories that originated from Russia. Interesting to note that most of these political posts involved the two presidential candidates (Kurtzleben, 2018). It was clear that most of these stories gained a lot of traction on Facebook due to its 8.7 million engagements, proving that exposure was inherently present during the election. However, the number of engagements should not be a shock to most due to the nature of the general feed algorithms social media companies program into their applications. These algorithms are established to prioritize information that receives the most amount of activity, regardless of if the content is truthful. This results in outlandish

headlines swarming users' feeds, making it harder for the average user to decipher if what they see on the internet has any merit.

In 2020, the world began to face a global pandemic. The catastrophe brought a lot of unknowns, and many found themselves looking at social media for answers. Specifically, Facebook became a space where users commonly saw information regarding COVID-19. The company finished 2020 with more than \$28 billion in profit and saw a 53 percent increase in user activity (Statt, 2021). Yet, in a similar fashion to the 2016 presidential election, the world began to see a division within itself regarding opinions on using vaccines to combat the pandemic. However, this time, policymakers were aware of the reach misinformation had on social media and began to question Facebook's feed algorithm. In response, Facebook claimed that users within their platform have a right to free speech, which became a popular reason amongst other social media companies to fight off limiting policies (FB papers, 2022). Additionally, it became apparent that Facebook was aware of the amount of misinformation surfacing on their platform and chose to ignore the issue, even with the death toll rising. As a result, Facebook came out with a public statement to clarify its perspective on censorship versus misinformation. The company claimed that it considered "harmful misinformation" as a matter of opinion, which can be tied to one's political views, socio-economic status, and so forth (FB papers, 2022). Furthermore, the social media giant suggested that they will not change their feed algorithm to "automatically" delete harmful content from their platforms - stating they require a manual review before anything is removed. With the world slowly changing back to its old ways, it was evident that social media possessed numerous ways to affect society.

Given the evolution of technology up until this point, and the traction social media has on society, the future of misinformation is left in the hands of social media companies. With the first

amendment instantiated within the constitution, social media companies can argue any ideas are allowed to surface their applications - even if it is false or controversial (Haskins, 2022). With the previous two historical case studies in mind, this paper reveals the relationships misinformation has with social media through Actor-Network Theory and introduces the difficulty of containing misinformation through Wicked Problem framing.

STS Framework

The two STS frameworks that are in use to analyze the effects misinformation has on social media are Actor-Network theory (ANT) and Wicked Problem framing. Actor-Network theory is a methodology that was developed during the 1980s by scholars to understand the relationships between humans and inanimate objects (Crawford, 2020). A notable scholar who made significant achievements in discovering Actor-Network theory was the French sociologist and philosopher Bruno Latour. By using Latour's theory, hidden relationships are revealed between entities during current events revolving around misinformation and unveiling unintended consequences (Cresswell et al., 2010). In recent years, the Actor-Network theory has grown in popularity since the theory has the versatility to evaluate relationships within science, technology, and society. However, there are aspects within the theory that fails to provide analysis regarding the social structures within the relationships between humans and inanimate objects. Furthermore, scholars from Southeast University in China find the theory fails to clarify what actors are defined as humans and non-humans (Yao & Liu, 2022). With these flaws being apparent in the theory, defined actors will be stated in both the 2016 presidential election and COVID-19 to establish a societal hierarchy between users, policymakers, and social media companies.

In 1973, theorists Horst Rittel and Melvin Webber coined the term wicked problem to define ideas that are too complex for rights and wrongs (Wicked problem). Rittel and Webber stated that wicked problems consist of the three following characteristics: unsolvable, contain overlapping stakeholders, and are unstructured. By using wicked problem framing, the future of misinformation is clarified due to defining solutions that will mitigate the current problem. Unlike Actor-Network theory, wicked problem framing can be used to analyze any problem, not just those that pertain to the science, technology, and society field. In a Harvard Business Review article, Camillus uses the framework to analyze how to design a business strategy (Camillus, 2014). By gathering information from top CEOs in the nation, Camillus concluded that the strategic-planning process incorporates the fundamentals of wicked problem framing. Companies are faced with issues that cannot be resolved by collecting more data or breaking issues into smaller problems. With the failure to do so, top-level executives are faced with trying entirely new processes to gain a slight indication that they achieved the right answer. The trial-and-error entities face when trying to combat a wicked problem is one that many theorists claim to be the framework's downside. What is the point of trying to figure out a wicked problem if there is no end goal?

