

Misinformation and Disinformation in the Era of COVID-19: The Role of Primary Information Sources and the Development of Attitudes Toward Vaccination

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ABSTRACT

Misinformation is not new; however, the proliferation of social media has resulted in a much broader reach and instantaneous impact. Results from such proliferation were seen during the 2016 and 2020 elections in the United States. The reach of false information in the context of a U.S. Presidential election would not be the pinnacle of the harm it can cause. In the current context, the spread of false information in the middle of a pandemic and related to causes, cures, and conspiracies, has the potential to do real harm, if it has not already. Now that vaccines are widely available in some countries, this harm may result in lives being lost that did not have to be. In this paper, we explore vaccination status in the context of information sources used by individuals. The results suggest that a lack of trust and engagement in traditional news outlets is associated with lower levels of COVID-19 vaccination initiation or completion. Higher levels of engagement with sources that have been used in the past to propagate conspiracy theories, such as YouTube, are also associated with lower levels of vaccination initiation or completion. Public health implications and the need for greater information literacy are discussed.

CCS CONCEPTS

• **Security and privacy** → **Social aspects of security and privacy**; • **Human-centered computing** → **Social networking sites**.

KEYWORDS

misinformation, disinformation, COVID-19, security, information integrity, survey, vaccination status

ACM Reference Format:

Marc Dupuis, Kelly Chhor, and Nhu Ly. 2021. Misinformation and Disinformation in the Era of COVID-19.

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SIGITE '21, October 6–9, 2021, SnowBird, UT, USA

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ACM ISBN 978-1-4503-8355-4/21/10...\$15.00

<https://doi.org/10.1145/3450329.3476866>

The Role of Primary Information Sources and the Development of Attitudes Toward Vaccination. In *Proceedings of the 22nd Annual Conference on Information Technology Education USB Stick (SIGITE '21), October 6–9, 2021, SnowBird, UT, USA*. ACM, New York, NY, USA, 6 pages. <https://doi.org/10.1145/3450329.3476866>

1 INTRODUCTION

Social media has become an essential and convenient tool of individuals' lives, which provides numerous benefits for users, from sharing a moment of one's life, communicating with friends and families, to sharing the latest news. Clicking, scrolling, and re-sharing on social media has gradually become a popular activity of a majority of users. The newer the information and its content are, the more people are interested in sharing it via social media, regardless of the direct nature of the information [15].

With the broad and global network that social media provides to connect users, information can be spread instantaneously on all social-media platforms to a majority of users around the world [8, 33]. During delicate moments or pandemics the information can be spread faster [28]. Since users crave information in order to find any possible solutions for their problems, information can influence users' behaviors and responses. As a result, social-media users are susceptible to engage with misinformation and perhaps unwittingly disseminate false information.

COVID-19 has placed everyone under the pressure to make health decisions and look for any possible treatments from all available sources. COVID-19 cures and remedies have spread unabated on social media, which leads a vast number of users who blindly trust and follow such false information to make risky health decisions. For instance, the rumor about malaria medicine pills that could cure and prevent COVID-19 spread quickly over the Internet. A 44-year-old Vietnamese man was sent to an emergency room with severe symptoms of vomit and respiratory failure after overdosing on 15 malaria pills by following this rumor [17]. In the USA, an Arizona man died and his wife was seriously ill after they took chloroquine phosphate that was recommended by former president Trump on televised briefings where he said that it could help to prevent COVID-19 [9]. Before that, former president Trump advocated unproven medicines and treatments on his tweets which was liked and retweeted by many of his Twitter followers [21].

Despite the warnings and recommendations from health experts and organizations, misinformation related to COVID-19 cures and remedies has proliferated globally via social media. Thus, understanding how and why users are deceived and unknowingly spread COVID-19 cures and remedies will provide us with better understanding on how to prevent the impact of such misinformation on public health. While there are ample tools to help protect individuals from a variety of cybersecurity threats [6], the same is not true for attacks on the integrity of information, such as the spread of misinformation and disinformation.

Information technology education has a role to play in addressing this challenge. This may be through a greater emphasis being placed on the design of systems so that they take security into account from the beginning, including the integrity of information [20], or greater efforts to integrate information literacy through a variety of introductory courses (e.g., [4]).

In the current study, we seek to answer the following research question through a large-scale survey:

RQ: How do the sources of information individuals use to obtain their information related to the pandemic relate to whether or not they seek a vaccine for COVID-19.

