

**Unravelling Social Media’s Role in the Propagation of COVID-19 Misinformation**

(Technical Paper)

**Anatomizing “Fake News:” Epistemologically Reframing Misinformation to Reorient Healthcare Interventions**

(STS Paper)

A Thesis Prospectus Submitted to the  
Faculty of the School of Engineering and Applied Science  
University of Virginia • Charlottesville, Virginia  
In Partial Fulfillment of the Requirements of the Degree  
Bachelor of Science, School of Engineering

**Shomik Ghose**

Fall, 2020

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

Signature \_\_\_\_\_ Date \_\_\_\_\_

Shomik Ghose

Approved \_\_\_\_\_ Date \_\_\_\_\_

Anil Vullikanti, Department of Computer Science

Approved \_\_\_\_\_ Date \_\_\_\_\_

Kathryn A. Neeley, Associate Professor of STS, Department of Engineering and Society

## Introduction

The adoption of digital information systems has revolutionized how knowledge is produced, disseminated, and discussed, enabling users to be both the producers and consumers of an infinite stream of content. More than ever, citizens feel better informed about current events, more intimately connected with friends and family, and uniquely empowered to affect sociopolitical change (Purcell & Rainie, 2014, p. 1-3). However, this disintermediation can also foster the dissemination of incorrect information and unsubstantiated rumors, collectively termed misinformation. Recognizing the escalating role and consequences of misinformation in recent events, including the UK Brexit referendum, the 2016 U.S. presidential election, and the COVID19 pandemic, the World Economic Forum ranks the spread of digital misinformation as one of the foremost threats to global development (Kuklinski et al., 2000). The repercussions of misinformation are particularly tangible in healthcare: for instance, though connections between the MMR vaccine and autism have been thoroughly debunked, 21% of US parents still express substantial doubts about vaccine safety (Paules et al. 2019, Poland and Spier, 2010). In 2017, these misinformation-based choices drove a 31% increase in vaccine-preventable disease, resulting in thousands of lives lost and billions of dollars in expenditures (Larson et al, 2011, Poland and Spier, 2010). Despite the severe and escalating nature of the misinformation epidemic, interventions by the medical community such as dissemination of peer-reviewed research, publication of expert fact-checking reports, and organization of publicity campaigns have failed to significantly reduce the spread of medical misinformation (Trethewey, 2019).

The inefficacy of these measures can be attributed to inadequate understanding of the cultural and technical nuances behind modern misinformation. Through innovations such as social media, the way that people find information and acquire knowledge has fundamentally changed, thus transforming both the etiology of and our responses to misinformation. To successfully target and control the spread of medical misinformation, we must first comprehensively understand the problem at hand; towards this end, this prospectus proposes a two-pronged approach to characterize modern misinformation. The technical component of this project seeks to quantify the penetrance and impact of COVID19 misinformation in social media; Facebook user data will be mined and leveraged to understand how social media promotes the consumption and distribution of COVID19-related misinformation. The STS component will look to understand how changes in culture and knowledge acquisition have facilitated the proliferation of misinformation and propose ways that the medical community can improve misinformation interventions.

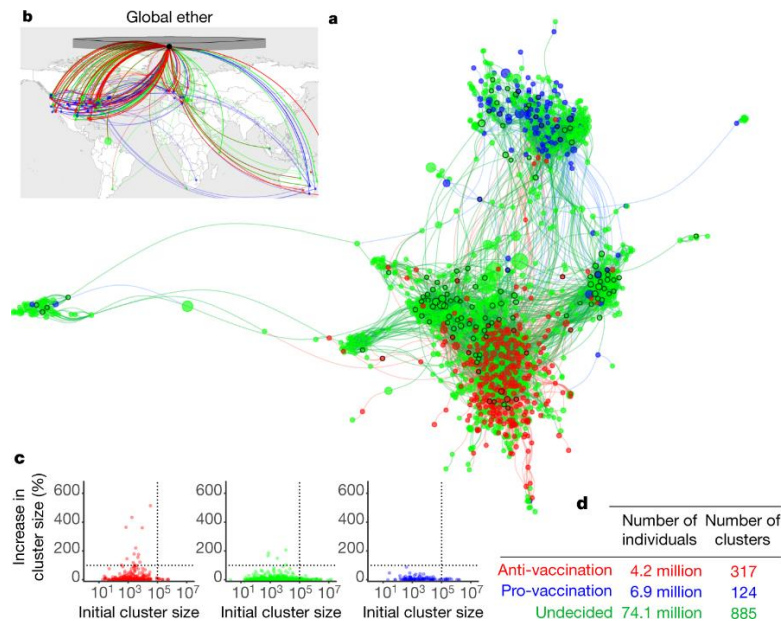
**Technical Topic: *Unravelling Social Media's Role in the Propagation of COVID19 Misinformation***