Wicked problem framing is an important technique to use when analyzing misinformation, specifically the future of social platforms and fake media. What can policymakers do to mitigate misinformation in the future? Are social media companies at fault for allowing their platform to exercise free speech? These questions have parallels with Camillus' article, as policymakers find themselves in a similar situation to top-level executives. By defining distinct problems found within the current network of misinformation, wicked problem framing will be vital in understanding what the best course of action is in the future.

Results and Discussion

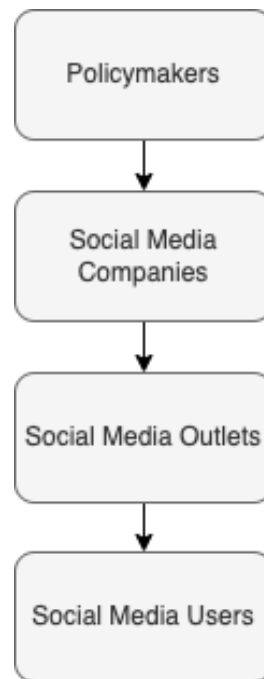
During World War I, governments used propaganda to manipulate society. Since propaganda is a form of misinformation, the term has been relevant in society for the past century. However, with the introduction of social media, adapting to the volume of misinformation stemming from popular outlets like Facebook and Twitter has become difficult. In recent years, social media saw users divided around topics such as the 2016 presidential election and COVID-19. Furthermore, distrust started to cloud the public's trust in major news outlets because it was unclear what to believe (Lazer et al.). To regain the trust of the population, policymakers need to implement rules that mitigate misinformation, and news outlets must educate their audience to deduce false information.

2016 Presidential Election

The first case of this analysis is about *Social Media and Fake News in the 2016 Election* by Hunt Allcott and Matthew Gentzkow. The purpose of the journal was to analyze the exposure of misinformation that America faced during the 2016 presidential election (Allcott & Gentzkow, 2017). With Trump winning the 2016 election, many began to speculate if misinformation from social media influenced voters' perspectives on the candidates. Trump's campaign extensively used Twitter to reach voters, hoping to gain an audience by directly addressing the general population. Once the election concluded, Mark Zuckerberg, the CEO of Facebook, admitted that 126 million Americans were shown Russian-backed, political ads that contained misinformation affiliated with the political candidates (The danger of fake news in the 2016 election). When analyzing inanimate entities, like social media, Actor-Network Theory (ANT) can examine how America became so polarized from the 2016 presidential election.

Figure 1

Allcott and Gentzkow's Social Hierarchy of Misinformation if all Actors played their role



Throughout Allcott and Gentzkow's Journal, different actors within the network played a role in exposing one another to misinformation. As shown in Figure 1, a societal hierarchy is displayed in the order of policymakers, social media companies, social media outlets, and social media users. As policymakers rest on the top, their action to implement rules against misinformation directly affects their relationship with other entities. However, due to the unexpected rise of misinformation on social media during the 2016 presidential election, policymakers failed to make any immediate actions that affected other actors. Fake news that was propagated on social media was too foreign for policymakers to grasp, making their position in the network stagnant. Below policymakers lie social media companies and the select people in a position of power within those companies. As mentioned above, Mark Zuckerberg acknowledged his platform was used as an avenue for misinformation during the 2016 presidential election. Yet, when Facebook came under fire for their coverage of the campaign,

Zuckerberg explained that the problem was not the introduction of misinformation, but that the volume has increased since the days of traditional media. Furthermore, he claimed that he could not control users from clicking on a post that conforms to their worldview (Shahani, 2016).