In section 2 we discuss some of the background literature. This is followed by section 3 where we details the methods employed. Next, we discuss the results in section 4. This is followed by a discussion in section 5 and then some concluding remarks in section 6.

2 BACKGROUND

2.1 Misinformation

For more than 50 years, Listerine had claimed that its mouthwash prevented colds and sore throats. This was untrue. The U.S. Federal Trade Commission mandated the company to create ads that corrected the false claims. After the ads aired however, a telephone survey indicated that 42% of respondents still believed that the product could be an effective cold remedy [18].

Mis- and disinformation is the spread of disingenuous information disguised as fact. Usually, people look for the truth, but sometimes misinformation can be the “truth” for some people. Misinformation is content that is created with the goal to deceive or mislead, but those that spread the content (e.g., through social media) may believe the information to be true [34]. In contrast, disinformation is a type of misinformation in which those that spread it know it to be false, untrue, or otherwise misleading.

One of the prevalent types of misinformation that we see every day are ads. The number of people who saw the Listerine commercial is significant given the number of individuals who encountered this misinformation and yet still believed it when corrective information became available. There seems to be an underlying factor to why people still cling to false information.

With the development of the Internet, misinformation can be accessed more easily and reach more people. People can even create their own content and disseminate it through many media, such as videos and online articles. In a study analyzing disinformation in Europe, the Facebook interactions with posts containing false news exceeded those of posts made by real news outlets [10]. This is concerning because with the amount of people that use social media, they are able to access and spread information publicly by

sharing and privately by messaging. Also, they might not look at the TV or real news outlets which sometimes has preventive measures and debunking against fake news.

In the context of COVID-19, academics have also noted that social media is the most important source of information and has higher rates of misinformation when compared to other types of information sources [13]. There is not a verified way to make sure that all information is correct on social media. People would likely not be able to know officially if some encountered information is real or not. How the information is reported may have bias, which could turn it into misinformation. This creates a false portrayal of the information, which can cause people to behave differently. Behavior modification is driving force to why misinformation is being spread throughout society.

Additionally, anti-vaccine information which can be considered as misinformation can be ingrained. Even when encountering information to disprove anti-vaccine sentiments, people do not change their mind about what they believe [16]. There could be an underlying factor in people believing other sources of information. With the current COVID-19 pandemic, there is more misinformation that is rampant just like political propaganda.

2.2 Misinformation and COVID-19

In December 2019, the COVID-19 outbreak had started in Wuhan, China. Eventually, it had spread throughout the world and created a global pandemic. COVID-19 has impacted many aspects of daily life and has resulted in the death of over 4 million people worldwide as of August 5, 2021 [32]. Along with this pandemic, there also has been a “infodemic” dubbed by the WHO [31]. There has been huge spread of disinformation online through social media and even by government officials. During the pandemic and increased digital screen time for people, misinformation can propagate anxiety and panic into people [1]. This effect is similar to political propaganda and there seems to be an underlying factor that causes such effects. For example, in an international study involving the UK, Ireland, US, Spain, and Mexico in the effects of COVID-19 misinformation, the increased susceptibility to misinformation causes people to not follow public health guidance about COVID-19 [27].

Furthermore, low-income countries can be impacted by this infodemic. One study showed that countries with a lower GDP are exposed to more false claims than other countries [2]. The exposure to higher numbers of false claims could be related to low-income areas if they do not have the proper information and possibly believe it because that it is the only information they have access to. Also, it seems that older people are susceptible to believing COVID-19 misinformation. In a study analyzing behavior outcomes of COVID-19 misinformation in sub-Saharan Africa, the belief of misinformation was predominant in older respondents [23]. Another study also supports this as older adults are seven times more likely to share misinformation [24]. Although in a study analyzing the Australian public’s understanding and attitudes of COVID-19, there seemed to be an association of misinformation belief among younger adults [25]. Thus, age may be a factor in negative misinformation behavior, but the evidence is not consistent with respect to what age group may be most prone to this undesirable behavior.

Unproven substances that are believed to prevent or kill the Coronavirus have been spread over the Internet. That not only threatens public health but also endangers users who are fragile and eager to find possible treatments to prevent the virus. For instance, more than 400 Iranians were killed, and over 2,000 sickened after drinking high alcohol content or methanol mixing with bleach because they believed these could kill Coronavirus in their bodies [14]. Some Americans believed that drinking and ingesting bleach or chlorine dioxide could help to prevent or kill COVID-19, leading to some serious health issues [3]. Similarity, a majority of Hindus have consumed cow urine, which is believed to be a miracle remedy to cure COVID-19, and as a result, many individuals were hospitalized with severe illness [29]. Another substance that was believed to cure and prevent COVID-19 spreading by Doctor Stella Immanuel was hydroxychloroquine [22]. This false information was spread widely and used on some COVID-19 patients, resulting in some serious heart-related problems and death in some patients [11].