Since its introduction in the early 2000's, social media has served as an effective tool to connect with likeminded individuals, spread information, and share ideas. Unfortunately, in recent years, the social media landscape has become increasingly polluted with a cacophony of opinion, dubious news reporting, and false information. Experts at Pew Research Center suggest that up to two of every five news articles shared on Facebook contain significant misinformative elements (Anderson and Raine, 2017). Simultaneously, social media has become

influential than ever: in 2018, 36% of US young adults ages 18-29 reported receiving their news primarily from social media outlets like Twitter and Facebook (Shearer, 2018). The juxtaposition of these two effects underscores the importance of challenging the flood of fake news and disinformation which plagues social media platforms. The healthcare arena is no exception, and the healthcare community must confront the spread of erroneous and dangerous medical misinformation on these digital platforms. Ranging from discussion of alternative herbal treatments to skepticism about medical research, misinformation on social media can have tangible deleterious consequences for public health. For example, during the COVID19 pandemic, Facebook groups objecting to the wearing of masks posed significant challenges to efforts to mitigate the epidemic. Estimates suggest that about 10-15% of adults in the US and Canada refused to wear masks, leading to thousands of additional infections and animosity towards healthcare professionals (Taylor and Asmundson, 2020).

Social media offers unprecedented access to diverse ideas and viewpoints; however, individuals online tend to prefer interacting with users and consuming content which concur with their previously held beliefs. Many studies indicate that users overwhelmingly choose news articles from outlets aligned with their political opinions (Iyengar and Hahn, 2009, Van der Meer et al, 2020). These insular consumption patterns create “echo chambers” – groups where shared, potentially incorrect, beliefs are reinforced, and conflicting information is disregarded. These echo chambers allow those with controversial beliefs and prejudices to locate and identify with a community, thus facilitating the growth of fringe beliefs, conspiracy theories, and highly partisan content – prime breeding grounds for misinformation. Social media companies are not without culpability in the spread of misinformation; companies such as

Twitter and Facebook present users with algorithmically curated feeds of posts, designed to keep users engaged and on their platform. This phenomenon generates “filter bubbles,” algorithmically generated echo chambers where automatic content recommendations inadvertently amplify ideological segregation by only suggesting content the user will agree with and therefore engage with (Bechmann and Nielbo, 2018). Closed networks like echo chambers and filter bubbles are dangerous as they diminish the exchange of differing perspectives, thereby enabling further polarization and proliferation of misinformation. These effects are demonstrated below in Figure 1, where Facebook pages are grouped by similarity of content. Anti-vaccination groups demonstrate stronger page growth, tighter groupings, and more significant segregation compared to pro-vaccination groups throughout 2019, reflecting the formation, growth, and increasing radicalization of closed networks (Johnson et al., 2020).



**Figure 1.** A clustering plot of 100 million Facebook pages associated with the topic of vaccines. Red and blue pages correspond to anti-vaccination and pro-vaccination pages, respectively. Sizes are determined by page membership. Anti-vax pages display tighter clusters and stronger segregation patterns reflective of echo chambers (Johnson et al., 2020).