While Zuckerberg has the final say on Facebook's role in misinformation, he chose to open his platform to any content that conformed to their community standards. As the owner of a very influential social media application, his stance of knowingly allowing misinformation to surface on Facebook acts as a catalyst for misinformation to reach a greater population.

Social media lies under its superior and is the one actor who can disrupt other actors. For the month around the 2016 presidential election, roughly 159 million impressions on news involving the election were interacted with through social media outlets like Facebook and Twitter (Allcott & Gentzkow, 2017). From those 159 million impressions, 55 percent of the information reached was flagged as false information. With 87 million impressions deemed inaccurate, those connections between social media users and their perception of the presidential candidates were infected. However, Allcott and Gentzkow analyzed a separate metric during the 2016 presidential election. They found that 41.8% of fake news during the campaign period was spread using social media. As a prominent source of information, social media had a grasp on the population pre-election day. If social media was removed from the equation during the 2016 election, Americans would have spent on average 25 fewer minutes viewing fake news in comparison to their roughly 66 minutes browsing information regarding the campaign (Allcott & Gentzkow, 2017). If both policymakers and technological companies maintain inactive in their positions, then ANT emphasizes the power shift towards social media outlets as it possesses the biggest reach among all the actors. As the dynamic shifted towards social media, the public reaped the repercussions. With viewers of misinformation being the last actor on the hierarchy,

they are forced to consume and react to what is shown on the internet. Without any power within the network, users must believe or discredit what is propagated on social media. During the months leading to the election in 2016, users found themselves polarizing their political ideals as they were exposed to misinformation (Lazer et al.). Katherine Ognyanova, an assistant professor at Rutgers University concluded that “strong liberals who were exposed to right-leaning misinformation will most likely reject its claim and mistrust the current Republican party.” The notion mentioned by Ognyanova soon became an everlasting cycle during the 2016 presidential election as supporters from both parties began to place more trust in their party. Furthermore, the population began to trust polarized information from sources like Facebook and neglect mainstream media (Lazer et al.). As America started to distrust the media, the population saw itself in a divided position as the stagnant actors found it nearly impossible to reverse the effects of misinformation.

Throughout the 2016 presidential election, the network saw a power shift towards social media outlets as other powerful actors were dormant. With free rein to infect the population, America saw first-hand what misinformation could achieve on a wide scale. Within Allcott and Gentzkow’s journal, it is evident that misinformation was present in the political campaigns in the months leading to the election. It is clear through ANT that the population was directly affected by misinformation, and perspectives on the election candidates were skewed by information that surfaced on social media.

COVID-19

The second case study of this analysis is about *Misinformation on social networks during the novel coronavirus pandemic: a quali-quantitative case study of Brazil* by Priscila Biancovilli, Lilla Makszin, and Claudia Jurberg. The motive behind the research paper was to examine the

presence of misinformation in the Brazilian population during the COVID-19 pandemic (Biancovilli et al., 2021). The Brazilian researchers analyzed 232 pieces of misinformation published by Agência Lupa, a Brazilian fact-checking service. During their research, it was noted that 76% of false information was published using Facebook, and nearly half of the stories claimed to be *real-life* situations. Additionally, 92.9% of the published texts contained content that were classified as *health tips* (Biancovilli et al., 2021). During the global pandemic, Brazilian citizens were exposed to health-relation misinformation with no help from the government (Tardáguila, 2022). When examining Brazil's experience with misinformation in 2020, it is evident there needed to be a collective effort from many actors to see misinformation mitigated from social media.

Corruption has become one of Brazil's biggest impediments in making strides toward equality and social justice (Brazil). Due to the government's instability, the president of Brazil is a very influential actor. For example, the World Health Organization released protective guidelines that were endorsed by the Ministry of Health during the height of COVID. However, President Bolsonaro routinely questioned the credibility behind the guidelines and forced the Brazilian population to either conform to the words of the head of the government or openly go against them (Biancovilli et al., 2021). As the actions of the president became the precedent, it was hard to find information within the country that was credible. Thus, leading to ill-informed citizens about the global pandemic. As online access to health information increased throughout the years, the number of interactions with misinformation on social media started to trend upward and intensified during the global pandemic. Similarly, to the social hierarchy mentioned in the 2016 presidential election, if government positions and social media companies are stagnant in their stance against misinformation, the general population starts to create a division

within itself. The polarization was transparent when analyzing the information surfacing around the COVID-19 vaccine. While the vaccine became readily available to the public, the World Health Organization found itself fighting a separate pandemic. A pandemic plagued social media networks with misinformation regarding a tool to fight against a deadly disease. As misinformation became a direct factor in changing the population's perspective on the vaccine, the World Health Organization coined the phrase *infodemic* (Skafle et al., 2022).