With the continuity of COVID-19 and the rise of its variants in some countries, such as in the UK, India, and Vietnam, disinformation related to COVID-19 cures and remedies continues to be created and spread on the Internet. As long as the Coronavirus is still spreading over the world and there is no definitive treatment for it, some individuals are still fearful, anxious and will seek possible treatments that are spread and believed by others on the Internet.

3 METHODS

3.1 Participants

Prior to data collection commencing, Institutional Review Board (IRB) approval was obtained and this study was classified as exempt from full review.

In order to collect data so that we may answer the underlying research questions, we deployed a survey on the Qualtrics survey platform. Participants were recruited through Amazon's Mechanical Turk (MTurk), which has been shown to be a reliable and efficient method to recruit research participants so long as quality control measures are put in place [5, 30]. They were eligible to participate in the study if they had successfully completed at least 1,000 prior HITs (human intelligence tasks) at an approval rate of 98% or greater.

Participants were compensated with \$2.50 for their time. 90.9% of participants felt that the compensation provided was either comparable (75.8%) or easier for the money (15.1%) when compared to other projects they had completed on MTurk. The remaining 9.1% felt that more effort was required when compared to other projects.

A total of 545 participants began the survey with 26 participants failing one of the three automated quality control questions embedded within the survey questions themselves and another three participants failed an open-ended question that served as an additional quality check. Thus, 5.3% of participants that began the survey failed quality control measures in place. This resulted in 516 usable responses to the survey.

Slightly over half of our participants identified as male (51.9%) with the remaining participants identifying as female (47.3%), non-binary or third gender (0.2%), or preferred not to say (0.6%). Most participants identified as White (77.3%), followed by Asian / Pacific

Islander (9.5%), Black / African American (6.0%), Other / Multi-Racial (4.3%), and Native American / Alaskan Native / Indigenous (0.4%). Approximately half (52.7%) of the participants were between the age of 18 and 39 with the remaining participants (47.3%) 40 or older. The participants were generally well-educated with 61% of participants having earned a Bachelor's degree or higher. Only 9.7% of participants had not completed any college coursework.

3.2 Materials

When possible, previously developed and validated measures were used. For the social media questions noted in Table 1 that are used in the comparison between the two vaccine initiation groups, we used the items developed and validated by Gruzd and Mai [12].

Questions related to vaccine status were developed based on public health tracking data, literature searches, and a cognitive interview with undergraduate and graduate students related to possible vaccine statuses. Ten different vaccination status classifications were developed. An additional variable was created based on this data that indicated whether someone had either been vaccinated (or are scheduled to be vaccinated) or have not yet begun the process (or do not intend to).

While there may be a significant difference between those that have not yet initiated the vaccination process when compared to those that have no intention of doing so, our interest was in better understanding the differences within a U.S. population during a time in which the ability to schedule a vaccine was readily available to the general public. Understanding some of the greater nuances between the participants within each of the two newly created vaccination status categories is a worthwhile endeavor, but beyond the scope of the current study.

4 RESULTS AND ANALYSIS

Analysis was conducted using Statistical Package for Social Sciences (SPSS) version 19.0. Since we divided our participants into two groups based on vaccination status, we performed an independent samples t-test to compare the means between the two groups of participants. The results of this analysis are found in Table 1. The table provides information on the results of the t-tests performed, including the degrees of freedom, which may vary based on whether equal variances were assumed or not and the total number of participants that answered a particular question, the significance level (i.e., p value), the difference between the two groups, and the means for each group. Significant findings have been placed in bold and italicized.

The first question we examined relates to one's trust in the news from a variety of sources, including friends and family and the mainstream media. Individuals that have higher levels of trust in the mainstream media, political party and leaders, and public service / government agencies and departments are much more likely to have initiated or completed the vaccination process to protect them from COVID-19.

Next, we examined the types of sources used by our participants to get their news on the COVID-19 pandemic. Interestingly, higher levels of preference for getting their news from sites other than social media were associated with higher levels of vaccination initiation or completion. This question was asked on a Likert scale for

each of the five options provided. Thus, participants could choose “prefer a great deal” for both online and social media options.