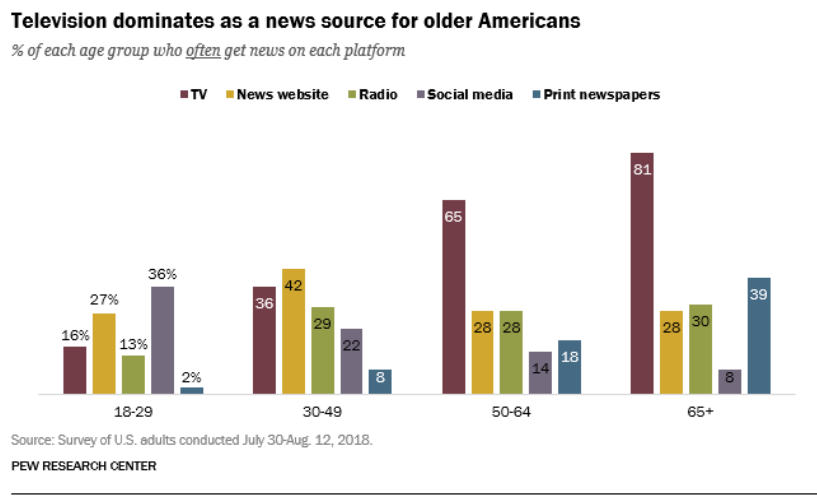
To gain a deeper understanding of how social media and the closed networks it creates affect the spread of misinformation, I analyze Facebook user behavior during the COVID19 period. Towards this end, several organizations offer high quality data about user behavior on social media. Facebook's CrowdTangle platform enables researchers to analyze interactions and trends across social media by providing access to public content from large Facebook pages, groups and Instagram accounts. BuzzSumo, a content insight platform provides additional information on user interaction patterns and engagement with various news articles and video postings. Leveraging these different data sources, I seek to achieve the following specific objectives:

1. Characterize the user interaction patterns of an echo chamber by understanding who joins these insular Facebook communities and how they interact within them by using CrowdTangle data of flagged Facebook groups.
2. Understand how false news propagates through social media by using BuzzSumo to study what kind of content succeeds on Facebook, paying specific attention to misinformative content and commonalities among users of closed networks.
3. Quantify social media's impact on the spread of COVID19 misinformation by combining our data sources and tracking the prevalence and popularity of misinformative COVID19 content across flagged Facebook groups.

Integrating the insights from these different approaches, we can develop a robust understanding of the interplay between our newest digital information systems and prevailing cultural narratives. This holistic approach to the sociotechnical problem of misinformation will thereby allow us to formulate effective solutions and countermeasures.

**STS Topic: Anatomizing “Fake News:” Epistemologically Reframing Misinformation to Reorient Healthcare Interventions**

An effective democracy relies on a well-informed public; when citizens are misinformed, society and policy will be commensurately impaired (Kuklinski et al., 2000). Throughout the 20th century, news media fulfilled this role by reporting on events around the world, developing robust evidentiary standards, and keeping larger organizations accountable through dissemination of quality information. However, as Figure 1 below illustrates, the rise of digital information outlets is threatening the social role and influence of conventional news media. As illustrated in Figure 2, Pew Research Center indicates that in 2018, 42% of those ages 30 to 49 get their news from websites like The Huffington Post or BuzzFeed News, with purely digital outlets like social media finding increasing success among younger, tech-oriented audiences (Shearer, 2018). More than ever, users look to the increasingly disintermediated internet as the primary source for their factual knowledge: a study by Bråten et al. revealed that 73% of students believe “the internet is the best source of truthful information” (2005).



**Figure 2.** Pew Research Center survey results reflecting how the news sources are changing across different age ranges. Younger generations are increasingly looking to disintermediated digital platforms for their news (Shear, 2018).

Through the advent of digital media, the way that our society acquires and processes knowledge – termed epistemology – has fundamentally changed.

As outlined in the technical section, these same changes in the information landscape have enabled malicious actors to use misinformation to disseminate conspiracy theories, sow doubts about news media trustworthiness, and erode confidence in expert opinion. However, the moniker of “misinformation” is a misnomer which belies the full scope of the problem: this phrasing suggests that these false beliefs can be simply dispelled with accurate information. In practice, modern misinformation is seldom corrected by factual intervention; rather, it is characterized by aggressive belief persistence and mistrust of dissenting parties (Chan et al., 2017). Misinformed groups adopt a distorted epistemology which eschews familiar evidence-based reasoning in favor of ideological conformity. To illustrate, following the 2016 presidential election, a YouGov poll indicated that 48% of registered republicans believed in President Trump's claim of 3 million votes having been illegally cast despite significant evidence to the contrary (Levine and Levy, 2018). Of this scenario Gopnik (2017) postulates, “[the] lie is not a claim about specific facts; the lunacy is a deliberate challenge to the whole larger idea of sanity.” By disregarding broader truths and objective evidence in favor of an alternative epistemology, these citizens could justify their existing beliefs and rationalize the received misinformation.