Social media platforms are a public space. The intention behind social media applications is to connect people throughout the world who would not usually do so. An example is when elected officials use platforms like Twitter to communicate with their followers (Leetaru, 2017). Since social media was built around the foundation of being a public space, the idea has backfired in especially corrupt countries due to the use of propaganda and misinformation. By using ANT, it becomes apparent how the COVID-19 situation became so chaotic, especially in terms of the division within the population about vaccines. The following actors played a focal role in resulting in the statistics mentioned above from BMC Public Health's research on misinformation: President Bolsonaro, social media companies, health officials, and social media users. With the corruption of the government, the public mainly distrusted the statements released by the government and President Bolsonaro. With no informational power as a president, Bolsonaro had no grasp on controlling the *infodemic* in Brazil. Additionally, social media companies started to see legality issues with misinformation as Mark Zuckerberg found himself in numerous court cases throughout December 2020 for an antitrust lawsuit against the Federal Trade Commission (Staff & Nguyen, 2021). With Facebook being occupied with a lawsuit against the FTC, many other social media companies become inactive in their fight against misinformation due to their circumstances with the antitrust law. As a repeat of the

situation in the 2016 presidential election, power shifted to those that purposely injected misinformation into social media. As of February 2022, only 10.6% of the population below the equator received a COVID-19 vaccine. Availability does contribute to the number, but a consensus to refuse the vaccine became the foremost reason for denying the vaccine (Skafle et al., 2022). With power repositioning itself to misinformation, health officials found a hard time combating the stigma around vaccines. Even recently, first-world countries are trying to solve the issue of misinformation as 1.6 million likes have been scrapped from misleading vaccine tweets from November 1st to December 5th (Hsu, 2022). With a divided population, misinformation has become a prevalent topic among policymakers. However, there is not a clear solution to the problem, as power is transferred from one actor to another within the network.

Future of Misinformation

It is impossible to solve the issue of misinformation. As mentioned in the two case studies, completely removing misinformation from society is a wicked problem. However, a collective effort from all actors within the network can help mitigate its effects. To begin with, policymakers and social media companies possess the most amount of power when regulating the type of information that surfaces on platforms like Facebook and Twitter. Since the spread of information has become easier for the regular user, social media companies need to step in and flag posts that may be “misleading” or false. An example that Twitter took in the right direction was to implement Community Notes within its platform. Now, contributors on Twitter can now leave notes on a tweet that they find potentially misleading. If enough flags are associated with a tweet, then that tweet has a public note associated with it that screams misinformation (About community notes on Twitter | Twitter help). Nonetheless, even with community notes implemented into Twitter, misinformation continues to propagate through the platform.

Additionally, the feature relies on contributors to flag tweets, meaning if there are enough ill-informed users, then credible sources could be flagged as misinformation. It is imperative to emphasize the need for users to educate themselves on topics like presidential elections and vaccines to have a collective understanding. Due to misinformation's complex nature, different actors need to act in the right interest to make headway against the *infodemic*.

Limitations

Misinformation is a broad topic, so specifically looking at social media neglects others avenue people use to consume information. In America, the options that are the minority to social media are the following: television, radio, and print publications. Without researching misinformation on those platforms, it is ignorant to conclude society's current state against misinformation. Furthermore, the research conducted within this paper chose to analyze only two case studies, with the first case being in 2016 and the second in 2020. With the research paper being written in 2023, the paper also chooses to ignore the fight against misinformation post-COVID era.