Beyond the types of sources used, our next question focused on the specific social media outlets that participants used to acquire their information on the pandemic. Out of ten possible social media sites, only two differed significantly between our two groups. Individuals that obtain more of their news related to the pandemic from YouTube are more likely to not have initiated the vaccination process yet. The opposite was true for individuals that acquired information related to the pandemic from TikTok.

Our fourth question did not have any significant results. The perception of misinformation about COVID-19 found on social media sites was not related to one’s initiation of the vaccination process.

Finally, we examined the actions taken by individuals when they would encounter misinformation related to COVID-19 on social media sites. Individuals that initiated the vaccination process were more likely to mute, unfollow, or block an account, as well as report an account or post that shared misinformation to the social media site.

5 DISCUSSION

5.1 Implications

The results found in this study suggest that the level of trust people have in the news sources they consume may have an impact on their beliefs in the safety and efficacy of the vaccine. The dislike and/or distrust of the mainstream media by some results in them seeking information elsewhere. This may include news sources they do not consider mainstream media, such as Fox News Inc., or websites or social media outlets that are more likely to cater or provide an outlet for others to cater to these individuals, such as YouTube.

And as noted in the results section, individuals that are more likely to get their news from YouTube are also more likely to not have begun the COVID-19 vaccine process. Different personalities have been known to use YouTube to push fringe or conspiracy theories on the YouTube platform, such as Alex Jones.

The results also suggest that greater consumers of news from online, print, radio, and television are more likely to have either been vaccinated or at least have scheduled their first shot. This was not found for the social media category. Does this preference for other news sources balance the misinformation prevalent on social media?

Finally, individuals that have initiated (or completed) the vaccination process are also more likely to take proactive measures in combating misinformation they see on social media.

5.2 Limitations

There are a few limitations worth mentioning. First, a single survey was used with a crowd-sourced participant pool. MTurk workers have an inherent incentive to complete the work as quickly as possible, which could impact their attention to the questions. The length of the survey could also cause issues with fatigue and attention for the participants. While most MTurk workers believed that the compensation provided was fair, their motivation for completing the survey cannot be ignored.

Second, common method bias cannot be ruled out since a single research method was employed—a survey [19, 26]. We did use several quality control procedures to help minimize the likelihood that common method bias would become a significant issue. For example, the participants are anonymous to the research team and participants were asked to simply answer honestly. Additionally, we conducted the Harman’s single-factor test. Although this test does have some issues, it works well as a screening tool, especially when used in conjunction with the other methods outlined in the current section to help mitigate common method bias from becoming problematic [26]. The amount of variance explained by a single factor was 16.37%, which is below the 50% maximum threshold. Thus, while we do not believe common method bias was a significant issue in the results we obtained, it cannot be ruled out completely.

Third, a survey was used without any experimental treatments involved. Thus, causality cannot be assumed with any of the relationships noted herein. We do not know if it is the misinformation that is *causing* a lack of vaccine initiation (or completion); we simply know that they are related to one another. Future research should examine this more closely to better determine what interventions, if any, may be most appropriate and effective.

6 CONCLUSION

The COVID-19 pandemic is far from over. While vaccines are readily available in some countries, such as the United States, they remain difficult to get in many countries around the world. Nonetheless, we are not fighting against the pandemic alone. Instead, we face a very serious threat related to misinformation. While debate will continue to ensue over the role of misinformation (and disinformation) related to the 2016 presidential election in the United States, the current threat from misinformation related to the COVID-19 pandemic has global health consequences today and remains an issue that can and should be addressed. Greater innovation and creativity is needed to address the misinformation and disinformation crisis, such as peer feedback mechanisms (e.g., [7]) and improved design considerations on social media platforms.

Within information technology education, we have a responsibility to ensure that we continue to look beyond just hardware and software. People use the systems students are trained to understand and administer. Inherent to the concept of information technology is *information* itself. Should information literacy be part of information technology education? Reasonable debate and discussion should occur in response to this question. Regardless, one thing that is clear is that the lack of information literacy in society has significant real-world implications, even when away from the computer systems themselves.

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A VACCINATION STATUS

What statement most accurately reflects your vaccine status for COVID-19?