In a meta-analysis of misinformation debunking strategies, Chan et al. (2017) note that the medical community’s attempts to attenuate the spread of medical misinformation have been largely unsuccessful. When considered through the lens of alternative epistemologies, the



inefficacy of evidence-based interventions in the healthcare space becomes consistent – it is counterproductive to use facts to reason with someone uninterested in objective evidence. Due in part to this failure to mitigate the propagation of medical misinformation, groups espousing anti-vaccination, anti-mask, and predatory alternative treatments have been enjoying unprecedented growth and influence in recent years (Johnson et al, 2020). Concurrently, public trust in our medical institutions is steadily declining; a 2016 Gallup report revealed that only 36% of individuals have confidence in the US medical system, while 1 of every 5 individuals express doubts regarding the credibility of scientific findings (Saad, 2018). As such, it is imperative that the broader community prioritize the mitigation of medical misinformation. Accordingly, the STS component of this project seeks to apply the lens of epistemology to the problem of misinformation. A literature review will provide insight as to how and why digital media systems have modified knowledge acquisition patterns and how this has changed the way misinformation affects individuals, thereby introducing cultural and technological dimensions to augment our understanding of the complex sociotechnical systems which underlie misinformation. With this improved awareness of the problem space, we may then determine ways to reorient healthcare interventions to improve outcomes and reduce the spread of and belief in dangerous health-related falsehoods.

### **Conclusion**

Misinformation and disingenuous journalism are by no means a new phenomenon; however, the advent of digital information systems have revolutionized the methods of content consumption and production alike, with broader implications for how misinformation develops

and spreads. The technical portion of this project will look to understand how social media aids the spread of misinformation. In particular, the role of insular networks like echo chambers and filter bubbles during the COVID19 pandemic will be considered. The STS component of the project will consider to what extent modern belief-persistent misinformation can be explained by changes in epistemology. These insights will then be leveraged to improve the effectiveness of misinformation interventions by the medical community.

While the proposed technical and STS work is largely exploratory and conceptual, these steps are imperative to furthering our comprehension of the problem at hand. As Chan et al. (2017) underscore, current approaches to preventing medical misinformation are insufficient, therefore, exploratory work such as that outlined in this prospectus is essential to mature our understanding of the complex sociotechnical system which underlies misinformation. By clarifying the interactions that between social media, epistemological shifts, and misinformation, we may identify weaknesses in our current interventions and better equip the fight against misinformation.