Future Research

In the future, I would like to see more research in analyzing how misinformation through artificial intelligence affects society. With tools like ChatGPT being released to the public, I am interested to see how companies can manipulate information to persuade groups of users like the 2016 presidential election and COVID-19. If the user decides to believe what "answer" ChatGPT gives them, then the power to disperse "factual" information to the public relies solely on companies that control these AI tools. On the contrary, artificial intelligence can be the missing piece in winning the fight against misinformation on social media. Artificial intelligence is at the

forefront of technological breakthroughs, so I am curious to see what social media companies can accomplish with the help of a powerful tool.

Conclusion

Social media has grown to become a prominent news outlet for most humans that possess a hand-held device. With this growth came unintended consequences like exposure to misinformation. As a result, misinformation has plagued society by polarizing groups and placing a sense of distrust in mainstream news outlets. When analyzing the 2016 presidential election and COVID-19, it is evident that the fight against misinformation is not over. Different actors within the network have a role to play when fighting against a wicked problem. Therefore, it is imperative to understand how misinformation manipulated society during those events and what the next steps are to mitigate its effects in the future.

Works Cited

- Allcott, H., & Gentzkow, M. (2017). Social media and fake news in the 2016 election.
<https://doi.org/10.3386/w23089>
- Anderson, J., & Rainie, L. (2022, September 15). *The Future of Truth and Misinformation Online*. Pew Research Center: Internet, Science & Tech. Retrieved February 3, 2023, from <https://www.pewresearch.org/internet/2017/10/19/the-future-of-truth-and-misinformation-online/>
- Biancovilli, P., Makszin, L., & Jurberg, C. (2021, June 23). *Misinformation on social networks during the novel coronavirus pandemic: A Quali-Quantitative Case Study of brazil - BMC public health*. BioMed Central. Retrieved March 13, 2023, from <https://bmcpublikealth.biomedcentral.com/articles/10.1186/s12889-021-11165-1#citeas>
- Blake, A. (2021, November 25). *Analysis | a new study suggests fake news might have won Donald Trump the 2016 election*. The Washington Post. Retrieved February 3, 2023, from <https://www.washingtonpost.com/news/the-fix/wp/2018/04/03/a-new-study-suggests-fake-news-might-have-won-donald-trump-the-2016-election/>
- Brazil*. Transparency.org. (n.d.). Retrieved March 14, 2023, from <https://www.transparency.org/en/countries/brazil>
- Brown, S. (2020, October 5). *MIT Sloan Research about social media, misinformation, and elections*. MIT Sloan. Retrieved February 2, 2023, from <https://mitsloan.mit.edu/ideas-made-to-matter/mit-sloan-research-about-social-media-misinformation-and-elections>

Camillus, J. C. (2014, August 1). *Strategy as a wicked problem*. Harvard Business Review.

Retrieved February 5, 2023, from <https://hbr.org/2008/05/strategy-as-a-wicked-problem>

Crawford, T. H. (2020, September 28). *Actor-network theory*. Oxford Research Encyclopedia of

Literature. Retrieved February 5, 2023, from

<https://oxfordre.com/literature/display/10.1093/acrefore/9780190201098.001.0001/acrefore-9780190201098-e-965;jsessionid=E76DFB1CB82F7B51EDAD73CC74EDEECC>

Cresswell, K. M., Worth, A., & Sheikh, A. (2010, November 1). *Actor-network theory and its*

role in understanding the implementation of information technology developments in

healthcare - BMC Medical Informatics and decision making. BioMed Central. Retrieved

February 5, 2023, from

<https://bmcmmedinformdecismak.biomedcentral.com/articles/10.1186/1472-6947-10-67>

The danger of fake news in the 2016 election. Center for Information Technology and Society -

UC Santa Barbara. (n.d.). Retrieved March 13, 2023, from

<https://www.cits.ucsb.edu/fake-news/danger-election>

FB papers: How meta became the biggest hub of covid-19 misinformation. Gizmodo. (2022,

October 20). Retrieved February 3, 2023, from [https://gizmodo.com/facebook-papers-](https://gizmodo.com/facebook-papers-covid-19-coronavirus-misinformation-1849667132)