Recorded as COVID-19 Vaccination Initiated (or Completed)

- (1) I am fully vaccinated
- (2) I have received one shot and will be getting the second shot soon
- (3) I have received one shot and do NOT plan on getting the second shot
- (4) I am scheduled to receive the vaccine

Recorded as COVID-19 Vaccination NOT Initiated

- (1) I plan on scheduling to receive the vaccine soon
- (2) I previously had COVID-19 and thus do not feel I need the vaccine
- (3) I may get the vaccine sometime later this year
- (4) I will only get the vaccine once it has been fully approved by the FDA
- (5) I will only get the vaccine if it becomes required by my employer
- (6) I have no intention of getting the vaccine

Table 1: Statistical Analysis Results for Social Media Usage Questions

How much do you trust the accuracy of news about the COVID-19 pandemic from:						
Statement	t	DF	p	Delta	Vaccine Initiation	
					Yes (N=349)	No (N=167)
Friends and family	1.389	292.6	0.166	0.143	3.017	2.874
Mainstream Media	9.308	514	0.000	0.936	3.092	2.156
Partisan sites	-0.380	513	0.704	-0.033	1.937	1.970
Political party and leaders	3.118	513	0.002	0.281	2.299	2.018
Public service / Government agencies & departments	9.972	295.4	0.000	1.084	3.587	2.503
Where do you prefer to get your news about the COVID-19 pandemic from?						
Statement	t	DF	p	Delta	Vaccine Initiation	
					Yes (N=349)	No (N=167)
Online (news website or mobile app)	3.963	266.6	0.000	0.457	3.828	3.371
Print (newspapers, magazines)	3.474	363.9	0.001	0.361	2.163	1.802
Radio (broadcast, satellite)	2.548	514	0.011	0.270	2.181	1.910
Social media	-0.530	514	0.596	-0.067	2.292	2.359
TV (broadcast, cable)	4.768	514	0.000	0.598	3.023	2.425
How often do you get news about the COVID19 pandemic from the following social media sites / messaging apps?						
Statement	t	DF	p	Delta	Vaccine Initiation	
					Yes (N=349)	No (N=167)
Facebook	0.173	514	0.863	0.020	2.080	2.060
You Tube	-2.214	284.8	0.028	-0.278	2.117	2.395
Instagram	0.146	514	0.884	0.015	1.596	1.581
LinkedIn	0.899	514	0.369	0.070	1.309	1.240
Twitter	0.226	514	0.822	0.027	2.063	2.036
Pinterest	1.798	390.2	0.073	0.114	1.264	1.150
Snapchat	1.659	389.0	0.098	0.108	1.269	1.162
Reddit	1.614	514	0.107	0.181	1.911	1.731
TikTok	1.976	384.4	0.049	0.146	1.355	1.210
Messaging apps	0.134	514	0.893	0.012	1.473	1.461
How often do you encounter what you perceived as misinformation about the COVID19 pandemic (false, inaccurate or misleading information) on the following social media sites / messaging apps?						
Statement	t	DF	p	Delta	Vaccine Initiation	
					Yes (N=349)	No (N=167)
Facebook	-0.835	301.2	0.404	-0.099	2.679	2.778
YouTube	-1.203	514	0.229	-0.125	2.181	2.305
Instagram	-0.926	514	0.355	-0.106	1.883	1.988
LinkedIn	-0.444	514	0.657	-0.042	1.479	1.521
Twitter	-1.039	292.4	0.300	-0.124	2.158	2.281
Pinterest	-0.803	514	0.423	-0.078	1.467	1.545
Snapchat	-0.194	514	0.846	-0.019	1.484	1.503
Reddit	-1.415	278.5	0.158	-0.154	1.834	1.988
TikTok	-0.117	514	0.907	-0.012	1.610	1.623
Messaging apps	-0.268	514	0.789	-0.027	1.596	1.623
When faced with what you think is misinformation about the COVID-19 pandemic on social media sites or messaging apps, how often have you done the following:						
Statement	t	DF	p	Delta	Vaccine Initiation	
					Yes (N=349)	No (N=167)
Consulted other sources to verify the information	1.874	299.0	0.062	0.236	3.404	3.168
Directly challenged an account that shared misinformation	0.298	514	0.766	0.034	1.986	1.952
Limited your overall use of social media / messaging app	1.288	514	0.198	0.161	2.479	2.317
Muted, unfollowed or blocked an account	3.303	348.4	0.001	0.390	2.450	2.060
Reported an account/post that shared misinformation to law enforcement	0.305	514	0.761	0.031	1.570	1.539
Reported an account/post that shared misinformation to the media	1.174	514	0.241	0.121	1.642	1.521
Reported an account/post that shared misinformation to the site	2.352	514	0.019	0.264	1.917	1.653