## References

- Anderson, J., & Rainie, L. (2020, August 17). *The Future of Truth and Misinformation Online*. Pew Research Center: Internet, Science & Tech. <https://www.pewresearch.org/internet/2017/10/19/the-future-of-truth-and-misinformation-online/>. [Website]
- Bechmann, A., & Nielbo, K. L. (2018). Are we exposed to the same “news” in the news feed? *Digital Journalism*, 6(8), 990–1002. <https://doi.org/10.1080/21670811.2018.1510741> [Journal]
- Bråten, I., Strømsø, H. I., & Samuelstuen, M. S. (2005). The relationship between internet-specific epistemological beliefs and learning within internet technologies. *Journal of Educational Computing Research*, 33(2), 141–171. <https://doi.org/10.2190/e763-x0ln-6nmf-cb86> [Journal]
- Chan, M.-pui S., Jones, C. R., Hall Jamieson, K., & Albarracín, D. (2017). Debunking: a meta-analysis of the psychological efficacy of messages countering misinformation. *Psychological Science*, 28(11), 1531–1546. <https://doi.org/10.1177/0956797617714579> [Journal]
- Gopnik, A. (2017, January 27). *Orwell's "1984" and Trump's America*. The New Yorker. <https://www.newyorker.com/news/daily-comment/orwells-1984-and-trumps-america>. [Editorial]
- Iyengar, S., & Hahn, K. S. (2009). Red media, blue media: evidence of ideological selectivity in media use. *Journal of Communication*, 59(1), 19–39. <https://doi.org/10.1111/j.1460-2466.2008.01402.x> [Journal]
- Johnson, N. F., Velásquez, N., Restrepo, N. J., Leahy, R., Gabriel, N., El Oud, S., ... Lupu, Y. (2020). The online competition between pro- and anti-vaccination views. *Nature*, 582(7811), 230–233. <https://doi.org/10.1038/s41586-020-2281-1> [Journal]
- Kuklinski, J. H., Quirk, P. J., Jerit, J., Schwieder, D., & Rich, R. F. (2000). Misinformation and the currency of democratic citizenship. *The Journal of Politics*, 62(3), 790–816. <https://doi.org/10.1111/0022-3816.00033> [Journal]
- Larson, H. J., Cooper, L. Z., Eskola, J., Katz, S. L., & Ratzan, S. (2011). Addressing the vaccine confidence gap. *The Lancet*, 378(9790), 526–535. [https://doi.org/10.1016/s0140-6736\(11\)60678-8](https://doi.org/10.1016/s0140-6736(11)60678-8) [Journal]
- Levine, S., & Edwards-Levy, A. (2018, May 27). *Almost half of republicans believe millions voted illegally in the 2016 election*. HuffPost. [https://www.huffpost.com/entry/republicans-voter-fraud\\_n\\_5b0850f8e4b0fdb2aa53791f](https://www.huffpost.com/entry/republicans-voter-fraud_n_5b0850f8e4b0fdb2aa53791f). [Website]

- Ozawa, S., Portnoy, A., Getaneh, H., Clark, S., Knoll, M., Bishai, D., Patwardhan, P. D. (2016). Modeling the economic burden of adult vaccine-preventable diseases in The United States. *Health Affairs*, 35(11), 2124-2132. doi:10.1377/hlthaff.2016.0462 [Journal]
- Paules, C. I., Marston, H. D., & Fauci, A. S. (2019). Measles in 2019 — going backward. *New England Journal of Medicine*, 380(23), 2185–2187. <https://doi.org/10.1056/nejmp1905099> [Journal]
- Poland, G. A., & Spier, R. (2010). Fear, misinformation, and innumerates: How the Wakefield paper, the press, and advocacy groups damaged the public health. *Vaccine*, 28(12), 2361–2362. <https://doi.org/10.1016/j.vaccine.2010.02.052> [Journal]
- Purcell, K., & Rainie, L. (2014, December 8). Americans feel better Informed thanks to the Internet. Pew Research Center. <https://www.pewresearch.org/internet/2014/12/08/better-informed/> [Website]
- Saad, L. (2021, January 14). *Military, Small Business, Police Still Stir Most Confidence*. Gallup.com. <https://news.gallup.com/poll/236243/military-small-business-police-stir-confidence.aspx>. [Website]
- Shearer, E. (2020, August 27). *Social media outpaces print newspapers in the U.S. as a news source*. Pew Research Center. <https://www.pewresearch.org/fact-tank/2018/12/10/social-media-outpaces-print-newspapers-in-the-u-s-as-a-news-source/>. [Website]
- Taylor, S., & Asmundson, G. J. (2020). Negative attitudes about facemasks during the COVID-19 pandemic: The dual importance of perceived ineffectiveness and psychological reactance. *MedRxiv*. <https://doi.org/10.1101/2020.11.17.20233585> [Journal]
- Trethewey, S. P. (2019). Strategies to combat medical misinformation on social media. *Postgraduate Medical Journal*, 96(1131), 4–6. <https://doi.org/10.1136/postgradmedj-2019-137201> [Journal]
- Van der Meer, T. G., Hameleers, M., & Kroon, A. C. (2020). Crafting our own biased media diets: the effects of confirmation, source, and negativity bias on selective attendance to online Nnews. *Mass Communication and Society*, 23(6), 937–967. <https://doi.org/10.1080/15205436.2020.1782432> [Journal]