[covid-19-coronavirus-misinformation-1849667132](https://gizmodo.com/facebook-papers-covid-19-coronavirus-misinformation-1849667132)

Haskins, J. (2022, May 2). *Fake news: What laws are designed to protect*. LegalZoom. Retrieved

February 3, 2023, from [https://www.legalzoom.com/articles/fake-news-what-laws-are-](https://www.legalzoom.com/articles/fake-news-what-laws-are-designed-to-protect)

[designed-to-protect](https://www.legalzoom.com/articles/fake-news-what-laws-are-designed-to-protect)

Hsu, T. (2022, December 28). *As covid-19 continues to spread, so does misinformation about it.*

The New York Times. Retrieved March 14, 2023, from

<https://www.nytimes.com/2022/12/28/technology/covid-misinformation-online.html>

Kurtzleben, D. (2018, April 11). *Did fake news on Facebook help elect Trump? here's what we know.* NPR. Retrieved February 3, 2023, from

<https://www.npr.org/2018/04/11/601323233/6-facts-we-know-about-fake-news-in-the-2016-election>

Lazer, D., Wilson, C., & Roberston, R. E. (n.d.). *"Fake News" lowers trust in mainstream media across party lines, study finds.* Rutgers University. Retrieved March 13, 2023, from

<https://www.rutgers.edu/news/fake-news-lowers-trust-mainstream-media-across-party-lines-study-finds>

Leetaru, K. (2017, August 1). *Is social media really a public space?* Forbes. Retrieved March 14,

2023, from <https://www.forbes.com/sites/kalevleetaru/2017/08/01/is-social-media-really-a-public-space/?sh=231135d22b80>

Shahani, A. (2016, November 11). *Zuckerberg denies fake news on Facebook had impact on the election.* NPR. Retrieved March 13, 2023, from

<https://www.npr.org/sections/alltechconsidered/2016/11/11/501743684/zuckerberg-denies-fake-news-on-facebook-had-impact-on-the-election>

Skafle, I., Nordahl-Hansen, A., Quintana, D. S., Wynn, R., & Gabarron, E. (2022).

Misinformation about covid-19 vaccines on social media: Rapid review.

<https://doi.org/10.31219/osf.io/tyevj>

Soll, J., White, J. B., Sitrin, S. S. and C., & Gerstein, B. M. and J. (2016, December 18). *The long and brutal history of fake news*. POLITICO Magazine. Retrieved February 2, 2023, from <https://www.politico.com/magazine/story/2016/12/fake-news-history-long-violent-214535/>

Staff, the P. N. O., & Nguyen, S. T. (2021, March 18). *FTC sues facebook for illegal monopolization*. Federal Trade Commission. Retrieved March 14, 2023, from <https://www.ftc.gov/news-events/news/press-releases/2020/12/ftc-sues-facebook-illegal-monopolization>

Statt, N. (2021, January 27). *Facebook usage has soared during the pandemic, but the company warns of 'significant uncertainty' ahead*. The Verge. Retrieved February 3, 2023, from <https://www.theverge.com/2021/1/27/22253055/facebook-q4-2020-earnings-report-app-usage-record-user-numbers>

Tardáguila, C. (2022, October 25). *One year later: Brazil has never been so prepared to fight fake news*. Americas Quarterly. Retrieved March 14, 2023, from <https://americasquarterly.org/article/one-year-later-brazil-has-never-been-so-prepared-to-fight-fake-news/>

Twitter. (n.d.). *About community notes on Twitter | Twitter help*. Twitter. Retrieved March 14, 2023, from <https://help.twitter.com/en/using-twitter/community-notes>

Wicked problem. What's a Wicked Problem? (n.d.). Retrieved February 5, 2023, from <https://www.stonybrook.edu/commcms/wicked-problem/about/What-is-a-wicked-problem>

Yao, S., & Liu, K. (2022, December 13). *Actor-network theory: Insights into the study of social-ecological resilience*. International journal of environmental research and public health.

Retrieved February 5, 2023, from

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9778769/>